

ADVANCED PROJECT

How Business Process Improvement Methodologies Can Improve Small Business Performance

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Spring 2017

F-11: Can design and produce a significant product that demonstrates advanced competence in a particular subject matter.

F-12: Can demonstrate knowledge of several current business process improvement methodologies and applications, and design a customized business process improvement guide for small businesses.

## Introduction

Historically, business process improvement methodologies have been reserved for medium and large sized enterprises to help improve their complex business processes and enhance the quality of mass produced goods. Pioneered by large corporations such as Toyota, Motorola, and General Electric, business process improvement methodologies came to the forefront of American businesses in the 1980's as a response to the current economic decline and looming foreign competition. However, today's fiercely competitive global market demands high quality and constantly improving processes from every business, large and small. Larger firms depend upon small businesses to provide high quality products and services at low costs to manage supply chain issues within a global market (Kaushik, et al). The small business sector accounts for a large swath of the US economy and is growing. The US Small Business Association states that there are 28 million small businesses in the US that account for 54% of total US sales and provide 55% of all jobs. The number of small businesses has steadily increased since the 1980's and has added 8 million new jobs since 1990 (United States Small Business Association). To fully harness this expanding economic market, small businesses need to focus on constant improvement and to do this must embrace business process improvement methodologies.

While business process improvement methodologies have been regularly implemented in larger corporations over the past three decades, there have been consistent challenges in applying them in a small business context. Given limited human and financial capital, many small businesses do not execute systematic process improvement methodologies. In their work, *Developing a BPI Framework and PAM for SMEs*, Zulfiqar Khan and Rejeev K. Bali cite finances, time, human capital, and general understanding of improvement philosophies as the biggest resource constraints for small enterprises adopting a business process improvement methodology (349). For example, methodologies such as Six Sigma are difficult for small businesses to utilize due to how major Six Sigma training companies structure their services with most requiring large up-front payments to use the copyrighted training materials (Antony). Additionally, small businesses have limited human capital resources especially in terms of training budgets and delegating specialized roles to individuals (Antony). Within small businesses, workers often fulfill multiple functions and have diverse accountabilities making dedicated roles difficult. Lastly, the large management industry surrounding business process improvement methodologies have pushed management ideas and fads with ever increasing speed leading to confusion and mixed results. As Stuart Crainer and Des Dearlove point out in their 2006 work *Whatever Happened to Yesterday's Bright Ideas?* "the business world has embraced culture change, TQM, Quality

Circles, re-engineering, the balanced scorecard, knowledge management, the learning organization, Six Sigma, and core competencies” just to name a few of the many utilized buzzwords and lingo associated with business process improvement (35). Crainer and Dearlove further address this advent of a buzzword culture by stating “the global language of management is, in the eyes of many both in and out of the corporate work, a terrible linguistic aberration, a vacuum of meaning wrapped around neat phraseology” (37). While this helped create a common business language across corporations, it has led to confusion regarding principles and application of methodologies. More importantly for small businesses, the glut of new methodologies and management philosophies raises the question “Do the big ideas serve any useful purpose? Do they actually work?” (Crainer and Dearlove 36). Small businesses cannot afford to pay for a solution that fails to add value.

This paper seeks to address how small enterprises can apply the lessons of business process improvement effectively without the financial burden associated with BPI implementation and without simply adopting “buzzword” language and not seeing any improvement. In answering this problem, I will analyze three major, and highly referenced, business process improvement methodologies, paying particular attention to the historical context in which these processes were developed. The three chosen methodologies will illustrate the diversity of procedures and techniques found in many of the most popular BPI methodologies. Following the analysis, this paper will seek to synthesize the foundational principles of these three BPI methodologies to help small businesses understand the fundamental principles of BPI methodologies so that small businesses may understand the techniques and procedures most appropriately suited to their unique business environment. By recognizing the underlying principles that have given way to popular process improvement tools, a small business can better understand the foundation in which business process improvement is built upon, giving them access to focus on the most important pillars for success.

To fully understand business process improvement methodologies, this paper will explore the history and development of three popular and long-standing business process improvement methodologies: Total Quality Management, Lean manufacturing and its roots in Toyota Production Systems, and Six Sigma. Specifically, this paper will analyze the development of quality improvement theory within Total Quality Management and pay particular attention to the underlying principles of Six Sigma and Lean manufacturing. Additionally, concentration will be on the economic climate and culture in which these methodologies were developed to better understand why these improvement methodologies were created and what problems they were seeking to address. An analysis of the

findings of this paper will synthesize the main principles of these methodologies to help lay the groundwork for the Advanced Project artifact, an accompanying visual guide for small businesses to recognize and understand the main principles of Total Quality Management, Lean manufacturing, Six Sigma into their organization. To begin, an introduction to business process improvement and its definition will be explored. Next, we will highlight BPI's relationship with project management before exploring the economic climate of the 1970's and 1980's that gave rise to this improvement industry.

### Business Process Improvement and Role of Project Management

In today's increasingly complex and ever-changing business paradigm, it is essential for companies to continuously improve their products and processes to stay competitive. As ubiquitous as the terms "continuous improvement" and "business processes" have become, there is still no academic consensus on how these terms should be defined. For the purposes of this paper, I will define continuous improvement with the Japanese term for continuous improvement, kaizen, which is the process of making constant improvements, no matter how small, to eliminate all waste that adds cost but provides no value. A business process will be defined as a series of actions used to accomplish a specific goal (Liker). It is important to note that according to scholarly literature, there is no consensus on a definition for continuous improvement. As Nadia Bhuiyan and Amit Baghel highlight in their work, *An Overview of Continuous Improvement: From the Past to the Present*, "Continuous improvement tends to be used as a general term that has acquired many of its attributes from other quality initiatives such as Total Quality Management and Lean Manufacturing" (766).

For this paper, I will use H. James Harrington's definition of business process improvement to help clarify the methodologies to be explored. A leading quality and performance expert, Harrington defines business process improvement (BPI) as "a systematic methodology developed to help an organization make significant advances in the way its business processes operate" (20). To achieve this, Harrington emphasizes eliminating waste and streamlining operations to increase overall quality of product and processes. With this definition in mind, I will focus on the in-depth systematic improvement methodologies that are frequently referenced in both popular business publications and academic or scholarly research: Total Quality Management, Six Sigma, and the Toyota Production System also known as Lean Manufacturing. These methodologies all meet Harrington's definition of BPI as they all provide methods for achieving systematic improvements by eliminating wastes, improving operations, and increasing quality of both processes and products. Most importantly, Harrington's definition of BPI stresses that total implementation of an improvement methodology throughout an

organization is the key to success. Total Quality Management, Six Sigma and the Toyota Production System are in-depth methodologies that each emphasize this point rather than encouraging using just segments or certain tools as this ultimately leads to mediocrity or failure.

When looking across the expanse of BPI methodologies, there are consistent themes that are present throughout. These key themes, or principles, of BPI could be categorized as: overall business improvement and increase in financial profits, maximizing human potential, and leadership and organizational culture. Every methodology seeks to improve the business and ultimately increase its profits and this is most successfully achieved by eliminating existing waste and improving overall quality. Additionally, workers at every level play an integral role in the success of implementing and sustaining a BPI process. It is in an organization's best interests to cultivate an environment that nurtures and expands worker's knowledge and skills. Leadership and an organization's culture can decide the fate of BPI process implementation and its future success. From the onset, leadership and culture shape a business and in turn, determines how important education and training are as well as the company's metrics for success. When exploring the landscape of BPI methodologies, the most successful implementations have been company-wide, cross-functional, and stressed the importance of investing in workers and using clear measurements as a guide for decision-making.

While exploring BPI methodologies, it is important to highlight the role in which project management plays in the implementation and success of BPI. If BPI signifies the continuous process of business improvement within an organization, project management is the specific implementation of change, with a clearly defined start and end. Projects cannot extend forever, but may result in the launch of a new process or the improved continuation of a current process. Historically, project management (PM), was a major step for business management in gaining control over organizations, emerging technologies, and the labor force (Johnson). Much like BPI was a response to the encompassing economic climate of the 1980's-present, project management was a response to the complex nature of emerging technology, technical problems, and organizational issues within the military, government, and business (Johnson). According to *A Guide to the Project Management Body of Knowledge (PMBOK Guide)*, a project is defined as "any undertaking with a defined starting point and defined objectives by which completion is identified," and "in practice, most projects depend on finite or limited resources by which objectives are to be accomplished" (Yasin, Martin, and Czuchry 20). In general, project management tools and techniques fall into five groups or "project phases": initiating, planning, executing, monitoring/controlling, and closing ("What is Project Management?"). As Gilles

Garel points out, “there is no unified theory of project management” and it is roughly based on “the articulated best practices of North American engineering projects” (663). It is important to note that project management is not a true functional area of a business such as accounting or marketing because of its temporary nature. However, project management serves a necessary role in the implementation of BPI. Most BPI methodologies launch as a project and PM tools and techniques are used throughout its implementation.

