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Lean Principles:: Can Proven Manufacturing Techniques Benefit an Information Technology Organization?

Erik D. Kim
Regis University

LEAN PRINCIPLES: CAN PROVEN MANUFACTURING TECHNIQUES BENEFIT AN INFORMATION TECHNOLOGY ORGANIZATION?

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BY

Erik D. Kim

APPROVALS

Ali Asgari, Thesis Advisor

Douglas I. Hart

Stephen Barnes

Abstract

The benefits of Lean Principles have been reaped in manufacturing for many years and have been seen recently in other verticals. A comprehensive review of the scientific literature exposed that within the information technology field, Lean Principles remains relatively unknown or used. As corporate senior management seek to save costs, information technology needs to provide clear and concise guidance on how to maximize production efficiencies while minimizing costs. If a company cannot leverage information technology properly, staffing and budget cuts are likely. This paper discusses the potential benefits for information technology organizations to utilize Lean Principles. A case study revealed that in a short period of time an information technology group within an education institution implemented information technology improvements that actualized some of the benefits of Lean Principles.

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To my parents, the lessons learned in life impacted me as a young man. I hope I'm fulfilling the potential you saw in me. Thank you for believing in me.

To my children, my hope is that you excel at and love everything you do. Dream, hope, aspire, and dare to go get it…in other words, YOUGOTTAWANNA! Thank you for your love, joyful hearts, and always being my inspiration to be a better man.

To my wife (my Weakness) – you have been my embodiment of what love is. My appreciation for your unselfish heart, sacrifice, patience, and love are impossible to put into words. I can tell you that all of my successes are because of your love and steadfast dedication. It may take a village to raise a man, but it takes a family to make him better. Thank you, babe…for everything.

To God, thank you for being the Rock of my salvation. May I bring glory to your name with everything I do.

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Chapter 1 – Introduction

To begin, one must understand what Lean Principles are. If you want something done the quickest and easiest way, give it to the most impatient person you know. They will inherently use Lean Principles to create the most efficient and effective approach. While this is an oversimplified explanation, it is a close approximation of the definition. Lean Principles are based on a philosophy of providing the highest level of customer value. It also means to embrace a daily habit of continuous improvement and learning. It calls to strive for zero defects, eliminating waste, and producing only what is needed at that moment. All of these objectives must be accomplished by concentrating on the manner in which the outcomes are attained. To that end as well, professional respect would be paramount in dealing with customers and employees at all levels. (Bashin & Burcher, 2004; Imai , 1986; Ishikawa, 1985; Sayer & Williams, 2012).

This research focuses on the application of proven, successful Lean Principles from the manufacturing world to an information technology organization. By presenting supportive information on Lean Principles and information technology, readers will be able to exploit the presented information from the literature review, case study, and noted outcomes for their own use in potential business proposals or implementations of Lean Principles.

1.1 Problem

In spite of mixed beliefs that information technology is essential to an organization's continued internal existence and development, researchers and scholars struggle to identify its fundamental efficiencies. As well, questions remain as to whether information technology can realize positive correlations to fiscal performance. Unmistakably, information technology

groups are often times relegated to "an overhead function" and thus inevitably incur deep cuts in resources during financially difficult times (Foreshaw, 2008; Gunasekaran & Nath, 1997).

Regardless of the overhead association, there are a number of theories and case studies that suggest if information technology is used effectively and efficiently, information technology can enable an organization to distinguish itself from poor performers. In fact, companies have invested heavily in third party evaluations to assist with identifying the magic bullet to enhance its information technology group. For instance, various frameworks can be purchased, put into practice, and then receive that particular brands' certification. Examples of these common frameworks include: The Information Technology Infrastructure Library (ITIL) and the Control Objectives for Information and related Technology (COBIT). However, no known studies or templates can identify the overall mentality or philosophy of the company that successfully exploits its information technology group. Any measured outcomes would require significant consideration of the company's approach to its information technology. (Bruun & Mefford, 2003; Greis & Kasarda, 1997; Dent-Micallef & Powell, 1997; Middleton, 2001; Hicks, 2007; Christopher & Towill, 2010).

1.2 Importance

Information technology support and integration within a company is not an optional luxury. In spite of previous debates about the value of information technology, this is a vital departmental group which, if under supported, can see the operational wheels of the company come to a halt. For example, if a department's printer is no longer printing, or the network attached storage (NAS) device is locked up, and/or e-mail messages are not being sent or received, the company would surely then experience some level of work stoppage. What other company department can be relied upon to identify the root cause of the problem; let alone how

it can be remedied? And how much money will work stoppages cost with every passing minute of lost productivity? (Foreshew, 2008; Gurbaxani, Kraemer, & Mellville, 2004, The Storage Networking Industry Association, 2010).

How the information technology group responds to each set of circumstances is equally as important as responding at all. To succeed at offering continued value, and contributing to the bottom line, information technology groups will benefit by changing their thinking. While Lean Principles can add significant value to any group, measureable outcome can surely be realized with the application of Lean Principles to information technologies (Alarcon, Gazmuri, Maturana, & Vrsalovic, 2005; Bass, 2002; Sowada, 2011).

Chapter 2 – Literature and Research Review

This chapter forms the foundation of the research effort by reviewing literature on Lean Principles and information technology. A limitation in available research was that Lean Principles in information technology is a new topic. As such, there were no known resources that studied the benefits of Lean Principles on information technology organizations in any discernible detail. Research limitations extend to geography as little research was uncovered from the United States to Europe and to South America. The last limitation was a six-month case study on the effects of Lean Principles in an information technology department. Now with the understanding that little research on Lean Principles and information technology has been completed, we can proceed with a review of current literature (Cusumano, 1994; Imai, 1986; Ishikawa, 1985; Kalay, 2005; Koskela, 2004).

There are a number of concerns about the value of Lean Principles as an efficiency model. One criticism was that if Lean Principles are implemented, there is no way to ensure equal representation between blue-collar and white-collar workers in kaizens or Lean Principle councils. The only imbalance of representation inside an organization is if the entire work force is not involved. Another criticism addressed if there was enough continuous improvement, eventually job loss would occur in manufacturing as well as in the administrative offices such as finance. This is a possibility, but the real likelihood is that people will be promoted or retrained as operations grow from higher output. The last concern regarded if the output didn't deliver the expected results, it could be viewed as a failure. Ultimately, the unknown factor is whether or not the best methods of sharing expectations ever occurred according to Lean Principles. Doing so, however, opens the door to processes, techniques, and ideas that addresses the aforementioned concerns (Cusumano, 1994; Kniberg, 2009; Koskela, 2004; Lean Value

Solutions International, 2011; Lockheed Martin Corporation, 2009; Mann, 2010; Schmidt & Lyle, 2010).

The manufacturing industry uses Lean Principles to diminish cost and improve the quality of their products and services. Lean Principles could also be used in the information technology sector for similar goals. The current focus of the literature on Lean Principles is centered on manufacturing with a smattering in the construction and education fields. (Emilani, 2004; Granja & Picchi, 2004; Imai, 1986; Jones, Medlen, Merlo, Robertson, & Shepherdson, 1999; Machado, 2007; Mann, 2010; McBreen, 2008). Similar studies and books on Lean Principles for software development were identified. However, no research has been done studying the application of Lean Principles in information technology organizations to improve efficiencies (Dedrick, Kraemer, & Linden, 2007; Foreshew, 2008; Hicks, 2007; Kalay, 2005; Kraemer, & Linden, 2007; Leffingwell, 2011; Middleton, 2001; Nygard, 2007; Parnell-Klabo, 2006; Poppendieck & Poppendieck, 2007, 2010).

One company that has mastered the application of Lean Principles is the Toyota Motor Corporation (Toyota). Toyota has become the de facto standard to follow for implementations of Lean Principles in many companies. Toyota demonstrated that being enthusiastic about making improvements is just as important as finding the right corporate culture to embrace. Companies that casually use common buzz words associated with Lean Principles such as kaizen events, gemba walks, value stream maps, or 6S, but do not embrace the necessary corporate culture, will have a failed implementation. Companies that mimic Toyota's focus on continuous improvement methodology can benefit from the successes of a disciplined approach to Lean Principles. Toyota has avoided the use of vogue descriptors in place of a true focus on process improvement. Rather Toyota developed attainable goals such as respect in the work place, 99%

defect free products, profit creation, or diminished lead-times (Davenport & Short, 1990; Gurbaxani, Kraemer, & Mellville, 2004; Hicks, 2007; Kalay, 2005; Smalley, 2005).

