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Adaptive Lean Manufacturing Implementation For Organizations With Rapid Leadership Turnover

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ADAPTIVE LEAN MANUFACTURING IMPLEMENTATION FOR ORGANIZATIONS WITH RAPID LEADERSHIP TURNOVER

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Abstract

Lean Six Sigma seeks to optimize workplace efficiency and is now world renowned as the standard for how to maximize profits, perfect quality control, and emphasize workplace safety. Almost every large scale engineering company has in some shape or form a Lean Six Sigma aimed concept of operations to the point that a subset of the Lean Six Sigma Institute is focused towards compiling packages to assist those companies that have not implemented it to make the transition.

These packages while efficient, operate with the understanding that the ideologies they deploy will be implemented from the top down and that once complete, the challenge is simply maintaining the implemented processes. However, there are organizations in the world that to no fault of their own, either are so large that it is impossible to fully implement any elements of lean manufacturing or are so rapidly operating that it is impossible to isolate all of the organization's managerial staff at one place in time.

Thus, we seek to answer the following question:

How can organizations implement exterior, all-encompassing process changes when rapid leadership rotation and operational tempo prevent the standard implementation of isolating all employees and pausing processes to change into a more efficient organization?

We show a model developed with these constraints in mind through a hypothetical organization that must undergo Lean Six Sigma implementation. The model takes a modified approach to standard implementation by customizing the transition packages to best be accepted by the organization as opposed to fully remodeling the organization in one fell sweep across all echelons.

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Chapter 1: Introduction

Lean manufacturing and Six Sigma serves as an industry standard since the development of autonomous technology and the breakthrough of Industry 4.0. The concept comes from engineering developments through Toyota and Motorola seeking to eliminate wasted actions and controlling the variables that modify a product (Vivekananthamoorthy & Shanmuganathan, 2011). In engineering, faults, failures, or equipment downtime in the production cycle cost large amounts of money and work hours due to rewrites and root cause analysis; something that Lean Six Sigma works to reduce (Hassan, Marimuthu, & Mahinderjit-Singh, 2016). Lean manufacturing accounts for all aspects of a business starting at the top with management and ownership all the way down to the production floor. Aspects addressed include time management, business model canvas, how goals are tracked, and office/production layout. While it is not the final standard of how to run a company, it has become the model applied to just about every engineering firm or any business that incorporates engineering into the service they provide, with a prime example being John Deere (Usrey & Ford, 2000).

1.1 Military Overview

As of the publication of this paper, United States Department of Defense (DoD) and its subordinate branches of the military (Army, Navy, Air Force) have begun to incorporate Lean Six Sigma principles (Tonkin, 2007). The incorporation began by collaboration with civilian entities and has quietly transitioned to training military personnel in basic Lean Six Sigma, commonly referred as Lean Management (Malenic, 2007). Overall, the incorporation has stymied at the highest levels and remains almost entirely present in the acquisition process; where decision makers decide on what engineering companies to contract with for the latest technology to use for day to day operations (Smith, Wilson, & Burke, 2008). Examples include General Dynamics for the Stryker personnel carrier, Honeywell for the M1A2 Abrams tank engine, Raytheon for laser used simulation technology and Dell for office laptop computers. As products reach the end of their life cycle, contracts are either renewed or new technology is produced. Originally, scheduled down time of equipment was not necessarily considered when acquiring a new piece of equipment; the emphasis was on the equipment's capabilities in use. Now, the latest airplanes, helicopters, and ships are being upgraded over time in accordance with the project life cycles associated with them. And because the respective DoD entities are incorporating Lean Six Sigma into their acquisition ranks, the face to face interaction between Production Company and product approval team has strengthened due to the common lexicon and goals. (Malenic, 2007)

A primary example of Lean Six Sigma being applied to the military successfully is logistics. The transportation of personnel, equipment, and supplies is a key element to any military operation and requires significant planning prior to execution. Akin to acquisitions, logistics, especially at depot level, have been able to drastically improve by using Lean principles such as Value Stream (Acero, Torralba, Perez-Moya, & Pozo, 2019). Maintenance is always a key aspect to military equipment and regular servicing and preventative maintenance are considered time when the equipment cannot be used and therefore, the downtime must be reduced. Both Air Force and Navy have been able to successfully reduce these down times and regular cost through Lean Six Sigma and serve as a case study of successful implementation (Tonkin, 2007).

1.2 Opportunities for Growth

Despite the advantages and successful deployments of Lean Six Sigma to high echelon units, the principles remain isolated to Corps level and above, with some Divisions employing systems analysts that may or may not be taught Lean Six Sigma. The overall lack of knowledge below Brigade has resulted in a lost connection between echelons regarding how day to day operations occur, to include configuration management and office to production floor layouts; something case studies have been able to apply with success at multiple levels with some strain but otherwise a smooth transition (Chen & Cox, 2012). This is important to understand as it shows the immediate disconnect between Army upper echelon and units at the tactical level (Brigade, Battalion, and Company). Lean manufacturing emphasizes that the lean methodology must be applied from the top down. Because the Army has not implemented the principles into its subordinate echelons, tactical units are still operating in a work environment that is not streamlined and spends a significant amount of work hours focused on the wrong areas, something that Lean Six Sigma looks to remove and something that case studies have shown to be effective (Monteiro, Pacheco, Dinis-Carvalho, & Paiva, 2015). (Jennings & Root, 2006)

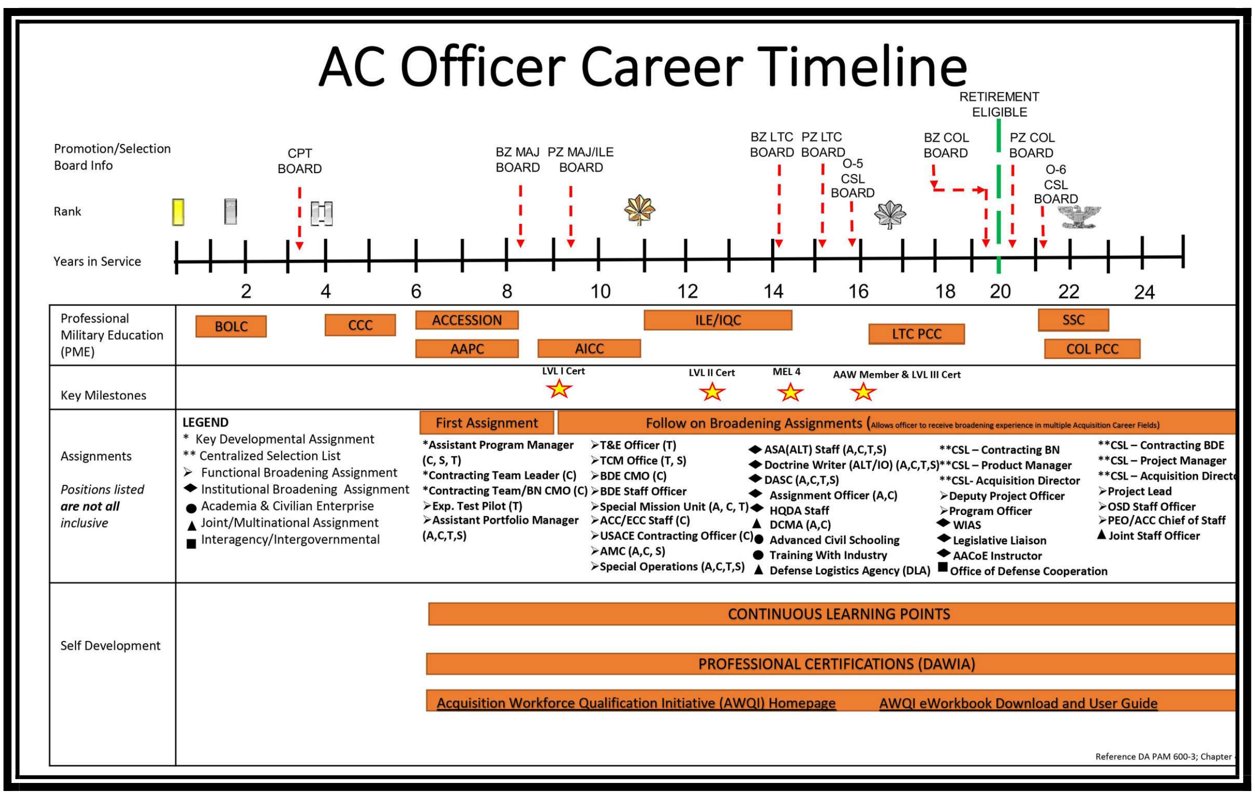

Figure 1.1 : Active Component (AC) Officer Career Path that includes each professional development standardized school. Each school is presented as acronyms but essentially, Army

officers are formally educated on the jobs they will have by rank as the Officer is promoted. (Department of the Army, 2014)

The opportunity for growth identified through current literature and analysis is that the Army has not implemented Lean Six Sigma principles into the Officer Professional Development (OPD) and therefore, continues to operate in an environment that has not considered the full implementation of organizational efficiency. In accordance with Army doctrine, the goal is to make a tactically sound, developed decision before the enemy can. By deliberately ignoring current industry standards for efficiency, Army leaders are not able to make said decisions in an environment that utilizes maximized industry efficiencies. The advantage to maximizing these efficiencies is that the Army will have finally implemented basic lean manufacturing principles to the whole organization. Offices will be more streamlined, less rework will be conducted, and overall, the Army will be conducting daily operations and enjoying the same benefits that the industrial engineering world have been for the last several decades.

1.3 Lean Six Sigma Overview

Lean Six sigma breaks its processes into various categories and within those categories exist the tools that a trained person can use for improvement namely, Kaizen events. Kaizen events are continuous improvement opportunities that focus towards improving quality, reducing changeover times, product maintenance, and materiel flow (Lean Six Sigma Institute, 2020). Continuous flow is a practical tool that looks to reduce or eliminate breaks in production. In it, the flow of a work cell is modeled and inefficiencies are identified. Quick setups are a modernized approach towards, similar to continuous flow, reducing time when the product is not being worked on. Quick setups focus on the handoff between shift employees and how long it takes the outgoing employee to leave versus the time it takes the incoming employee to begin work; analogous to a racing team pit crew. Total productive maintenance looks forward, focusing on having replacement parts on hand for equipment in the event it breaks down and simultaneously conducting preventative maintenance and services. Finally, kanbans analyze the logistics behind a product being used, the time it takes to restock the product, and synchronizing the use against time so that there is always a product available for use, minimal excess, and in the event of expiration dates, enough product present to service users but not so much that expired products create waste. Overall, Lean Six Sigma offers a multitude of tools to eliminate waste and inefficiencies in practice. (Lean Six Sigma Institute, 2020) In the next chapter, the literature researched to identify this opportunity for operational growth will be reviewed.

