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# Exploring the Use of Lean Thinking and Six Sigma in Public Housing Authorities

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SAMEER KUMAR AND KENNETH F. BAUER  
UNIVERSITY OF ST. THOMAS

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*There are more than 3,300 public housing authorities throughout the United States providing affordable housing to eligible low-income families, the elderly, and individuals with disabilities. This housing is principally provided through the administration of federally funded housing programs. The funding for these programs is inadequate to meet the growing need for affordable housing, requiring public housing authorities to find innovative ways to do more with less. A few public-sector organizations have turned to private-sector quality management practices in response to similar challenges. Lean thinking and Six Sigma are two popular quality initiatives found in the private sector. This paper explores whether lean thinking and Six Sigma can be successfully applied to public housing authorities by providing an overview of these quality practices, investigating the unique challenges that will be encountered in their implementation, examining the experience of similar organizations adopting these practices, and providing a case study that demonstrates how these principles and techniques can be applied in an affordable housing process. This paper should be valuable to policy or decision makers who may be considering the applicability of these private-sector quality management practices within public housing authorities or other similar special-purpose local governmental units.*

*Key words: Lean, Lean Six Sigma, process improvement, public housing authorities, quality management, section 8*

## INTRODUCTION

There are more than 3,300 public housing authorities throughout the United States (HUD1 2007) providing affordable housing to eligible low-income families, the elderly, and individuals with disabilities. Unlike general-purpose local governments such as municipalities, counties, and townships, which provide a broad range of services to the general public, these public housing authorities are special-purpose units of local government that were created under their respective state laws with the express limited purpose of providing affordable housing and other related services to the citizens residing within their political jurisdictions. These public housing authorities are quite diverse in size, scope, and organizational structure, with the smallest employing only a few part-time employees and the largest being the New York City Housing Authority with 13,100 employees providing affordable housing to 7.8 percent of the population of New York City (NYCHA 2007).

The purpose of this paper is to explore the application of lean thinking and Six Sigma in public housing authorities. An overview of public housing authorities in the United States is presented, followed by a literature review that provides a brief summary of lean thinking and Six Sigma, along with the challenges public housing authorities might face when implementing these public-sector quality management practices. In addition, as there appears to be no documented instances of lean thinking or Six Sigma in public housing authorities, examples of these quality practices in similar organizations are

presented. A case study follows that demonstrates how lean thinking and Six Sigma principles and techniques can be applied to a public housing authority process. This paper should be valuable to policy or decision makers who may be considering the applicability of these private-sector quality management practices within public housing authorities or other similar special-purpose local governmental units.

### OVERVIEW OF PUBLIC HOUSING AUTHORITIES

The principal activity of most public housing authorities is the administration of affordable housing programs that are funded by the U.S. Department of Housing and Urban Development (HUD). These programs provide decent, safe, and sanitary housing to eligible low-income families, the elderly, and individuals with disabilities. The annual funding for these programs totaled more than \$21 billion in the proposed 2008 federal budget (HUD2 2007). The largest of these programs are Public Housing and Section 8. The Public Housing program was created under the provisions of the U. S. Housing Act of 1937 (Mitchell 1985) and subsidizes the development and operation of publicly owned housing units serving almost 3 million low-income individuals (CLPHA1 2007). The Section 8 program was created under the provisions of the Housing and Community Development Act of 1974 (Mitchell 1985) and provides monthly rental assistance payments to public and private-sector landlords on behalf of more than 4.7 million low-income individuals (CLPHA2 2007).

These federal housing programs generally limit the amount that low-income participants are required to contribute toward their housing costs to no more than 30 percent of their adjusted gross income (Sciacqua 2005). This income-based rent requirement originated from federal legislation passed in 1969 that is more commonly referred to as the Brooke Amendment to the United States Housing Act of 1937, which established rent affordability as a basic principle for these federal housing programs (Lane 1995). HUD has since provided operating and

capital grant funding to public housing authorities to subsidize the difference between the actual costs of these programs and these income-based rents. While this methodology ensures affordability for program participants, it leaves most public housing authorities with very little control over their revenues and financially dependent on federal subsidies.

This dependence has created financial hardships for public housing authorities and the families and individuals they serve, as ongoing federal budget deficits have resulted in inadequate funding for these affordable housing programs. This comes at a time when there is a large and growing need for affordable housing (HUD3 2007). The Public Housing program has been particularly hard hit, with the proposed 2008 federal budget expected to subsidize public housing authorities at only 84 percent of their actual operating needs—the sixth year that subsidies have not been fully funded—and it leaves a backlog of needed infrastructure improvements estimated at \$18 billion to \$20 billion (PHADA 2007). The situation is unlikely to improve any time soon, as federal budget deficits are expected to persist over the next 10 years and then grow even larger in succeeding decades due to rising healthcare costs and the aging of the population (Rice and Sard 2007).

Public housing authorities have little choice but to find innovative ways to do more with less. These challenges are similar to those found throughout the broader public sector, where the public continually demands greater service at lower costs (Snyder 2004). A few general-purpose local governments have responded to similar pressures by implementing private-sector quality management practices that have a well-documented record in business as being a way to generate significant savings through process improvement and innovation. These practices are largely based on the work of individuals such as W. Edwards Deming, Joseph M. Juran, and other quality gurus who helped resurrect the post-World War II Japanese economy (Maguad 2006). From these early efforts developed many different quality management practices, with lean thinking and Six Sigma being two popular quality initiatives in the private

sector (de Koning and de Mast 2006; George 2003; Smith 2003a; Smith 2003b).

## LITERATURE REVIEW

There is a considerable amount of literature available regarding the use of lean thinking and Six Sigma within the private sector, but relatively little regarding their use in the public sector, and nothing that relates specifically to public housing authorities. The purpose of this literature review is to examine journal articles, research papers, reports, books and government, vendor and industry publications, and Web sites to provide an overview of lean thinking and Six Sigma, identify the major challenges that will face public housing authorities in implementing these practices, and examine their use in similar organizations.

## Lean Thinking

Lean thinking originated within the Japanese automobile industry following World War II and is principally based on the Toyota Production System (TPS), which was developed by a production executive named Taiichi Ohno and was used to improve the quality and productivity within the Toyota Motor Company (Ohno 1988). Lean later increased in popularity in the 1990s, after the publication of the bestselling book, *The Machine that Changed the World: The Story of Lean Production* (Womack, Jones, and Roos 1991), which chronicled how organizations could transform their operations by adopting the lean approach developed at Toyota. Lean has since been widely adopted across every manufacturing industry ranging from automobiles to electronics, and it is being increasingly applied to a wide range of private-sector service organizations, including some governmental entities (Lewis et al. 2007).