As Toyota has effectively demonstrated for decades, Lean Principles' worthwhile objectives include 1) continuous quality improvement, 2) reduced lead times, 3) eradicate waste, and 4) diminished cost (George, Maxey, Price, & Rowlands, 2005; Jones et al., 1999; Kennedy, 2008; Lean Value Solutions International, 2011; Lockheed Martin Corporation, 2009; Schmidt & Lyle, 2010; Mann, 2010; Poppendieck et al., 2007; and Sayer et al., 2012). Understandably, however, any company must develop its corporate goals carefully in order to fully embrace Lean Princples' objectives (Imai, 1986; Ishikawa, 1985; Kalay, 2005; Davenport & Short, 1990). Table 1 (Ordóñez, Schweitzer, Galinsky, & Bazerman, 2009) introduces a basic framework for company goal development to ensure proper progression towards Lean Principles.

Table 1. Ten Questions to Ask Before Setting Goals.

Table 1
Ten Questions to Ask Before Setting Goals

Question to ask before setting goals	Why is this important to ask?	Possible remediation
Are the goals too specific?	Narrow goals can blind people to important aspects of a problem	Be sure that goals are comprehensive and indude all of the critical components for firm success (e.g., quantity and quality).
Are the goals too challenging?	What will happen if goals are not met? How will individual employees and outcomes be evaluated? Will failure harm motivation and self-efficacy?	Provide skills and training to enable employees to reach goals. Avoid harsh punishment for failure to reach a goal.
Who sets the goals?	People will become more committed to goals they help to set. At the same time, people may be tempted to set easy-to-reach goals.	Allow transparency in the goal-setting process and involve more than one person or unit.
Is the time horizon appropriate?	Short-term goals may harm long-term performance.	Be sure that short-term efforts to reach a goal do not harm investment in long-term outcomes.
How might goals influence risk taking?	Unmet goals may induce risk taking.	Be sure to articulate acceptable levels of risk.
How might goals motivate unethical behavior?	Goals narrow focus. Employees with goals are less likely to recognize ethical issues, and more likely to rationalize their unethical behavior.	*Multiple* safeguards may be necessary to ensure ethical behavior while attaining goals (e.g., leaders as exemplars of ethical behavior, making the costs of cheating far greater than the benefit, strong oversight).
Can goals be idiosyncratically tailored for individual abilities and circumstances while preserving fairness?	Individual differences may make standardized goals inappropriate, yet unequal goals may be unfair.	If possible, strive to set goals that use common standards and account for individual variation.
How will goals influence organizational culture?	Individual goals may harm cooperation and corrode organizational culture.	If cooperation is essential, consider setting team-based rather than individual goals.Think carefully about the values that the specific, challenging goals convey.
Are individuals intrinsically motivated?	Goal setting can harm intrinsic motivation.	Assess intrinsic motivation and avoid setting goals when intrinsic motivation is high.
What type of goal (performance or learning) is most appropriate given the ultimate objectives of the organization?	By focusing on performance goals, employees may fail to search for better strategies and fail to learn.	In complex, changing environments, learning goals may be more effective than performance goals.

Table 1. Adapted from "Goals Gone Wild: The Systematic Side Effects of Overprescribing Goal Setting" by, Ordóñez, L. D., Schweitzer, M. E., Galinsky, A. D., & Bazerman, M. H., 2009, *Academy Of Management Perspectives*, *23*(1), 6-16.

Once corporate goals have been established, achieving a state of continuous improvement encompasses several actions. First and foremost all of the processes must align with the customers' needs. In almost every case, the final product and the processes to create that product should be the focus of quality improvement activities. For example, one can test that a finished PC boots up into the appropriate operating system, all associated hardware and input/output ports work, and are packed correctly. These quality checks, prior to delivery, ensure customer satisfaction rates remain high and customer returns low. At any point of assembly, one can also examine if the process of installing the DVD player in a PC is the most efficient. Processes can

be reviewed to see if any can be combined. For example, it might save time and money to install the DVD player and outside case at the same workstation. Other processes that could be examined might include how to improve desktop deployment times, reduce trouble ticket queues, or improve software development life cycle (SDLC) delivery times (George, Maxey, Price, & Rowlands, 2005; Hiranabe, 2008; Jones et al., 1999; Lean Value Solutions International, 2011; Lockheed Martin Corporation, 2009; Schmidt & Lyle, 2010; Mann, 2010; Poppendieck et al., 2007; and Sayer et al., 2012).

Not all process improvements come by way of happenstance or through implementation of some of the common Lean Principles methodologies. Some developers intentionally subject nascent systems to risks to see how they miscarry, so they can then in turn put together healthier systems. Evidence suggests that putting these systems through the paces is part of the evolutionary processes. Unearthing the processes that do not work early on is a natural part of the paradigm shift towards Lean Principles (Denning, Gunderson, & Hayes-Roth, 2008; Drucker, 1995; Edersheim, 2007; Fraser & Mancl, 2008).

But continuous improvement involves more than just processes and materials. Special consideration should also be made in regards to improvements in human resources. It is important to make sure improvements are not necessarily focused on an individual alone, but the team's behavior should likewise come under greater scrutiny. Emphasis on defining who the team members is necessary to avoid lapses in communication. As an example, senior leadership from various companies has failed at improvement efforts or kaizen events because they did not define their teams properly. But even in the midst of rising success, it is important to note that people need to be acknowledged. Toyota hasn't forgotten that people put quality in the products built. They recognize their employees for their successes and improvement ideas. They make it

a priority to create an atmosphere in which people obey rules and follow standards as if they were natural instinct (Cathy, 2002; Coutu & Beschloss, 2009; Public Affairs Division, Toyota Motor Corporation, 2012).

Akin to Toyota, when Southwest Airlines (SWA) is mentioned it conjures up feelings of the highest levels of customer service for many. SWA and Toyota share a passion for continuous improvement that many run-of-the-mill companies envy. SWA puts employees first, customers second, and shareholders at the bottom. Successful companies like SWA, value the front-line people because they make local decisions and must be effective at delivering best-in-class customer results. This fosters an environment that allows employees to habitually devote their skills and ingenuity. It also helps the companies recognize and promptly respond to varying market conditions and opportunities. (Cathy, 2002; Poppendieck et al., 2010).

Being able to respond to those opportunities means that eliminating waste must be infused into the corporate culture and supported by senior leadership. Eliminating waste must begin with answering whether or not the customer would be willing to pay for what the company is doing. The literature offers eight forms of waste, which make a commonly accepted acronym TIMIWOOD (*Transportation*, *Inventory*, *Motion*, *Injuries*, *Waiting*, *Over production*, *Over processing*, and *Defects*). *Transportation* waste can involve adding superfluous approvals for paperwork, moving materials multiple times without added value, or sending a product or documentation long distances inside a building or even cross country. Too much *Inventory* waste could include retaining obsolete documentation, *inventory* part changes could cause existing *inventory* to become obsolete, or widespread rework and research may result when problems surface or changes need to be implemented. *Motion* waste of a product can be prevented if its next location has an action that is going to be accomplished immediately or if

processes are consolidated and collocated as much as possible. Companies that foster an environment to root out poor ergonomic working conditions, abuse of equipment, and complacency of tools can eliminate the cost and wasted time caused by frequent *injuries*. Following proper work instructions and safety procedures can greatly reduce the risk for *injuries*. Waste from *waiting* can create cost and cause frustration. Some examples are waiting for a meeting to begin on time, chasing down the correct location, email that copied everyone on every response in an email trail, or people and computers waiting on the next step or action. Reducing *over production* waste can mean printing the exact amount of materials for a meeting or halting production instead of keeping people working on projects or parts that are not needed or paid for by the customer. *Over processing* waste is often possible to eliminate by removing unnecessary steps or number of times a product or document is touched. Having a clear understanding of what the customer is willing to pay for and the customer's expectations will ease *over processing*. Waste from *defects* cause companies to spend money on rework, overtime to accomplish the rework, scrap materials, incorrect or missing information, or products or documentation that do not meet requirements. In addition to diminishing the profit margin for all employees, it also lowers morale. A company's ability to maintain a good reputation and to continue growing is greatly dependent on its defect rate (George, 2002; Imai, 1986; Ishikawa, 1985; Lean Value Solutions International, 2011; Lockheed Martin Corporation, 2009; Parker, 2008; Poppendieck et al., 2007, 2010; 200Schmidt et al., 2010).