Chapter 2: Literature Review

The literature regarding Lean Six Sigma published to reputable sources is both numerous and thorough. The subject of implementing Lean Six Sigma into industries previously not utilizing the tools available is also fortunately thoroughly documented. Journalists, scholars, researchers, and even businessmen & women have been searching for decades about how to make their organization more efficient.

2.1 John Deere Implementation

In 2000, John Deere was able to implement the kanban tool into their production line (Usrey & Ford, 2000). The company hired Lean Six Sigma consultants to observe their current system for production and generate a way forward to maximize efficiency while still removing as much cost to implement as possible. The team analyzed all aspects that were effecting the production and developed multiple courses of action for upper management to decide on the way forward.

Utilizing kanbans is one of the simplest tools previously identified to transition a process into lean manufacturing while also not requiring the total shutdown of the system of interest. Analysts observe the system during regular operation and quantify the supply sources, time to refill those supply sources, downtime in the event of no supply, and average consumed rate (Lean Six Sigma Institute, 2020).

The primary educational point of this use case instance is that this was not a start to end overhaul of a company into lean manufacturing. This was an implementation of one out of the several improvement tools available in Lean Six Sigma and can serve as evidence that full implementation is not mandatory to improve the efficiency of an organization but can be customized to best fit the situation.

2.2 Army Materiel Command

The military has begun the process of incorporating Lean Six Sigma into their ranks namely through Army Materiel Command (AMC) (Jennings & Root, 2006). The process, though arduous, focuses on analyzing the time required to deliver equipment to the end user (Soldier) and managing the overall flow of product from depot to depot. Teams have been established and given upwards of Green Belt Certification to better understand how the processes of equipment movement are complex and must be regarded as such.

The Army has also begun to instruct the highest echelon leaders on the benefits of Lean Six Sigma thinking as well as employing specific subject matter experts to be educated on Lean Six Sigma and advise these leaders (Jennings & Root, 2006). Furthermore, senior leaders have begun to view organizational activities as systems or even systems of systems. There is currently no literature confirming that the Lean Six Sigma practices have been able to be incorporated any lower than these senior leaders; it is still very much an aspect that has been more outsourced to advisors than genuinely being embraced at all levels.

One aspect of the incorporation to address is how certain companies have, rather than adhere strictly to the Lean Six Sigma program, created their own unique in-house customization of the program to best fit their practices. Raytheon serves as a constant contractor to the military and has their own program titled “Raytheon Six Sigma” (Jennings & Root, 2006). This use case can further help address how the military can customize how they incorporate Lean Six Sigma into the full force, rather than bring it in under the use of advisors and subject matter experts.

The earliest iterations of the Army branch of United States Armed Forces comes from a 2007 article included in the September edition of Inside the Army. In it, LTG Thompson presents that over the last few years, beginning in 2004, the Army had begun training select officers towards

Lean Six Sigma namely focused towards the green and black belts as the primary status of what was considered a successful training group (Malenic, 2007). Despite positive monetary results towards Army Materiel Command, the general does openly admit his apprehension towards first incorporating it. Through the general's eyes, it would have been better to train their own officers through their own curriculum instead of outsourcing to an independent certification program (Malenic, 2007). This recollection, albeit through a very small sample size, can display at least one point of view as to why apprehension is met when considering implementing Lean Six Sigma into an organization.

The Army's approach to incorporating Lean Six Sigma or lean manufacturing principles became a conscious effort in the early 2000s however; the United States Air Force can trace their incorporation of lean manufacturing as far back as 1999. After many years of attempting to lean out their materiel repair and distribution at depot level, USAF began to apply the principles and the results were significant. Costs and time to repair were reduced by the use of what USAF refers to as Rapid Improvement Events (RIEs) that can be interpreted as a militarized Kaizen event. (Tonkin, 2007)

2.3 United States Air Force & Navy

As USAF had their quantifiable successes with their depot level maintenance, the US Navy began to incorporate lean manufacturing into their depot level maintenance as both USAF and USN rely heavily on enormous pieces of equipment operated on by possibly hundreds of users and down time of equipment was shown as contributing to losses in the form of "Readiness", a term used to quantify a unit's ability to deploy in the event of a military action. USN saw similar improvements but also began to incorporate their own customized version of Lean Six Sigma under the name Lean Six Sigma College (L6SC). This further allowed USN to train their own officers and leaders in lean manufacturing as opposed to sending them to a dedicated certification course. (Tonkin, 2007)

An important aspect of the beginnings of military application of lean manufacturing is that Lean and Six Sigma are not one time events that will solve all of the inefficiencies in a given organization. The mentality that must be applied is one of continued growth (Lean Six Sigma Institute, 2020). Each key leader identified for comment with regards to the initial stages of applying lean manufacturing to the military echoed the same mentality (Tonkin, 2007).

2.4 United States Army

As the military began to further implement lean manufacturing into their top level acquisitions processes, the hybridization of lean manufacturing language with military lexicon began to emerge. By 2008, the Army had begun talking about implementation in the phase concept that Lean Six Sigma utilizes (Smith, Wilson, & Burke, 2008). Specifying definition, measurement, analysis, improvement, and control phases is part of the fundamental structure of Lean Six Sigma and allows for compartmentalization but also sequencing of the many different tools available to make the organization more efficient. In the instance of this use case, the Army was able to apply the proper structure to improve their cost analysis requirements document. By taking a deliberate approach towards improving the process, the Army was able to reduce time spent on the requirements document by approximately 30%. (Smith, Wilson, & Burke, 2008)

2.5 Lean vs. Six Sigma

It is important to understand at the root of all of these organizational efficiency tools and methodologies that Lean Six Sigma is, at its core, two separate methodologies merged into one. Lean Six Sigma is a merger of the Six Sigma thought process and the lean thinking or otherwise referred to as lean manufacturing; the former being developed and trademarked by Motorola and the latter being developed and trademarked by Toyota in the mid to late 1980s (Vivekananthamoorthy & Shanmuganathan, 2011). Six Sigma looks to analyze data results to a level of expertise that the data can then be adjusted to maximize efficiency. Lean, on the other hand, looks to remove operational inefficiencies through the tools identified in the previous chapter and otherwise remove waste from an organization. (Vivekananthamoorthy & Shanmuganathan, 2011)

It is critical to understand the difference between the two thought processes. Six Sigma is a management ideology, which focuses on statistical improvements to a business process, it is aimed towards further understanding what elements of an organization contribute to production quality while Lean focuses towards making process more efficient such as optimizing system down time and otherwise wasted time that is either being paid for through wages or increasing the lead time necessary for the product to be in use by customers. In previous iterations of the US military and private industry applying Lean Six Sigma to their organization, a majority if not all focus goes towards lean manufacturing. This is due to the sequencing necessary for proper implementation. Six sigma is organized based on already eliminating the elements of an organization that negatively affect the end product, focusing more towards making a higher quality product (Lean Six Sigma Institute, 2020). While the implementation process is necessary and the primary focus of this paper, the difference between the two ideologies while large organizations do not typically delineate between the two must be understood to better comprehend the step by step process outlined in this research work.

2.6 Lean Office and Business

Lean principles have been implemented in private business so much so that the idea of a Lean Office has become commonplace. Lean offices look to apply lean tools to reduce inefficiency in the office even if the primary product that the business creates is not engineering related. Simple ideas such as where to place common tools or where the desks are oriented on the office floor are accounted for and then a plan is generated to get the business from where they are currently to where they need to be to best reduce waste in the form of a Value Stream Map (VSM). (Chen & Cox, 2012)

An anonymous business requested the consultation from a team of Lean Six Sigma practitioners to implement the lean office in 2010-2011. The team went about this by utilizing the VSM to quantify lead times, down times, and graphically convey where the business was compiling waste (Chen & Cox, 2012):

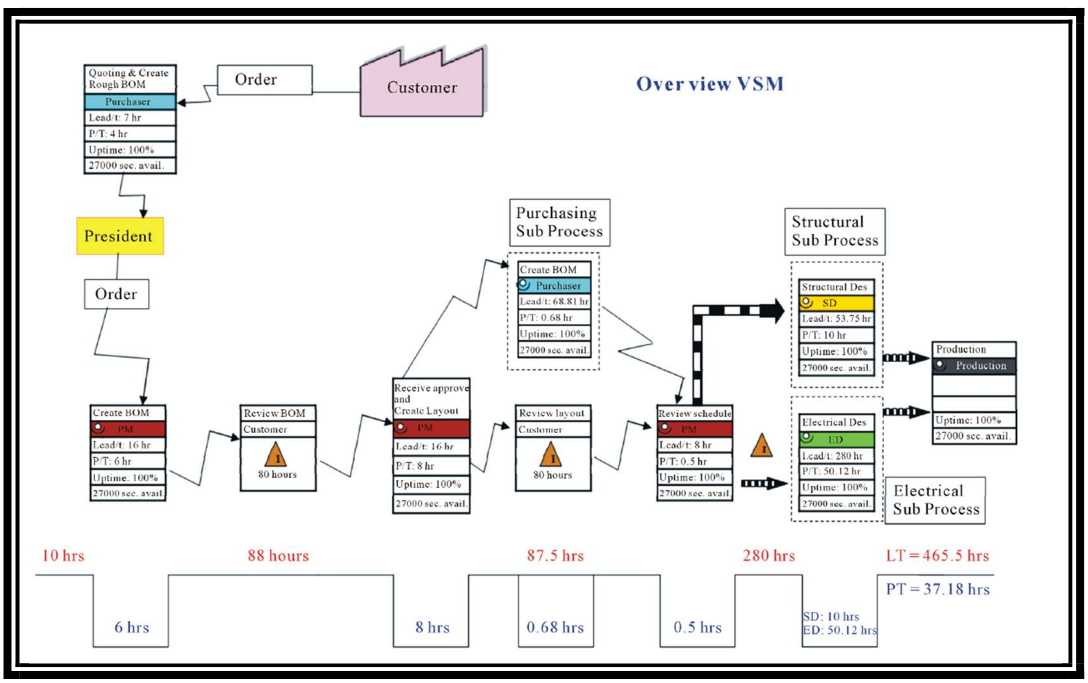

Figure 2.1 : The Overview VSM for the current state identified in the use case. The overall VSM path covers from customer order through production across time moving left to right. LT annotates Lead Time while PT annotates Process Time. (Chen & Cox, 2012)