#### The Economic Climate that Gave Rise to BPI: The 1970’s Crisis

In the contemporary business environment, the need for continuous improvement is taken as a given. Business leaders may question how to achieve continuous improvement but they never question the need for it. As much as this is taken for granted today, this has not always been the case within American industry. Henry Ford is lionized for the improvements he made to manufacturing, however, he would not have described these innovations as a step in an endless process of improvement. Rather, Ford, like his modernist contemporaries, would have believed that he had finally found the solution to industrial production. Much like Isaac Newton determined the laws by which the motion of planets could be determined, Henry Ford had discovered the laws by which industry could be governed. An influential contemporary of Ford, Frederic Taylor made this connection explicit stating that “the best management is a science, resting upon clearly defined laws,” (iv). While such a mindset may appear arrogant, business leaders within American industry had reason to be confident. As Harvard Business School professors Robert Hayes and William Abernathy point out “until the late 1970’s, the United States tended to regard itself as the exemplar of modern management” with “this view bolstered by more than three decades of positive trade balances that appeared to provide clear evidence of the superiority of the ‘American system’ of mass production” (141). Due to the impact World War II had on the global economy and foreign companies, particularly Japan and Europe, the US had a distinct advantage. Recovering from utter decimation from bombings, occupation, and warfare, foreign companies were forced to confront manufacturing and industry with little capital or supplies. Instead they focused on what they could control: quality of processes and goods. This led to the development of Toyota’s Production System and the birth of lean manufacturing. In contrast, US industry returned to the peacetime mass production of goods with high demand and virtually no foreign competition (Kruger). There simply lacked any urgency to question or improve the status-quo processes and procedures of traditional US industry. To end this long-standing American hubris an economic crisis of the kind that America experienced in the 1970’s was necessary.

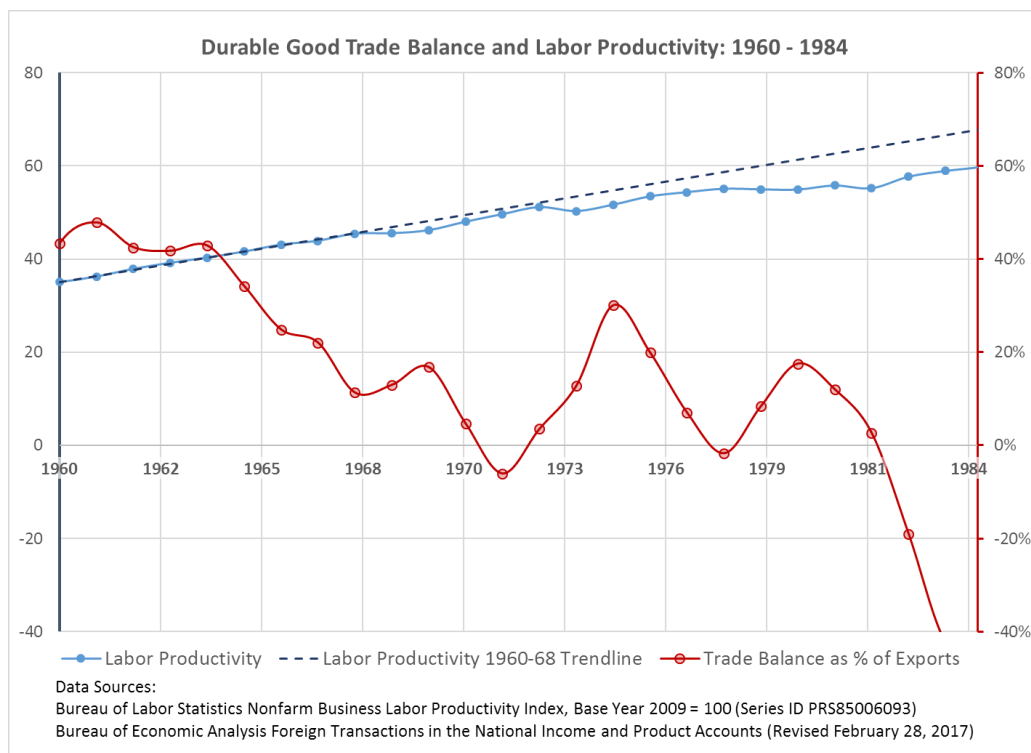


Fig. 1. This graph depicts both Labor Productivity in Worker Output per Hour and the Trade Balance of Durable Goods (Exports minus Imports divided by Exports) from the Bureau of Labor Statistics. Additionally, there is a trendline of expected Labor Productivity given the growth rate from 1960 thru 1968. As illustrated, the US Trade Balance begins to stagnate and fall at the same time as the Labor Productivity growth begins to fall below the expected rate (United States Dept. of Labor and Dept. of Commerce).

On July 15<sup>th</sup> 1979, President Jimmy Carter addressed the nation from the Oval Office. His tone was solemn as he declared that there was a “fundamental threat to American democracy” which he identified as “a crisis of confidence.” As President Carter saw it, American confidence had been lost.

The erosion of our confidence in the future is threatening to destroy the social and the political fabric of America [...] We've always believed in something called progress. We've always had a faith that the days of our children would be better than our own [...] Our people are losing that faith [...] The symptoms of this crisis of the American spirit are all around us. For the first time in the history of our country a majority of our people believe that the next five years will be worse than the past five years [...] The productivity of American workers is actually dropping, and the

willingness of Americans to save for the future has fallen below that of all other people in the Western world.

Although, President Carter said that worker productivity was falling, per hour output was still rising although at a declining rate and well below the trend established by the previous decade (Figure 1). In fact, the previous year marked only the second time in 100 years that imports of durable goods had exceeded exports alarming manufacturing leaders. As depicted in the graph (Figure 1), the US economy saw a consistent decline in exports relative to imports since 1960 with significant, chaotic, fluctuations throughout the 1970's before experiencing a rapid and serious decline in the early 1980's. Although, a negative trade balance has become the new normal in American business (Figure 2), this was a shocking negative indicator in 1979.

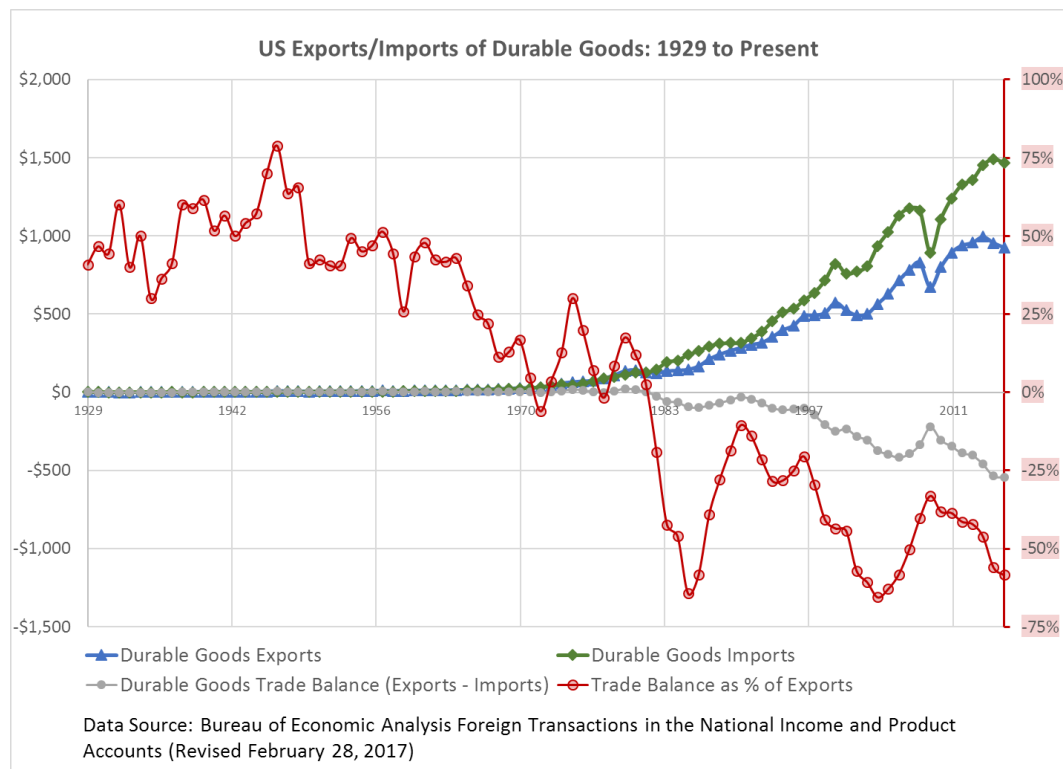


Fig. 2. This graph depicts Exports and Imports of Durable Goods to include the Trade Balance (Exports minus Imports) and the Trade Balance as a percentage of Exports. For the past three decades, the US has had a consistent and significant deficit in the trade of



durable goods. While accepted as “normal” in 2017, this was a troubling economic indicator in the 1980’s (United States Dept. of Commerce).

### Total Quality Management

In June 1980, NBC News aired “If Japan Can, Why Can’t We?” and introduced the American public to the work of W. Edwards Deming. Three years later, President Reagan issued Executive Order 12428, establishing the President’s Commission on Industrial Competitiveness which focused on the “ability of United States firms to meet international competition at home and abroad.” (<http://www.presidency.ucsb.edu/ws/?pid=41529>). The growing trade imbalance meant that within the global market, American companies were being beat on quality. The American response to this threat is embodied in what became known as Total Quality Management, a business philosophy built largely on the work of W. Edwards Deming.

At the end of World War II, quality was not considered to be vital for success in industry as there was large demand for American goods with little foreign competition. Volume and quantity were deemed critical for business while quality was not and there was enough profit to cover the extra costs for low quality (Kruger). In order to be effective, the perception of quality had to move from a traditional viewpoint as a function to inspect for errors after goods were made to a more modern idea of preventing errors from occurring through quality management systems (Gladieux). Foreign threat to the US market share increased in the 1970’s when goods such as Japanese cars and televisions began to surpass American goods in terms of quality and heightened the search for solutions for effective management (Petersen).