Lean is an integrated system of principles, practices, tools, and techniques that are focused on reducing waste, synchronizing work flows, and managing production flows (Koning et al. 2006). The reduction of waste is the cornerstone to the lean approach. In lean, waste is also referred to as non-value-added activities. Value-added activities

are those that contribute to what the customer wants from a product or service, while all others are considered to be waste or non-valued-added activities that should be eliminated from the process (George 2003). The elimination of these non-value-added activities reduces cycle time and costs, which results in more competitive, agile, and customer responsive organizations (Alukal 2003).

## Six Sigma

Six Sigma was developed in the early 1980s at the Motorola Corporation and was popularized in the late 1990s by former General Electric CEO, Jack Welch (Furterer and Elshennawy 2005; de Koning and de Mast 2005). Six Sigma's foundation was in the statistical analysis of data, and this is reflected in its name, which refers to a statistical measure of process performance (Maguad 2006). Besides Motorola and General Electric, other major corporations have embraced Six Sigma including AlliedSignal, Lockheed-Martin, Polaroid, and Texas Instruments (Hahn et al. 1999). The reported advantages to implementing Six Sigma include increased market share and higher profit margins (Harry 1998). While Six Sigma originated within manufacturing in the electronics industry, it has since been adopted across many other industries and has spread into the service sector, including a few government organizations.

Six Sigma refers to the philosophy, tools, and methods used to seek, find, and eliminate the causes of defects or mistakes in business processes by focusing on the outputs that are important to the customers (Antony and Fergusson 2004; Snee 2000). Six Sigma represents a highly disciplined and statistically based approach to quality (Hahn et al. 1999). Six Sigma methodically analyzes underlying data and identifies the root causes of problems as opposed to using subjective opinions. Since every step in a process represents an opportunity for a defect to occur, Six Sigma seeks to reduce the variation in these steps, which results in the occurrence of fewer defects and the production of higher quality goods and services. By controlling this variation, Six Sigma prevents defects from occurring rather than simply detecting and correcting them.

## Unique Challenges Facing Public-Sector Organizations

### Lack of profit motivation

A fundamental difference between public- and private-sector organizations is the lack of profit as the primary motivation or objective in government (Foster, Howard, and Shannon 2002). This is particularly true of most general-purpose governmental activities such as public safety, highways and streets, and economic development that are usually supported through taxes, grants, and nonexchange revenues (Gauthier 2005). Financial results are usually not as important to public-sector organizations that are responsible for promoting a particular aspect of the public's welfare (Ostroff 2006). This lack of profit motivation was also noted by W. Edwards Deming as being a differentiator among public and private organizations when choosing between quality management methods (Deming 1986).

Public-sector organizations engage in some business-type activities such as public utilities for water, sewer, and electric services, which are usually financed in whole or in part by user fees charged to external parties for goods and services (Gauthier 2005). The affordable housing programs administered by public housing authorities are generally considered to be business-type activities. These business-type activities share many similarities to private-sector businesses, but profit is usually not their primary motivation. While private-sector organizations implement quality management practices like lean thinking and Six Sigma to achieve competitive advantage and bottom-line results, public-sector organizations' initiatives will often focus on increasing efficiency and effectiveness to better utilize scarce financial resources.

### Role of politics

Successful lean thinking and Six Sigma implementations require strong leadership. Unfortunately, governments—particularly general-purpose governments—are political organizations, and leadership change is often only an election away. It is hard to guarantee the type of continuing top-level ownership

that is required in these quality practices when political leadership is transitory (Krings, Levine, and Wall 2006). The nature of politics encourages governments to focus on short-term rather than long-term performance (Deming 1986). Quality management implementation is also complicated by many governmental processes overlapping between different levels of government and across functional departments that may be managed by politically independent elected officials (Krings, Levine, and Wall 2006).

The political challenges for general-purpose governments can sometimes come from within the organization. In the City of Fort Wayne, Indiana, the mayor had to work with a city council that was controlled by the opposing party and who voted down any additional funding for Six Sigma training for two years (Morgan 2003). For special-purpose governments such as public housing authorities, whose governing boards are generally appointed rather than elected, local politics may not have as direct of an impact on the organization as will national politics. The principal challenges will come from Washington D.C. and will relate to the direction of national housing policy, congressional appropriations for federally funded housing programs, and the rules and regulations that govern their expenditure.

### Resource constraints

Public-sector organizations are subject to both human resource and taxpayer funding constraints. Individuals with the needed research and statistical analysis talent to implement quality management programs such as Six Sigma are not generally found or internally developed as routinely as in the private sector (ASQ 2007). There are also very few leaders in government who have a familiarity with private-sector quality management programs and understand their potential (Morgan 2003). Finding the funding for these programs can also be difficult, as lean thinking and Six Sigma, in particular, require a significant financial commitment by the government. Ironically, the reason public-sector organizations often turn to these quality initiatives is to find ways to cope with resource shortfalls, so getting taxpayer approval may be difficult.

Many public-sector organizations have looked externally for assistance in implementing private-sector quality practices. The City of Kingsport, TN, enlisted the help of hometown Eastman Chemical Company, which donated more than 200 hours of time and expertise at no cost for the city's Six Sigma efforts (Ruller 2004). The City of Fort Wayne, IN, obtained affordable training from a nonprofit vendor that provides Six Sigma training to small and medium-sized companies (Morgan 2003). Without such public-private collaboration or the ability to access low-cost training and consulting resources, many public-sector organizations will struggle to find the resources necessary to fund the implementation costs associated with private-sector quality practices.

### **Workplace culture**

Workplace culture has been recognized as a major factor or challenge to quality management implementation (Antony and Banuelas 2002; Coronado and Antony 2002; Kwak and Anbari 2004). The infrastructure commonly found within private-sector organizations to support their quality management programs such as lean thinking and Six Sigma may not exist in public-sector organizations and will need to be created (ASQ 2007). In addition, information sharing and openly airing mistakes is often not the norm within government because the public sector tends to produce a risk adverse culture, which impedes substantial change (Kernaghan 2003). The public-sector experience has been that the penalties for failure are almost always greater than the rewards for exceptional service (Ostroff 2006).

Changing this culture within an organization is difficult and will require leaders who can communicate well and are willing to demonstrate their commitment to adopting quality management practices. The mayor of Fort Wayne, IN, had a litmus test when approached by other mayors asking about adopting Six Sigma. He asked them if they would be willing to attend a two-day executive session on Six Sigma and if they would agree to sitting through a Black Belt or Green Belt training course to get a feel for what it takes. Nine of 10 mayors who expressed

interest in Six Sigma were not willing to make such a commitment, which was an indication that the quality initiative was probably not going to get done (Morgan 2003). Implementing private-sector quality management practices requires public-sector organizations to focus considerable time and effort addressing workplace culture issues.