The VSM is able to map the entire process from order request to production is analyzed and each stage of the process has its own hours. This is extremely important to understand that every aspect of the production must be accounted for. Once complete with understanding the current layout of the business, the team was able to design the future VSM (Chen & Cox, 2012):

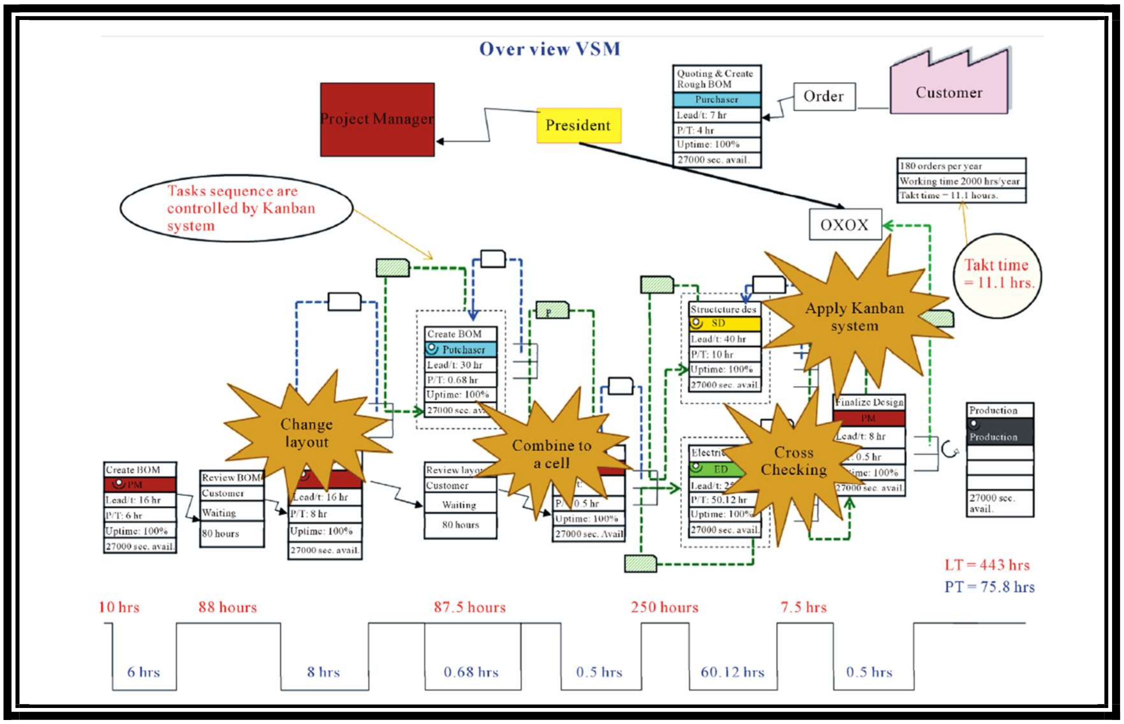

Figure 2.2 : The Overview VSM for the proposed state. This state models the state identified by the consultation team with a significant increase in efficiency. The reduced lead time equates to less time between customer order and product completion while the increased production time equates to less down time. (Chen & Cox, 2012)

Each of the explosion-like graphics denotes processes that must be implemented in order to go from current to future VSM properly in the form of Kaizen events. Throughout the rest of the consultation, the team was able to quantify changes, the business was able to complete the implementation, and the business was able to experience cost reductions and down time reductions (Chen & Cox, 2012). Overall, this use case serves as an example of utilizing the previously identified lean tools to successfully make an organization more efficient.

2.7 The Lean Six Sigma Institute

The process to implement lean into an office or business does not have to be as formal as conducting a full audit of the VSM. In 2011, a team from Portugal conducted a similar consultation to a public organization by focusing towards 5S, visual management, standardization, and daily Kaizen reinforcement. Overall, the process was significantly simpler albeit with a much smaller organization. (Monteiro, Pacheco, Dinis-Carvalho, & Paiva, 2015) 5S refers to cleaning up, arranging, neatness, discipline, and ongoing improvement; all of which when translated to Japanese, begin with the letter S. Visual management is a form of placing visual aids near or close enough to objects that will be used to simplify operation. Standardization or in some cases configuration management is a concept where any type of form, process, database operation, or administrative action are made universal throughout the entire operation; eliminating personal bias or confusion when processes overlap into other departments. (Lean Six Sigma Institute, 2020)

5S, visual management, and standardization are concepts first instructed in the Lean Six Sigma white belt certification. White belt is the first level of certification in the Lean Six Sigma Institute and provides the baseline of what is described as “low hanging fruit”; very simple and very basic improvements that can be conducted with little instruction. As such, white belt certifications are recommended for 100% of an organizations workforce as opposed to the yellow belt which is recommended to 20-50% depending on the need established by management. Yellow belt is when the employee is first considered a practitioner of Lean Six Sigma while white belt is very simple ways to improve that are best served by the daily employees; yellow belt concepts are much more elaborate and deliberate. (Lean Six Sigma Institute, 2020)

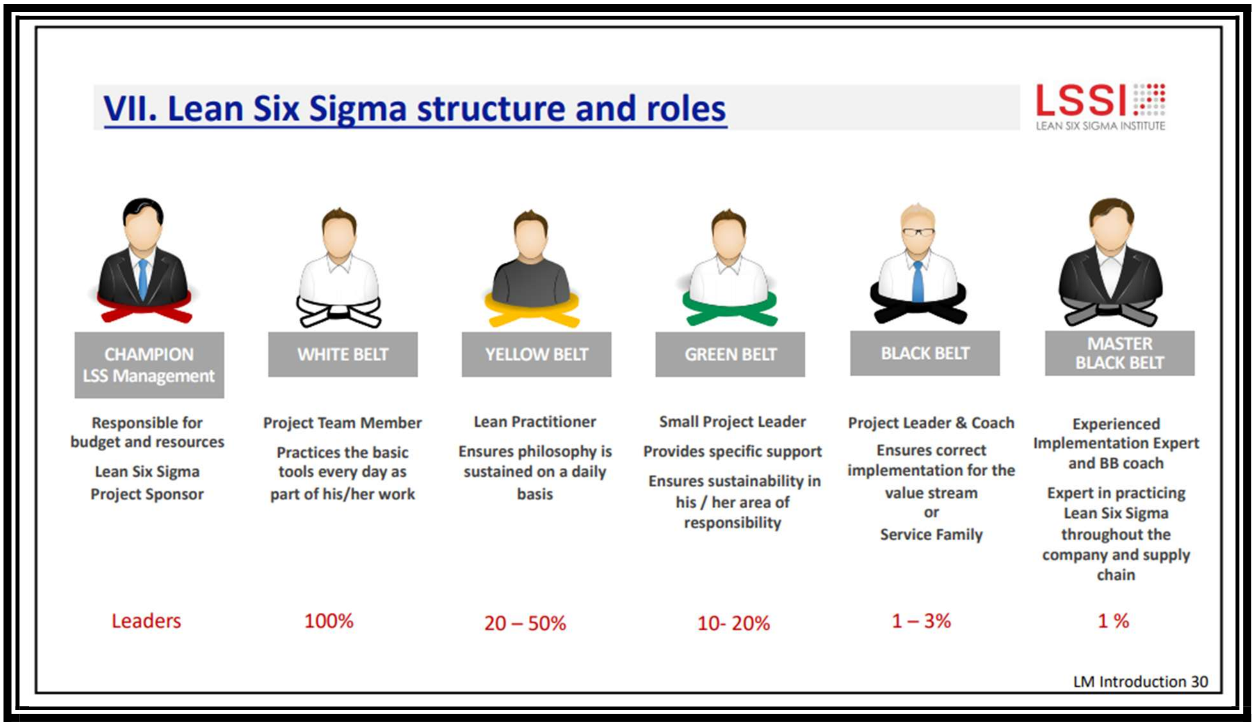

Figure 2.3 : The levels of Lean Six Sigma. Including certifications with respective responsibilities within their organization (Lean Six Sigma Institute, 2020).

2.8 United States Army Doctrine and Professional Development

The Army and other branches of the USA armed forces are government organizations. This categorization is crucial to understand where motivations come from. Private business measures success typically through net profits; gross profit minus cost. Government organizations are almost all built on systems of rules or regulations. Law dictates how government agencies operate as opposed to other quantifiable metrics like profits. As such, Army policy and procedures are built on laws and regulations and the manuals to convey these concepts are written in a law-like fashion; portraying what must happen as opposed to how it should happen.

Army Officer Professional Development outlines the requirements that an officer must achieve in order to continue progress through career ranks. Timelines like the one addressed in the introduction are customized based on the officer's branch. Infantry officers must serve in specific positions such as operations officer while logistics officers must serve as a support officer;

effectively the same equivalent position in terms of the amount of responsibility but completely different in terms of what the responsibilities are. (Department of the Army, 2014)

The important aspect to understand of Army doctrine is that it will tell you what must be done, not how it must be done. Officer Professional Development dictates that an officer must attend a military education system at each rank in order to be educated on what they must do with the new rank (Department of the Army, 2014). Lieutenants attend Basic Officer Leader Course, Captains attend the Captain's Career Course, Majors attend the Command and General Staff College etc. However, the doctrine does not necessarily dictate what subjects must be educated at these schools. Often, schools will take feedback from the active force as to the shortcomings of the respective ranks from their supervisors. This adds a certain level of adaptability to the education system of the Army; it lends itself to being able to meet the needs of future supervisors.

2.9 United States Army Use Case

The six sigma portion of Lean Six Sigma is much more significantly focused towards quality improvement and understanding what variables can tell an organization where the inefficiencies are and emphasizes the idea of controlling the system over time (Hassan, Marimuthu, & Mahinderjit-Singh, 2016). Six sigma has not been fully implemented into the US Armed Forces below depot level logistical movements. Despite this, the US Army has been able to apply the VSM method of understanding their own process as a means of improvement. Through VSM, Army logistics were able to reduce total activities by almost half from the time a unit requests a piece of equipment and overall, seen increases in activities that added value by upwards of 30% and reduced activities that do not add value by half (44% down to 19%). (Acero, Torralba, Perez-Moya, & Pozo, 2019)

2.10 Literature Review Conclusion

Overall, there is significant room for expansion with regards to the Army's implementation of Lean Six Sigma with primary the basic lean manufacturing principles. Every supporting article researched and reviewed showed that yes, the Army has acknowledged the benefits of lean manufacturing but the progress of spreading it throughout the force has been limited. Combined with the structured education progression of Army officer development, this gap in knowledge can be addressed through potentially minimal changes or additions to current Army schools.

