# Six Sigma in Non-Manufacturing Environments*

**Hasan Akpolat**

Faculty of Engineering, University of Technology Sydney, Australia
hasan.akpolat@uts.edu.au

## Abstract

Despite the fact that much has been published about Six Sigma in the business and academic press and on the Internet in recent years, there is still confusion among many people, particularly those who work in the transactional and service environments, about the nature of Six Sigma. It is true that Six Sigma like other process improvement programs before was first applied to manufacturing processes; however, many corporations including General Electric and Sony have successfully applied Six Sigma to their transactional and service processes as well. Six Sigma is used by many companies not only to improve the quality of their products and services but also to achieve quantifiable financial results, improve management style and communication, and achieve customer and employee satisfaction.

Whether in manufacturing or non-manufacturing environments, the application of Six Sigma differs from organisation to organisation. Although there are many common elements between these applications, however, special care must be taken when customizing Six Sigma to suit the organisations' needs.

In this paper, the author provides some practical and useful guidelines for Six Sigma deployment. This paper is not about the use of numerous statistical tools and techniques that can be found in a typical Six Sigma toolbox. The main emphasis has been placed both on the concept and the implementation of Six Sigma, particularly within the non-manufacturing areas of business.

**Key Words:** Six Sigma, non-manufacturing, process, transactional, service, quality improvement

## 1. Introduction

Since its inception in the 1980s, Six Sigma has developed remarkably and is increasingly

* This paper is an abstract from the author's new book entitled *"Six Sigma in Transactional and Service Environments"* Gower Publishing, UK, 2004

gaining international popularity, in Europe and Asia as well. Six Sigma is a result of the evolutionary process of quality innovations over the past five decades. It combines quality improvement tools with strategic management processes to achieve substantial bottom-line results and improve the overall performance of an organisation.

The main characteristics of the Six Sigma methodology include:

- Strategic alignment
- Top-down approach
- Customer focus
- Management and staff involvement
- Project management
- Measurement and improvement

The real power of Six Sigma comes from its *top-down management* approach. If used correctly, Six Sigma is an extremely powerful concept to drive a company wide continuous improvement program. As with any management initiative, Six Sigma is dependant on top management commitment and involvement. However, unlike the other improvement programs, top management plays a clearly defined role within Six Sigma. Not only they have to lead the initiative, but they also have to be actively involved in the Six Sigma projects.

One of the main benefits of Six Sigma is that it improves communication among various management levels. All Six Sigma participants have to undergo a well-defined training program and learn how to use the quality improvement tools effectively. Six Sigma tools have clearly defined application guidelines and link improvement efforts to organisational goals and objectives. Using these tools throughout the company enables managers literally speak the *"same"* language.

The strength of Six Sigma lies in the facts that:

- It is truly an open management technology and is not managed or owned by anyone
- It can be easily customized by any implementing organisation to suit various management goals
- It is not merely focussed on defect reduction but can be applied all areas of business including transactional and service environments
- It is supported by a well-defined toolbox for measurement and analyzing processes employed
- It creates a platform for internal and external communication forums where experiences and knowledge can be shared

◦ It can be easily integrated with other management practices.

Some of the typical reasons for implementing Six Sigma include:

◦ Improve productivity and profitability
◦ Reduce cost and cycle time
◦ Managing the culture change within an organisation
◦ Challenging the competition with new ideas and innovation
◦ Forming and improving supplier-customer relations
◦ Expanding businesses into foreign and domestic markets
◦ Transformation of business structures and/or operations

## 2. Definition of Six Sigma

In a nutshell, Six Sigma is a business concept that is built upon a well-defined and robust infrastructure which directly involves personnel from several management levels targeting quality and process improvement projects to drive a company's continual improvement efforts. It combines quality improvement tools with strategic management processes to achieve substantial bottom-line results and improve the overall performance of an organisation.

| Sigma Level | Number of Defects Per Million Opportunities (DPMO) | |
|---|---|---|
| | Process centered (Short Term situation) | Process shifted by 1.5 σ (Long term situation) |
| 1 σ | 317,400 | 697,700 |
| 2 σ | 45,400 | 308,537 |
| 3 σ | 2,700 | 66,807 |
| 4 σ | 63 | 6210 |
| 5 σ | 0.57 | 233 |
| 6 σ | 0.002 | 3.4 |

**Figure 1.** Sigma levels and corresponding number of defects per million opportunities

The original purpose and meaning of Six Sigma was to reduce defects or errors in a product or process to a level of near perfection. If we imagine that a bank has 1,000,000 transactions in a given time frame and the process is at *three* sigma level, 2700 out of 1,000,000 those transactions would be outside the three sigma limits (Figure 1). Improving the same process to *six* sigma level would mean that only 2 out of 1 billion transactions would be outside of those limits under the assumption that there was no shift in the process mean. However, if we considered the fact that the process mean shifted over time as much as 1.5 sigma, the process six sigma level would equal to 3.4 errors per million transactions.

