Implementing the 5S Methodology for the Graphic Communications Management Laboratory at the University of Wisconsin-Stout

by

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Abstract

5S is a basic foundation of Lean Manufacturing systems. It is a tool for cleaning, sorting, organizing and providing the necessary groundwork for workplace improvement. This research effort dealt with the implementation of 5S methodology in the Graphic Communications Management laboratory at the University of Wisconsin-Stout.

A detailed application of the 5S system is given. It will impact the instructors and students of Graphic Communications Management program that work within the selected laboratory. By following the 5S methodology, this research effort may show significant improvements to safety, productivity, efficiency, and housekeeping. The research documents improvements by using before and after pictures. It also intends to build a stronger work ethic within the students and faculty who would be expected to continue the good practices.

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Chapter I: Introduction

5S is an approach to organize, order, clean, standardize and continuously improve a work area. 5S is not just about housekeeping. It is one of the efficiently-working tools of Lean Manufacturing. The program gets its name from five activities beginning with the letter S, which were derived from five Japanese words. The words are Seiri, Seiton, Seiso, Seiketsu, and Shitsuke, which when translated mean Sort, Set in Order, Shining, Standardize, and Sustain, respectively. Sort helps to remove all unneeded items; only what is needed stays. Set establishes locations and quantities needed for efficient operation. Shine represents cleaning through inspection. Standardize implements visual displays and controls. Sustain helps to keep the organization effort in place through training and total employee involvement.

The Graphic Communications Management (GCM) program of the University of Wisconsin-Stout (UW-Stout) is the foremost graphics program in the Midwest, leading to a Bachelor of Science degree in Graphic Communications Management. GCM provides a comprehensive array of courses to its students. A following is a list of the main content areas of the GCM curriculum that use this lab (Graphic Communication Management, 2010):

- Pre-media
- Production
- Post-press
- Management
- Integration

GCM laboratories are equipped with outstanding tools, which give students hands-on experience with all phases of graphic communications work. The GCM program provides illustrative printing operations using all of the major reproduction processes as well as various

types of inks, cleaning agents, chemicals, coatings, and solutions. A variety of tools are used during the operation and maintenance of machines. Additionally, many different printing substrates are used and printed products are generated (Graphic Communication Management, 2010).

Statement of the Problem

The labs used by the GCM program have become unorganized and crowded, which hinders the movement of people and materials. Productivity and learning become impeded and time is wasted searching for the correct tools because of congestion and disorganization.

Purpose of the Study

The purpose of the study was to identify, analyze and implement the process of 5S to organize and manage selected GCM laboratory areas at UW-Stout. This research was to implement 5S methodology in the screen-printing lab and make suggestions for continuous improvement of unorganized and chaotic areas. The desired results and benefits projected for the GCM labs were a more efficient layout for work stations as well as an organized and labeled storage for all tools, equipment, and materials. It was also important to fully utilize all available space in the lab, and improve the flow of work such as from screen preparation to drying to printing to cleaning the frames. Faculty and students will be able to use this study to decisively evaluate the advantages of implementing 5S methodology in other areas and labs being used by the program.

Furthermore, the objective of this study was to highlight 5S methodology as a Lean Manufacturing tool. Another important purpose of this study was to focus on continuous improvement actions.

Assumptions of the Study

The assumptions of the study were:

1. All GCM staff/students were committed to 5S implementation and participation in its use.
2. The GCM staff was proficient in their job and machines were in good working condition.
3. 5S implementation was carried out based on the needs of the GCM program at UW-Stout.
4. The GCM staff will teach students 5S practices to standardize and commit to sustaining the practice.

Definition of Terms

5Ms. A manufacturing quality problem solving model or tool that is based on using five factors of manufacturing namely Manpower, Machines, Medium, Mission, and Management to gain desired outcomes.

5S. A philosophy based on five Japanese terms utilized for creating and sustaining a well-organized workplace that is more efficient and productive in operation.

Bleach. A chemical that is used to remove color or stains (Merriam-Webster, 2010).

Blockout Cabinet. Common storage unit for inks, cleanser, safety glasses, etc., which are used during blockout operations and screen-printing preparation.