Reductions of TIMIWOOD allow companies to become more responsive and flexible to customers or other processes. Lowering the total cost is the anticipated result, which consists of both direct and indirect cost savings of the products and services provided. Value stream mapping is an integral part of Lean Principles that help uncover the waste and find the value of

each process (George, 2002; Imai, 1986; Ishikawa, 1985; Lean Value Solutions International, 2011; Lockheed Martin Corporation, 2009; Parker, 2008; Poppendieck et al., 2007, 2010; Schmidt et el., 2010).

Value stream mapping is a graphic illustration of the order of actions in the creation of the product to be delivered to the customer. Using this tool will assist in reducing the non-value added actions and eliminate the waste outlined in TIMIWOOD. Creating the value stream map should be specific and not involve trying to fix the whole company at once. To avoid "eating the whole elephant", the kaizen team should be working only on one process. Using a dry erase board or perhaps sticky notes, a map of how that process is accomplished today needs to be created. To be thorough, this step needs to include mapping the flow of material and information and the link between them. In order to keep the customer's needs in mind, begin mapping the process from the finish to the beginning. The next step would be to analyze the existing state for opportunities for improvement. It is critical to recognize that there are no bad ideas, thus all ideas should be heard and noted. Empowering the kaizen team to isolate waste or contribute ideas can help discover the root causes. Sometimes the boss can put limitations that can hamper the creative atmosphere and spirit. Therefore, don't let the boss speak first. Let answers free flow naturally rather than going clockwise around the room to get an answer out of each person. The ones with the most creative ideas may not be the ones closest to the process, so eliminate the notion that the experts have the right answer. Encourage creativity by taking unconventional lined notes, drawing, sketching, and letting loose on the idea charts. Having toys like building blocks or squish balls can stimulate the mind and make the environment more comfortable. After the suggestions have been reviewed, the kaizen team will make a future state map of the given process that integrates those improvements. The last thing to do would be to form and

implement the improvement plan (George, 2002; Kelley, 2001; Lean Value Solutions International, 2011; Liker, 2003; Lockheed Martin Corporation, 2009; Parker, 2008; Poppendieck et al., 2007, 2010; Rother & Shook, 2009; Schmidt et el., 2010; SOLE – The International Society of Logistics, 2005).

Another Lean Principle approach which eliminates waste by increasing process speeds is DMAIC, or Define-Measure-Analyze-Improve-Control. The *Define* phase consists of organizing the project such that the goals are established along with the expected outcome or value. The *Measure* phase maps out the processes and collects data about the project. It gives the team an opportunity to create charts for the *Analyze* phase. In the *Analyze* phase, statistical tools help the team to analyze the data to find variations in quality. The *Improve* phase allows the team to create solutions based on what was extrapolated from measuring and analyzing previously. Lastly, the *Control* phase validates the newly improved processes. These phases, if properly led, will guide a team, department, or organization through identifying causes of waste, finding the best practices, and making sure they stick to using those solutions (George et al., 2005; Lockheed Martin Corporation, 2009; Mann, 2010).

Arguably, Lean Principles has witnessed growth from a uniquely Japanese philosophy to one that is embraced across the world and into many new verticals. Failure is not the most appetizing word no matter in which language it occurs, but the word in and of itself is not always a bad thing. Reis (2011), for example, spent several long months developing an instant message program to work on multiple networks. The original strategy was abandoned, thereby leaving all of his work in the recycle bin. It could have been easy to understand why he might be hurt or upset by the change. However, even though his time and effort might have been considered a waste (something targeted for elimination in Lean Principles), it wasn't. If the first iteration were

never built, they would not have had anything upon which to make improvements. It would have been impossible to gain in-depth customer insight and ultimately help them get on a path of success. This also means that Lean Principles can be applied successfully if it is predicated on creating norms and guidelines for all parties concerned (Butcher, Cullen, Hickman, Keast, & Valadez, 2005; Emilani, 2004; Granja & Picchi, 2004; Kennedy, 2008; Ries, 2011).

Even though Lean Principles can be successful in information technology, the literature revealed some challenges in order to avoid future failures. For example, enormous tracking systems for partially completed work or rework can create a place to hide defects. A queue with defects can create a false sense of security. It lures the user into believing that it is being worked on, when the opposite is true. These queues can become one of the elements of waste in TIMIWOOD. In accordance with Lean Principles, defects should be dealt with immediately so that it does not create extra transportation or other additional waste. In an information technology group, this can be a valid concern for PCs on the shelf. Unless they are properly labeled or in a status designated bin, no one would know what has been or needs to be done to it. If possible, PCs should be worked on immediately upon arrival and continuously until the issue is resolved (Lockheed Martin Corporation, 2009; Mann, 2010; Poppendieck et al., 2007, 2010).

Other challenges for Lean Principles in information technology are time crunches and the demands for "I need it yesterday". For instance, when a software developer hears that message, the action item becomes do whatever it takes in order to be done with it. The ensuing mess materializes into careless changes made to the baseline code. This wreaks havoc on the simplicity of the baseline and convolutes it, which could be construed as a form waste according to TIMIWOOD. Subsequently the amount of defects in the baseline code goes up and the end results reveal a colossal increase in time. These two points emphasize the need to define

customer expectations in the very beginning, evaluate processes carefully in a kaizen event using the value stream mapping steps, in addition to making the eradication of TIMIWOOD a top priority (Lean Value Solutions International, 2011; Lockheed Martin Corporation, 2009; Poppendieck et al., 2007, 2010).

Although customer expectations may seem to be difficult to meet, the company should be able to say that the customer knows everything that is being done and is willing to pay for it. If Lean Principles are to be successful in information technology groups, specific details are needed in order to meet those expectations. Many organizations use a service-level agreement (SLA) to help mitigate that risk. SLAs are merely contractual agreements about how well the business must provide its services. Since information technology management considers their organizations to be suppliers of critical services, there is a common movement in information technology operations toward higher degrees of competence. SLAs help management be very precise about the resources they need to fulfill the customers' needs. Some organizations struggle to develop process standards, which is another important part of Lean Principles (Davenport, 2005; Imai, 1986; Ishikawa, 1985; Nygard, 2007).

Standards can lead to more competitive prices for the organization's services. Often moving to process standards creates its own economically viable option, which will be highly sought after. To that end, information technology groups have also used the Information Technology Infrastructure Library (ITIL) to help establish standards. This global method outlines procedures, tasks and checklists which are organizationally agnostic. In other words, the method is not the Toyota, Ford, or Sears' way. It is a generic method that can be applied to any organization. ITIL enables the information technology group to form a starting point that can be

used to measure improvements and show plans (Davenport, 2005; Imai, 1986; Ishikawa, 1985; Nygard, 2007).

Deciding to use ITIL, SLAs, or Lean Principles can be a huge commitment financially and functionally. A corporate culture change means that the CEO and supporting leadership cannot fail to support the change. Lean Principles must be an educated decision, even though those at the top may be cautious about committing any resources to an unknown benefit. Decisions are speculative by nature and are a process of consigning current resources to an unpredictable future. This can require a company or its leadership to seek out why and how the change must occur (Byrne, & Gerdes, 2005; Davenport, 2005; Imai, 1986; Ishikawa, 1985; Nygard, 2007).

As a proven example within the software arena, Schmidt & Lyle (2010) gave one of the most successful examples of Lean Principles in action. The Open Source community has processes and creates products as dynamic if not more so than many Commercial off the Shelf (COTS) products. The community is comprised of a global network of contributors that collaborate to create a very long list of powerful products free of charge. Even when acute issues appear, the virtual global network collaborates quickly until a solution is created. All of this is done without a financial incentive or supervisory direction. While one might question why anyone would want to work for free; the Open Source community draws in those who desire that which we all do: trust, respect, and commitment. And although those benefits are not listed in any Lean Principle manual, it raises the question as to whether or not they should (Schmidt et al., 2010).