Most processes in transactional and service environments typically operate below three sigma levels, unless it is a process which has specific legislative requirements (for instance safety or environmental regulations) or is running at higher financial risks. The identification of the sigma level required for a process depends on various factors including customer and market pressures, resource availability and other strategic decisions.

## 3. History of Six Sigma

There are three major stages of Six Sigma development to date (Figure 2). In the late 1980s and early 1990s, Six Sigma was used mainly by US American multinationals and predominantly in the manufacturing environment to reduce product defects and improve productivity. In the late 1990s, Six Sigma gained enormous acceptance mainly due to the successful and spectacular application led by Jack Welch, former chairman and CEO of General Electric Co. In the past few years, not only has the number of international Six Sigma applications increased, but it has been also applied to almost every business function including research and development, customer service, accounts payable, human resources and IT services.

## 4. Manufacturing vs non-manufacturing

According to the Australia and New Zealand Standard Industrial Classification (ANZSIC) manufacturing can be defined *as the physical or chemical transformation of materials or components into new products.* This can be an automated, semi-automated or a manual transformation. Therefore, manufacturing often involves a combination of machinery, tools, equipment, power and labor in order to bring materials to the desired product state. Typical

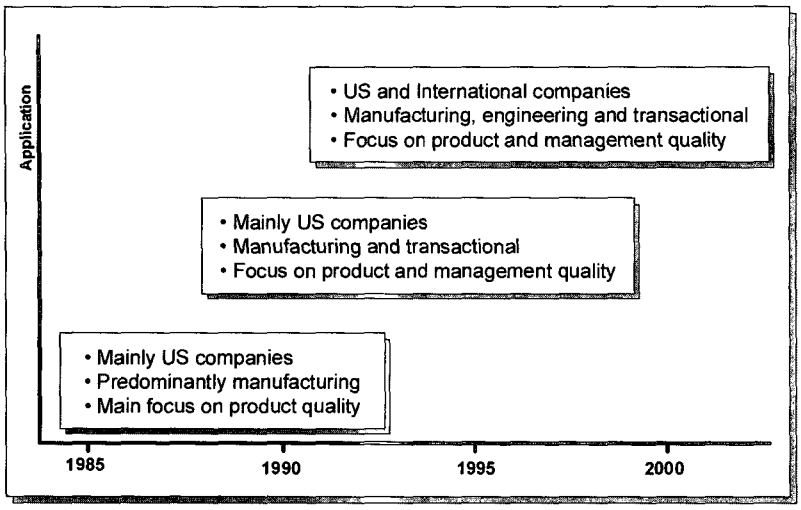


**Figure 2.** The history of Six Sigma

manufacturing activities include design and development of products, production and/or assembly, inspection and testing of products. Due to the fact that manufacturing activities deal predominantly with products, manufacturing industries are usually grouped into the following product categories including:

- Primary and fabricated metal products
- Chemical products
- Industrial and commercial machinery
- Electronic and electrical equipment
- Automotive and transportation equipment
- Wood and textile products
- Printed and published media

In the last few decades, we have witnessed an increasing degree of transformation in the industrialized economies, namely a shift from typical manufacturing to non-manufacturing / service activities. In most of these countries, the majority of the workforce is now employed by the non-manufacturing industries which often account for more than two third of the gross domestic product (GDP).

According to the ANZSIC, any category other than manufacturing can be classified as *non- manufacturing*. However, it is important to note that construction and mining industries are treated as separate categories within ANZSIC.

Typical examples of non-manufacturing categories include:

- Transportation and communication
- Electricity, gas and sanitary services
- Wholesale and retail trade
- Finance, insurance and real estate
- Service industries

Service industries are further divided into sub-categories including:

- Hospitality and recreation
- Health and aged care
- Legal and accounting
- Education and public administration

Both manufacturing and non-manufacturing organisations employ processes that are common to both sectors. These processes are usually of transactional or service nature. Typical non-manufacturing processes may include:

- Sales and marketing
- Inquiry handling and order processing,
- Forecasting and production planning
- Accounting and procurement
- Budgeting and management (financial) reporting
- Inventory and warehousing
- Distribution and transportation
- Pre-sales or after-sales service
- Customer relationship management
- Human resource management

Most manufacturing processes are concerned with *tangible* outcomes as they deal with a physical product (look, touch and feel). In contrast non-manufacturing processes are *less tangible*, as the physical product is often non-existent or difficult to discern. Some of the typical characteristics of non-manufacturing processes in transactional or service environments can be also problematic including:

- Processes are usually not well defined
- Processes are often poorly documented
- Measurement of process output is inconsistent or ill-defined

- Processes often cross boundaries between departments or functional areas
- Processes are usually perceived as 'cost centres' rather than 'profit centres'

Every product or service, whether consumed immediately or used over a period of time, is an outcome of a process. One of the main characteristics of service is that the service provider is often in contact with the customer. In most cases, these contacts are individual transactions. And every transaction has an impact on the customer. Service can be tangible, intangible or a combination of both.