Changeovers. Production or work related actions where pieces of equipment or materials have to be changed in order to start production of a different item.

Checklist. "To do" lists or lists that are used to cross-check whether or not a particular activity has been performed correctly or not.

Corrugated Box. A shipping container made from layers of fluted cardboard.

Continuous Improvement. The regular improvement of production processes, products or services using tools and systems that utilize data tied to customer satisfaction.

Frame Drying Cabinet. A set of drawers with temperature and airflow controls, which is used to hold wet screen frames while they dry out.

Garment Printer. A Screen-printing press, which is used to print multiple colors on textiles and garments.

Graphic Communications. Process of creating, producing, and distributing material incorporating words and images to convey data, concepts, and emotions.

Ink. A colored material for printing and/or reproducing an image (Merriam- Webster, 2010).

Inspection. The method of checking the manufacturing process.

IR Flash Cure Unit. Equipment that uses an infrared heat source to dry colors printed on a surface (either paper or cloth) before proceeding to print the next color during a screen-printing operation.

Just-in-Time (JIT). A planning and scheduling system for a manufacturing process in which there is little or no manufacturing material inventory on hand at the production site.

Kaizen. A component or activity of Lean Manufacturing for continuous improvement of the workplace to reduce waste and increase efficiency.

Kanban. Kanban is a component of Lean Manufacturing and is a process to signal the need for an item on the production floor, or supply of a unit in a factory.

Lean. Business processes focused solely on providing customer defined value while eliminating waste activities associated with production and administration.

OSHA. Occupational Safety and Health Act, which one enacted in 1970 to protect workers from industrial hazards.

Pallet. It is a platform, made with wood or plastic to transport materials in the print production area.

Paper Cutter. A piece of equipment or tool for cutting or trimming sheets of paper to required size (Merriam-Webster, 2010).

Pull Production. A component of Lean Manufacturing that describes the movement of a product's flow through the manufacturing process. It generally implies that the operators in successive workstations have greater control on product flow.

Push Production. A component of Lean Manufacturing that describes the movement of a product's flow through the manufacturing process. It generally implies that the operators in preceding work stations have greater control on product flow.

Red-Tag. A form or document used in 5S and usually made on red-colored paper that is attached to junk items or items identified for relocation in a workplace until assignable action can be undertaken.

Screen Frame Clamp. A device designed to hold a screen-printing frame in place while it is used during the printing process.

Screen Printing. A technique used for printing by using a squeegee to force ink all the way through an assembly of porous fabric and a stencil (Beach, 1997).

Screen Stretching. The process of tightly fitting a meshed cloth over a frame to create a screen that can be used for printing.

Spatula. A thin knife made of metal or plastic and used to transfer ink from ink can to printing press.

Stencil. An impervious material perforated with lettering or a design through which ink is forced onto a surface to be printed (Merriam- Webster, 2010).

Stirring Stick. A flat thin implement used especially for mixing, or scooping ink (Merriam- Webster, 2010).

Stitcher. A machine that binds pages of a book or pamphlet together by means of wire staples (Merriam- Webster, 2010).

Surplus. Articles, items or materials that are available in quantities exceeding the required number or amount and could be either disposed off or stored away more permanently.

Trimmer. A machine with which trimming or cutting is done (Merriam- Webster, 2010).

UV Curing Unit. A machine that uses ultraviolet radiation to cure a printed ink film.

Value Stream Mapping. A technique used to analyze and improve the lead-time. It can be used in different environments of Lean Manufacturing processes to identify opportunities for improvement.

Washout Booth. An enclosed area used for preparing and reclaiming screen-printing stencil.

Limitations of the Study

This 5S implementation pertains only to the GCM lab 130 of UW-Stout during a period of time from September 2010 to January 2011. This study and project could also be extended to other areas of the GCM lab or other work areas on campus, which were not included in this study. The limitations of this study were:

- The study and results of 5S methodology were specific to GCM lab 130 only.