### **The customer**

In the private sector, the customer is usually the one who ends up owning a product or receiving a service, or is the "one who pays the bills" (Evans and Lindsay 1999). In the public sector, determining who the customer is can be much more difficult. Is it the taxpayer, the elected official, the governing body, or the individual who receives a government product or service? Unlike the private sector, where the customers are usually willing participants in voluntary exchange transactions, the person who receives a government product or service may actually be an unwilling or even reluctant participant in a nonexchange transaction, such as an inmate who is being incarcerated in a state prison.

The private-sector concept of the customer will need to be expanded for many public-sector organizations to include their primary stakeholders. While the concept of stakeholders is not new to most private-sector organizations, the range of public-sector stakeholders and their influence is usually much greater in the public sector. For public housing authorities specifically, stakeholders may extend beyond the organization and the person who is receiving housing services, to include HUD, which may be funding the service, local municipalities, the local citizenry, and tenant advocates.

## Unique Challenges Facing Public Housing Authorities

### **Federal funding**

The principal activity of most public housing authorities is the administration of federal housing programs. The federal government is organized into autonomous departments based on the type of service



being delivered. This vertical “stovepipe” structure was designed to facilitate the delivery of a single service (Biedell et al. 2001). Allocating tax dollars through these departments encourages them to fund their own objectives rather than engage in collaborative initiatives (Kernaghan 2003). Public policy within such an environment is generally focused on breaking complex problems into subproblems or components that can be more easily analyzed and managed in a rational manner, rather than looking at such problems from a holistic perspective (Chapman 2002).

Such a deconstructionist approach to complex problems often results in a micromanagement approach by the federal government. Federal funding of local services often prescribes rigid guidelines of what services are to be provided, how they are to be provided, and to whom they are to be provided (Bardach and Lesser 1996). These guidelines govern areas such as procurement, personnel, and budgeting, and were originally adopted to prevent wrong-doing but have resulted in workplaces that are much less flexible than those in the private sector (Ostroff 2006). The operations and culture of public housing authorities are shaped by very detailed and prescriptive rules and regulations extending well beyond that found in general-purpose governments or private-sector businesses.

## Similar Organizations That Have Applied Lean Thinking and Six Sigma

### Scottish public sector

The Scottish Executive commissioned a research report prepared by the Warwick Business School titled, “Evaluation of the Lean Approach to Business Management and Its Use in the Public” (Radnor et al. 2006). The purpose of this report was to evaluate the lean approach used within the Scottish public sector. This report analyzed evidence from four different sources: a literature review, a case-study analysis, a survey of public-sector organizations, and

the evaluation of three pilot programs. One of these pilot programs involved the improvement of a housing repairs process at a local government authority, which is similar to a process that might be found at most public housing authorities. The case studies, survey, and pilots were undertaken between June 2005 and March 2006.

The research indicated that lean is transferable to the public sector and can be used to develop more seamless processes, improve flow, reduce waste, and develop an understanding of customer value. Lean was thought to be best suited to organizations with high volume, repeatable tasks that would allow for increased standardization and integration along with less hierarchical management structures allowing for greater empowerment and engagement of the employees. To ensure the greatest success in lean, it was felt that organizations should have an awareness of the need for improvement, the capacity to deal with change, and an organizational culture that is receptive to understanding the customer, process analysis, and the ability to use relevant data to drive process improvement.

### Social housing in the United Kingdom

A 2005 report titled “A Systematic Approach to Service Improvement” issued by the Office of the Deputy Prime Minister detailed public-sector results of applying “lean systems” methodology in the social housing sector. This methodology was described as being principally based on systems thinking and the lean-based principles used by Toyota. These social housing organizations provide services to more than 4 million households in the United Kingdom and share many similarities to public housing authorities within the United States relating to the types of housing services provided. A pilot program was developed for three housing organizations to learn and use this methodology across several service areas including rent collection, debt recovery, voids and turnovers, and responsive work repairs.

The conclusions reached from the study were that lean systems improved services in each pilot and that tenant satisfaction ratings also increased. It appeared that the lean systems methodology could be applied

more broadly to the social housing sector, but it would require a management commitment from the top, an acceptance that this was a change to the way of working and not just a quick fix, and a willingness by all those concerned to openness and honesty about the work they do. A 2006 follow-up report titled “A Systematic Approach to Service Improvement—an Update” showed that process improvements were being maintained in two of the service areas. One of the service areas was not able to maintain its initial improvements due in part to a lack of focus by senior management and staff, concerns by employees that efficiencies would lead to job cuts, and the lack of a systems-thinking approach.

### **City of Fort Wayne, IN**

The City of Fort Wayne is one of the first, if not the first, municipality in the United States to implement Six Sigma. The City of Fort Wayne implemented Six Sigma to improve its customer service and increase the effectiveness of city government. According to the City of Fort Wayne’s Web site, Six Sigma has saved the city more than \$10 million since 2000 (City of Fort Wayne 2007). The Six Sigma effort was initiated by Mayor Graham Richard, who had previously founded a nonprofit organization called the TQM Network, which provided affordable Six Sigma training to small and medium-sized companies (George 2003). This organization was used by the city in its successful Six Sigma deployment, and it was noted that this would not have been possible without the collaborative effort of the TQM Network (Morgan 2003).

Implementing Six Sigma in the public sector requires a strong leadership commitment. According to the Mayor of Fort Wayne, IN, one reason there may be so few Six Sigma implementations currently in the public sector is because there are usually very few people with private-sector experience and experience with Six Sigma moving into government service (Morgan 2003). This impacts the implementation of Six Sigma, and public-sector organizations should expect to have a long learning curve, because public employees may not have any experience with quality initiatives (George 2003).