In the non-manufacturing processes, one of the most commonly used metrics is *time metrics.* At a bank counter or for a delivery service for instance waiting time is one of the most annoying aspects of the service for the customer. Customers feel the difference if the service is performed quickly or slowly, and they value prompt and speedy service. Typical time metrics may include: Elapsed time; Cycle time; Lead time; Idle time; Transportation time; Delivery time; Waiting time; Product freshness (Storage time); and Delays.

When analysing non-manufacturing processes, the following questions assist the identification of areas for improvement:

- Which steps are critical to the process outcome?
- How long does it take to complete the entire process and the critical steps?
- Which are the weakest links?
- Are there any repeated or duplicated steps?
- Are there any unnecessary steps in the process?
- Which steps add (extra) cost to the process?

## 5. Six Sigma Projects

A typical Six Sigma project has five phases; Define, Measure, Analyse, Improve and Control, commonly referred to as the DMAIC methodology. In the Define phase, the improvement area is identified and project requirements such as project time frame, team membership and necessary resources are defined. In the Measure and Analyse phases, data is collected and analysed to determine changes to the process in order to achieve a desired outcome. These changes are then implemented in the Improve phase, while in the Control phase actions are taken to ensure that process changes are stable and the process does not return to its original condition. The flow of these activities and their relationship with each

other is shown Figure 3. Note how the VOC and VOB play an active and important role in the strategic analysis.

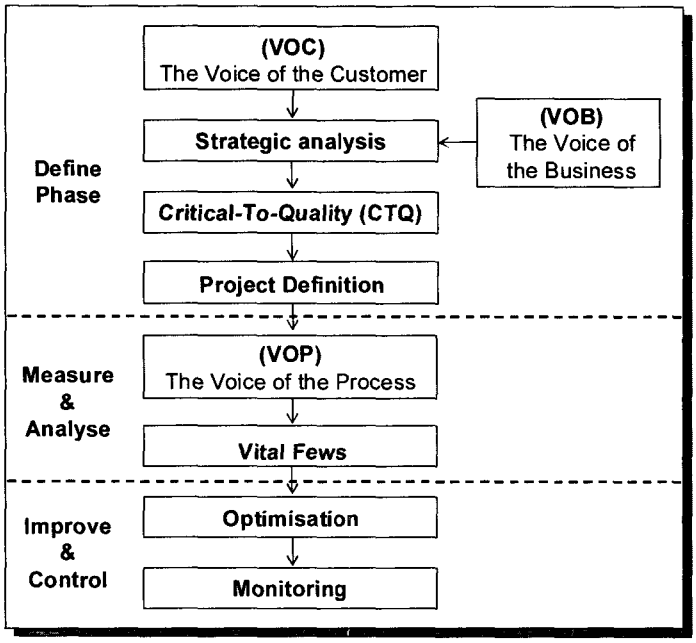


**Figure 3.** Typical Six Sigma project flow diagram

DEFINE phase is perhaps the most critical phase within any Six Sigma project. Many aspects need to be thoroughly analysed before an improvement effort can be committed. These aspects include the voice of the customer (VOC), the voice of the business (VOB) and the current state of the processes.

The identification of a need for improvement, namely selection of the *right* Six Sigma project, is one of the critical activities in the DEFINE phase. Whether in manufacturing or non-manufacturing operations, company's performance results can be used as a starting point. These results may include:

- Market share
- Sales volume
- Customer complaints
- Staff turnover
- Employee complaints

Specific projects in the non-manufacturing environments may be selected from the areas including:

- Customer service
- Returned goods and warranty process
- Accounts receivable and accounts payable
- Distribution and supply chain
- Inventory and warehousing
- Computer networks

## 6. Conclusions

The Six Sigma methodology is a result of the evolutionary process of quality innovations. It is a business concept that combines quality improvement tools with strategic management processes to drive a company's continual improvement efforts and achieve substantial bottom-line results. Although it was originated and used mainly in manufacturing environments in the late 1980s, Six Sigma is not only for manufacturing and as a matter of fact many large organisations use it both in the manufacturing and non-manufacturing environments of their business operations. The core concept which underlies Six Sigma is based on *process thinking*. Due to this fact, Six Sigma can be applied to any process and perfectly suits non-manufacturing processes as well.

## References

1. Akpolat, H.: *Six Sigma in Transactional and Service Environments,* Gower Publishing, UK, October 2004.