- This exercise may have been limited by its current layout, processes, and laboratory flow patterns.
- Recommendations may not be relevant as pieces of equipment may be taken out or added, which would change the way processes are conducted in the lab.
- The proposal as to what the 5S methodology was capable of doing, may not be accepted as actionable information from the viewpoint of a new researcher in a different lab or workspace elsewhere.
- Other universities could potentially reference this study for their own initiatives but the safety-conscious environment and level of cooperation at the UW-Stout may not be considered to be equivalent always.

Chapter II: Literature Review

This chapter reviews the current literature on Lean and 5S practices. It explores the concept of 5S and its implications in a workplace. The basic information and its philosophy highlight the significance of 5S. This chapter will attempt to answer some of the questions of a 5S implementation with a literature review. It is hoped that it can serve as a reference for the Graphic Communications Management program in the continuous improvement of its facilities. At close, the chapter discusses the five terms that form the basic principle of 5S and the practices involved.

Lean Manufacturing

The roots of Lean Manufacturing concepts are derived from the production system of the automobile manufacturing industry. The first cars of master craftsmen were built using a wide range of skills and abilities, but with low efficiency and at high cost. Later, Henry Ford documented these limitations and broke the assembly process down into 30-second tasks, which were performed almost a thousand times a day (Krafcik, 1988). Later, the concepts of teamwork create the Toyota Production System (TPS) by merging the skill of master craftsmen with the knowledge of Eiji Toyoda and Taiichi Ohnos. For the first time in 1990, Womack, Jones, and Roos' famous book wrote about the Lean Manufacturing concept.

Many researchers have defined Lean Manufacturing. Some researchers defined Lean Manufacturing as manufacturing process only while others felt that it could be applied to variety of industries (Worley & Doolen, 2006). According to Cooper, Keif, and Macro (2007), "Lean is truly a journey, much like your journey through life" (p 1). The Lean philosophy of the Toyota organization, the founder of Lean, is based on the premise that diverse groups always solve problems at a faster pace and generate superior answers compared to each individual from that

team.

All service or production industries can implement Lean Manufacturing to reduce and eliminate waste in a manner that is simple, feasible, reliable, cost effective, and synergistic with other programs. Lean Manufacturing defines waste as anything that adds costs to the product without adding value that the customer would pay for (Pirraglia, Saloni, & Van Dyk, 2009). Therefore, Lean practices help improve the product or information flow through the process, shorten the lead times, support continuous improvement, and as a complete philosophy, help reduce defects of the products or information (Marchwinski, 2007).

Cutting costs is not the only aspect that Lean Manufacturing is concerned with (Pirraglia, et al., 2009). It also is used to get big benefits using less human capital, space, monetary capital, and time, which free resources to increase available capacity (Womack & Jones, 1991). According to the President of Lean Enterprise Institute (LEI), Dave LaHote (2007), organizations focus only partially on cost savings resulting from waste reduction, which adversely diverts their attention from opportunities of improving the company. By focusing entirely on Lean Manufacturing tools and waste reduction, some companies have excelled in leading their industry with superior products or services, profitability, or growth. The only industry where processes have evolved from an art to a science is the printing industry (Cooper, et al., 2007). Lean concepts are a logical fit for all print corporations. The systematic orderliness of work areas that 5S offers, have valid applications in the printing industry (Cooper, et al., 2007).

5S- The Beginning of Lean

5S is an essential part of Lean Manufacturing (Cooper, et al., 2007). Lean Manufacturing is a popular trend in the manufacturing sector which is still being implemented today (Strategos,

2007). Worley and Doolen (2006) proposed that those organizations which adopt Lean as a program can help maintain market share and remain profitable during downward moments in the economy. Lean Manufacturing is made up of several components like 5S, kaizen, kanban, pull production, quick changeovers, and value stream mapping (Worley & Doolen, 2006). 5S is time and again referred to as the foundation of Lean (Lanigan, 2004).