### **Six Sigma in small companies**

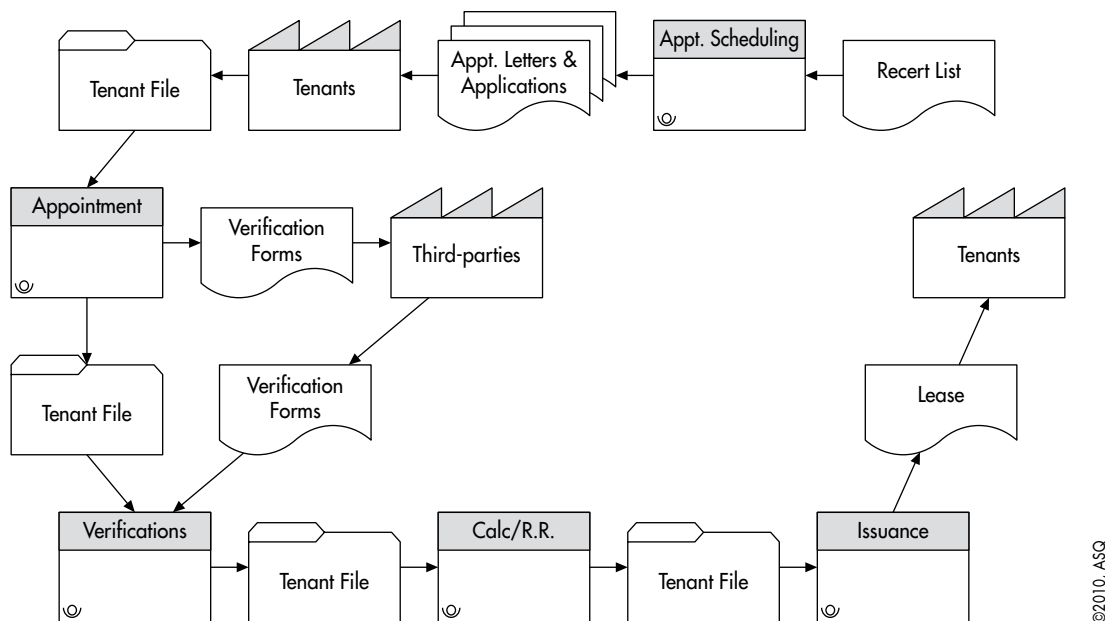
While Six Sigma has gained a significant following among many large companies, it has not yet been widely adopted among small companies. According to a survey published by *Quality Digest Magazine* (Dusharme 2003), 22 percent of the companies surveyed had a Six Sigma program, but 90 percent of these were units, divisions, or sites of larger organizations, with three-quarters of these being organizations with more than 2000 employees. Money and personnel were cited as being serious hurdles for small companies when it comes to Six Sigma. The survey also showed a drastic drop in the percentage of companies using Six Sigma after the second or third year, which may indicate a lack of leadership among top management.

For small companies, the cost and time commitment related to Six Sigma can be significant. The training for the management team and Champions may require a time commitment of one to five days and cost from \$1,000 to \$2,500; Black Belt and Master Black Belt training may require four weeks of training, costing from \$12,000 to \$50,000 (Waxer 2004). In a small company, if this person were to leave, the financial loss could be devastating. Black Belts should therefore be people with long-term interests in the organization. In small companies, the executive may need to serve dual roles as an executive leader and a Champion, with one or a only a few Black Belts working part time on projects within their functional areas (Brue 2006). Unfortunately, a 50 percent effort will result in less than a 50 percent result (Waxer 2004).

## **CASE STUDY: APPLYING LEAN SIX SIGMA TO A HOUSING PROCESS**

The purpose of this case study is to demonstrate how lean thinking and Six Sigma principles and techniques can be applied to a public housing authority process. Because there are no documented instances of these quality practices being used in any public housing authority, this case study is

Figure 1 Value stream map—Current state.



limited to applying lean Six Sigma methodology to a recently completed process improvement project that was performed by the Dakota County Community Development Agency, which provides affordable housing and community development services to the residents of the third most populous county in Minnesota and one of seven counties comprising the Twin Cities metropolitan area. While this government agency has not yet implemented an organizationwide quality management program, this project did utilize many of the tools and techniques associated with lean and Six Sigma and, therefore, provides a useful example of their use in housing processes.

This project involved the tenant re-examination process for a large, locally financed senior housing program whose purpose is to provide quality, affordable housing for senior citizens. The program receives no direct federal subsidy, and all operating and debt service costs are paid from the revenues generated from the housing developments and local property tax revenues. Similar to federal housing programs, the monthly rent that tenants are required to pay is generally based on a percentage of their projected annual income consisting of salaries,

social security, public and private pensions, and investment earnings. The agency must regularly re-examine the annual income of these tenants and recalculate their rent amount. The program has a floor and ceiling rent, which reduces the variability possible with an income-based rent and helps to ensure the financial viability of the program.

The current re-examination process was heavily influenced by the agency's familiarity with the federally funded Public Housing program. This program has numerous detailed and prescriptive procedures that must be followed. As a locally financed initiative, the senior housing program was not required to follow these procedures, which added unnecessary costs and inefficiencies to the re-examination process. The process improvement project was focused on eliminating these inefficiencies from the process while maintaining the existing income-based rent structure and ensuring the financial viability of the program. A cross-departmental team was assembled with personnel representing the accounting, finance, and property management functions. The following sections present the work that was performed using the five-step define-measure-analyze-implement-control (DMAIC) problem-solving model.



Figure 2 Time study (current state).

	Appointment Scheduling	Appointment	Verifications	Rent Calculation	Lease Issuance	Total
Program Support Assistant	0:02:05	0:00:00	0:07:40	0:10:10	0:12:29	0:32:25
Property Manager	0:05:19	0:45:00	0:00:56	0:15:56	0:01:52	1:09:03
Current State (minutes)	0:07:24	0:45:00	0:08:36	0:26:06	0:14:21	1:41:28
	Appointment Scheduling	Appointment	Verifications	Rent Calculation	Lease Issuance	Total
Property Manager						
Check Re-exam List	0:00:19					0:00:19
Setup Appointments	0:05:00					0:05:00
Perform Appointments		0:45:00				0:45:00
Follow up on Verifications			0:00:56			0:00:56
Perform quality control review				0:15:00		0:15:00
Follow up on errors				0:00:56		0:00:56
Follow up on leases					0:01:52	0:01:52
Current State (minutes)	0:05:19	0:45:00	0:00:56	0:15:56	0:01:52	1:09:03

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## Step 1: Define the Problem

The first step in the DMAIC model is agreeing on and defining what the project is and what it should accomplish. As previously noted, the re-examination process for the locally financed senior housing program was considered to be inefficient and therefore more costly than it needed to be. From a lean perspective, the primary goal of the project could be stated as reducing the amount of waste or non-value-added activities in the senior housing re-examination process, with value being determined from the standpoint of the principal stakeholders in the process that were deemed to be the senior housing tenants and the local governmental entity. It was then determined that process improvements could be measured in terms of the percentage reduction in the staff time required for the process.