Chapter 3 – Methodology and Case Study

Christian Victory Academy of Central Florida, Inc. (Christian Victory Academy) is a private kindergarten – 12th grade school in Orlando, Florida. Christian Victory Academy was selected for this case study to understand the benefits of Lean Principles implemented within its information technology department. One of the primary motivators for selecting this institution was that, as a private school, limited operating expenses are funded from private donations and tuition rates; some of the lowest in the state of Florida. Furthermore, after a number of conversations discussing Lean Principles with the school's administrator (principal), Paula Williamson, it was understood that there was both an opportunity and desire to realize any improvements on the institution's behalf. Action research methodology was applied because of the close collaboration potential to work with the information technology department in a kaizen [case study]. Action research is simply learning by doing. A particular group of people, Christian Victory Academy in this instance, pinpoint a problem, take steps to fix it, observe the outcomes, and if it does not meet their expectations, repeat the process. And as is unique to action research, a case study is conducted while simultaneously collaborating with the people for which processes may be changed. Attaining this dual objective necessitates the active collaboration of the researcher and subject group. Accordingly, action research emphasizes the significance of co-learning as a crucial aspect of the research process.

The specific area of study centered on the institution's information technology department's backup and storage practices. It was understood that there was a general disconnect and lack of understanding in the information technology department about these loss prevention practices. This case study was developed to examine the hypothesis that using a combination of DMAIC, value stream mapping, and 6S tools from the Lean Principles toolbox

would help improve this one process within the institution's information technology department. Likewise, we examined whether using proven techniques from the manufacturing industry would produce similar successful outcomes within the information technology department of an educational institution. Specifically, these beneficial outcomes would include, identification of the policies or procedures for backups and restoration, necessary equipment, identification of responsible persons, and the locations of all vital resources involved in the process.

The initial conversations with Ms. Williamson centered on the overall concept of Lean Principles. In addition to DMAIC, value stream mapping and 6S were of particular interest. Our discussions thoroughly clarified 6S, which stands for *sort*, *shine*, *set in order* [straighten], *standardize*, *safety*, and *sustain*. *Sort* is the action of extricating what is necessary from the unnecessary. *Shine* simply means to clean the whole working area by eliminating trash, dust, and waste. *Set in order* is to return things to their right place, which should abolish hunts for misplaced items. *Standardize* takes what has been done, maintains it, and continues to improve on them. *Safety* ensures that the work place is as hazard free as possible by identifying and labeling the dangers and hazards. *Sustain* has the whole organization take what has been accomplished and making it part of the corporate culture. Ultimately, Ms. Williamson felt that if her staff received training in Lean Principles, Christian Victory Academy's information technology department would become more efficient. This improvement in efficiency would realize higher quality and broader selection of services for their customers [the students].

An initial training session was conducted at Christian Victory Academy for the entire staff. The training provided by a facilitator included a review of Lean Principles with an emphasis on DMAIC, value stream mapping, TIMIWOOD, and 6S. Both CDs and hardcopies of

the PowerPoint slideshow, Appendix A, were handed out to the participants during the training presentation. The participants consisted of the following:

- The total number of participants was 15 (13 women, 2 men) and ranged in age from 21 to 60 years.
- The participants were required to attend at the direction of the Administrator, but were not compensated.

After presenting the Lean Principles training to the information technology department, a kaizen event was initiated on the backup and restoration process. Typically, a kaizen event involves a sponsor, facilitator, and team members. The sponsor is one that has the authority to implement the changes of the kaizen team. The facilitator is someone that identifies the tools needed and keeps the kaizen team on track during the activity. And generally the kaizen team would be comprised of only those people from the respective department that handles the process, or are themselves the process owners.

During the *define* phase, as mentioned above, some of the anticipated outcomes included identification of the policies or procedures for backups and restoration, equipment used, responsible persons, and locations of all resources involved in the process. These outcomes were shared and agreed upon at the onset of the kaizen.

The *measure* phase revealed a number of issues. The information technology department consists of three employees. Team member 1's responsibility was general daily desktop support and occasional backup restoration. Team member 2's responsibility was overall database support, occasional desktop and server maintenance, and very infrequent backup creation. Team member 3's responsibility included website updates and rare backup execution. After interviewing the information technology department staff individually, it was discovered that

none of them understood when or if backups were being accomplished, or what medium was used for the backups and, where the medium was stored. Likewise, if there was a log to track the backups and, where the log was located; if there was a backup schedule, what information was to be backed up, or how to do a restore if needed.

The *analyze* phase allowed the kaizen team to review the data from the *measure* phase. It was realized that better communication, a defined process, and documentation was needed. The documentation needed to include what was going to be backed up, where the storage medium and log would be stored, when the backup would be accomplished, how the backup would be accomplished, and who would do the backup. This baseline illustrates that there was a lot of room for improvement. Ergo, the brainstorming techniques outlined in value stream mapping were applied to achieve the maximum benefits.

Because of the collaborative nature within the information technology department, the *improve* phase was met with a flurry of ideas. All suggestions were listed as possible solutions. Most notably, storage media proposed included CDs, DVDs, and USB jump [thumb] drives. A number of the backup methods included manually accomplishing the backups, using software such as Veritas to schedule backups, and creating Microsoft Windows scripts. Suggestions for the frequency of backups included full backups nightly, weekly, monthly, or a full backup once and incremental backups every night afterwards. The kaizen team reviewed the developed recommendations with Ms. Williamson to find the solution that worked best for their institution.

After the review, Christian Victory Academy decided to create a policy that was to be kept within a hardcopy backup log maintained by the Administrator. This was an example of *set in order* from the 6S training they received. The *standardize* concept was created with a policy which read, "Christian Victory Academy's (CVA's) Documents will be backed up on either a

Re-writable CD or Jump Drive every week. Paula Williamson is in charge of the Jump Drive, and will back up CVA's Documents every other Tuesday. The Jump Drive will not be kept at CVA, but will return home with Paula when not in use. Shaina Eastman is in charge of the Re-writable CD, and will back-up CVA's Documents every other Tuesday (opposite of Paula's schedule). The Re-writable CD will not be kept at CVA, but will return home with Shaina when not in use." (CVA, 2012).

Essentially, one measure of success for the kaizen event through the *control* phase would be demonstrated when team members could locate the backup medium. And such an incident transpired during the six-month observation period when a team member successfully accomplished a file restoration with no supervisory direction. Because of the Lean Principles implemented, the backup log and jump drive were in the rightful place. The team member was able to restore the file and helped other staff members return to work quickly. Ultimately, Lean Principles both aided the information technology department in completion of its first kaizen event, and established the foundation for continued operational improvements and growth.

Chapter 4 – Discussion

Albeit, Christian Victory Academy is not in the same industry, nor is it the same sized company as Toyota and although Toyota's strategy should not be considered the blueprint for all companies, Christian Victory Academy did accept many lessons from Toyota's implementation of Lean Principles to create a better path for itself (Sawyer & Williams, 2012). One of the most significant appreciations was Christian Victory Academy's commitment to continuous improvement. DMAIC and 6S proffered simple and affordable steps the school could implement. Building on the kaizen event held for the information technology department provided a tangible example for future improvements. The DMAIC and 6S tools learned in the Lean Principles training was adopted as an ongoing catalyst for Christian Victory Academy to achieve sought after financial growth.

The kaizen event conducted with the information technology department using Lean Principles was facilitated because of the collaborative nature and working dynamics within Christian Victory Academy. Often Lean Principles implementations or even kaizen events alone can be challenging because egos or personal agendas get in the way. The experiences with Christian Victory Academy's information technology department were to the contrary. Fortunately this kind of success and collaborative attitude can be very infectious, which the school, as a whole, will need in pursuing their growth potential.