5S is one of the essential steps to set in motion and bring about a flourishing Lean culture (Cooper, et al., 2007). It provides the groundwork for significant improvements in work and the workplace as a way to modify how people approach their planned future state. Van Patten (2006) and Samuels (2009) concur that 5S is often understood as a simple strategy to clean the shop floor, but it can be a potent application for developing a successful business and deploying a new standard of workplace practices. When everything has a place and there is a position for all things, a 5S program will serve for supporting a clear picture of the workplace (Bullington, 2003). Many organizations not only apply 5S as a first step of going Lean, but also emphasize on the removal of wait-time and no value-added activity. In a 5S workplace, tools kept on a shadow board are obvious at a distance and time spent looking for items is greatly reduced (Howell, 2009).

5S has its birth place in the Japanese society. 5S stresses cleanliness, orderliness and discipline by holding improvement events. With this program there is less organizational vagueness, and it also creates an atmosphere of team work and team participation. Mentioning the aspect of team effort is key to sports as well as the dynamics of a business as a whole. Some improvements also include increased capacity from freeing shop floor space and shorter run times through gains in product throughput (Kobayashi, Fisher, & Gapp, 2008).

5S Philosophy

5S has been a fundamental part of Japanese culture and society for several decades dating back to just after World War II (Osada, 1991). According to Kaoru Kobayashi, et al., (2008), 5S generates improvement actions for members of companies and each of their individuals alike. In Japan, it takes place in many environments including homes, schools, communities, and workplaces, without exception. When there are problems going unnoticed, the implementation of 5S helps to uncover those hidden problems. 5S is divided into three core ideas (orderliness, cleanliness, and discipline) upon implementation (Kobayashi, et al., 2008):

Orderliness. The core ideas of orderliness include setting in order and sorting unnecessary materials. Orderliness sorts out all the unnecessary items, simplifies processes, and gives associates their responsibilities. This maximizes efficiency and effectiveness of participants in an organization (Kobayashi, et al., 2008). Orderliness means to place things in a systematic way with specific rules or principles so in the future, it will reduce workloads and lessen human errors (Osada, 1989). It also mandates that the right things are in the right places or right layout so people can find materials easily whenever and wherever they are needed.

Cleanliness/visual management. Due to enhanced transparency, anyone in the organization can easily realize current or future errors in an instant (Osada, 1989). For instance, when workers tried to work in certain areas, they saw a shadow board and taped off areas on the floor, an ink knife missing, a light cord draped across the floor onto the press, an empty pallet, an empty spot on the ink shelf, a missing T-wrench for the stitcher, oil leaks, spills (Cooper, et al., 2007). Before work begins, all missing tools and equipment can be located and put in the correct positions, so tasks can be perform correctly. To remove all dirt and organize the workplace, 5S puts good housekeeping into practice, which helps to maximize effectiveness contributing to a

safer work area with a reduction in work related injuries (Osada, 1991).

Discipline. This step talks about the dicipline which can be gained through culture, training, and education and is implemented within 5S system to standardize the work. High-quality teams cooperate by the policy. Group behavior is a communal action, whether in a business organization or service sector that helps in building a strong team, group thinking, communication and implementing projects (Osada, 1991). Kobayash, et al. (2008) also supported the same ideas in their article, implementing 5S within a Japanese context. Training and education boost the level of self-esteem. Training and development also lead to increased quality of work/life and work standards.

5S as a Management Technique

Management changes when it embraces 5S and each person within the organization implements it to peform job efficienctly and effectively. In recent times 5S was the number one management priority among Japanese top executives (Osada, 1991). One of the benefits of 5S is that it enables management to have organized networks that attain the continuous improvement goals of the organization (Maggie, 2006). Maggie (2006) also emphazied the success of 5S application through the support of top level management. In the west, most of management still perceivs 5S as housekeeping and only few recognize it as having a more strategic approach (Kobayash, et al., 2008).

5S as a management technique has both socio-economic and philosophical roots. This management method, denotes the Japanese concepts of training the body and mind through different techniques of discipline (Kobayash, et al., 2008). Hirano (1993) developed a different approach of 5S techniques, whereas Osada (1991) based it as a management theory. Hirano (1993) presents a more practical view that enables Just-In-Time (JIT) production, rather than a

way of guiding action. Whether it is Sort, Set in Order, Shine, and Standardize management technique or 5S plus Safety management technique being applied by different authors, the basic management technique is still 5S philosophy.