In the present work, we propose a 3-step model to address the identified performance opportunities and will be addressed through three avenues. First, the basic principles that would aid the Army must be identified, as it is unfeasible to implement 100% Lean Six Sigma; there is simply too many fundamental differences in how Lean Six Sigma operates and how Army tactical missions are conducted. Second, the material must be customized and localized to Army lexicon. It is one thing to translate the industry language to the current Army lexicon however, analysis has shown that the implementation must be customized to the customer lexicon in order to ensure a smooth transition and prevent the need for retraining once complete. Finally the deployment plan must be analyzed. The structured schooling of Army officers can serve as a automated ingest point for lean manufacturing but what is taught based on rank must be customized similar to the belt categorization of Lean Six Sigma. All three of these avenues will feature Lean Six Sigma in a very detailed way and therefore a review of the techniques offered from Lean Six Sigma will be conducted in the follow on chapter.

Chapter 3: Lean Six Sigma Techniques

Leans Six Sigma has been used by many organizations and there are numerous tools that have been developed to help implement the six sigma concepts, for example in electronics (Kissani, 2016), aerospace (Modarress, Ansari, & Lockwood, 2005), healthcare (Kanamori, et al., 2015), among others. In this chapter a review of different techniques used in Lean Six Sigma will be presented such as 5S, Value Stream Map, Visual Management, Error Proofing, and Continuous Improvement. 5S (Housekeeping) looks to organize the work space to allow for minimal wasted effort to the goal of being able to find any object in the area within 30 seconds. Andon (Visual Management) incorporates common visual notifications to maintain organization, account for safety, and allow people using the system to understand what is happening without having to ask someone or research the situation. Poka – Yoke (Error Proofing) aims to remove as many opportunities for error to occur as possible, human or automated. Value Stream Maps (VSM)s provide a visual representation for an organization to truly see where waste is being conducted and provide the framework towards becoming more efficient. Finally, the incorporation of Kaizen (Continuous Improvement) events are the structured way to apply the tools previously outlined to the VSM and create the plan to reach the proposed VSM. (Lean Six Sigma Institute, 2020) (Lean Six Sigma Institute, 2020)

3.1 5S - Sort, Set in Order, Shine, Standardize, Sustain

5S stands for sort, set in order, shine, standardize, and sustain; the steps involve going through everything in a space, deciding what's necessary and what isn't, putting things in order, cleaning, and setting up procedures for performing these tasks on a regular basis. 5S obtained its name as an evolution to Ford Motor's CANDO program once it was exposed to Japanese executives. Ford established a formal order to their housekeeping with cleaning up, arranging, neatness, discipline, and ongoing improvement being the process accepted to keep a clean and organized workspace. Once incorporated into Japanese companies, the translations of those principles serendipitously all began with the letter S; Seri, Seiton, Seiso, Shitsuke, and Seiketsu, respectfully. Further evolutions once L6S was organized converted the principles to sort, straighten, shine, standardize, and sustain, allowing the English speaking companies to still use the term 5S natively. (Lean Six Sigma Institute, 2020)

Sort is conducted akin to a household conducting a spring cleaning event. Items are inventoried and the decision must be made if it is to be kept or otherwise appropriately disposed of as it no longer contributes progress to the system and is otherwise simply taking up space in storage. (Lean Six Sigma Institute, 2020)

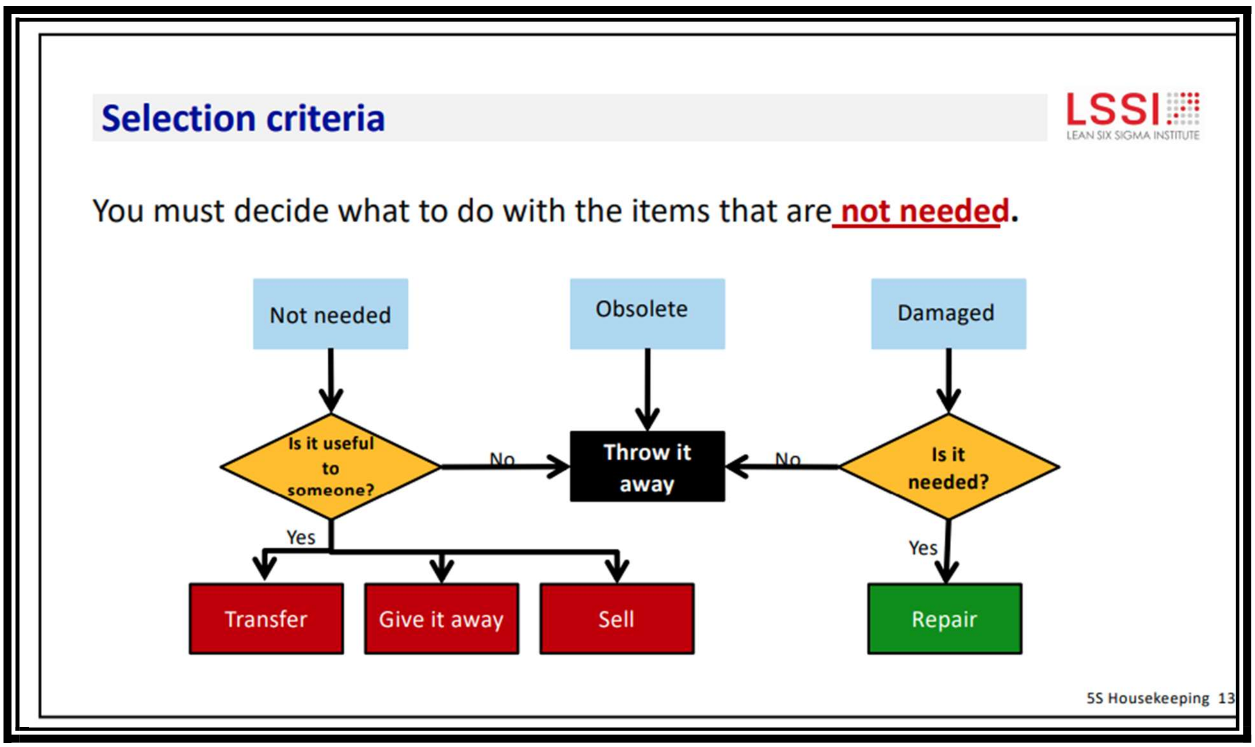

Figure 3.1 : The selection flowchart in accordance with Lean Six Sigma White Belt. The process emphasizes identifying the use of the item before assessing if it should be retained or retired. (Lean Six Sigma Institute, 2020)

Straighten takes the items that remain after the sorting process and assigns them to a designated area. Items must be grouped by function or grouped in accordance with what items must be used together so that the user is moving less to get to the storage of items they will commonly operate. Further analysis into the straighten process must account for ergonomics, shift changeover, storage of expendable items, and the overall workflow of the area. As an example, if one specific worker is the only one that uses a pneumatic hose then analysis would lend us to couple that device with the worker's workspace. This would reduce the amount of time the worker is moving to assemble his or her workstation and also reduce the clutter of personnel moving with the worker now no longer contributing to the area's traffic. (Lean Six Sigma Institute, 2020)

The shine, standardize, and sustain phases, while separate, can be loosely linked through the concept of discipline and follow up. Shine accounts for workplace cleanliness. Cleaning supplies must be stored and if no localized sanitation services are provided, a regular schedule for cleaning must be implemented. Standardization involves the evaluation of the current system. Checklists are generated and scheduled audits are conducted to verify that the process is working, such as the 30 second rule for finding items, and identify potential shortcomings that could be implemented later. Finally, sustainment is concentrated on enforcing that the previous four steps have been accomplished. It involves follow-ups, improvements, and publicly acknowledging that the process has worked by providing positive feedback to the users. Like similar Lean Six Sigma tools, this process is ongoing and requires that the management constantly review that the processes are being followed in order to ensure user compliance and allow for improvements in the future. (Lean Six Sigma Institute, 2020)

3.2 Andon Technique

Andon is the Lean Six Sigma tool used for visual management and gets its name from the ancient Japanese practice of protecting lamps from gusts of wind or breath with paper. The paper was translucent enough that the lamp was still detectable from a distance but protected from external elements that might extinguish the flame. The primary purpose of the andon was to convey a simple visual signal at distance so that, understanding what the andon was signaling, users could understand what was going on prior to engaging with service providers or other workers. (Lean Six Sigma Institute, 2020)

The modern applications of andons have now included text and auditory signals to convey that something is happening in an autonomous fashion. This can be as simple as turning from green to red or vice versa when a production line is shut down for an abnormality or referring to customer service; most modern grocery stores have now incorporated a blinking light into registers, indicating that further assistance is needed such as verifying identification to purchase alcohol or troubleshooting coupon cards. Likewise, a hotel can project to all vehicles passing by if they have a vacancy or not through a simple light flashing at the passing traffic.

The primary aspects of andons are that they must be simple and must serve a purpose throughout the organization. Andons are not meant to be distractions or attempts to look visually appealing to a customer or supervisor. The three categories within andon are visual displays, visual metrics, and visual controls. Visual displays pertain to marking layouts and helping visualize the organization of elements within the organization, similar to the straighten technique of 5S but also taking into account simple instructions such as how to operate a machine. Visual controls are meant to prevent errors from occurring by labeling certain points in an organization. An example of this would be painting the handicapped logo on a handicapped parking spot in a parking lot. This visual control, through law enforcement tickets, prevents a non-handicapped person from parking in the spot, preventing those with disabilities from using the cell. Finally, visual metrics are ways to project the quantifiable goals of an organization such as completed orders or the dreaded “days since last workplace accident” display. These three combined efforts combat waste in that there is no meeting to discuss how many orders were processed nor is there a worker running to his or her supervisor to notify them a machine is down due to mechanical failure. All of these communications are made visually or through short auditory messages that the organization understands. (Lean Six Sigma Institute, 2020)

3.3 Poka Yoke

Poka-Yoke serves as a preventative measure towards product defects. Engineering quality control is heavily focused towards preventing defects in products as outsourcing has created many proverbial webs of product trade between organizations. Production success is based on a product meeting the requirements as outlined by the stakeholders and defects can be considered any aspects of the product that violate these requirements. Poka-Yoke as a tool of Lean Six Sigma in an effort to “error-proof” the organization; if the organization can eliminate the opportunities for human error to occur, then the quantity of defects caused by human error will reduce. And while mechanical errors can be researched, documented, or otherwise prevented from happening in future occurrences, human error is complex and in some cases unpredictable. (Lean Six Sigma Institute, 2020)