To gather information about the re-examination process, a current-state value stream map was prepared, as depicted in Figure 1. The preparation of a value stream map is a very useful tool because it allows

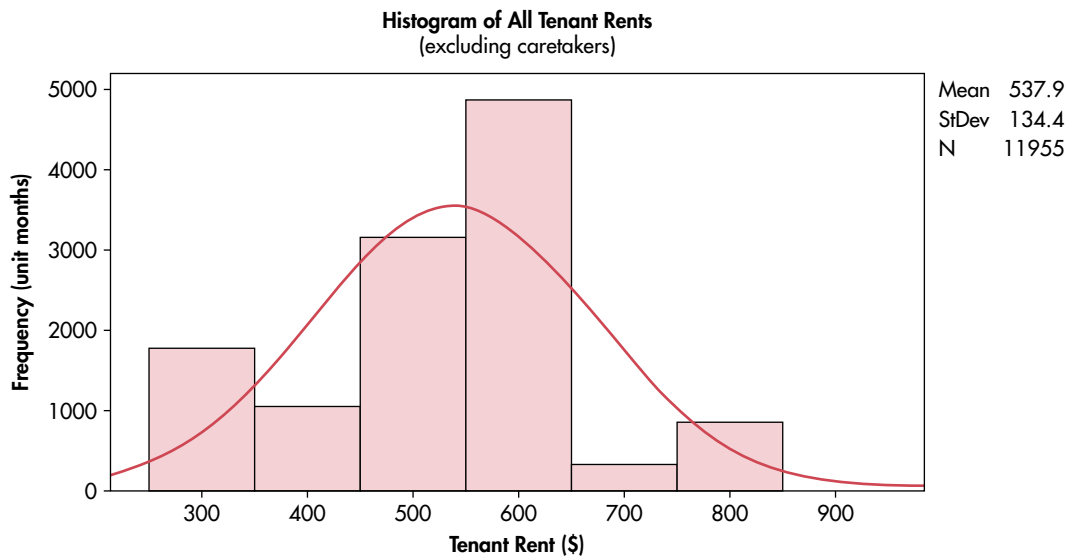
Figure 3 Traditional PUM analysis.

Description	Actual	
	PUM	Amount
<b>Operating Receipts</b>		
Dwelling Rent	\$537.90	\$7,080,000
Garage Rent	\$29.01	\$381,838
Commercial Rent	\$12.97	\$170,715
Laundry coin	\$10.01	\$131,755
Other income	\$1.15	\$15,140

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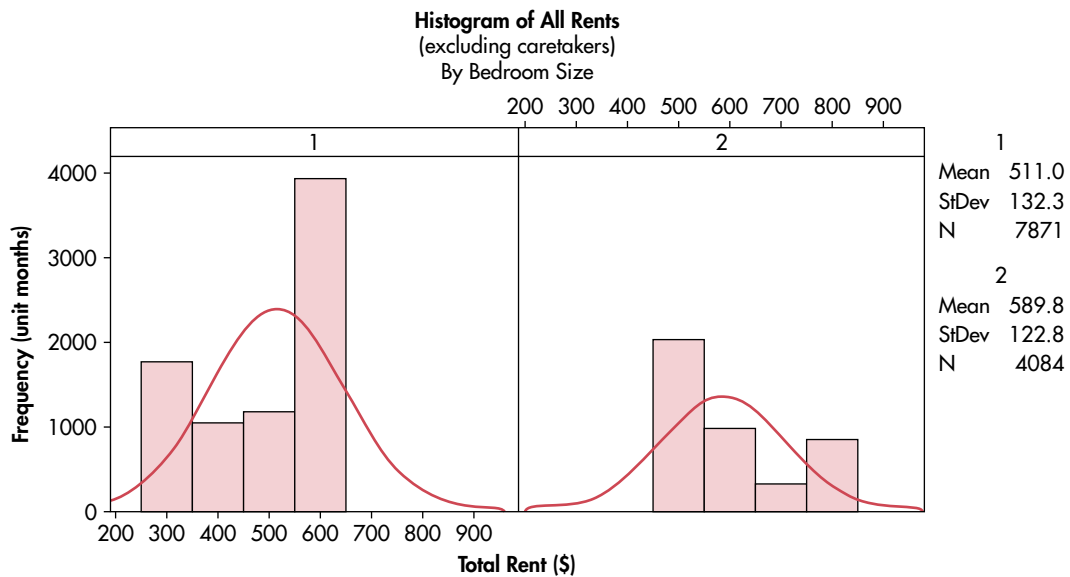
team members to easily see and understand the flow of work and information that is required for the process and it can also be used to capture actual process data. Preparing the value stream map may require the team to “walk through” the process and collect the data. For this map, the data collected are related to determining the number of positions involved in the re-examination process, the quantity of work being performed by each

Figure 4A Histogram—all rents.



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Figure 4B Histogram—Rent by BR size.



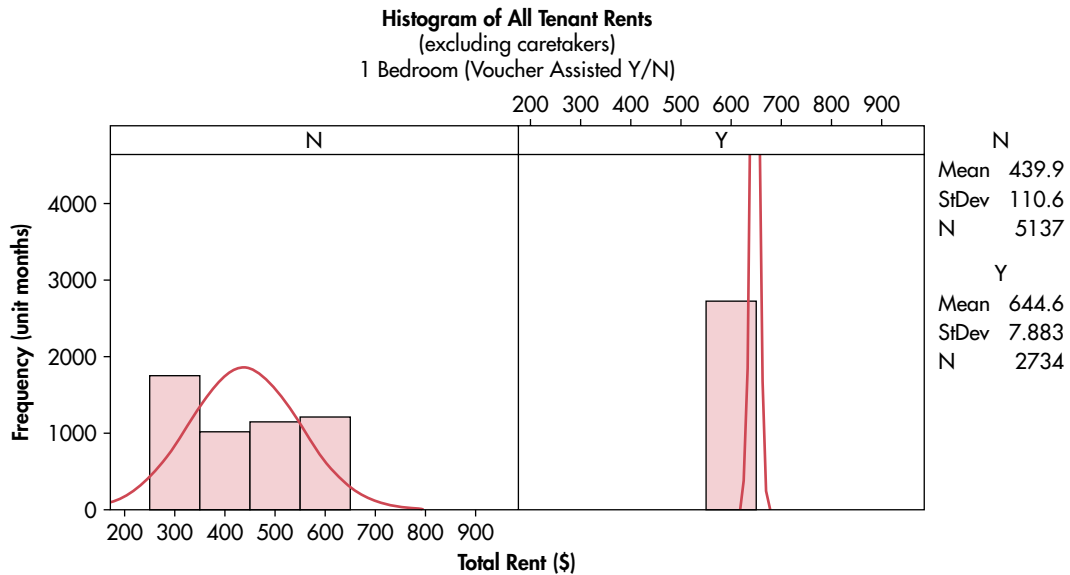
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position at each step in the process, the frequency at which the work moved through the process, the cycle time (measured from the beginning of the process to the end), the queue time (the amount of time work will wait), and exceptions to the process such as rework.