### What is Total Quality Management?

According to Sanford Friedman, Total Quality Management (TQM) rests on the philosophy of continuous improvement and serves as the basis for all quality and personnel management utilized in today’s business world. The concept of quality traditionally began as a mechanism to inspect for errors after a product had been made and before it went to market. Modern approach to quality has shifted from this idea and applies quality less as a control function and more as a management function. Today, business owners link high quality with profitability and are using it as a metric in strategic planning processes (Calingo). A fully integrated TQM philosophy involves all aspects of a company including its product design, customer service, marketing, sales, vendors, and manufacturing processes (Friedman). There are seven elements most commonly associated with TQM and include: customer-driven quality, strong leadership, continuous improvement, full employee participation, management by data and

facts, organization-wide application, systematic quality strategies, quality and operational results, and standardized methods and practices (Calingo np). As author Volker Kruger states, “TQM comprises a business strategy for harnessing the full capacity of all the company’s resources—not only technical—in order to achieve world class quality at minimum costs” (Kruger 146). In short, effectively applying TQM in an organization requires a complete business reorganization.

The primary goal of TQM is to drastically reduce or eliminate waste of all kinds within a system (Fletcher). Potential sources of waste include time, effort, human resources, capital, errors, and/or repairs. TQM is difficult to define due to its all-encompassing nature and a myriad of sub-set theories. Additionally, it has been implemented differently by many consultants and companies leading to further confusion about its principles and its overall effectiveness. There were many failures due to a glut of “experts” touting TQM fueling continued misunderstanding of TQM’s underlying philosophy and principles. However, authors W. Edwards Deming, Philp Crosby, and Joseph Juran are consistently viewed as the most prominent authority figures on TQM and few individuals were as well-versed on the subject when it was first introduced in the 1980’s. Therefore, to accurately discuss the fundamentals surrounding the theory of TQM, an in-depth analysis of each authors’ contributions to TQM is necessary.

#### W. Edwards Deming

W. Edwards Deming, the primary pioneer of TQM, first brought the concept of improved quality management to the forefront of American businesses and consumers by being featured on the NBC program entitled: *If Japan can, Why Can’t We?* (Kruger). The broadcast focused Japan’s industrial recovery after World War II and compared this success with the problems surrounding American industry (Petersen). As these problems were examined, Deming offered positive solutions on how the United States could improve setting himself apart from the other commentators (Petersen). Deming first began his career in the 1940’s in Japan giving lectures and seminars on quality and economic improvement and he is considered an integral part of Japan’s industrial renaissance during the 1950’s (Kruger and Petersen). In fact, Japanese manufacturers created the quality award the “Deming Prize,” in his honor and he received the Second Order Metal of the Sacred Treasure in 1960 from the Emperor of Japan for his outstanding contributions to Japanese industry (Kruger). Deming’s principles are centered on his philosophy that improving quality makes improving productivity possible which in turn, improves a business’s market competitiveness (Kruger). For Deming, low quality means high costs, wasted resources, and a loss in the competitive position of an organization (Kruger). In addition, Deming stressed that variation, deviation from set standards, was the enemy of quality and caused errors

(Petersen). He categorized variance by cause, either common or special. Management typically focused on special variance which Deming defined as caused by an individual or worker error. Instead, management's primary focus should be on eliminating common variance, defined as error caused by the system, apart from human error (Petersen). He contended that too much time was spent correcting the mistakes by individual workers rather than improving the whole system (Petersen). Deming argued that improvements to quality would yield increases in productivity, decreases in cycle time, increases in capacity, lower production costs, improved profits, happier customers, greater market share, more jobs, fewer customer complaints, and less litigation (Petersen). To improve the total quality of an organization, Deming developed a 14-point program, a Shewhart Cycle for improvement, his System of Profound Knowledge, and the Deming Chain Reaction. These tools and methodologies helped to shape TQM and its theories.

#### Deming 14 Point Program

Deming first published his 14-point program in his book, *Out of the Crisis*, as a response to industry management's failure to plan for the future and innovatively create quality products and services. As Steve Gibbons highlights, Deming describes his points as "the basis for transformation of American industry. It will not suffice merely to solve problems, big or little. Adoption and action on the 14 points are a signal that the management intend to stay in business and aim to protect investors and jobs" (Gibbons, n.p). Deming's 14 point program is summarized below (Kruger 147-150):

1. Create constancy of purpose for improvement of products and service. A company has to have long range goals and plans for continuous improvement.
2. Adopt a new philosophy. Quality must become the new business model for the company where mistakes and defects are considered unacceptable.
3. Cease dependence on inspection to achieve quality. Deming notes that quality does not come from inspection but from improvement of work processes.
4. End the practice of awarding business on price tag alone. Companies should look for best quality suppliers and vendors.
5. Improve constantly and forever the system of production and service. Quality is not a one-off effort.
6. Institute training on the job to thoroughly prepare workers.
7. Institute leadership among management.

8. Drive out fear to ensure that everyone may work effectively. Deming contends that it is the role of management to develop a positive work environment which enables workers to express their ideas, ask questions, and are not afraid to make suggestions or ask for guidance.
9. Break down barriers between staff departments. Encourage cross functional communication to improve overall quality.
10. Eliminate slogans, exhortations, and targets for the workforce. Deming argues that defining a goal without the necessary method for achievement is useless. Not every worker can move at the same pace and still produce quality work.
11. (A) Eliminate numerical quotas for the factory floor. Deming emphasizes that qualitative targets are superior in achieving long term change and solutions.
11. (B) Eliminate numerical goals for management.
12. Remove barriers for all workers that hinder workmanship. Supervision, raw materials, and equipment should all be quality to ensure a quality product.
13. Encourage education and self-improvement for everyone. Continuous training helps employees improve their performance and work. In particular, Deming stresses the importance for training in statistical tracking and statistical charts.
14. Put everyone within the organization to work to accomplish the transformation.

Deming insisted that companies enact his entire program and not cherry pick portions (Petersen).

To help facilitate managers in implementing his program, Deming created the Shewhart Cycle for Improvement and the Deming Chain reaction.

#### Shewhart Cycle

Named for Deming's mentor, Walter Shewhart, the Shewhart Cycle consists of a circle with numbers 1-4 running clockwise with each number representing a series of action steps. An example of a Shewhart Cycle is shown in Figure 3.

## Shewhart cycle: Deming—1986 / FIGURE 6

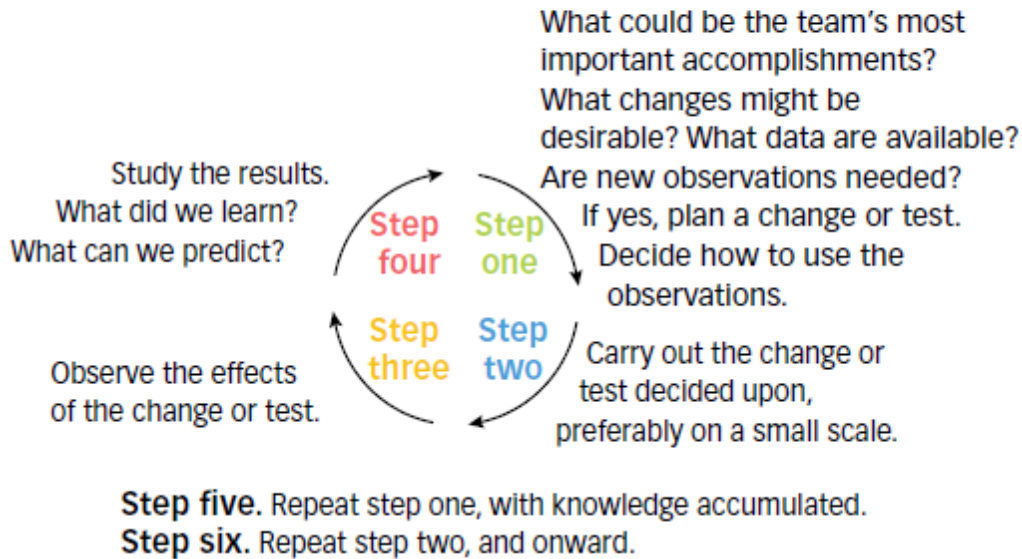


Fig. 3. Shewart Cycle (Moen and Norman 27)

As depicted in the graph the Shewhart Cycle has 4 steps:

- 1) Observe, collect relevant data and using data decide on plan or test.
- 2) Carry out the change or test on a small scale.
- 3) Observe the effects of the change or test.
- 4) Study and learn from the results.

A 1986 version of this model contains 2 additional steps (Petersen 481):

- 5) Repeat step 1 with knowledge accumulated.
- 6) Repeat step 2, and onward.

In his later years, Deming would refine this cycle and rename it the Shewhart Cycle for learning and improvement or the PDSA cycle (Petersen). It consists of a circle with the functions: "Plan, Do, Study, Act" listed in a clockwise fashion as a flowchart for learning and improving the quality of a product or process (Petersen).

Deming Chain Reaction

A key to the success of Deming's theory is his chain reaction model that illustrates how improvements in quality improve a system or business as a whole. Entitled the Deming Chain Reaction, the chart was one of Deming's favorites and is shown below:

#### Deming Chain Reaction



Fig. 4. Deming Chain Reaction (Hunter)

This chart helps illustrate how an improvement in quality can impact an entire organization from its production to its sales and market share. It highlights the benefits of quality improvement such as, increases in productivity, capacity, market share, and lowered costs and better profits (Petersen). While Deming was clearly the most prominent figure in the field of TQM, Philip B. Crosby and Joseph Juran were also major figures in developing Total Quality Management's core principles and fundamentals.

#### Philip B. Crosby

Philip B. Crosby used his extensive corporate experience and excellent communication skills to become a popular figure in the TQM movement of the 1980's. Founder of the Quality College, the largest TQM consulting firm in the world during this time, Crosby's main contributions to the TQM was

his concept of zero defects that is housed within his 4 absolutes of quality management (Petersen).