Poka-Yoke can be broken down into four categories: physical, sequential, counting & grouping, and information. Physical Poka-Yoke focuses towards how objects interact with one another, similar to the square hole/round peg children’s toy that is used to teach basic shapes. A prime example of physical Poka-Yoke is any type of charging cord for personal devices. Defects can occur in cell phones, tablets, smart watches and other similar devices if too much or too little electricity is transferred to the product. Utilizing standardized charging ports like USB, USB-C, or magnetized contacts ensure that the cable standard meant for the proper current is the only current that can be plugged into the device. Sequential Poka-Yoke focuses on ensuring that procedures cannot be done out of sequence. This is common in assembly lines and a key example from sequential error proofing can be when assembling a metal casing. Often, in order to save cost and reduce waste, a whole container will be produced from one sheet of the selected metal or alloy. Once necessary cuts are made to the sheet, each bend that must be made using 90° vice grips is numbered. This allows the worker operating the machinery to know that bend #1 must occur before bend #2 and so on. Counting & grouping focus toward two separate but similar Poka-Yokes. Counting aims to automate tedious counting processes. An organization that relies on accurate attendance counts for profit can place a worker at the point of entry and ensure they count every patron that enters the facility. However, if the worker were replaced by a subway style turn barrier, then the process has the possibility of being more accurate and less prone to errors so long as necessary measures are in place to prevent bypass attempts. The organization has effectively removed the human error from the process and now has that same worker able to be reassigned to a more necessary task. Grouping focuses on ensuring all of the necessary parts to conduct a process are available, similar to the Straiten phase of 5S. An example of this is any furniture that can be purchased but requires user assembly. Good organizations will include a parts kit that has all of the assembly parts included. Great organizations will partition and label like items as a means of reducing the possibility of a customer using the wrong part. Organizations that fully embrace error proofing will color code the like items, already grouped, into the color scheme of the assembly instructions. Finally, information Poka-Yoke incorporates andons into the error proofing.

Examples in current businesses include marking suspect currency bills during financial transactions for further analysis. By making a simple mark on a $100 bill that looks a little too pristine to be genuine, a business can submit it to authorities for counterfeit tests. In this use case, the business is the organization and the faulty currency is the defect. While information Poka-Yoke is andon centric in nature it also incorporates the Sort phase of 5S; items are marked based on what their purpose serves. In 5S, this is used to error proof an organization's inventory consolidation and ensures that the proper items are retained, disposed of, or submitted for repairs.

3.4. Value Stream Management (VSM)

Value Stream Management (VSM) is the method from Lean Six Sigma for an organization to see itself and map standard operations; taking into account production time, job allocations, down time, and identify where the inefficiencies are within their operation. (Lean Six Sigma Institute, 2020)

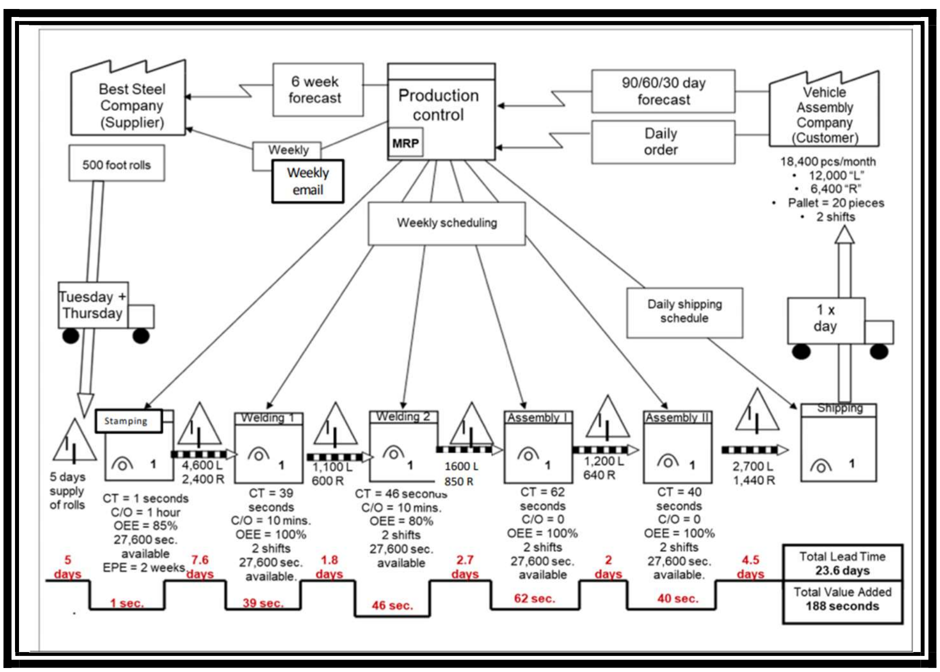

Figure 3.2 : Example VSM annotating the time spent from order to distribution. Note that under each of the process boxes at the bottom that the Cycle Time (CT), Setup time between products (C/O), and the Overall Equipment Effectiveness (OEE). These times are then accumulated across the whole stream to quantify the whole process.

VSMs serve as the start point for an organization to best understand exactly what must happen to make the organization most efficient. From these calculations, three products are able to be created: the Spaghetti Diagram, the Future State Value Stream, and the Balance Chart. All three products are different but the overall statistic that is being referenced in these processes is the Takt Time. Takt time, in short, is the overall time to produce a unit over the calculated demand for the product. Total employee availability minus breaks, setup times, or any otherwise mandatory detractors from production are calculated to understand exactly how much time is available that can be allocated towards production. The demand for the product must be analyzed using historical data and current customer contract requirements. The final product is the available time (in seconds) over the demand (units produced per work shift); being annotated in Seconds per Unit. (Lean Six Sigma Institute, 2020)

3.5 Spaghetti Diagram

The Spaghetti Diagram gets its name from the manual tracing done to show how much movement goes into a production floor to produce a product. The organization must map out the current layout of their floor and trace how much movement is required to move the product from station to station. Once identified, the organization can see where too much movement is happening and modify the floor layout accordingly. In the below example note how a person must move around the entire finished product storage area to go from final assembly to shipping while the product must bypass the shipping station in order to be stored for future shipping. A more ideal setup would have the product moving from Assembly II, to Finished Product Storage, then to Shipping with the Shipping and Finished Product Storage positions swapped. (Lean Six Sigma Institute, 2020)

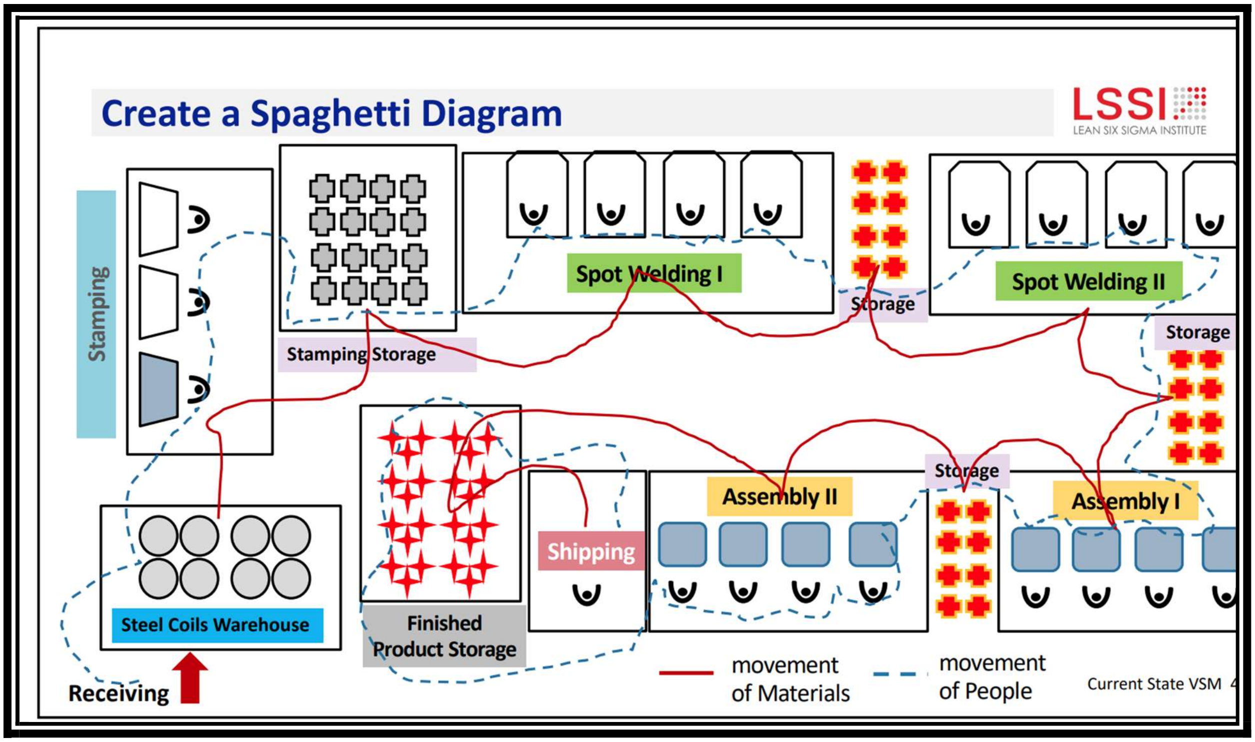

Figure 3.3 – Spaghetti Diagram example. This continues to use the example of a production line that requires welding and assembly across the shop floor, note the consistency with the previously identified VSM. (Lean Six Sigma Institute, 2020)

The Balance Chart is arguably the simplest graphical representation of productivity in a company. In it, every stage of production (in the ongoing example, this would be the welding stations, assembly stations, and stamping) is analyzed and represented in a bar graph of stations(X axis) against how long it takes for the station to apply its contributions to the product via the cycle time(Y axis). The important aspect of this diagram to analyze is the cycle time of each station against the takt time. Takt time represents the time necessary to produce a product against the demand for the product. Engineers can look to the cycle time and decree anything with a cycle time longer than the takt time as a productivity bottleneck. (Lean Six Sigma Institute, 2020)