As part of Christian Victory Academy's continued expansion, the institution has voluntarily accepted to participate in operational inspections in order to receive additional curricular certifications and accreditations. Ergo, the institution has insightfully identified the need for standardization of processes, and has implemented policies to ensure that necessary changes can take place. Christian Victory Academy has raised its level of self-awareness, pride,

and initiative. Nonetheless, enthusiasm alone isn't enough to change an organization. Continued success at Christian Victory Academy will require daily application of its newly acquired tools and top level support in order to become a very Lean Principled organization.

Chapter 5 – Conclusions

The researcher discovered a sundry of prospects for additional research that applies to continuous improvement from Lean Principles in an information technology organization. Future research, extending beyond the current six-month case study time constraints, would improve this research by implementing and monitoring a comprehensive continuous improvement program within Christian Victory Academy. A two or three year study should be sufficient time for this research to showcase a broader understanding of continuous improvement successes from the Lean Principles efforts. For example, process improvements outcomes for PC repair, network analysis and troubleshooting, and ticket queue lengths would be good starting points. Other potential studies could focus on information technology supply ordering and tracking process, software license compliance, and information technology policy reviews.

Additional information technology case studies should advance a deeper understanding of other industries' corporate culture concerns, continuous improvement concerns, and policy management. Such research could provide much deeper explanations of the undefined, potential concerns surrounding corrective improvement implementations than was identified in the case study at Christian Victory Academy.

The hypothesis of this thesis was: Can proven manufacturing techniques benefit an information technology organization? The research recognized a number of elements that potentially add to implementation success. The most notable are:

- Use of kaizen events
- Elimination of TIMIWOOD
- Use of value stream maps
- Use of DMAIC and 6S

- Random idea flow during brainstorming
- A fostered, continuous improvement environment

Even though those elements increase the success margin of Lean Principle implementation, managers from a non-profit company expressed the same concerns that every company should. Program-of-the-month syndrome is a term that is used to describe a company's decision to try a different program every month until their problems are fixed. In order to avoid this syndrome, Lean Principles must permeate the corporate culture. Companies, both for-profit and non-profit, can get caught up in the latest buzz-words and catch phrases. There are a handful of variations of Lean Principles, but they are all predicated on continuous improvement and the eradication of waste. Lean Principles is not a methodology that can be purchased. Rather, it is a philosophy that must be nurtured and developed from the bottom up. Using commercial off the shelf software (COTS) as an example, COTS are simply meeting a goal of a project rather than addressing the ongoing needs of users. Dissimilarly, Open Source allows for Lean Principles to thrive since it focuses on the needs and desires of the customer. Christian Victory Academy could not use Lean Principles alone to "fix" their back-up issue. To succeed, the institution required shareholders that believed in Lean Principles, and who were willing to promote it on a daily basis (Jones, Medlen, Merlo, Robertson, & Shepherdson, 1999; Leffingwell, 2011; Machado, 2007; Parker, 2008; Poppendieck et al., 2007; 2010; Sayer & Williams, 2012; Schmidt & Lyle, 2010).

Interestingly however, according to Mora (1999), less than 10 percent of companies actually succeeded at implementing Lean Principles. Chief complications that companies encounter in attempting to apply Lean Principles have included a short fall in direction, planning, communication, and adequate support. As well, company employees must fully understand and

embrace the direction established by its leadership; with proper planning needing to be communicated clearly and frequently. Clearly those charged with implementation must be made aware of what is supposed to happen and or when; less they should not be expected to fulfill those same plans. Reliance on the old adage "do as I say and not as I do" will not contribute in the least to any level of success. It is incumbent upon each layer of the company to support the others regardless if its level of responsibility. Otherwise, resistance, back-biting, and personal agendas will prevent the organization from reaching its full potential. Optimistically, however, for those that adopted Lean Principles, devotees realized between 40-90% for cost savings, labor savings, and overall cost reduction in quality and inventory. Without question, these numbers offer a compelling reason for a whole-hearted investment into Lean Principles (Bashin & Burcher, 2004; Bommelje & Steil, 2006; Koskela, 2004; Mora, 1999).

Similar to Christian Victory Academy, most companies can initiate Lean Principles by first selecting one organizational area for implementation. Thereafter, the area should be measured to determine success outcomes from Lean Principle implementation. Although each company's corporate culture, mission, and financial factors may differ; it is indeed possible to achieve similar continuous improvement successes to Christian Victory Academy (Butcher, Cullen, Hickman, Keast, & Valadez , 2005; Byrne & Gerdes, 2005; George, 2005; Greis & Kasarda, 1997; Imai, 1986; Ishikawa, 1985; Kelley, 2001; Kennedy, 2008; Lockheed Martin Corporation, 2009; Mann, 2010).

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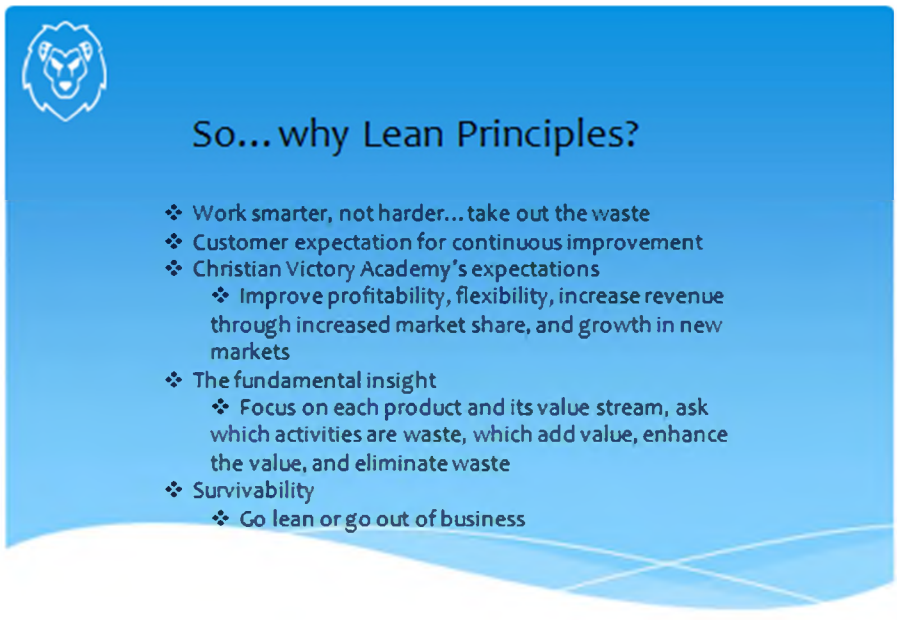
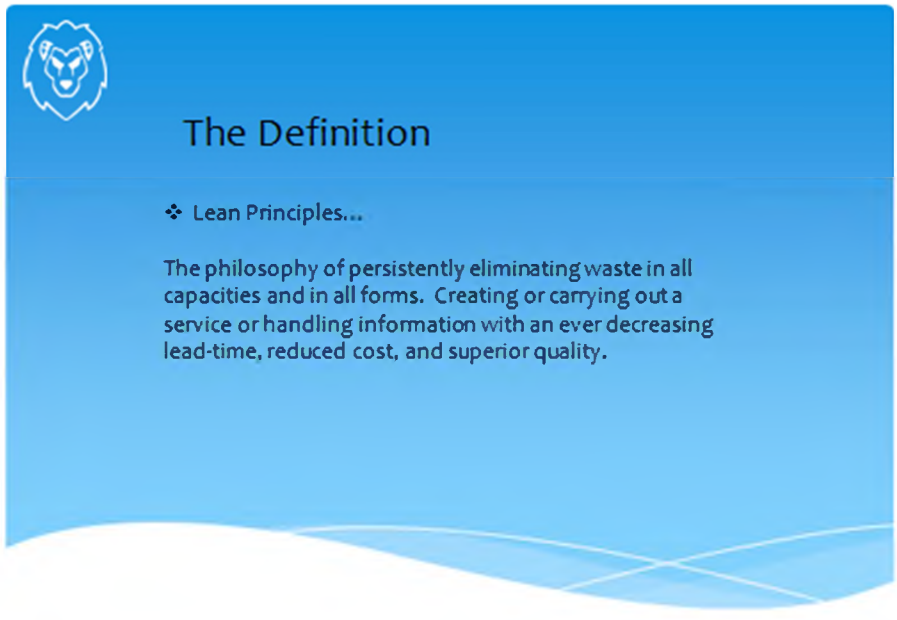
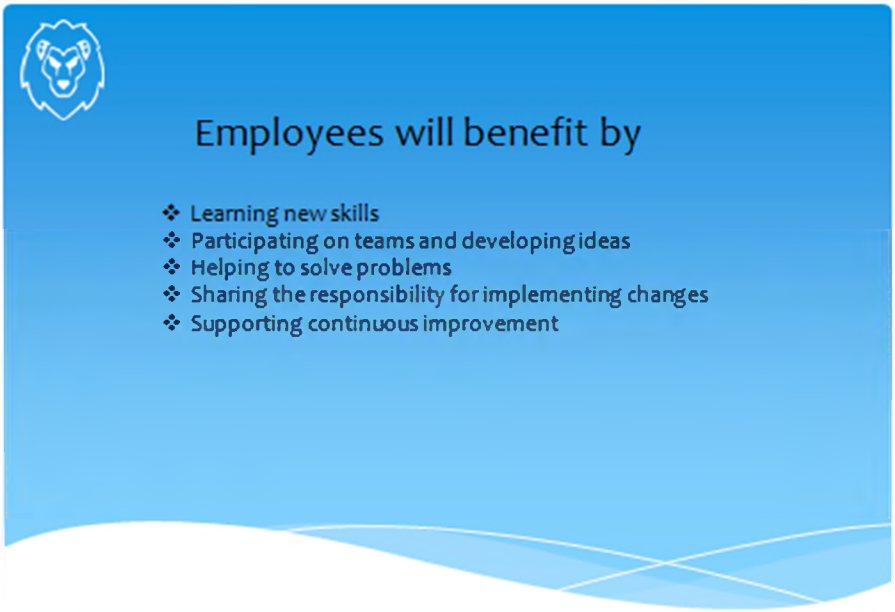
Appendix A. Lean Principles training given to Christian Victory Academy