Crosby's four absolutes of quality management include:

1. DIRFT- Do It Right the First Time. Crosby insisted the definition of quality must be the conformance to requirements and that customers who spoke about quality must define expectations in specific terms (Kruger). The key component to DIRFT is clear requirements have been defined and are understood by both customers and the business.
2. The system of quality is prevention (Kruger).
3. The performance standard is "zero defects". Crosby believed that mistakes were the result of either two factors: lack of attention or a lack of knowledge, both of which can be corrected (Kruger).
4. The measurement of quality is the price of nonconformance. Crosby's idea was that quality could be measured quantitatively as the costs of nonconformance, the costs of doing things wrong, were equal to the costs of quality (Kruger).

Joseph Juran

Like Deming, Juran made significant contributions to Japanese industry and was awarded the Order of the Sacred Treasure by Emperor Hirohito for his work (Petersen). Juran's theories rested on the idea that quality control must be conducted as critical part of management (Kruger 150-151). Juran's notable additions to the quality management field were tools: the Juran trilogy and the triprol concept (Petersen). The Juran trilogy is used to describe the interrelationship of the three processes used to manage overall quality: quality planning, quality control, and quality improvement (Petersen). The quality improvement process is the most important in the trilogy because improvements directly to the system reduce chronic waste (Petersen). Juran believed that improvement began here rather than with quality planning as it provided a measurable return on investment (Gibbons ). A visual of Juran's trilogy is depicted below:

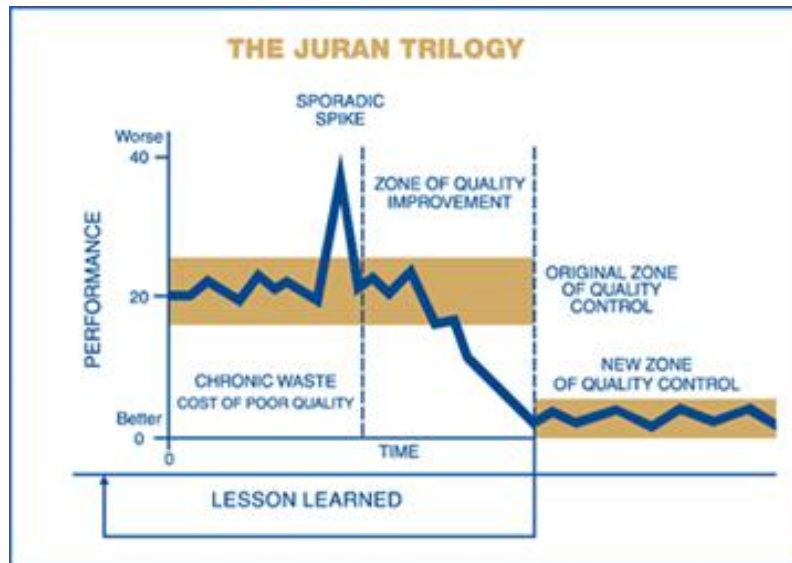


Fig. 5. Juran Trilogy (Wallace)

Juran’s Trilogy diagram highlights his philosophy of improving an organization’s system rather than adopting a new system like Deming proposes. In addition to the Juran Trilogy, Juran also created a flow diagram entitled the Juran Tripol Concept to push the idea to consider process systems as a whole with interrelationships rather than independent functions (Petersen). A simple diagram, the Tripol Concept depicts the three main roles of a process: suppliers, the processor, and the customers. Juran believed that studying understanding the relationships between the parts of a system provided full understanding of the system and provided substantial opportunities to increase quality (Petersen). The Juran Tripol Concept is depicted in figure 6.

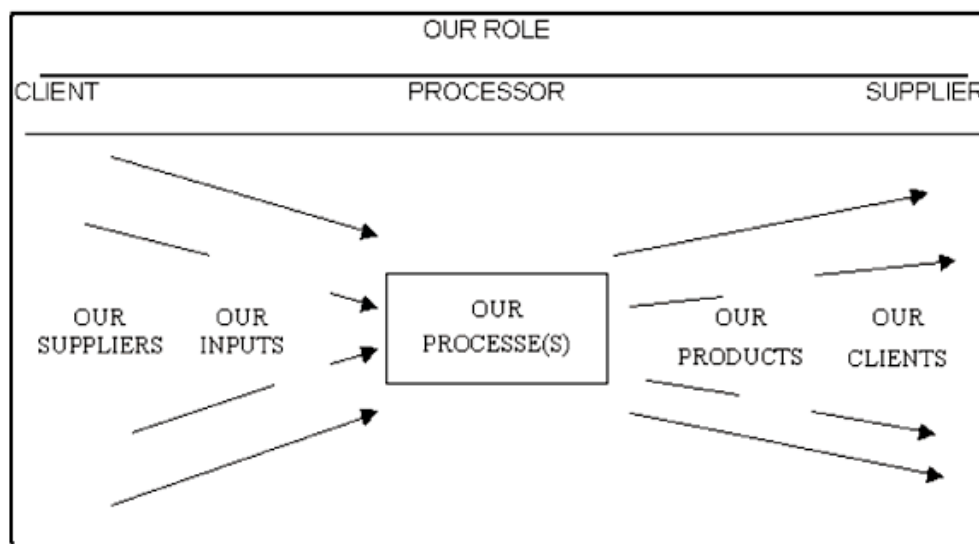




Fig. 6. Juran Triprol Concept (Sestren and Neto n.p.)

As one can see, Juran was trying to emphasize the interrelationships between suppliers, producers, and consumers in terms of quality. By looking at product production in this manner, one could pinpoint quality improvement opportunities in sectors outside of just an organization's processes.

Although TQM is conducted differently by consultants and organizations, there are some basic similarities among successful TQM applications with many of them attributed to Deming's work. As Deming stressed, the methodology must be adopted throughout an organization and must have full, long standing, managerial commitment to succeed. Additionally, Deming emphasized a constant purpose throughout implementation with a unified philosophy intent on change within management (Petersen). TQM measures often failed if they were temporary endeavors or were lost to other, more attractive management fads and ideas.

The search for American industry solutions continued to overtake the private and public sector. In 1987, the Ronald Reagan administration established the Malcolm Baldrige National Quality Award. The award focuses on seven concepts of quality: leadership, information and analysis, strategic quality planning, human resource development and management, management of process quality, quality and operational results, and customer focus and satisfaction. The purpose of this award is to: recognize US companies focused on continuous improvement, encourage American companies to improve quality and productivity, establish guidelines and criteria for improvement, and recognize the achievements of companies that have improved the quality of their goods and services. In 1988, Motorola achieved the distinction of being the inaugural winner of the Baldrige Award and with that achievement brought publicity to the BPI methodology developed by Motorola engineers ("How the Baldrige Program Began: The Birth of a Unique Public-Private Partnership").

#### Six Sigma

Total Quality Management helped pave the way for more analytically focused BPI methodologies such as Six Sigma. While TQM focuses on overall organizational change and results, Six Sigma provides businesses with tools to measure and analyze business processes to help focus on specific business process results (Mehrjerdi). Author Frank Anbari summarizes Six Sigma with the following succinct diagram:

Six Sigma = TQM + Stronger customer focus + Additional data analysis tools + financial results + Project management.

The traditional factors of TQM serve as the foundation of Six Sigma in focusing on quality control and quality improvement. The Six Sigma Methodology was created by Bill Smith, an engineer working at Motorola. Smith identified a lack of quantitative rigor in the current quality management process, and developed a set of statistical tools to quantify the quality improvements TQM sought to achieve (Basu).

#### Definition of Six Sigma

Motorola implemented Six Sigma with the aim of reducing quality costs: costs of quality defects and costs of failing to meet customer requirements (Antony and Banuelas). Like TQM, Six Sigma focuses on eliminating waste in order to achieve customer-defined quality. Unlike TQM, Six Sigma includes a statistically defined goal of acceptable quality. As Yahia Zare Mehrjerdi explains in his work, *Six-Sigma: Methodology, Tools, and its Future*, “the central theme of Six Sigma is that products and processes can be improved dramatically by understanding the relationships between the inputs to a product or process and the metrics that define the quality level of the product or process” (80). To fully understand this concept, let’s explore the mathematical foundations of Six Sigma.

Sigma is denoted by the Greek alphabet letter  $\sigma$  and is used to identify the level of variability within a process or product (Mehrjerdi). Specifically, within statistics, sigma refers to a sample or population’s standard deviation, a measure of variance from the mean. In this way Six Sigma is clearly linked to Deming in that quality is measured in terms of variance. A sigma quality level indicates how close a product comes to reaching its quality goal. If a manufacturing process is rated as reaching one sigma level it means that 68% of products are acceptable, three sigma level means 99.7% are acceptable, and six sigma designates that 99.9997% of products are perfect (Dambolena and Rao). In Six Sigma language, this quality level is translated into determining the number of defects per millions opportunities. A Six Sigma quality level of 99.9997% is equal to 3.4 defects per million opportunities (DPMO) with opportunities defined as any chance for a product to not meet the required specifications (Mehrjerdi). Therefore, “Six Sigma means that for any given product or process quality measurement, there will not be more than 3.4 defects produced per 1,000,000 opportunities” (Mehrjerdi 79). In 2011, it was believed that most companies operated at three sigma which means that they produced 66,000 errors per million opportunities (Mehrjerdi). A successful Six-Sigma program would drastically reduce this number, resulting in costs savings and waste reduction.

The theoretical basis of Six Sigma is centered on the statistical concept of normal distribution. As Frank Anbari points out, “normal distribution indicates that a process has many observations around its mean (its average) and fewer observations the further and further away from the mean” (Anbari).