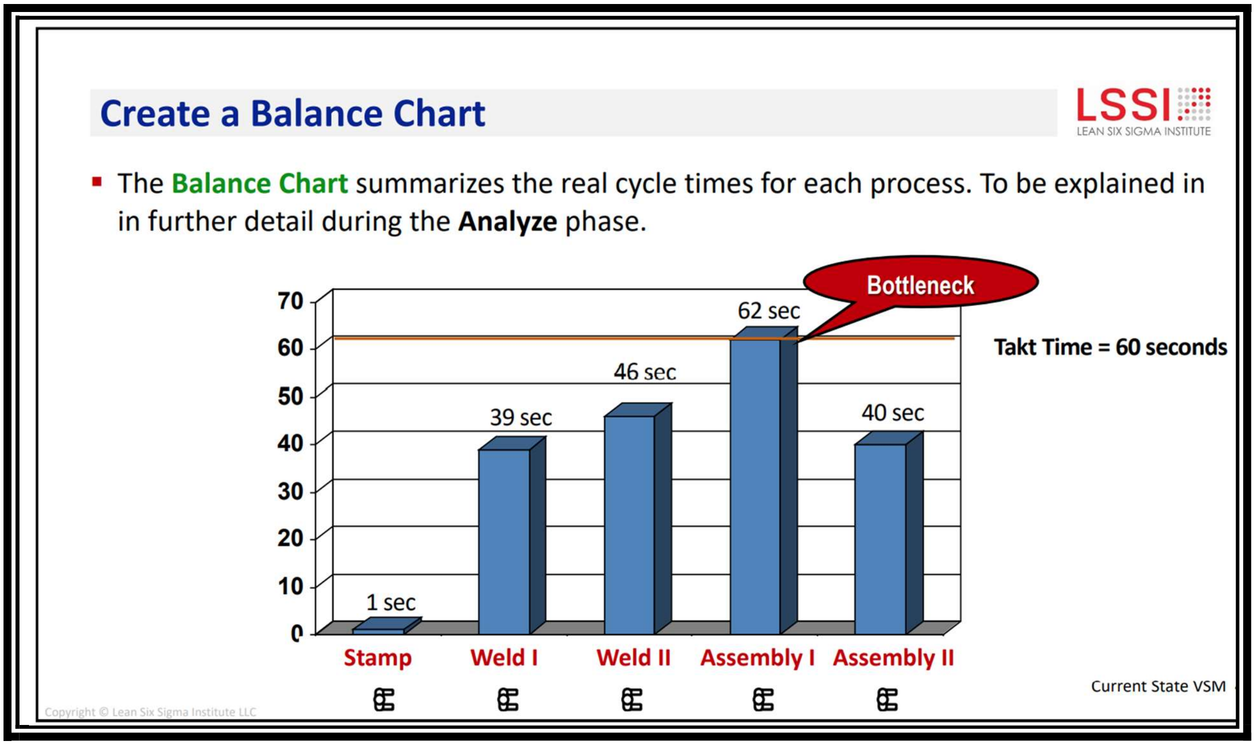

Figure 3.4 : Balance Chart. This chart graphically represents every station in the production process and compares their cycle time against the takt time. Because Assembly I's cycle time is two seconds longer than the takt time, that station is a clear bottleneck to the production process. The time to assemble against the demand is less than how long it takes that station to do its job. Strong organizations can identify these bottlenecks and audit the station to better conduct its business while not affecting the overall process. (Lean Six Sigma Institute, 2020)

The Balance Chart, Spaghetti Diagram, and the overall VSM all allow an organization to see within itself and, more importantly, quantify what processes are contributing negatively to their overall production. One tool applied to an organization can help reduce waste however, when each of these three processes are applied simultaneously, the overall situational awareness of the company increases and previously identified tools such as andon and 5S can then be deliberately applied to those processes that may be serving as a production bottleneck.

3.6 Kaizen

The final tool identified for basic lean manufacturing implementation is a Kaizen event. The Kaizen name comes from the two Japanese words "kai" and "zen", roughly translating in

English to “make change for the better”. Kaizen events are the formally structured procedures that track the incremental implementations of the previously identified lean manufacturing tools. The process is very thorough, involves significant documentation for tracking, and provides the quantifiable deliverables when an organization wants to “change for the better” by implementing 5S or andon as small projects or go into incredible detail by mapping the current VSM, looking at a balance chart, and mapping the future VSM that the organization is striving to achieve. (Lean Six Sigma Institute, 2020)

Basic Kaizen events can be broken down into three phases: preparation, implementation, and follow up. In the preparation phase, the key leaders of the organization identify the current state and plan out the implementation schedule based on the level of change needed to be implemented; generally speaking, simple tools like 5S and andon take about a week to fully implement while larger Lean Six Sigma processes can take upwards of a month. The planning team must be able to fully plan out the implementation but also ensure that the plan is detailed enough and distributed early enough so that the remaining members of the organization can understand exactly what they must do to ensure compliance. The implementation phase occurs over the course of a day, typically no more than two, and is 100% attended by the team. Production, where available, is shut down so that no one is distracted by the day to day operations. This is why the limitation is set to one day so that the organization can dedicate 100% of the manpower and understanding to the changes but minimize detriments to the daily production. Every member of the team has been theoretically trained on what must happen and they execute accordingly. Finally, the follow up phase occurs. This phase is a key aspect in that the follow up phase is something that is largely demanded of Lean Six Sigma. If no follow up is conducted, then the potential for degradation back to the previous norm increases; placing the efforts of the organization in jeopardy. Follow ups are conducted through meetings, spot checks, inspections, audits, and any other means in which a manager wishes to receive the information. (Lean Six Sigma Institute, 2020)

3.7 Techniques Conclusion

The fundamental aspect of lean manufacturing tools that must be understood is the customizability available to the practicing organization. This is not a one size fits all type of methodology that every organization must adhere to. The only mandatory requirements indicated by Lean Six Sigma are that if an organization adapts a tool or variant of Lean Six Sigma to their organization, it must be done from management all the way down to the end user and follow up is absolutely mandatory. These requirements are mandatory because if an organization is truly dedicated to becoming more efficient, then it must embrace the tools being used at all levels of leadership and because implementing a change is inherently resisted by those who have developed the habits and memory of what the current state is. If follow up events are not conducted then the probability that employees will revert back to their old ways or what is comfortable to them increases. All of these tools are meant to make the organization and employees of the organization more efficient. In the next chapter, the 3-step model to actually implement these techniques will be further detailed and outlined.

Chapter 4: Model Overview

The proposed 3-step model comes as an amalgam of several similar-in-nature decision cycles. DMAIC is successful because it takes the approach that a decision maker must understand what the current situation is in order to fully understand how to change it for the better (Lean Six Sigma Institute, 2020). PDCA (Tague, 2020) and the OODA Loop (Luft, 2020) concepts are similar as well, requiring analysis prior to solution development and implementation. The US Army even has their own cycle for combat engagements with DIDEA: Detect, Identify, Decide, Engage, and Assess (Department of the Army, 2015).

The necessity for a new model comes from the cyclic nature of organizational leadership in many companies to include Army Officer leadership (Department of the Army, 2014). Officers serve in positions a maximum of two years and in many cases far fewer. The impact of losing a current member of the team who knows the standing procedures such as how the office layout was constructed or how to keep a desk area optimized cannot be emphasized enough. If a consultation team were to help the organization integrate lean manufacturing to their processes, only to have half the team leave six months later, it is impossible to predict how much the team will regress back to the inefficient level. In the time a team could implement lean manufacturing into an organization, a majority, if not all, leaders will have changed. Our 3-step model will condense common aspects of each of these models for use cases to implement lean manufacturing into organizations that by their very nature are cyclic and have rapid turnover in terms of leadership. In this case, the model steps will be Identification, Localization, and Deployment.

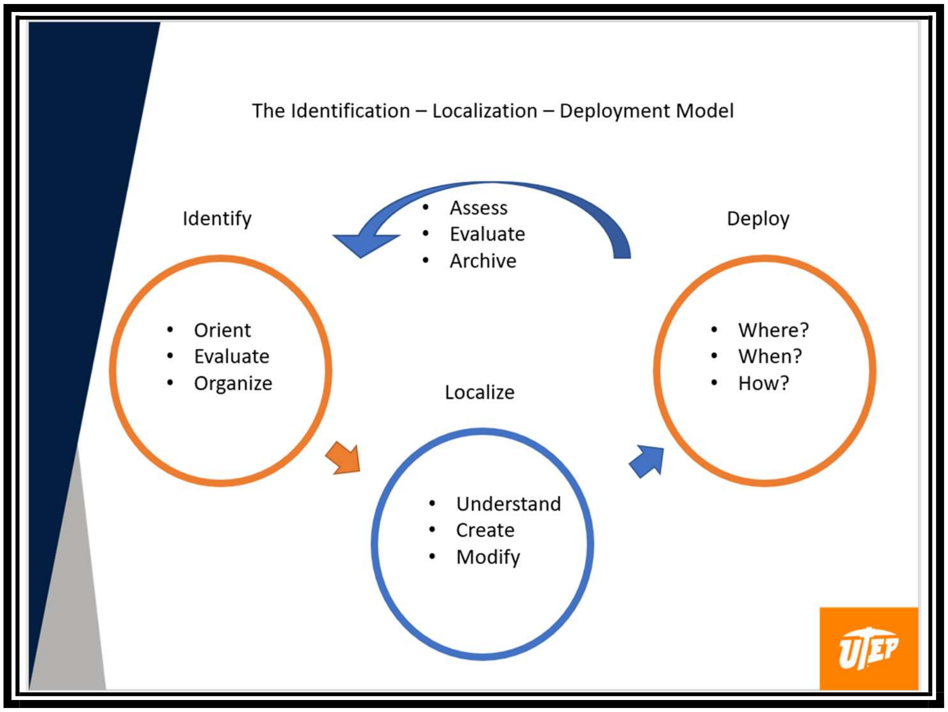

Figure 4.1 : The proposed Identify-Localize-Deploy Model (ILDM). The model looks to address implementation with complex, high leadership movement organizations by focusing on ease of product implementation and deployment.

4.1 Identification

The identification phase of this model is meant for the team assigned to implement lean manufacturing to study the organization top to bottom in order to fully understand what aspects of lean manufacturing, if any, have already been implemented. Through the course of organizational growth, perhaps practices such as 5S or VSM have already been adapted to the organization from intuitive leaders or previous attempts to fully incorporate Lean Six Sigma, albeit perhaps under a different language/lexicon.