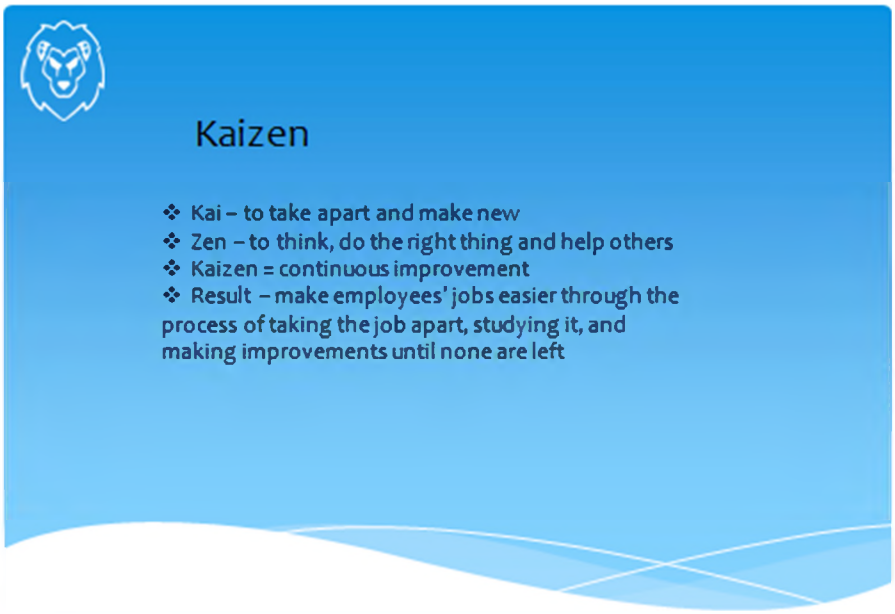


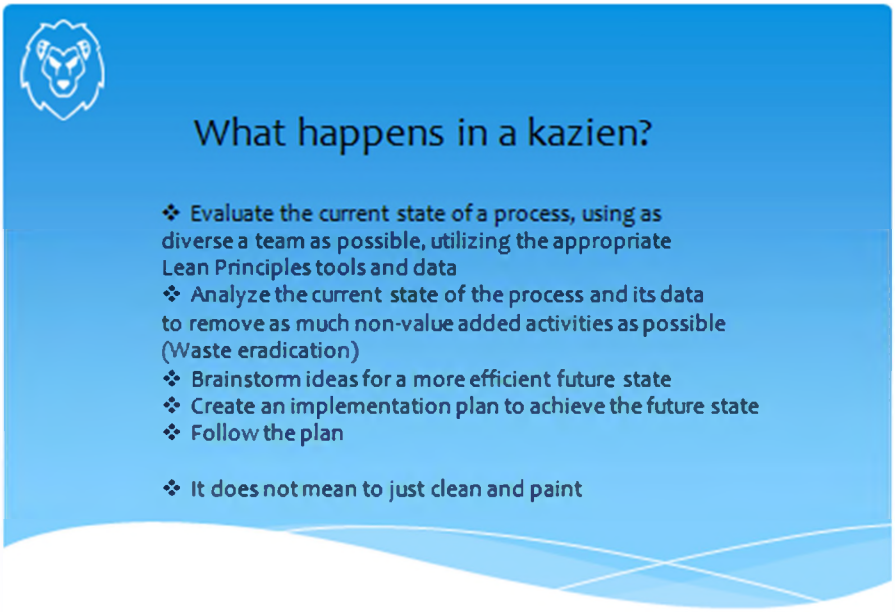



Employees will benefit by
❖ Learning new skills
❖ Participating on teams and developing ideas
❖ Helping to solve problems
❖ Sharing the responsibility for implementing changes
❖ Supporting continuous improvement

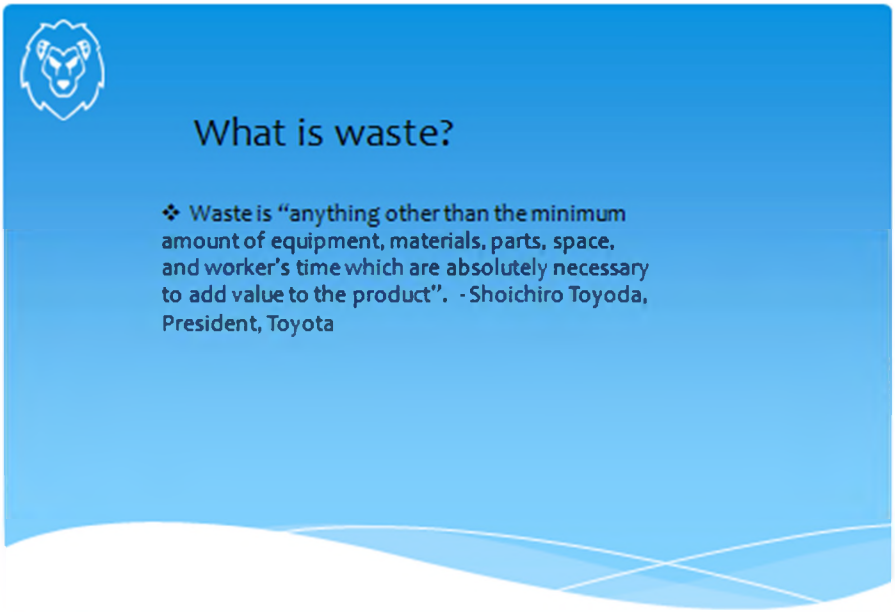

What will you get in return?
❖ Cross-training
❖ A continuous improvement philosophy
❖ Standard, quality processes
❖ A more interesting work place
❖ Camaraderie and improved morale
❖ An organization focused on a common goal
and more competitive in the market
❖ Ownership - empowerment
Involved employees make world class products


DMAIC
Define – organize, define goals
Measure – collect data
Analyze – study data
Improve – create new solutions, eliminate waste
Control – validate new process, redo if needed


Kaizen
Kai – to take apart and make new
Zen – to think, do the right thing and help others
Kaizen = continuous improvement
Result – make employees' jobs easier through the process of taking the job apart, studying it, and making improvements until none are left