Therefore, one sigma level quality expresses more defect per million opportunities than three sigma or six sigma because its closer proximity to the mean of the process. As the sigma value of the process increases so does the performance of the process, decreasing errors while maximizing output. This concept can be visualized as a bell curve with its tails getting increasing smaller the further away from the mean. An example is shown in the following photo.

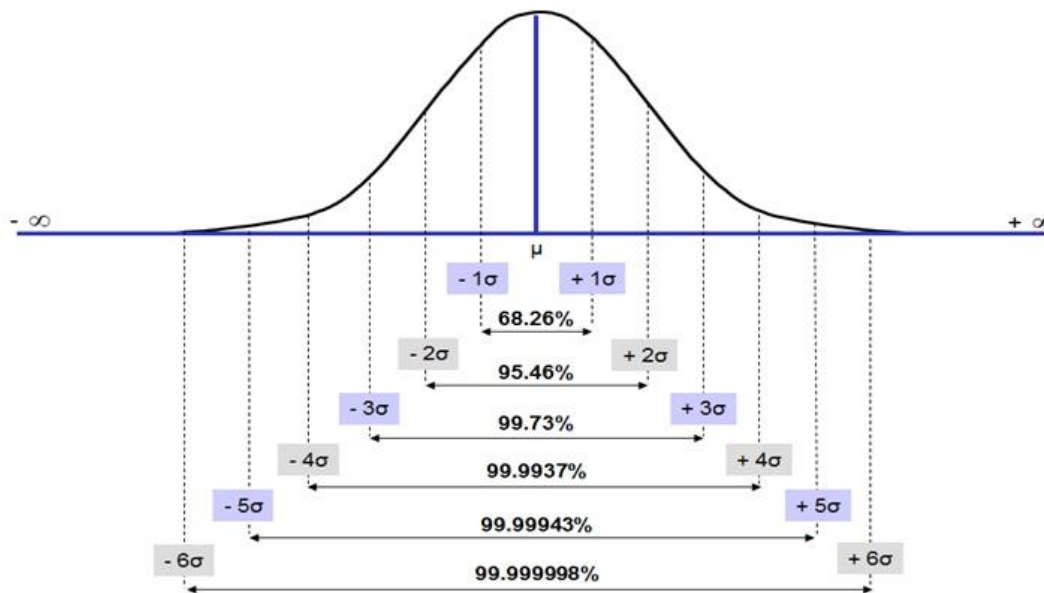


Fig. 7. Sigma Levels (“Six Sigma DMAIC Process- Measure Phase- Measurement System”)

As depicted, the natural spread of process variables, which are subject to specifications and tolerances, decreases as you move further away from the mean (Dambolena and Rao). Six Sigma is powerful due to its empirical and data driven approach to determine specifically how a system is performing (Mehrjerdi). By focusing on understanding which inputs have the greatest effect on system and through controlling these inputs, the Six Sigma approach can drastically improve the quality of a system’s outputs, or products (Mehrjerdi).

#### Six Sigma Methodology

Although Six Sigma has foundations in strict statistical process measures, advocates of Six Sigma claim that its definition has developed from that to a business improvement methodology and problem solving methodology (McAdam, Hazlett, and Henderson). This is in part due to Six Sigma’s operational improvement methodologies. Depending on the focus of improvement, Six Sigma has two methodology tracks to employ – DMAIC for existing processes and DMADV for new products or processes (Mehrjerdi).

## DMAIC vs. DMADV

The DMAIC methodology stands for: Define, Measure, Analyze, Improve, and Control (Mehrjerdi). Used to improve existing products and processes, The DMAIC methodology is applied when the cause of the problem is unknown, potential for significant savings exists, and the improvement project can be completed within four to six months (Mehrjerdi). The DMADV methodology stands for: Define, Measure, Analyze, Design, and Verify (Mehrjerdi). The DMADV methodology is recommended to optimize the systems for new products and processes as highlighted by the fact that its final two steps focus on designing and verifying future products and processes (Mehrjerdi). For this study, the focus concentrates on the DMAIC methodology as it is standard in all Six Sigma implementations and is highly referenced in scholarly research.

### Define Phase

The define phase of Six Sigma's methodology is concerned with defining the problem, identifying the issues to be addressed, and identifying a project that is suitable for a Six Sigma improvement (Ehie and Sheu). Additionally, the define phase includes process mapping, defining project goals, and gathering data (McAdam, Hazlett, and Henderson). Perhaps most importantly, the define phase focuses on identifying customer needs. As Mehrjerdi points out, "in defining defects, Six Sigma focuses on developing a very clear understanding of customer requirements and hence is fully customer focused" (86).

The tools used in the define phase could include a project charter, a process flow chart, stakeholder analysis, DMAIC work breakdown structure, a Suppliers, Inputs, Processes, Outputs, Customers diagram (SIPOC diagram), and a VOC, or Voice of the Customer, chart (Mehrjerdi). These tools are employed to help identify customers, define critical quality characteristics, develop a team chart, and map a business process (Mehrjerdi).

### Measure Phase

Inside the measure phase of Six Sigma, process performance measures are created to measure the performance of the selected process (Ehie and Sheu). To achieve this goal, detailed process maps are created, data collection plans are developed, and the process capability and sigma baseline are established (Mehrjerdi). Several tools are used to achieve this end including: process flowcharts, benchmarking, measurement-system analysis, and process sigma calculation (Mehrjerdi). By the end of

this phase key measures have been identified, data has been collected, and the systems performance baseline and sigma level has been calculated (Mehrjerdi).

#### Analysis Phase

Within the analysis phase of Six Sigma, statistical methods are applied to the collected data to better understand the variables that create quality variance in the product or process (McAdam, Hazlett, and Henderson, Ehie and Sheu). This helps the Six Sigma team to determine root causes and identify value added and non-value added process steps. To achieve these results, many statistical analysis tools are implemented such as: histograms, Pareto charts, scatter plots, regression analysis, and time series/run charts (Mehrjerdi). This phase helps to quantify the process gap(s) and locate the opportunities for improved functionality.

#### Improvement Phase

The improvement phase aims to identify the means to remove the causes for defects and improve the process. The goals of this phase are to develop and test possible solutions and design an implementation plan. Potential solutions are developed through the use of tests such as design of experiments, assessing failure modes of these potential solutions, and validating potential improvements with the use of pilot studies (Mehrjerdi). Some tools to achieve this end include, simulation software, Pugh matrix, and mistake proofing (Mehrjerdi).

#### Control Phase

In this final phase, the focus is on maintaining the achieved improvement by continually reviewing and adjusting the process to suit the requirements of the project. Furthermore, the control phase is used to develop process standards and procedures, implement statistical process control, determine process capability and verify benefits such as cost savings, cost avoidance, and profit growth (Mehrjerdi). Lastly, the Six Sigma project is closed by developing transfer plans and handing it off to the owner (Mehrjerdi). The tools executed within this phase include process sigma calculation, control charts, and cost savings calculations (Mehrjerdi).

#### Six Sigma Application in Current Industry

Six Sigma was originally thought of as holding the most benefit to large manufacturing companies due to its emphasis on repetitive processes and its ability to track the flow of goods along a processing line (Mehrjerdi). Indeed, manufacturing companies such as Motorola, General Electric, and Allied Signal were the first organizations to embrace Six Sigma. Jiju Antony and Ricardo Banuelas

highlight the significant process improvements made by Six Sigma within their work, *Key Ingredients for the Effective Implementation of Six Sigma Program*. In their work, they note that between 1987-1994 Motorola reduced their in-process defect levels by a factor of 200, lowered manufacturing costs by \$1.4 billion, and increased their stockholders share value four-fold (Antony and Banuelas). Allied Signal reduced their new product introduction time by 16% and lowered their manufacturing costs by \$1 billion in four years (Antony and Banuelas). Additionally, General Electric saw a company savings of over \$1 billion within three years due to its Six Sigma implementation programs (Antony and Banuelas). Six Sigma is an essential strategy for organizations seeking to be competitive globally as it focuses on the integration of quality and business strategy into the shape and direction of an organization (McAdam, Hazlett, and Henderson). Research has noted consistently that supply-chain management (SCM) is not enough to handle the complexity, competition, and speed of a global business paradigm.

Six Sigma is growing in popularity as it expands to include other industries outside of manufacturing. A 2004 study by DynCorp found that 22% of the surveyed US companies have a Six Sigma program in place with 49.3% of these companies in manufacturing fields while 38.2% were companies in the service industry (Mehrjerdi). Additionally, in a survey comparing various business process improvement methodologies, Six Sigma rated the highest among BPI methodologies in terms of achieving the greatest results (Mehrjerdi).

#### Critical Factors of Six Sigma Success

Researchers have highlighted a number of critical success factors that are associated with successful implementation of Six Sigma process improvement projects. In their highly-cited work *Key Ingredients for the Effective Implementation of Six Sigma Program*, Jiju Antony and Ricardo Banuelas identified management involvement and commitment, cultural changes within the organization, linking Six Sigma to both the business' strategy and its customers, understanding Six Sigma methodology and tools, and project management skills as critical success factors. The first being most critical as they note that "any successful initiative like Six Sigma requires top management involvement for the provision of appropriate resources and training" (21). Without this support, the importance of the Six Sigma project could be questioned and its energy to promote change weakened. Through organizational cultural change, companies can effectively restructure its strategy to include Six Sigma tenets and encourage learning the Six Sigma methodology. Thorough understanding of the Six Sigma methodology among all employees is paramount to the success of any Six Sigma initiative. Mehrjerdi notes that education and training is the bedrock to success through sustained and visible management training and commitment,

continuing training for managers and participants, clear expectations, and careful selection of leaders and projects to meet company strategies (Mehrerjedi).