Communication

Communication is an important part of Lean-5S and the process of continuous improvement. It is necessary that 5S be well communicated among the users. Lack of communication results in the failure of 5S. For instance, in the whisper game, one person whispers a message to the other person and passes it down the line. When the message completes the circle and comes to the last person, it has become very different. Also, if the message was confusing to start with, it becomes even more vague. The players are always trying to adjust the message to match what they think they hear and expect unconsciously. This difficulty can exist in implementing 5S. Sometimes people do not do what they are told, like in the whisper game above, and it is not known either if they were told the right thing (Osada, 1991).

The importance of confirmation is always necessary in the beginning of 5S implementation. Osada (1991) mentions some of the 5S communication tools— inspection, checklists, on-site training, and inventing ways that force the checkers to be reliable. Communication methods should be proper and specific. It is important to learn how to be a good listener and convey a message that is understood properly by the next person.

The 5S Process

Steps of the 5S process are as follows:

Sort(Seiri). Sorting is the first step of 5S— removing all surplus items from the work center which are not needed for the immediate continual operations (Hough, 2008). At this stage

it is decided what is really needed and what is not. Any item or tool that is unaccounted, out of place, or unnecessary, needs to be clearly documented. A red-tag is a document made on red-colored paper that is attached to potential junk items in a workplace. The items are stored temporarily until assignable action can be undertaken; it is usually the starting point of a 5S exercise. Items are red-tagged with the best description of use or placement recorded on it.

All red-tagged articles are moved to a temporary holding area, and that area clearly is identified as the red-tag or Seiri Area. Equipment or anything else that is not of use, should be discarded as refuse to be thrown out (Howell, 2009). To implement the first step of 5S, a production team needs to know what material is used, when the materials in storage are to be used, where the required materials are, and what the users' requirements are (Hirano, 1993). This is an opportunity for every team to re-evaluate the tools at their disposal and make sure that they are using the best available tools for the process (Cooper, et al., 2007).

Set in Order (Seiton). The second step in a 5S launch, is taking the sorted items and putting them where they best support the function they provide. Group members should be motivated to place items at their point of use and improve the workplace's visual management (Van Patten, 2006). Before and after photos should be taken to document progress and to later use as examples in training for other 5S activities. Ongoing shift meetings, to discuss progress and explain activity benefits, are of key importance at this stage (Samuels, 2009). One important advantage of Set in Order is that everything needed for the job is clearly visible. Another was that the associates were given enough time to prevent an error ahead of time (Howell, 2009).

Another objective of this step is to arrange the work in such a manner that missteps can be easily identified and corrected, which is one of the main reasons why the implementation of visual controls is encouraged during this step. Associates may apply these philosophies by

referring to checklists, designing tool boards, parts containers and improving workplace design. The practice of shadow boarding can be used to quickly identify when a piece of equipment is missing from a workstation (Becker, 2001). Shadow boards are unique, not just giving tools a place to hang on a wall or board. They are located in the area the tools are needed with each one