The current-state value stream map identified five major steps in the tenant re-examination process, which consisted of scheduling an appointment

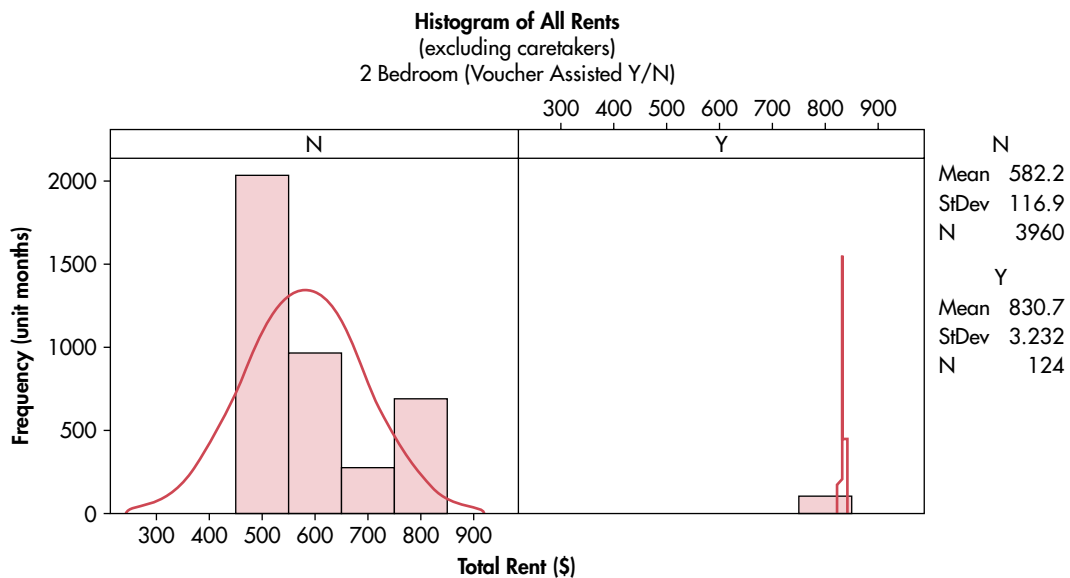
with the tenant, the actual appointment between a local government employee and the tenant, obtaining tenant income and asset verifications from third parties, performing the rent calculations, and issuing the lease. The re-examination process had a very long cycle time of up to 90 days. As shown in Figure 2, there is only one hour and 41 minutes of actual value-added time indicating that this is a

Figure 4C Histogram—1BR assisted/unassisted.



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Figure 4D Histogram—2BR assisted/unassisted.



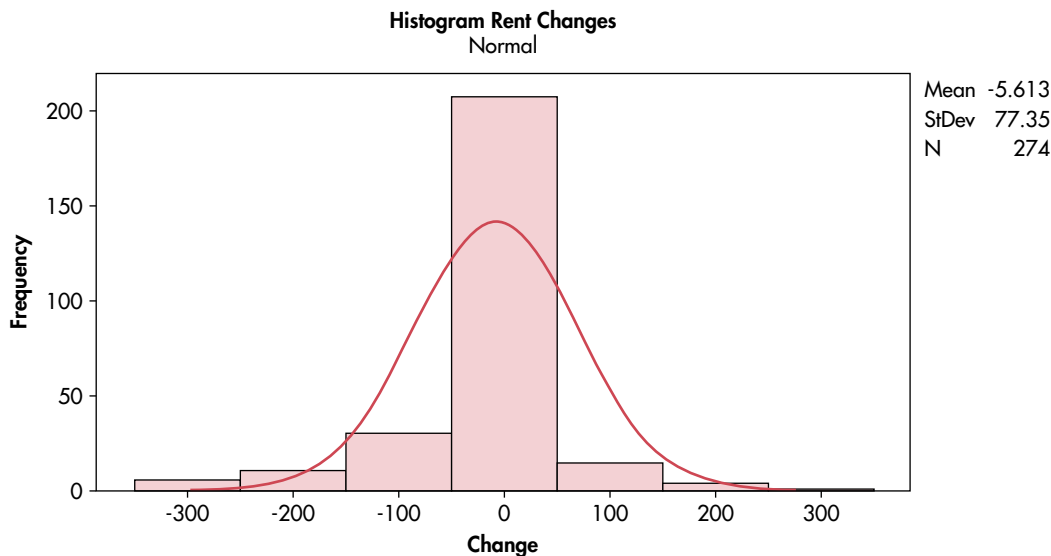
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very un-lean process. The remaining time consists of waste or non-value-added time composed of wait times, rework, and queue time. The income and asset verification step had particularly long wait times, as employees had to wait for verification forms to be returned by third parties. In some cases, verification forms had to be sent a second or third time.

## Step 2: Measure

This step involved collecting data to measure the performance of the current tenant re-examination process. Many of these data were already collected when preparing the current-state value stream map. Additional data were collected that related

Figure 5 Histogram—rent changes.



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to the income-based rents that are calculated by the re-examination process. These rents ensure housing affordability and create significant value to the process stakeholders. Traditional data collection relating to rents for public housing authorities involves tracking rental income and the number of units leased. Data analysis is generally limited to determining a per unit month (PUM) rental amount, which is calculated as the amount of rental income divided by the number of unit months available in the period. Such an analysis is presented in Figure 3. For this case study, a more in-depth analysis was prepared using a statistical analysis software program called Minitab. This program was used to calculate basic statistical measurements relating to these rents.

Figure 4A presents a histogram of the income-based rents for the senior housing program. This histogram indicated that there is a significant amount of variation with a mean monthly rent of approximately \$538 and a standard deviation of just over \$134. Additional statistical analysis was performed, and histograms were prepared that took into account that the senior housing program consisted of both one- and two-bedroom units (see Figure 4B—one-bedroom units on the left, two-bedroom units on the right) and that some

tenants were receiving government rent subsidies in addition to paying their income-based rents (see Figure 4C and 4D—unassisted rents on the left and assisted units on the right). This analysis provided considerable insight into the causes of variation in senior housing program rents, which would not have been possible using more traditional methods of data collection and analysis.