#### Six Sigma Training and Belt System

Six Sigma's success rests in part on the intensive training given to any employee working on or in conjunction with a Six Sigma program. In general, employees working with Six Sigma are highly trained in its methodology, statistics, project methodology, and leadership (Antony and Banuelas). During training, employees are taught three groups of techniques: process management tools, leadership tools, and team tools (Antony and Banuelas). Six Sigma training is broken down into a hierarchical system of "belts" with champions at the top, followed by master black belts, black belts, green belts and lastly, yellow belts (Anbari). Champions are generally high level management and are defined as "an organization's strategic and tactical leaders" (Anbari). Master black belts serve as technical resources to black, green, and yellow belts while black belts work on Six Sigma projects full time, often leading several teams (Anbari). Green belts and yellow belts serve on Six Sigma projects part-time but receive extensive training in the Six Sigma methodology to ensure the successful implementation of a Six Sigma project (Anbari). Similar to Deming and Total Quality Management, Six Sigma's capacity to drive real change is hinged upon the total commitment of the whole organization with a clear and sustained focus on the continuing education and skill development of its workers.

#### Six Sigma Impact and Analysis

Some of the many touted benefits of Six Sigma include: a "better understanding of changing customer requirements, improvement of quality and product delivery, reduction of waste, reduction of costs, improved products and processes, enhancement of competitive position, and a sustained competitive advantage" (Anbari 2). What makes Six Sigma most effective is its insistence on empirical testing of both the problem and the solution. In this manner, Six Sigma evolves out of TQM's blurry quality philosophy and is based on clear, measurable results. Six Sigma assumes that problems can be quantified into upper and lower limits of acceptability. In most manufacturing contexts, this is a valid assumption.

#### Toyota Production System and Lean Manufacturing

The Lean manufacturing methodology, pioneered in Japan by Toyota, challenged traditional mass production systems and successfully changed production practices within the automotive industry. As Lean methodology evolved it led to change within other companies both in and out of the

manufacturing industry. This section will explore the history behind the development of lean production by exploring the Toyota Production System, the conception of Lean manufacturing, and will clarify the definition of “Lean” for the work in this paper. Additionally, the impact of Toyota’s company culture, “The Toyota Way,” on the successful implementation of the Toyota Production System will be examined.

#### History and Development of Toyota Production System

The Toyota Production System is Toyota’s characteristic manufacturing process and is the basis for the concept of lean production and manufacturing today. As Jeffery Liker points out in his work *The Toyota Way*, “Toyota’s focus in the 1940’s and 1950’s on eliminating wasted time and material from every step of the production process—from raw material to finished goods—was designed to address the same conditions most companies face today: the need for fast, flexible processes that give customers what they want, when they want it, at the highest quality and affordable cost” (Liker 8). The story of the Toyota Production System, TPS, begins with the Toyoda family, generations of continued and pioneering leadership within the Toyota company. The son of weavers, Sakichi Toyoda was an innovator and inventor who grew up in a rural Japanese farming community in the late 1800’s (Liker). Discontented watching his family and friends toil over manual weaving looms, he set out to create a power-driven loom to alleviate their hardship (Liker). Unfamiliar with the science of generating power, Toyoda tinkered endlessly with a steam engine to understand its mechanisms and tried to have it power the looms. His trials and errors paid off as he figured out how to create Japan’s power loom. His “all in” approach to learning and discovery called, *genchi genbutsu*, which means, “go and see for yourself,” would become a fundamental part of TPS and The Toyota Way (Liker). This concept came to exemplify Toyota’s problem solving philosophy which encourages workers of all levels to seek out problems and solutions by “going to see them for themselves” and striving to continuously improve both the work system and as workers (Shang and Pheng 293). Integral to the success of his power looms, Toyoda developed a special mechanism that would stop the loom whenever the thread would break to help ensure quality cloth. This invention evolved into an overarching system that would become one of the pillars of the Toyota Production System: *jidoka*. *Jidoka* means “automation with a human touch” and signifies the building in of quality as you produce products or “mistake proofing” a process (Liker 16). These two pillars of TPS, *genchi genbutsu* and *jidoka*, anchored the foundation for Toyota’s organizational philosophy of continuous improvement.



Sakichi Toyoda sold the patent rights to his popular “mistake proof” power looms in 1929 and tasked his son, Kiichiro Toyoda, with developing Japan’s automotive business. As Liker points out, Sakichi Toyoda was aware that the world was changing technologically and he wanted to have his son contribute to the ever-growing world. Sakichi embarked these words of wisdom onto Kiichiro: “everyone should tackle some great project at least once in their life. I devoted most of my life to inventing new kinds of looms. Now it is your turn. You should make an effort to complete something that will benefit society” (Liker 18). Sakichi Toyoda’s commitment to learning and quality laid the foundation for what was to become the Toyota Production System. His son, Kiichiro Toyoda, continued this tradition of improved innovation while spearheading the Toyota company.

Kiichiro Toyota centered Toyota on his father’s philosophy of top quality, learning, and continuous improvement and added his own touches. The Toyota concept of just-in-time (JIT) manufacturing was created by Kiichiro Toyota (Liker). Influenced by what he saw in US automobile mass production plants with its large “buffer areas” and the US supermarket stocking system where items were ordered and replaced as supplied were just diminished, Toyoda created the “Kanban” or “pull” system (Liker). Just like a grocer would only reorder items as the shelf became depleted, the Kanban system was devised to alert the previous production section of a production process that they needed to manufacture new parts. According to Liker, the just-in-time (JIT) process is a set of principles, tools, and techniques that allows a company to produce and deliver products in small quantities, with short lead times, to meet specific customer needs (23). Toyota paired this process with Deming’s teachings that meeting and exceeding a customer’s requirements is the responsibility of every worker in an organization (Liker). Deming’s principle of “the next process is the customer” was integral to JIT’s success as the proceeding step of a process must follow the instructions given by the subsequent step (Liker). This was completely different than traditional mass production methods where parts were made in-masse and housed until used. This leaner method of production allowed Toyota to produce products without the expense of holding large inventories or holding defective parts. Due to Japan’s reconstruction after World War II these traditional mass production methods were not feasible for Kiichiro’s fiscal and supply restraints. As Liker points out, Toyoda family members grew up with a similar philosophy: “they all learned to get their hands dirty, learned the spirit of innovation, and understood the values of the company contributing to society (19).

Considered to be the “father” of the Toyota Production System, Taiichi Ohno was brought in as a shop floor supervisor of Toyota under Kiichiro Toyoda and gradually rose through the managerial ranks.

Under the guidance of Eiji Toyoda, Ohno was tasked with the challenge of improving Toyota's manufacturing process so that it would match the output of Ford's mass production model (Liker). Through multiple visits to America, Ohno saw and noted the flaws of Ford's buffered manufacturing process. Without the large cash and supply reserves of Ford, Ohno focused his attention on Ford's underlying production principles based upon Henry Ford's invention of the moving assembly line (Liker). Ohno pinpointed that continuous flow throughout the manufacturing process from supplies to the finished product would streamline processes and eliminate wastes (Liker). Since Toyota lacked the reserves to create waste, Ohno focused on developing a "system of one-piece flow that flexibly changed according to customer demand and was efficient at the same time" and further built out the JIT theory (Liker 22).

To help teach multiple Toyota plants and suppliers TPS, Toyota chairman Fujio Cho created the "TPS house" diagram and it is one of the most recognized visuals of TPS and The Toyota Way.



Fig 8. The Toyota Way (Liker 33).

As figure 8 shows, the "TPS house" illustrates the fundamental components of the Toyota Production System. Built upon the Toyota Way culture, the two pillars: Just-In-Time and Jidoka, cultivate continuous improvement, or the heart of the TPS home, by focusing on consistently reducing wastes and developing people and teams. The goals of TPS: highest quality, low costs, highest safety,

and high morale, create the roof and serves as clear goal posts for every process contained within TPS. The foundation to the Toyota Production System is the Toyota work culture: the Toyota Way.

#### Role of The Toyota Way in TPS

At the heart of what makes any company great is their culture. Company culture comes from its values, customs, and traditions, all of which together make a company unique (Marksberry). Toyota's overarching company culture directly attributed to its successful implementation of lean production practices because it built and nurtured an environment of learning, responsibility, teamwork, and respect. Jeffery Liker, in *The Toyota Way* commended TPS and the Toyota Way culture as "a system designed to provide the tools for people to continually improve their work" (36). Much like TQM, The Toyota Way represents an organizational culture, affecting every facet of the business. For Toyota, the power of TPS was strengthened through the company's commitment to continuously invest in their workers and have continuous improvement be the basis of The Toyota Way.

The Toyota Way operating philosophy can best be described as having mutual understanding between workers and the work they do. This corporate culture is suffused within the Toyota way work culture and is heavily influenced by the concepts of monozukuri, the process of making or creating things, and hitozukuri, the process of educating people (Marksberry). As Masaki Saruta points out, "the Toyota Way is a way of producing people and an educational system for such professional development" (490). The Toyota Way culture is a mechanism for a lean transformation to succeed as it helps strategically align company culture with the lean process throughout the enterprise. Continuous improvement is embodied throughout the Toyota Way. In Toyota, workers and managers meet challenges with courage and creativity to maintain the overarching long-term vision (Shang and Pheng). Kaizen, meaning continuous improvement, denotes to Toyota workers that business operations are to improve continuously and as a team member they are to continuously strive for further innovation and evolution (Shang and Pheng).

Jeffery Liker summarizes the 14 main principles of The Toyota Way in his work, *The Toyota Way*. The Toyota Way represents the culture born with the Toyoda family and nurtured within Toyota today. These principles can be organized into four main categories that capture the essence of The Toyota Way: long-term philosophy, using the right process, developing people, and continuously improve (Liker).