What happens in a kazien?
❖ Evaluate the current state of a process, using as diverse a team as possible, utilizing the appropriate Lean Principles tools and data
❖ Analyze the current state of the process and its data to remove as much non-value added activities as possible (Waste eradication)
❖ Brainstorm ideas for a more efficient future state
❖ Create an implementation plan to achieve the future state
❖ Follow the plan
❖ It does not mean to just clean and paint


Kaizen event benefits
❖ Short term – creates an environment that fosters immediate implementation of innovative ideas or improvements
❖ Long term – establishes the foundation for a continuous improvement corporate culture


What is waste?
❖ Waste is "anything other than the minimum amount of equipment, materials, parts, space, and worker's time which are absolutely necessary to add value to the product". - Shoichiro Toyoda, President, Toyota

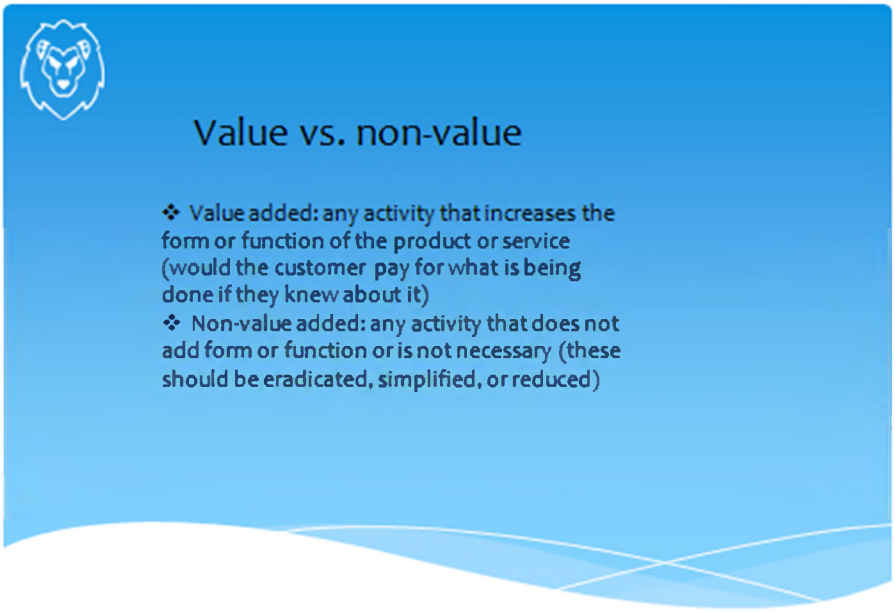

8 Forms of waste
❖ Transportation
❖ Inventory
❖ Motion
❖ Injuries
❖ Waiting
❖ Over production
❖ Over processing
❖ Defects

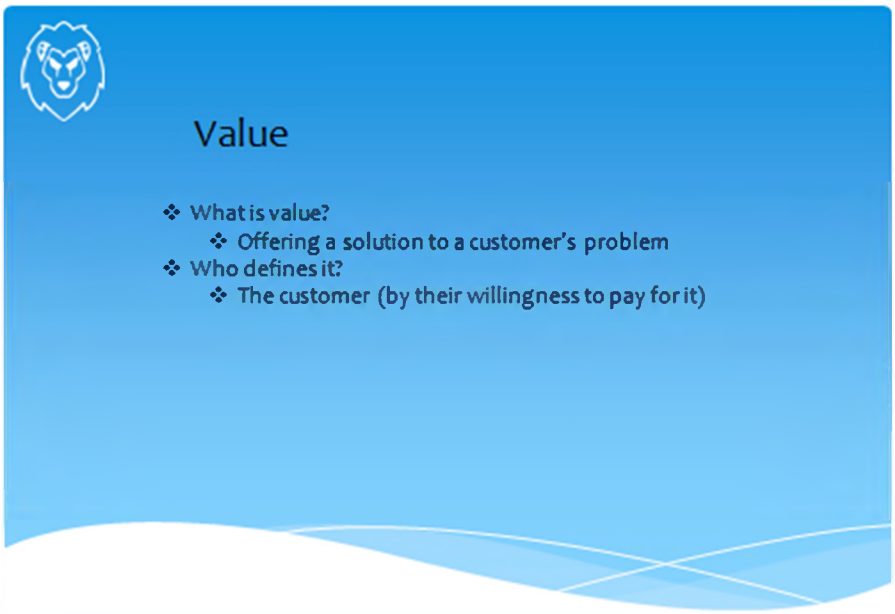
Root causes of waste

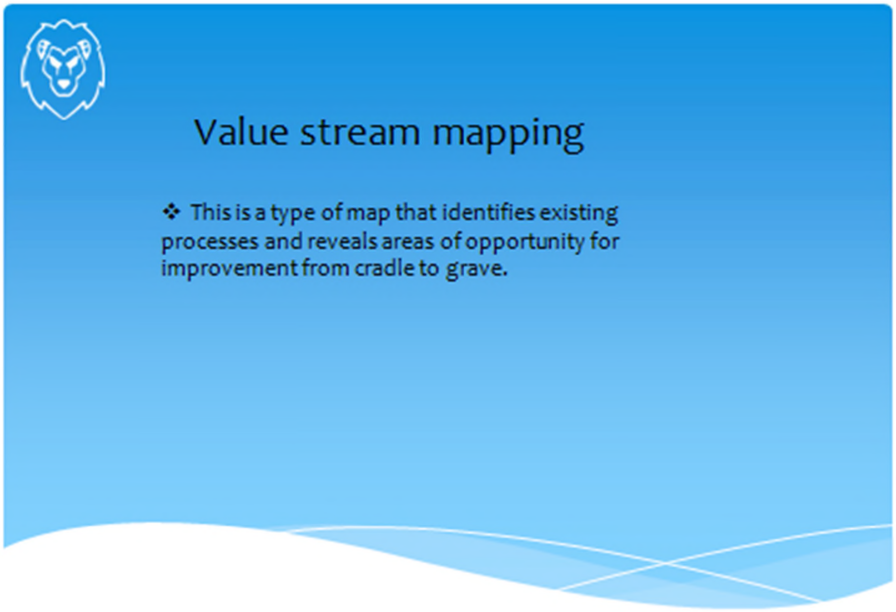
- Lack of organization, orderliness, or cleanliness
- Poor communication
- Long preparation times
- Poor scheduling
- Absenteeism
- Confused/congested work flow
- Ineffective delegation (micro-managment)
- Unclear responsibility or unaccountability
- Ineffective work place layout/design
- Ineffective planning
- Inconsistent work methods or instructions (WIs)
- Incomplete training

Spaghetti chart

Before After


Value vs. non-value
❖ Value added: any activity that increases the form or function of the product or service (would the customer pay for what is being done if they knew about it)
❖ Non-value added: any activity that does not add form or function or is not necessary (these should be eradicated, simplified, or reduced)


Value
❖ What is value?
❖ Offering a solution to a customer's problem
❖ Who defines it?
❖ The customer (by their willingness to pay for it)

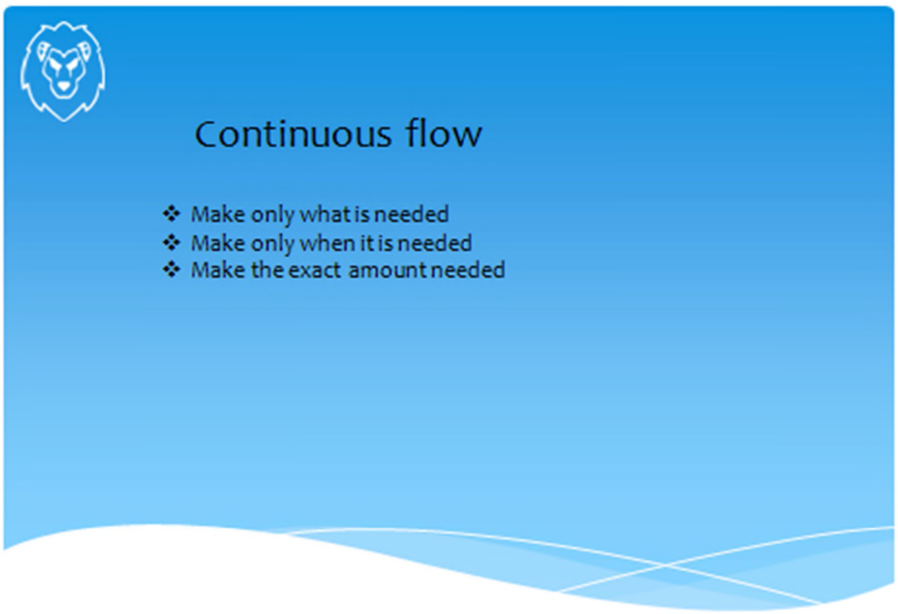

Value stream mapping
❖ This is a type of map that identifies existing processes and reveals areas of opportunity for improvement from cradle to grave.