### Step 3: Analyze

This step seeks to identify the root causes of waste and poor quality. Building upon the rental data previously collected, this step first sought to analyze the results of the reexamination process on the income-based rents. As shown in the histogram presented in Figure 5, most rent changes resulting from the re-examination process were relatively small in dollar amount with only a few significant changes noted. This can be explained by most senior residents having incomes that are relatively stable, with few individuals actively employed and most income derived from relatively fixed sources such as social security, pensions, and earnings from investments. As a result, it appeared that a significant amount of work resulted in relatively small changes in rents.

**Table 1** Waste in re-examination process.

Waste Category	Public Housing Agency Examples
Overproduction	<ul style="list-style-type: none"> <li>Producing paperwork in advance of when it is needed</li> <li>Initiating the process too far in advance</li> </ul>
Inventory	<ul style="list-style-type: none"> <li>Anything waiting to be acted upon in paper or electronic in-boxes and almost all forms of batch processing</li> </ul>
Waiting	<ul style="list-style-type: none"> <li>Computer downtime</li> <li>Employees having to familiarize or refamiliarize themselves with files</li> <li>Obtaining unnecessary supervisory approvals</li> </ul>
Extra processing	<ul style="list-style-type: none"> <li>Entering data ahead of time</li> <li>Requiring extra copies</li> <li>Unnecessary processing steps, reports, performance metrics</li> <li>Transactions requiring special handling</li> <li>Rules and regulations</li> </ul>
Correction	<ul style="list-style-type: none"> <li>Miscalculated rents</li> <li>Tenant or third-party verification errors</li> </ul>
Wasted motion	<ul style="list-style-type: none"> <li>Waiting for computers, printers, fax machines</li> <li>Poorly designed work spaces</li> </ul>
Transportation	<ul style="list-style-type: none"> <li>Multiple handoffs</li> <li>Multiple approvals</li> </ul>
Underutilized people	<ul style="list-style-type: none"> <li>Not providing employees with the authority and responsibility for making decisions at the lowest levels</li> <li>Management control and command</li> <li>Inadequate training</li> </ul>

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Additional analysis was performed to seek out the root causes of the large rent changes that were noted. This included examining the underlying rent calculations. It was determined that these large rent changes were primarily related to irregularly occurring events such as asset dispositions, changes in household composition including marriage or the loss of a spouse, and changes in employment status such as retiring from the workforce. As a result of this analysis, it was confirmed that most tenant re-examinations resulted in only very small changes in rent and that the relatively few large changes were related to specific and irregularly occurring events. The team concluded that there was a great deal of time and money being spent on activities that provided little or no value to the process stakeholders.

The current-state value stream map was then analyzed to identify waste or non-value-added activities. A listing of the various kinds of waste that were identified in this case study is presented in Table 1.

This waste can generally be classified as either Type I, which is waste that is unavoidable given

current rules, regulations, technology, or other barriers, and Type II, which is waste that is immediately avoidable, with only minimal changes to existing procedures and practices. Most of the waste identified in the case study was Type I, which could not be eliminated without first eliminating the requirement to perform income and asset verifications. As this was a locally funded housing program, rather than a federally funded one, it was considered feasible to propose the elimination of these requirements.

### Step 4: Improve

This step involves identifying the best solution and making changes in the process to eliminate the defects, waste, costs, and so on, that are linked to the customer or stakeholder need that was identified in the “define” step. This is often the step people jump to without first developing a fact-based understanding of the problem or issue and its root causes. For this case study, the objectives cited were reducing the number of waste or non-value-added activities in the



Figure 6 Future-state value stream map (detailed process data omitted).

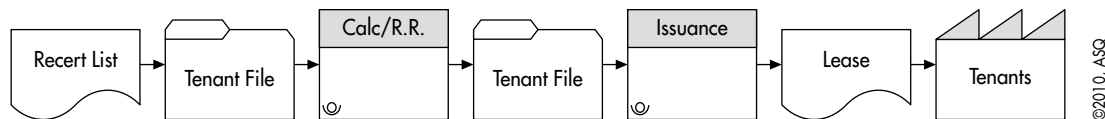


Figure 7 Comparison of current and future states.

	Appointment Scheduling	Appointment	Verifications	Rent Calculation	Lease Issuance	Total
Current State (minutes)	0:07:24	0:45:00	0:08:36	0:26:06	0:14:21	1:41:28
Future State (minutes)	0:01:24	0:00:00	0:00:00	0:04:36	0:14:21	0:20:21
Reduction (minutes)	0:06:00	0:45:00	0:08:36	0:21:30	0:00:00	1:21:06
Reduction (%)	81%	100%	100%	82%	0%	80%

senior housing reexamination process while maintaining the existing income-based rent structure and ensuring the financial viability of the program. The majority of waste or non-value-added activities that were identified in the process were related to the large amount of work required to recertify the income and assets of the senior housing tenants that resulted in relatively minor changes in rent. The best solution identified by the project team was to eliminate the program requirement to perform these verifications.

It was determined that initial rents for senior tenants would continue to be income-based at the time of admission, but that future rent adjustments would be based on inflation factors derived from the local housing market. This would establish the affordability of rents relative to the local market at the time of initial move-in, and would maintain that affordability using the inflation factors. It was determined that rents would be recalculated in the relatively few special circumstances, which had been identified in the “analyze” step. This solution allowed for a significant number of non-value-added activities to be removed from the re-examination process. This solution is documented in the future-state value stream map shown in Figure 6.

It is anticipated that the proposed future-state value stream map could reduce the cycle time of the

tenant re-examination process from approximately 90 days to just more than 30 days due primarily to eliminating waste or non-value-added time such as waiting for third-party verifications to be returned. Further reduction in the cycle time is hindered by state regulation that requires a 30-day notification to tenants of rent increases. As shown in Figure 7, there is a projected 80 percent reduction in the labor that is required for the re-examination process from approximately one hour and 41 minutes to just over 20 minutes. This improvement directly improves the bottom line of the senior housing program, and it allows staff time to be redirected toward other productive uses within the government.

### Step 5: Control

The purpose of this step is to ensure that any gains the team makes will last. For the case study, this step focused on documenting the new procedures, training staff in the changes, and handing off the ongoing management to the process owner. An objective of this project was ensuring the financial viability of the program; however, it should be noted that there is still considerable common cause variation in rental income because of the income-based rent methodology. To reduce variation in rents, the program could have adopted fixed rents like the private rental market.

That, however, would not accomplish the objective of the program. In the public sector, sometimes the goal is not to reduce variation, but rather to control it (Patton 2005).