#### 14 Toyota Way Principles (Liker 37-41)

### Long-Term Philosophy

- 1) Base your management decisions upon a long-term philosophy, even at the expense of short-term financial goals. Having a greater sense of purpose for an organization is essential to align the whole company toward a common purpose that is larger than financial gains.

### Using the Right Process

- 2) Create continuous process flow to bring problems to the surface. The goal of work processes is to create high value and continuous flow throughout an organization. In this way, problems within the system will become apparent and correctable.
- 3) Use Kanban or “pull” systems to avoid overproduction.
- 4) Level out the workload. As Liker points out “eliminating waste is just 1/3 of the equation for making lean successful. Eliminating overburden to people and equipment and eliminating unevenness in the production schedule is just as important” (Liker 38). Improperly utilizing labor, equipment, and production processes is an often unseen source waste.
- 5) Build a culture of stopping, identifying and fixing problems to continuously improve quality.
- 6) Standardized processes are the foundation for continuous improvement and employee empowerment.
- 7) Use visual controls to help locate problems. Liker contends using simple cues to help people determine if they are deviating from the standard process or condition.
- 8) Use only reliable, thoroughly tested technology that serves your people and processes.

### Developing People

- 9) Grow leaders who thoroughly understand the work, live the philosophy, and can teach it to others. As showcased by the Toyoda family, leaders serve as role models for the entire organization and embody the company’s way of doing business.
- 10) Develop exceptional people and teams who follow your company’s philosophy. It is important to use cross-functional teams to improve quality and teamwork and work-place flow.
- 11) Respect your extended network of partners and suppliers by challenging them and helping them improve.

### Continuously Improve

- 12) Go and see for yourself to thoroughly understand the situation (genchi genbutsu)

- 13) Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly.
- 14) Become a learning organization through relentless reflection and continuous improvement.

The Toyota Way is founded on respect for people and teamwork (Shang and Pheng). Toyota workers respect others and make every effort to understand others, while taking personal responsibility and work to build and maintain mutual trust (Shang and Pheng). Additionally, a Toyota worker is integral to his/her work team. In this culture, both the individual and the group benefit from maximizing team members knowledge and ability. As Saruta points out, the Toyota Way “stresses the ‘high quality/low cost’ and ‘high productivity and rich rewards ethos behind the lean production systems” (490). The Toyota Way culture creates an atmosphere where lean production principles can be fully utilized by every facet of an organization and workers and management can unite around a common purpose and goal. Phillip Marksberry points out that it was “Toyota’s strong unitary culture which was also adaptable” that gave Toyota its competitive strength (136).

#### Development of Lean Manufacturing

John Krafcik first coined the term, Lean Production System, in his seminal work: *Triumph of the Lean Production System*. Through his work at the MIT International Motor Vehicle Program, Krafcik explored the different mass production systems within the automotive industry and noted the different performance levels among Japanese, North American, and European car plants. He determined that plants operating with a “lean” production concept were able to manufacture a wide range of car models while adhering to high quality and productivity standards (Krafcik). Lean production systems are focused on increasing quality, eliminating waste, and lowering costs throughout the production line. In his search for high performance, Krafcik explored the Toyota Production System and historical roots in Henry Ford’s mass production system. He deems the Toyota Production System as the embodiment of his new production term: lean manufacturing. Given Toyota’s outsized role in the development and publicizing of lean manufacturing, lean manufacturing and the Toyota Way are often used interchangeably. However, it is useful to recognize that the original term was not lean but rather fragile and that the meaning of lean is best understood in comparison to buffered manufacturing.

#### Lean vs. Buffered Production Systems

The key distinction between the Toyota Production System and the popular production systems in the West was that Western auto production systems were highly buffered against nearly everything (Krafcik). As Krafcik points out, “inventory levels were high, buffering against unexpected quality

problems; assembly lines had built-in buffers to keep production moving if equipment broke down; legions of utility workers were kept on the payroll to buffer unexpected periods of high absenteeism; repair areas were huge to buffer against poor assembly line quality; and so on (44-45). Buffers, or inventory between processes, took away the need for improving the current system and lead to suboptimal performance. In essence, a lean production system is the antithesis of a buffered, recent Fordism system, and is a fragile system. “Fragile” was initially used by researchers to differentiate between more “buffered” systems but researchers on MIT’s IMVP team later changed “fragile” to “lean” which was seen as having a more positive connotation (Holweg). Lean, or fragile systems, are grounded in holding low work inventories, small repair lots, teams of highly trained and invested workers, and a lean supply chain. These facets of a lean system ensure that quality defects become apparent quickly rather than having possible defective parts in process but sitting in buffer stations. The Toyota Production System was pioneering in its interpretation of pure Fordism and its development of a lean production system.

#### Application and Misunderstanding of Lean

Since it was first introduced, lean manufacturing has taken the management world by storm with hundreds of books and articles all touting the benefits of lean principles applied to nearly every industry. But as we have explored with TQM, with this popularity explosion comes the potential for management “experts” to misunderstand the underlying principles that a BPI methodology rests on. In his article, *Six Sigma to Fit Sigma*, Ron Basu equates lean to mean fit and agile rather than its original definition coined by Krafcik in which a lean system meant a fragile system. Basu proports that “the predictable six sigma process combined with the speed and agility of lean produces definitive solutions for better, faster and cheaper business processes” (Basu 33). Knowing what we know about the origins of lean manufacturing, it can be asserted that authors such as Basu fail to recognize that lean fundamentally means fragile. “The term ‘lean production’ was first used by Krafcik in 1988, which was seen to have a more positive connotation.” (Holweg 426). “The name ‘lean’ is also regarded as helpful in disseminating the message... The name ‘lean’ was appropriate and played well to impatient Westerners, and especially consultants, who are always looking for something new to hawk” (Holweg 431). The confusion and fads that surrounded the management industry at its onset continue to plague today’s management consulting world. It is all the more imperative to focus one’s attention to understanding the fundamental principles of a BPI methodology to harness its full potential.

Basu critically misunderstands that with a lean or fragile system comes inherent risk due to the absence of buffers for error and that this process may not be applicable or profitable in certain cases. For example, Boeing announced in 2003 that they would implement lean manufacturing for producing their Boeing 787 Dreamliner. Boeing utilized the Toyota model for their supply chain, creating multiple tiers with tier 1 suppliers identified as strategic partners with the aim of achieving shorter development times and lower development costs (Tang and Zimmerman). "By outsourcing 70% of the development and production activities under the 787 program, Boeing can shorten the development time by leveraging suppliers' ability to develop different parts at the same time. Also, Boeing may be able to reduce the development cost of the 787 by exploiting suppliers' expertise," (Tang and Zimmerman 78). However, lean manufacturing comes with risk and Boeing realized that "Any break in the supply chain can cause significant delays of the overall production" (Tang and Zimmerman 79). When analyzing the process for the Dreamliner 787 it is noted that "The underlying design of the 787 supply chain is likely to cause major delays because its efficiency depends on the synchronized just-in-time deliveries of all major section from Boeing's tier 1 strategic partners. If the delivery of a section is delayed, the delivery schedule of the whole aircraft is delayed. Unless Boeing keeps some safety stocks of different complete sections, it is likely that Boeing will face late delivery," (Tang and Zimmerman 80). Ultimately, the authors recommend some buffered manufacturing to help ease the risks of Boeing's lean supply process as the process introduces risk that Boeing cannot manage. As Boeing illustrates, utilizing a lean system eliminates the buffers against variance therefore, increasing the system's risk. This discovery is significant in underlying the point that to effectively implement lean production, one must understand its fundamental principles and the impact that they may have.

#### Analysis of BPI methodologies

When seeking to understand the underlying principles of Total Quality Management, Six Sigma, and Toyota Production Systems/Lean, it is critical to note that they are products of a business' operations function. Designed to detect and correct for deficiencies within a company's processes and operations, each methodology has been proven effective at this task. Managers and engineers working within the operations function assume the customer and the product are fixed variables, allowing them to focus on improving quality. However, when applied to other business functions within an organization, the methodologies encounter problems for which they were not designed. Specifically, TQM and Six Sigma are highly focused on creating quality for the customer. The customer and the product is taken as a given within these methodologies. But the questions of which customers to target

and what products to produce are questions for an organization's strategy and marketing functions, not their operations function. Therefore, when a BPI methodology's frame expands from the operations function to encompassing the firm as a whole, customers and products are no longer held constant but instead are variables that must be considered when implementing a BPI methodology.

Critical distinctions between an operations perspective and a strategy and marketing perspective on customers and products exist for a variety of reasons. In many industries, identifying issues that matter to customers can be difficult: "In far too many cases, management simply relied on its preconceptions about what was important to customers [...] rather than verifying whether those assumptions had any basis in fact... When we asked managers why they didn't try to establish these connections, they often responded that the links were self-evident," (Ittner and Larcker 3). In addition, the value of customers can vary especially in relation to quality. Creating high customer satisfaction creates costs for a business that may or may not affect their revenue, thus decreasing profits due to the extra quality improvement costs. As Christopher D. Ittner and David F. Larcker point out in their *Harvard Business Review* article:

To hold on to the customers it had, the company set its sights on achieving 100% satisfaction for every one of them. However, the company never attempted to discover whether a correlation existed between an individual customer's level of satisfaction and the revenues and profits that customer generated. We discovered, in fact, that the expected relationship did appear – but only up to a point. Customers who were 100% satisfied spent no more money than those who were only 80% (5).