Why use a value stream map?
❖ Makes work and processes visible to improve communication and understanding
❖ Identify improvement opportunities, eradicate non-value added steps and reduce variables
❖ Determine the cause of a problem or condition
❖ Discover training and communication opportunities

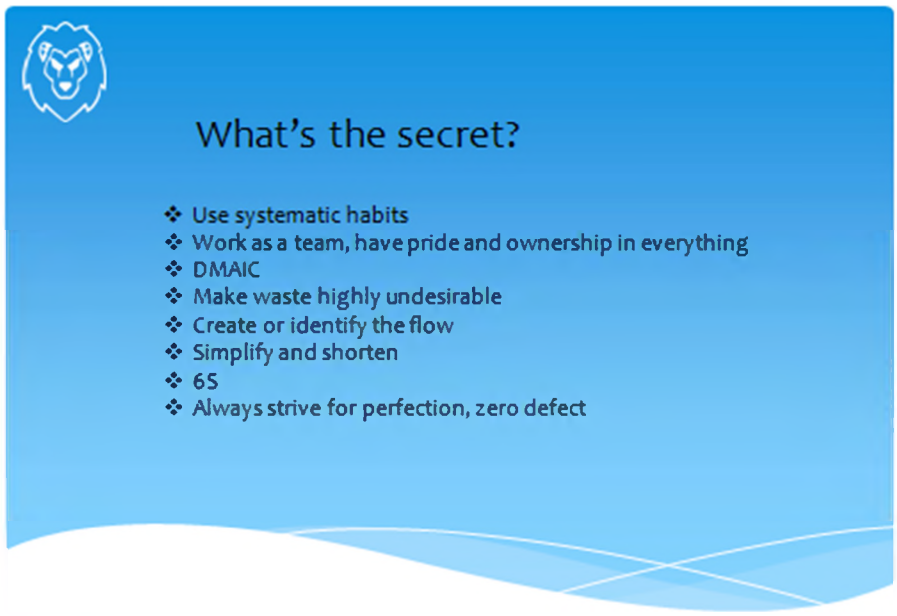
- Future state value stream map
- Current state value stream map

6S

- Sort: separate needed/unneeded items and discard unneeded items
- Shine: clean the equipment and workspace on a regular basis
- Set in order: make it visual, a place for everything and everything in its place
- Standardize: develop reliable methods and document them
- Sustain: stick to it, become part of corporate culture
- Safety: hazard and danger free or clearly identified


Continuous flow
Make only what is needed
Make only when it is needed
Make the exact amount needed


Why standard work?
Minimizes variation in work procedures
Establishes best practices to maintain quality
Provides a baseline from which a better approach can be developed
Provides for the ease of training and cross-training
Ensures safety


What's the secret?
Use systematic habits
Work as a team, have pride and ownership in everything
DMAIC
Make waste highly undesirable
Create or identify the flow
Simplify and shorten
6S
Always strive for perfection, zero defect

Glossary

Culture: How people do things in their workplace, which is founded on the cumulative habits people use to get them done.

Cycle time: The time it takes to complete one full repetition of work or before the cycle repeats itself.

Defect: An event that does not fulfill the specifications of established requirements.

Delay time: The time during a cycle of work that the goods, service, or information is waiting for next action within the process step.

Estimate At Completion (EAC): The sum of all estimated costs to complete a program from a set point in time.

Five Why's: A tool to help find the root cause of a problem. Widely accepted as Taiichi Ohno's practice of asking "why" five times whenever a problem was encountered, Sakichi Toyoda of the Toyota Motor Company originally developed the technique.

Flow: The state of continuous progress by adding value lacking deviations, backflows and disruptions or to have a product that moves through its process with little or no inactivity between steps.

Framework: A rudimentary structure, plan, method, or concept.

Gemba walk: A Japanese term that roughly means "where the action occurs" or "the actual or real place". Companies will use gemba walks as method of teaching lean management. When the team walks, the leader will typically ask the worker some questions. Depending on the answer, this will stimulate new questions and cause the employee to think about the current state differently.

Inventory: The storage of materials or information for future use or for contingency purposes.

Information Technology Infrastructure Library (ITIL): A set of procedures, tasks and checklists that are organization agnostic. It assists organizations in creating a minimum level of competency, compliance, and measure improvement.

Jidoka: A Japanese term that gives the ability of production lines to be halted in the event of equipment malfunction or quality problems by machines or workers who can push a button to stop the line.

Just-In-Time (JIT): A method for generating and distributing the right items or service at the right time in the right amount.

Kaizen: A Japanese term that means "change for the better" or "improvement". Companies host kaizen events on a regular basis to perpetuate the continuous improvement model.

Lead time: The time that passes between getting an order and delivering the product or service to the customer.

Lean Principles/thinking: The philosophy of persistently eliminating waste in all capacities and in all forms. Creating or carrying out a service or handling information with an ever decreasing lead-time, reduced cost, and superior quality.

Load leveling: Constantly adjusting the processes as appropriate to fit the demand.

Mistake proofing: This effort requires a commitment to a way of thinking and action that aims to eliminate waste while obtaining a zero defect status all of the time.

Motion: Movement of workers essential to finish a task.

MRP: Materials Requirements Planning is a computer-based production planning and inventory control system. It attempts to keep sufficient inventory levels to guarantee that requisite materials are obtainable when necessary.

Muda: A Japanese term for waste, an activity that devours resources and has no value.

Non-value-adding: These are tasks that do not transform parts, materials, or services into finished products. Tasks either add value or do not.

Non-value-adding, required: Some non-value-added tasks are compulsory. This task could be required by legal limitations, consumer contracts, or procedure fallibility. Tasks either add value or do not.

Over-processing: Extra effort or steps in a process that adds no value.

Physical process map: A type of map that records and displays the physical movement of materials or paperwork from start to finish.

Queue time: The time information, products, or services expend waiting for the next process step.

Required waste: Existing waste that cannot be eradicated because of installed technology or rational.

Return on investment (ROI): The difference between the investment of money, people, and time and the profit returned to the company for that investment.

Root cause: The core origin of a problem in a process or organization.

Sampling: A number of the potential measurements from a set are taken. This creates a broad view about the characteristics of the whole.

Six S (6S): Sort, shine, set in order, standardize, sustain, safety. These are six steps to removing unneeded items and organizing things. With 6S, a place for everything and everything in its place.

Spaghetti chart: A type of map that shows the route taken by a product as it journeys down the value stream. The display allows one to see the amount of transportation that occurs and the route characteristically looks like spaghetti.

Standard work: The designated sequential method of moving and making the product or service.

Transporting: It is the method of moving a product (a good, document, or service) from one point to another.

Value: The ability to give a consumer the desired information, product, or service at the right time for the right price.

Value added step: These are steps in the process that are critical for making the information, product, or service and are done correctly the first time and on time.

Value stream: The sum of value added and non-value added actions to deliver information, product, or service to the consumer.

Value stream mapping: This is a type of map that identifies existing processes and reveals areas of opportunity for improvement from cradle to grave.

Visual control: This allows management to monitor performance, quality and cost status quickly and easily. Visual controls should be comprised of simplified, large print, color coded, or easy to understand items.

Waiting: This stagnant time is considered non-value added.

Wait time: This is the idle time in the middle of process steps to delivering the information, products, or services.

Waste: This adds delay and cost to the information, products, or services. The seven classic wastes are known as TIMWOOD – transportation, inventory, motion, waiting, over production, over processing, and defects.

Work in process (WIP): This refers to any and all work that is presently being handled in a process step or has been handled through a process step already and is awaiting another operation.

Yield: The aggregate of the amount produced divided by the specific amount of input.