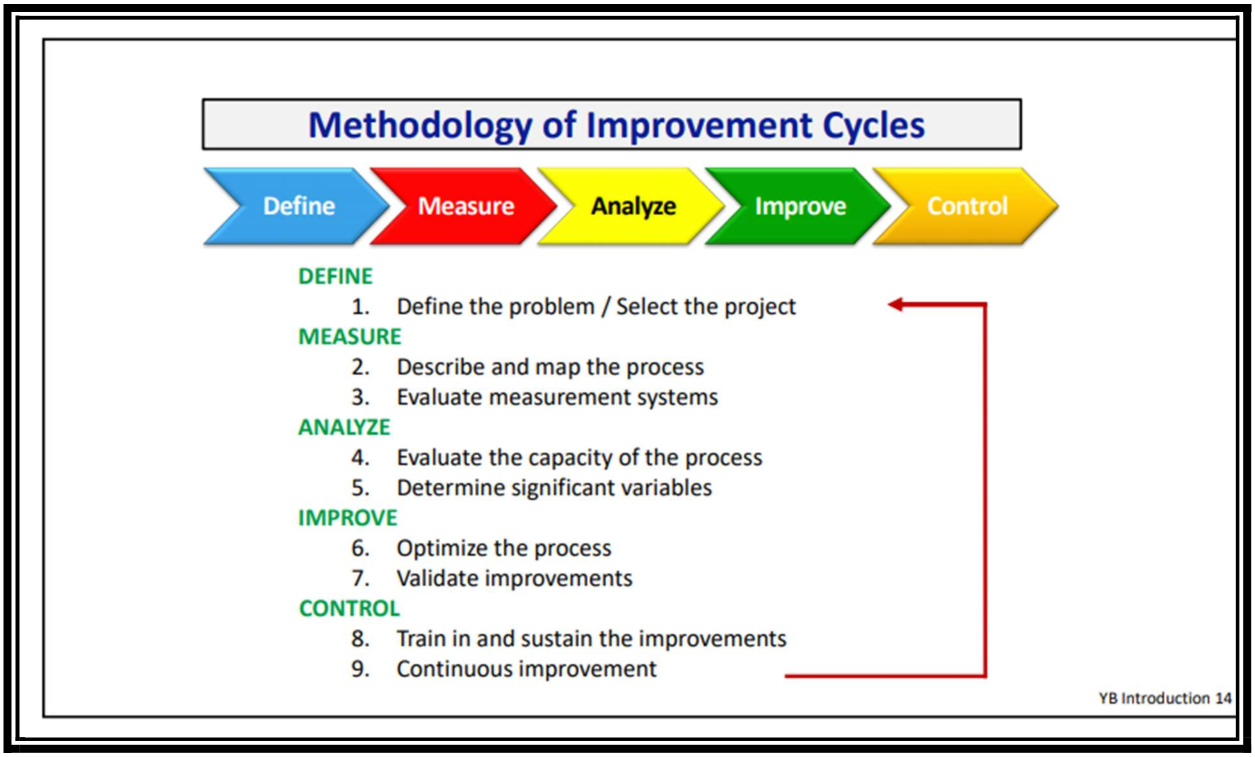

Figure 4.2 : The Define-Measure-Analyze-Improve-Control (DMAIC) model. Of note, this method requires extensive understanding of variable and how they affect a process. In the case of DMAIC, the model can be applied to organizations, applications, processes, and just about any level of system with relative success (Lean Six Sigma Institute, 2020).

It is important to note that the entire organization must be evaluated without bias but not without context. Some organizations simply do not need certain aspects of lean manufacturing because they already have a program in place that takes into account regulations, laws, or other constraints that require further context in order to fully understand. This must also be accounted for when the team moves to the localization phase as with any system, constraints must be acknowledged and adhered to for the organization to succeed. In the identification phase the team must:

1. Orient the organization's structure as to be able to evaluate the presence of lean manufacturing.

2. Evaluate the organization's structure to answer the following questions about every lean manufacturing tool:
    a. Does the tool exist? If yes:
    b. How is the tool customized to their organization? If no:
    c. Would the organization benefit from the tool?
3. Organize the results of the evaluation. The results must be able to be transferred to the localization team in such a concise manner as to prevent rework or any otherwise "lost in translation" defects.

The final results of the evaluation must be transferred to the localization team in a deliberate manner. This can be done through a meeting or a briefing, physical or virtual, but must be conducted in an environment where once the meeting is concluded, the localization team understands every aspect of the data provided by the identification team.

4.2 Localization

Localization and translation form a square/rectangle rule in their relationship. As not all rectangles are squares, translation is a form of localization. Translation aims to convert a word from on language into another while localization does not just translate but also incorporates context such as culture, history, meaning, and scope from one entity to another. The overall goal for a localization team is to ensure that when content is presented to another entity that the recipient feel and understand what the content creator envisioned while still holding their original contextual norms. In this specific use case, the content creator is the Lean Six Sigma team assigned to consult with an organization and the recipient is the organization.

The localization team must be able to accomplish two primary tasks:

1. Understand the context of the organization.

2. Create or modify the existing tools presented by the identification team in a way that can both be understood and implemented by the recipient in a way that does not require the client to enlist further consultation once the model cycle is complete.

In order to understand the context of the organization, the localization team must conduct extensive research. Interviews, literature review, and site surveys must be thorough and transparent. Interviews should be conducted in a manner similar to an engineering team beginning to elicit requirements from a stakeholder (the organization, in this case). Stakeholders do not always know how to articulate requirements and similarly organizational leaders do not always know how to articulate how they want an event to occur (Laplante, 2018). Literature review is important because organizations are heavily built on rules, regulations, historical lessons learned, and language. Perhaps the reason why the lean tool has not been implemented lies in the history of the organization or a government regulation. Site surveys can be done in conjunction with literature review and interviews but must be done all the way down to the end user of the organization and to the physical locations that will be most impacted by the implementation.

Creating and modifying the tools for implementation must be done with complete transparency to the client in order to foster trust and thoughtful feedback. If the tools created are rejected by the client after production, then the entire process must conduct rework to find the proximate cause. A certain level of creativity can be applied to this phase as creativity can potentially surpass previously structured means of tool creation so long as risk is identified and mitigated as necessary to both team and client satisfaction (Laplante, 2018). At end state, the localization team transfers the product to the deployment team in a way that the deployment team is purely focused towards teaching the tools to the organization.

4.3 Deployment

The deployment phase is where the education to the organization on what has been developed happens and is focused towards how to educate the organization, not necessarily what is being educated. What is being educated has already been developed through the localization and identification teams and as such, the handoff of information between teams must be conducted in a way that the deployment team is not conducting rework of previous phases. Many large organizations can fall into a habit of high manager turnover. This is not necessarily due to competence/incompetence; it could have to do with the complexity of the organization and the environment it operates in (Clingermayer, 2016). Engineering firms, professional sports coaches, military organizations, and more can approach the management turnover philosophy as an opportunity to develop their leaders in environments they are not used to in order to create a "more well-rounded" leader in an attempt to groom them for a higher managerial position in the future. The positive outcome is that when in the higher position, said leader understands how to work with a more complex organization because they have worked with the subordinate departments before and therefore understands how to manage them. The negative outcome is that this unintentionally creates a high leadership, philosophy, and experience turnover. (Clingermayer, 2016)

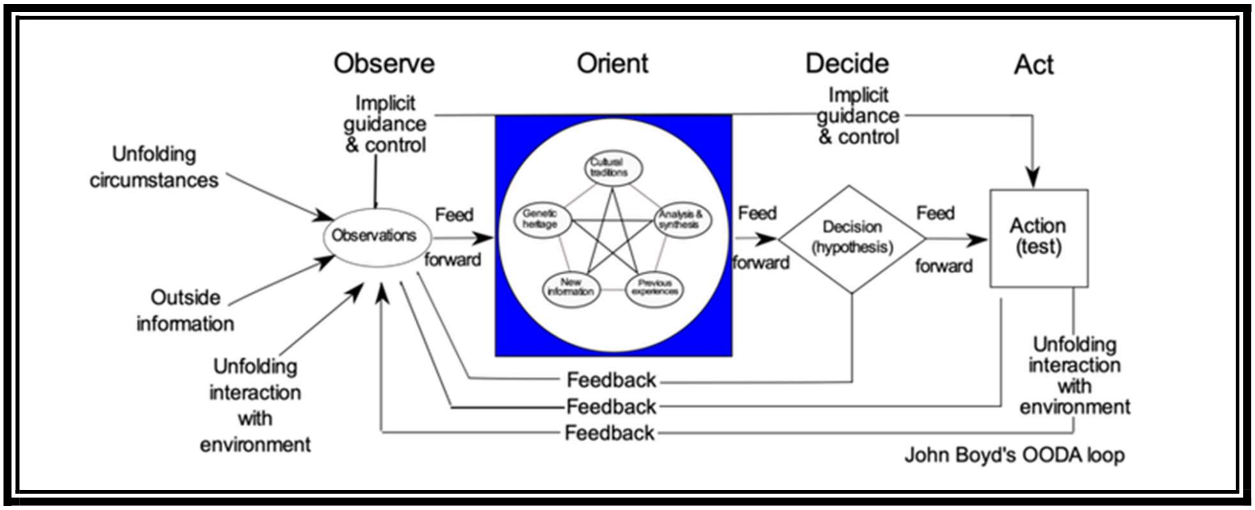

Figure 4.3 : John Boyd's OODA Loop. The loop is a decision making cycle adopted into many military organizations on the premise that in armed conflict, the leader that can accomplish the loop most efficiently wins. The deployment team can use similar decision making models in order to decide what best inception point for the organization to receive the implementation.

These outcomes are why the deployment phase exists: find a junction point in the career path of the organization's leaders and implement the localized lean manufacturing program there so that the implementation is not a once per cycle necessity but a fundamental education to the system itself. This is where the three questions that must be answered in the phase originate from. Where, when, and how the localized package is deployed will be analyzed by the team as a best means of ensuring full implementation. Is it feasible to educate the entire organization in one cycle? Should reference documents be altered as to reflect the implementation? Can this be done digitally or must physical presence be mandatory? The questions could be potentially limitless or as exponentially complex as the organization itself. At end state, the deployment team must hand off the final product to the organization having best packaged the implementation for organizational use and with full understanding from the organization about the deployment.

4.4 Model Summary

The 3-step model we propose has its fundamental roots in proven scholarly models of similar nature while simultaneously being unique enough to specify the intent behind each phase.

At end state, the model strives to provide customized variants of multiple lean manufacturing tools in a package that is not only accepted by the client or organization but also sustainable by the organization itself without the need for constant reassessment by a Lean Six Sigma team.

In the following chapter, a hypothetical organization will be created as a use case for the 3-step model. The organization will remain generic in nature as to provide anonymity from accidentally describing a real world organization and potentially inducing a bias to the use case while realistic enough as to show a proposed environment benefits from an identified opportunity to implement principles of lean manufacturing.