Additionally, not all customers are wanted or even valuable. For example, in 2004, Best Buy attempted to identify unprofitable customers and eliminate the forms of marketing that attracted them (McWilliams). Best Buy based its tactic on a business theory that rates customers based upon their profitability. With this mindset, products are sometimes viewed differently outside of an operations paradigm as seen with using inferior products to leverage clients. BPI practitioners tend to assume all customer are searching for only high quality products. However, in some cases, the consumer is far more conscious of the product's price than its quality. Strategically, businesses may actually seek to signal low quality in order to attract these bargain hunters. When analyzing BPI methodologies, it is imperative to look beyond its accompanying techniques and recommended application and study its core principles. By understanding these core principles and role within operations, a small business can adapt BPI methodologies to its unique environment to improve its business processes and products.



### Strategic Application of BPI in Small Businesses

As referenced in the introduction, small businesses are faced with high barriers to implement business process improvement methodologies. Smaller businesses have a limited number of employees and lack the internal specialization capabilities of larger companies to dedicate human resources to develop a BPI methodology internally. Additionally, small businesses have constrained financial resources that inhibit them from investing in expensive copyrighted methodology training such as Six Sigma and moreover, cannot afford to risk paying for a costly system that may fail to deliver results. Given these narrow resources, small businesses aiming to improve the quality of their processes and products can be tempted to simply apply what Hilmer and Donaldson termed “Instant Coffee Management” or “Techniques for all” (Hilmer and Donaldson 29). These “quick fix” techniques are attractive, particularly to a floundering small business, but they are based on the false belief that a “good manager needs not to go back to the first principles or hard thinking but instead should pick up and religiously implement the ‘right’ technique or program” (Hilmer and Donaldson 29). As Andrzej Huczynski states, “management is a fertile field for fads and quick fixes because the problems are intractable and the pressure to be seen “doing something” is intense” (Hilmer and Donaldson 32). However, this mistake can be especially dangerous for small businesses given its bound human and financial resources. To circumvent these issues, small businesses should focus on understanding the underlying principles to BPI methodologies to effectively pinpoint how they could apply to their individual business.

An integral component for any small business to recognize when thinking of adapting a BPI methodology is the importance of adapting these ideas to the constraints and context of the small business itself. As Nitin Nohria and James Berkley stress in their *Harvard Business Review* article, “Whatever Happened to the Take-Charge Manager?”:

the central concept of pragmatic management is the need to adapt ideas to a given context. Being able to judge the parameters of a particular situation and decide what ideas and actions will work in the context is what distinguishes the truly effective manager. Context includes both the macro and micro – from the cultural milieu of a host country, for example, to the personalities of employees on a management teams. Managers who are sensitive to context have a keen sense of the company’s history, including the successes and failures of past management programs. They know the company’s resources intimately, from physical assets to human capital. And they understand the organization’s and employee’s strengths and

weaknesses, so they can discern what actions are possible and how much the organization can be stretched (131).

BPI methodologies cannot be viewed as rigid when being applied to the highly varied world of small business but as a set of principles that serve as a guideline for small business managers to improve their processes and products.

The four main guiding principles gleaned from Total Quality Management, Six Sigma, and Toyota Production Systems/Lean manufacturing can be categorized into four overarching themes: Having a Vision and Purpose, Setting the Parameters, Understanding Variance as Risk, and People Matter. Each of these themes will be explored below.

#### Vision and Purpose

Having and disseminating a clear vision is integral for the success of any BPI methodology implementation. As Deming stressed in his work, an improvement in a business of any size has to be clear, constant, and consistent throughout an entire organization. This can only come from an organization's leadership. As seen within Toyota, its impressive improvement strategy was intimately understood by senior leaders and passed down to managers and the entire organization through leadership and training. Company leadership is responsible for identifying the encompassing purpose of the company and its desire for improvement and ensuring that it is known and understood by all employees at every level. Having a vision which incorporates a constancy of purpose facilitates a culture that embraces continuous improvement. The Toyota Way culture would not have taken root within Toyota without leadership's persistence that in order for Toyota to succeed every worker must strive for constant improvement. Most importantly, Toyota's success is in part due to its commitment to improving more than just their bottom line. As Sakichi Toyoda underscored with his words of wisdom to Kiichiro Toyoda: "everyone should tackle some great project at least once in their life. I devoted most of my life to inventing new kinds of looms. Now it is your turn. You should make an effort to complete something that will benefit society" (Liker 18). The most impactful businesses are ones that have a goal larger than their fiscal year returns. Businesses exist to meet a market demand with income being merely the byproduct of successfully meeting that demand. Within small businesses, leadership is all that more important as it more readily drives a small, intimate work culture. Therefore, when implementing a BPI methodology to improve a small business, its leaders have to stress why such process improvements are vital to the firm's long-range vision and goals.

#### Set the Parameters

Understanding the paradigm in which a small business operates is essential to understanding the industry structure and how a BPI methodology could leverage a small business within their industry. Like the chalk outlining the lines of a baseball diamond, understanding and defining the parameters of acceptable variance is key to defining quality in terms of variance. Deming stressed continuous company wide improvement to pinpoint areas of defect and eliminate the defects, or variance, produced by them. Six Sigma established explicit benchmarks for acceptable variance in terms of defects per opportunities. Likewise, TPS and lean manufacturing sets out to eliminate variance within a process by removing the buffers to a system and exposing its flaws.

Each of these BPI methodologies recognizes that variance is a permanent fixture and that no process is perfect and without some variance. Instead, TQM, Six Sigma, and TPS strive to identify and lower variance systematically and over time through continuous improvement. Six Sigma is implicit in acknowledging that variance is an intrinsic feature of production. The problem small business owners must address is determining the standards for acceptable variation within their particular contexts. Although managers may use the language of Philip Crosby in making a goal of “zero defects,” its essentially unattainable. Having clear defined parameters to measure your process is essential to avoid the trap of chasing unicorns.

Business processes should be measured by two standards: measures of performance and measures of effectiveness. Measures of performance aim to answer the question: “are we doing things the right way?” and measure of effectiveness ensure that processes are achieving the desired effect by asking “are we doing the right things?” Measures of performance verify that process outputs meet the quality standards that have been set. Measures of effectiveness confirm that these quality outputs positively impact the company’s strategic objectives.

#### Understanding Variance as Risk

Toyota was able to excel within the North American auto industry because American auto companies failed to recognize the level of waste and internal friction that was created by their traditional mass production processes. By operating with high levels of variation in quality they were at a competitive disadvantage when competing with Toyota. Toyota excelled because it identified the level of variance that could be sustained and meet their goals. While Toyota eliminated much of its variance, it did not eliminate all of it. Small businesses have to be pragmatic in determining and understanding the level of variance that can be accounted and eliminated when setting process improvement goals. Small business managers have to pragmatic when looking to implement a BPI

methodology and possess a willingness to embrace uncertainty and surprise. As Norhia and Berkley assert, “We believe that most of today’s off-the-shelf managerial innovations foster a regimentation that discourages managers from dealing effectively with the unexpected. The fashionable emphasis on being ‘proactive’ can give a false sense that all circumstances can be anticipated,” (136). As the Boeing Dreamliner project demonstrates, it is impossible for all variance to be eliminated and management has to accommodate variance induced risk by understanding where it exists and create buffers to account for them. While is this the opposite of a lean process, it may be necessary to employ flexible and creative strategies depending on the context in which a small business to reap the most benefit from a BPI implementation.

### People Matter

American manufacturing, both in the inter-war period and the period following WWII, was highly influenced by Taylor, who stressed the distinction between management and labor. Taylor held that “responsibility for making progress in any of the mechanic arts” should be with the “intelligent and educated men” rather than “upon the workmen who are actually laboring at the trade” (Principles of Scientific Management 53). According to Taylor “the most prominent single element in modern scientific management is the task idea. The work of every workman is fully planned out by the management on day in advance, and each man receives in most cases complete written instruction, describing in detail the task which he is to accomplish, as well as the means to be used in doing the work” (17). Taylor’s shortcoming was a failure to recognize the value of a firm’s blue collar labor force and described workers as being the “mentally sluggish type” (21). The Toyota Way was built upon the understanding that every worker has value and the ability to learn and improve. Additionally, Toyota incorporates workers as leaders of work teams, empowering them with the concept of genchi genbutsu, to go and see for themselves what a problem is and try to fix it. Six Sigma incorporates training in statistical methods at all levels of its belt training system and encourages managers to identify workers with potential to apply the Six Sigma training on the job. Deming stressed driving out workplace fear and cultivating a positive work environment that encouraged cross functional communication between departments to improve quality. He understood that the power of process improvement relied on harnessing the potential of workers. TQM, Six Sigma, and TPS/lean manufacturing underscores the importance of continuous training for workers to improve and maintain overall quality. For a small business, maximizing their limited human resources is the most important facet to implementing a BPI methodology.

## Conclusion

Through the exploration of three main business process improvement methodologies, paying particular attention to their development and history to highlight their foundational principles, this paper highlights the importance of understanding the underpinnings of BPI methodologies before implementation. Far too frequently, managers seek “quick fixes” to business problems and fall victim to applying inappropriate BPI methodologies for their context. Understanding how methodologies were created and what problems they address is vital for small businesses as they illustrate the foundational principles behind each methodology. Understanding these principles is integral to successfully adapting BPI principles to specific small business contexts and environments.

The artifact that accompanies this paper is an example of a presentation that would be given to a small company considering adopting a business process improvement method. The presentation does not provide any simple solutions or “cherry-picked” techniques as these are only effective if BPI principles are understood. Instead, it is a highly visual presentation of the main BPI principles identified in this research. This presentation hopes to serve as a warning to managers looking for “off-the-shelf” or “ready-made” solutions to complex problems.

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