**Table 2** List of potential challenges (Source: Maleyeff 2007).

Challenges common to private and public sectors	Challenges unique to the public sector
<ul style="list-style-type: none"> <li>• Inconsistent leadership motivation</li> <li>• Management competency in process improvement</li> <li>• Culture that considers time devoted to improvement less valuable than time devoted to “real work”</li> <li>• Union rules and relations</li> <li>• Technical skill of employees</li> <li>• Many undocumented processes</li> </ul>	<ul style="list-style-type: none"> <li>• The election cycle and term limits</li> <li>• Attitude of employees regarding stability and job security</li> <li>• Legislative controls</li> <li>• Competing special interests</li> <li>• Revenue not directly linked to value provided</li> </ul>

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## LESSONS LEARNED AND MANAGERIAL IMPLICATIONS

Public housing authority management is facing significant challenges due to inadequate funding and increasing demand, and must find innovative ways to do more with less. Private-sector quality management practices like Six Sigma and lean thinking may provide these public housing authorities with the tools and techniques to transform their service delivery models through process improvement and innovation. For example, combining the principles and tools of lean thinking and Six Sigma could provide an excellent way to improve the productivity and quality of providing financial services at a local government level (Furtherer and Elshennawy 2005). At present, these practices have found only limited use in public-sector organizations, with no reported instances of their use in public housing authorities. There are no theoretical reasons why these quality management practices could not be applied to public sector organizations. There are many unique issues and challenges, however, that have been presented in this paper that public housing authority management should carefully consider in assessing the applicability of these practices to their organizations. Specifically, unique challenges that are faced by public-sector organizations are: a) lack of profit motivation; b) role of politics; c) resource constraints; d) workplace culture; e) the customer; and f) federal funding.

Management should also consider some of the other benefits that may be realized by implementing lean thinking and Six Sigma. For instance, the

City of Coral Springs, FL, has received much attention as being the first state or local government agency to receive the Malcolm Baldrige National Quality Award (Lynn and Rapp 2007). This award seeks to raise awareness about the importance of quality and organizational performance. While the Baldrige Award has historically been given to for-profit organizations, in 2007 it was expanded to include nonprofit organizations such as government agencies, charities, and trade and professional organizations. Receiving such a prestigious award would publicly showcase an organization’s commitment to quality and excellence.

Theoretically, lean thinking and Six Sigma could be applied to any process where waste or nonvalue-added activities or variation exists. There should not be any distinction as to whether the process exists in a private- or public-sector organization. In reality, there are several significant and unique challenges that must be addressed by public-sector organizations when applying these private-sector quality management practices. While quality guru W. Edwards Deming cautioned against applying modern quality management approaches to government (Deming 1986), that does not mean these approaches will not work in government. Public-sector organizations, however, must recognize and understand how they differ from private-sector organizations and what impact this will have when applying these quality practices in government. Table 2 lists challenges in the private and public sectors.

For public housing authorities, there are many reasons to believe that private-sector quality management practices could be successfully applied to

processes in these special-purpose governmental entities. The case study presented in this paper demonstrates that lean thinking and Six Sigma tools and techniques can be successfully applied to a public housing authority process and that they can result in significant savings to the organization. In addition, the research and pilot programs conducted in the Scottish public sector, and particularly in the social housing sector within the United Kingdom, provide further evidence that these private-sector quality management practices can be successfully applied to public housing authority processes.

Lean thinking seems particularly well suited for adoption by public housing authorities because of its focus on eliminating waste or nonvalue-added activities from processes, thereby reducing cycle times and costs. With federal funding for affordable housing programs not keeping pace with demand, public housing authorities must find innovative ways to do more with less. Lean thinking provides public housing authorities the means to maximize value to their stakeholders while minimizing the cost of these programs. Significant cost savings, such as those noted in the case study, may only be possible in locally funded programs, with a much lesser impact felt in federal programs due to the number of rules and regulations prescribed by the federal government, which add waste or nonvalue-added activities to processes that cannot be eliminated without regulatory reform.

To successfully implement lean thinking, management must consider the following implications:

- **Empowerment.** Management must be willing to empower employees and to support work across traditional organizational boundaries, because the human element is an important variable in the services sector (Abdi et al. 2006). Also, the human component, made up of creative thinking, problem-solving skills, and teamwork, makes lean Six Sigma a dynamic system that always seeks to achieve higher performance (Salem et al. 2006).
- **Organizational structure.** While Six Sigma can also be used to eliminate waste, it is primarily focused on standardizing output by controlling the variation in processes. Six Sigma has a very

formal organizational structure that is based on “belts,” which require significant training costs and knowledge of statistics that is not generally found in most public housing authorities. Adequate training of all levels of involved people is very important (Ghun 2005).

- **Resources.** The Six Sigma knowledge can be a very powerful tool in process improvement, and the results noted in the case study would not have been possible without some knowledge of variation and statistical analysis. Public housing authorities, however, may find it difficult to make this type of commitment when the return on investment is much less certain than in the private sector. Except for the largest public housing authorities that may have more substantial resources to support Six Sigma, its application among most organizations will likely be dependent on their ability to access free or low-cost training and consulting services from other governments, nonprofits, and through public-private partnerships. Gijo and Rao (2005) also agree that inability to spare staff in the mandatory training and equipment for trials due to the usual operational pressures, as well as inadequate training facilities, may hamper the progress of successful lean Six Sigma implementation.

Finally, the research on lean Six Sigma implementation suggests other important factors to consider, such as:

- Recognition of successful projects and knowledge sharing (Ghun 2005).
- Coordination between functions. Often lean and Six Sigma projects are cross-functional and require coordination between various departments (Gijo and Rao 2005). Implementation will not be successful without commitment from all levels of employees and alignment of Six Sigma infrastructure and projects with organization goals (Ghun 2005).
- Hidden benefits and costs. It is difficult to quantify the financial benefit of improved service delivery that results in better customer satisfaction (Maleyeff 2007).

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### BIOGRAPHIES

**Sameer Kumar** is a professor of decision sciences and Qwest Chair in global communications and technology management in the Opus College of Business, University of St. Thomas. His major research interests include optimization concepts applied to design and operational management of production and service systems where issues relating to various aspects of global supply chain management, international operations, technology management, product and process innovation, and capital investment justification decisions are also considered. Kumar can be reached at [skumar@stthomas.edu](mailto:skumar@stthomas.edu).

**Ken Bauer** is the finance director for the Dakota County Community Development Agency located in Eagan, Minnesota, and holds professional designations as a certified public accountant (CPA) and a certified public finance officer (CPFO). He has been actively involved in the affordable housing industry for almost 18 years and has spoken on various accounting, finance, and management topics at state and regional industry conferences.