Chapter 5: Hypothetical Use Case

The use case that will be observed for implementation of the ILD Model is an office environment where end product is generic in nature but still allocates the necessary departments that a typical organization must employ such as human resources, operations, logistics, and tech support. These departments have intra office interactions while also having their own responsibilities internal to their own staff. The common variable that the model will address is that leadership positions have a rapid rate of turnover; for transparency, the turnover occurs asynchronous with leaders remaining in position no longer that two calendar years and no shorter than six months barring termination or other unforeseen circumstances.

5.1 Organization Overview

Each department follows its own career progression program that is somewhat similar to the others; the leader is trained for their position, serves in the position, and then the employee progresses to the next level of the organization in that department and repeats the cycle. A member of one department can serve in another however that practice is advised against due to the formal training requirement and is typically reserved for occurrences where a department chief is absent and the replacement has either not been identified or simply hasn't progressed enough to be qualified for the position.

Human resources is responsible for the documentation of employee information to include medical, salary, any organization-offered benefits such as insurance, and any other employee services that would otherwise be commonly referred to as "administrative" or "paperwork". Day to day activities include payroll audits, ingesting employee documents into the archive system, and handling the administrative side of employee termination. Employees typically approach the support wing of human resources in order to resolve personal record discrepancies such as salary changes or changes to benefits due to events such as marriage or childbirth.

Logistics is responsible for synchronizing all resources towards the organization's current and future operations. Resources can be as common as electricity to the building or as complex as coordinating landscaping for an expansion or public event. Employees typically approach the support wing for common office supplies or tools to do their job such as an air compressor for the shop floor. Requests are submitted in an organization formatted request form and actioned on in order of occurrence.

Communications enables interactions throughout the entire organization. Internet connections, storage server maintenance, computer life cycle management, and tech support govern the day to day tasks as well as contributing to the operations planning process by anticipating communication requirements and media appearances. This department is responsible for ensuring that each employee has a properly imaged computer system that connects to the organization's network and that the network is protected from security breaches. Typical employee interactions are almost exclusive to the tech support wing of the department. Employees submit trouble tickets for issues with equipment and issues are troubleshot in order of occurrence; similar to HR and logistics.

Finally, the operations department is responsible for planning all future events and tracking what is currently happening, monitoring all variables that can be attributed to the organization's business model. This is the largest department and employs its own subject matter experts (SME) so as to contribute their specialty. The plans wing and current operations wing are separate from each other but still report to the same department chief and the interaction between the two is plans provides the details to the current operations and current operations provide quantifiable feedback after events occur. The Chief of Operations oversees the transactions between the two, adding their own extra efforts in the event one cell is struggling to maintain efficiency standards. Employees typically do not interact with this department unless something is happing at user/production level that would place organization processes at risk, prompting a plan to be generated and implemented.

5.2 Leadership

The three key leadership positions in this organization that do not report to a respective department but overall bear responsibility for operational success are the Floor Manager, Chief of Staff (CoS), and Health/Safety/Environment Supervisor (HSE). Each has a differing job description but in terms of overall authority, the Floor Manager is the highest among the entire organization and while the HSE does not have less authority, their job is built more on standards and ethics and therefore have a differing level in terms of the organizational structure.

The Chief of Staff synchronizes all of the departments. Their responsibility is to ensure that each department is operating at maximum efficiency and that their contributions are to the benefit of other departments when applicable. The CoS reports to the Floor Manager and monitors the overall metrics of each department; providing recommendations to the Floor Manager at periodic intervals so that the Floor Manager can understand the status of the organization and provide guidance for where to adjust how departments operate. Perhaps the Floor Manger is more concerned about overdue personnel records and as such, the CoS can provide additional leadership efforts to ensure HR is addressing the issue. The CoS bears the same level of responsibility as the Chief of Operations however while operations is looking forward towards what the organization must do, CoS is looking across all departments to ensure maximum efficiency towards what the organization must do.

The Health/Safety/Environment Supervisor ensures employee compliance with all applicable standards that the organization must adhere to. Health standards can include as much as ensuring medical records are up to date, employees are conducting processes in an ergonomically positive manner, or that necessary medical personnel are available in the event of an accident. Safety is similar to health in that it is focused towards preventative actions to ensure employee safety. Personal Protective Equipment (PPE) standards vary by organization and the HSE both understands those respective standards and simultaneously ensures employee compliance. Environment standards similarly vary by organization but universally look to preserve the environment by ensuring proper storage, use, and disposal of harmful chemicals and the HSE must ensure employee compliance.

The Floor Manager is the overall head of the organization. They report to the next higher echlon's equivalent and are overall responsible for the actions and efficiency of all departments they supervise and any lower level echelons that are affected by their actions. The Floor Manager is both a manager and a leader; they must be intelligent and experienced enough to provide guidance and allow subordinate leaders to operate with a certain level of confidence but also be the ethical and moral standard of the organization.

5.3 Model Implementation

The identification phase begins this process and the team must be able to view the organization from the outside looking in. During the process, the identification team identifies that the organization is not operating independent but as a small part of a much larger organization. This is simply an iteration of an echelon within a tiered system. This is important to understand as it adjusts a previous assumption of the scope of this project.

Table 5.1 : Example identification phase handoff product.

	Organization Name REDACTED	Date of Consultation MM/DD/YYYY	Consultant: REDACTED		
Tool	Yes	No	Partial	Benefit	Notes
5S		X		YES	When conducted, is not done in a specific standard but to personal experience.
Andon	X			N/A	
Poka Yoke			X	YES	Error proofing operations are conducted to gov regulations.
VSM			X	MAYBE	End-product time to produce is very subjective to outside variables and therefore inconsistent.
Spaghetti Diagram		X		YES	When conducted, is not done in a specific standard but to personal experience.
Kaizen			X	MAYBE	Due to fluctuating environmental considerations, formal kaizen is impossible

The localization team now has the identification team's results and can begin researching the context of the organization. Overall notes of this localization is that the organization is government in nature, so rules are build based on policy and budget with a heavy emphasis on history; leaders are indoctrinated on the cyclic nature of history and therefore study history relentlessly. Once complete, the localization team's product looks like the following:

Table 5.2 : Example localization phase handoff product.

	Organization Name	Date of Consultation	Consultant:		
	REDACTED	MM/DD/YYYY	REDACTED		
Tool	To Be Implemented	Current State	Desired End State	Contextual Name	Recommendations
5S	X	Not formally taught so the current state of 5S is very subjective.	All members of organization understand 5S	**Station Organization**	Formally teach at a natural ingest point. This is an easy low hanging fruit to fix.
Andon					
Poka Yoke					
VSM					
Spaghetti Diagram	X	Organization layout is based on personal preference and some merit. Offices are dedicated for department management but where offices are is not considered.	Leaders at all levels understand how to layout a job area based on efficiency and reduced waste.	**Floor Layout**	Formally teach at natural ingest point. Could be difficult to get buy in unless taught at manager level.
Kaizen	X	All echelons strive for improvement but in varying ways. Often budget is the concern. Once identified for improvement, operations process creates the formal plan.	All leaders understand the need for continuous improvement.	**Always Improve**	Formal teaching not recommended. Recommend reinforce the desire to continuously improve in top echelon leaders and anticipate trickle down effect.

In this instance, the deployment team is given heavy recommendations of identifying an already existing point where the organization will have everyone together at the same time. Through further research, the deployment team identifies that, as mentioned in the Organization Overview, every leader by department must undergo formal training upon promotion. This creates the natural ingest point recommended by the localization phase team.

The deployment team then moves to answer the “how” portion of their requirements. The formal training for the organization is presented in a classroom format with a heavy emphasis on slide show presentation software. The team can then conclude that the proper way to deploy the training is in these education institutions by partnering with the governing authority of the institution. 5S can be taught at entry level training, Spaghetti diagrams can be taught at mid management, and Kaizen can be taught at upper echelon training. This overall package allows for the institution to teach itself, allow the organizations to receive already trained employees as opposed to doing a once-over iteration that lends itself to regression, and is minimal enough to not induce heavy change but maximize the benefits of implementation.

Furthermore, this organizational education system allows for leadership to customize the rubric of their employees. They primarily instruct employees how to do their job and the lean manufacturing tools will be only a fraction of what is taught. But hypothetically the lean manufacturing tools taught might not translate as well from the classroom to the field. In this instance, the high echelon leaders can reach back to the education system and provide feedback on what is working and what is not, further customizing the implementation after the consultation team is finished.

5.4 Conclusions

Overall this hypothetical use case highlights the customizability of the model and how the communication between the teams must be emphasized throughout the whole process. This use case presented a very inclusive, arguably stubborn, organization that can benefit from lean manufacturing significantly with minimal drastic shifts to daily operations. The model displays adaptability and a genuine desire to help organizations improve. In the next chapter overall results and further expansion of this model concept will be analyzed.

Chapter 6: Concluding Remarks

6.1 Significance of Research

This model's development represents an opportunity for lean manufacturing to be further implemented into many organizations across many countries. It also shows the importance of views and viewpoints when implementing large scale process changes. It is not enough to simply show the efficient way to do things, it must also become something from within the organization, capable of succeeding regardless of if the consultation forces it to happen. This can lead to more accepted use cases, more widespread use, and more creative instances where a previous attempt to implement did not work however a more customized package was accepted at a second attempt.

6.2 Future Work

The initial start point in future work would be a real life use case where the model was applied with the suggested organizational tools. Currently, this model only exists in a hypothetical state without physical proof of concept. Once conducted across several use cases, updated versions of the model can be created through data analysis of why a package deployment succeeded or failed; to the point of being able to customize the deployment not based primarily on the creativity of the team, but on pick-and-choose proven success cases.

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Vita

Brett Babcock was born October 24th, 1988 in Harris County, TX. The third son of Douglas and Dana Babcock, Brett graduated from Platte County High School in Platte City, Missouri Spring of 2007 where upon he immediately began post-secondary school at the University of Missouri – Rolla; now Missouri University of Science & Technology. Brett graduated from Missouri S&T with a Bachelor's Degree in Biochemistry and received an Officer's Commission into the United States Army through the Reserve Officer Training Corps (ROTC).

Brett has held numerous positions of leadership across multiple Army units and duty stations. After promotion to Captain, Brett led his Company, Attack Company, 67th Armored Regiment through a nine month deployment as the South Korea Rotational Armor Brigade. After completing command, Brett entered the Army Advanced Civil Schooling (ACS) to complete his Graduate Degree.

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