- **Figure 2.1.** Shadow Board

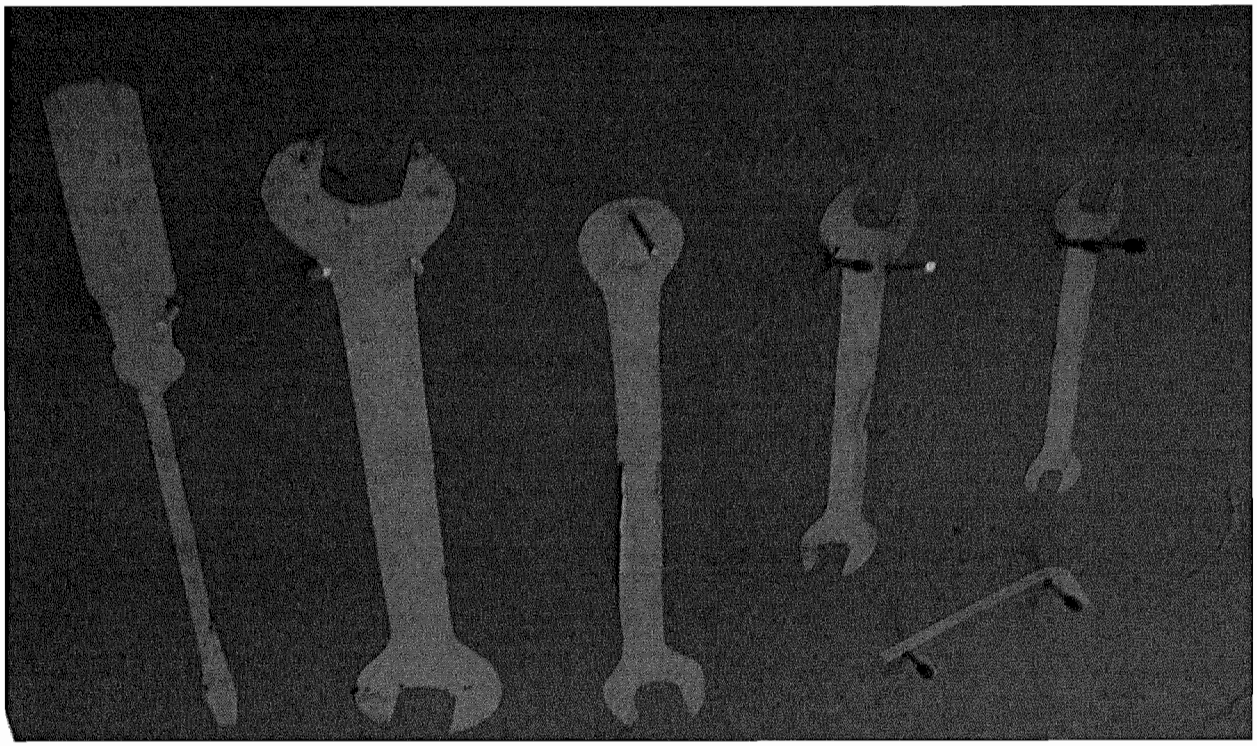

Figure2.1. A shadow board with six tools missing.

outlined in paint or taped. The main advantages of tool "shadowing" is that people instantly know which tool is missing and where it stored. Further more, if one is missing, it's easy to guess what lab users are looking for and where it belongs. Figure 2.1: Shadow Board shows an example of a shadow board.

Having the right tools in plain view near to the workplace where they are required, creates more efficient movement of people as well as materials (Cooper, et al., 2007). Knowing

where to look is the first critical first step in beginning to standardize a process (Howell, 2009).

Shine (Seiso). Once the unneeded is thrown away and sorting and set in order has taken place, it is now time for the sanitize phase (Howell, 2009). A cross-functional team should agree on what the cleaning standards need to be (Samuels, 2009). This is sometimes referred to as shine or sweep stage where teams thoroughly remove clutter and fix equipment or building components (Hough, 2008). The objective of this phase is to identify and eliminate the root causes of waste, dirt and damage as well as to clean up the work station (Van Patten, 2006). 5S projects that are almost entirely focused on cleaning and painting, prevent recording the valuable information that can be gained from assessing it (Van Patten, 2006). This step needs to have the full involvement of employees to gather the data of what they feel needs to be cleaned and how often it should be cleaned (Samuels, 2009).

Although it is imperative to create a cleaning schedule along with appointed duties for all personnel working in designated areas, some employees may mistakenly believe that they are not being paid to clean. In that situation, Cooper, et al., (2007) make the suggestion to list all applicable responsibilities in detail, including all areas to be cleaned, the schedule in which they are to be cleaned, and desired expectations where they were assigned. Another issue worth considering is that an unclean area is more susceptible to safety hazards that could potentially cause worker injury (Howell, 2009). This is of such importance that, Cooper, et al., (2007) also recommend this particular event be followed as a daily regimen.

Standardize (Seiketsu). After the orgaining and cleaning of a production area, it is essential that the area is maintained (Cooper, et al., 2007). This stage requires that the improvements of the previous three phases are maintained (Samuels, 2009). That's why organizations develop standardized procedures, rules, and expectations for maintaining

continuous activity in all of the areas shift by shift and crew by crew. This is a means of creating consistent ways for implementing the tasks outlined above on a daily basis (Cooper, et al., 2007).

The challenge is to visually maintain known, agreed upon conditions rather than to write work instructions (Van Patten, 2006). Teams can develop their own standards by using the 5Ms borrowed from Kaoru Ishikawa's Fishbone diagram. In it, he lists Manpower, Methods, Materials, Machines, and Measurements as the 5 components of the standardizing step (Ishikawa, 1986). An organization achieves conformity when employees value working to one common metric, rather than working however they feel like working or how they think a job should be done (Van Patten, 2006).

Sustain (Shitsuke). The benefits of the above four phases of 5S are powerful, visual and easily measured. However, without self-discipline, elements for sustainability, the success of a 5S program is brief and everything will atrophy or revert to the previous messy state (Maggie, 2006). In daily life; when we diet to lose weight, we still need discipline to help us maintain our objective. Therefore discipline and motivation go hand and hand to reach your goals (Santos, Wysk, & Torres, 2006). Several studies identify the fifth phase as the most difficult phase to perform of this program (Bullington, 2003; Cooper, et al., 2007; Womack & Jones, 1991). To continue the gains from implementing the 5S system, efforts should be taken to instill the importance of maintaining employee dedication for a neat, orderly and safe workplace, and reinforcing good work habits (Maggie, 2006).

Every employee needs to understand the importance of safety, order, and cleanliness and be willing to take the necessary steps that guarantee the prescribed standards are accommodated (Cooper, et al., 2007). When every square foot of a production floor is assigned to an associate, then clutter will not build up (Samuels, 2009).

Chapter III: Methodology

Introduction

The objectives of the study were to apply the 5S methodology in a pre-selected lab of the Graphic Communication Management (GCM) program at University of Wisconsin-Stout. The GCM lab was experiencing problems related to a disorganized floor space of materials, machines and storage spaces which could be re-organized using 5S implementation in the affected areas. It was intended that the study would serve as a reference for the laboratory management process and be a model for continuous improvement of this lab environment as well as other labs in the building or university. The 5S implementation was to evaluate the current situation and propose alternatives to improve flow of people, material, and work. In the long run, it is expected that students will benefit by learning what an impact 5S can have on their workstation and workflow.

Identifying the Problem

Identifying the problem was the first step before beginning the 5S implementation. The GCM instructors selected the GCM lab in room 130 of the Communication Technologies building as the area to implement 5S methodology. This lab is used for screen-printing. Screen-printing racks, shelves and unnecessary working tables occupied lots of space. Ink waste, unused screen frames, disorganized working tables, and an old four-color garment-printing press also occupied space. For efficient operation, all unorganized elements like materials, chemical cabinets, working tables, drawers, equipment, and screen-printing preparation machines needed to be identified, sorted, and either rearranged or removed from the lab.

Recording the Present Situation

After identifying problem, the very first thing to do was to start recording the present

situation by taking photographs. It was one of the important steps of the implementation. The photos of the existing surroundings within the lab were taken and dates recorded before 5S activities were implemented. The photographs helped in locating the problem areas provided, more detail, as well as in provided the basis of differentiating before and after states of 5S implementation.

Method

Sort. After identifying the problem and taking all the photographs of GCM lab 130, all the equipment, tools and machines were categorized as either needed or unneeded. Appendix A: List of the items in GCM lab 130 shows the list of all the equipment and tables in the lab. The items, tools, and materials which were not needed, were moved to the red-tagged area. A red-tag is a 5S form or document used to identify potential junk items in a workplace and storing them temporarily until assignable action can be undertaken. A red-tagged area was created in a corner of GCM lab 130 and in a corridor of the Communication Technologies building before being permanently removed. All items were temporarily moved and clearly marked with a large red paper tag, which contained all the details of tagging like work area, reason for tag, type of materials and disposition or reposition date for easy reference. A template for the red-tag sheet is included as Appendix B: Red-Tag. Lists of red-tagged items were as follows:

- Flatbed screen-printing press -1
- Printing table with frame clamp -2
- Four-color garment printing press -1
- IR flash cure unit -1
- Paper cutter -1
- Screen rack with printing frames -5

- Counter-height cabinet -1

All instructors, lab assistants, and students who use the lab were included as participants and instructed to question the need of each and every item. All of the screen-printing frames, ink, tools, machinery, parts, or consumable items, which were unused, outdated, or broken, were removed.

Set in order. The second phase was to reorganize the area. Without this step, standardization of the work area in the future would not be accomplished. Organizing all tools and eliminating unnecessary items would generate more space. Every machine, working table, garbage can and tool was reassigned to a location. These parameters were decided taking into account the work done at, or tool requirement of, a particular workstation. Three considerations were taken into account for the set-in-order phase:

- Where to fix position for all tools and machines?
- What items should be included in lab (identify all items)?
- How many of each item should be on hand (indicate amount)?

Drawing a 5S map similar to the one used in value stream mapping, made it easy to communicate with the instructors and teams about the current-state and future-state map of the lab and clearly gave a picture of the location of all the materials, supplies, printing machineries, etc., needed for the workspace. Lines were drawn to differentiate work areas clearly, such as frame dryer, screen-printing clamps, or IR curing unit. Every area, such as the blockout counter or washout booth were labeled and differentiated to increase the impact on safety. This ensured that items like inks, papers, chemicals, brushes and frames were not left to litter those areas. Special red-colored lines were marked on the floor to identify movable-equipment locations and specific work areas such as the six-color garment press area. Areas for storing daily-purpose

materials such as rolls of fabric, broom, mop, recycle bin, rag barrels and trashcans were also marked. Two dip tanks were bought for reclaiming screens. One tank is to hold water for removing blockout, and the other for holding the stencil-remover solution. Of the four existing flash curing units, one was red-tagged and sent to surplus. The remaining three rolling flash curing units, usually left in front of the emergency exit, were moved away from the exit to specified marked areas. This improved the safety of the room layout.

Shine. This was the third step- cleaning all the dust and dirt in GCM lab 130. In this step it was decided to divide the jobs between teams consisting of instructors and students and a scope of work for each team was created by asking questions like: Who was doing what? Which parts should be cleaned? What are the techniques and processes to clean the areas? And what were the reasons behind the dust and dirt in the lab? Consolidating daily activities, such as cleaning procedures, ordering cleaning supplies and giving responsibilities to each instructor and/or lab assistant for his/her areas in certain processes with certain methods were completed at this stage.

In GCM lab 130, there were mainly three areas that would have to be emphasized while cleaning: storage areas, equipment, and surroundings. Another task was to make a list of cleaning tasks, procedural steps for each person to do the job and designate a place for all the tools required for the job such as brooms, mops, and dust cloths/rags for sweeping and wiping floors. Cleaning responsibilities were to be assigned to each of the instructors and/or lab assistants in the near future. Appendix D: Cleaning Responsibility Sheet was the chart to be assigned to each lab assistant. The on duty lab assistant was to complete this sheet after finishing his or her duties. Students needed to be instructed to help the lab assistant with cleaning of the lab equipment. Students who have used any equipment should be instructed to clean that after

use.

Storage areas for all screen-printing frames, shelves, ink containers, and tools were cleaned before their contents went back to their designated areas. Getting rid of dust, grease, and ink from the lab was also an essential requirement. All the work stations or equipment, such as the washout booth, blockout counter, IR curing unit, screen stretcher, UV curing unit and garment press, etc. were also cleaned.

The surrounding area and walkways needed to be cleaned by an assigned person. Checkpoints of surroundings area were floors, work areas, windows, and electric lights.

The author created a cleaning responsibility sheet which was completed after all this was done, and submitted to instructors for further feedback and continuous improvement. An example of the responsibility sheet can be found in Appendix D.

Standardize. The fourth pillar of 5S methodology can exist only when the previous three methods are implemented and running routinely. The key to success for a tidy workplace at all times is for everyone to put forth a little effort every day. The secret of this method is to remember that there should be no unnecessary items, no mess, and no dirt. After cleaning, it is important to standardize the entire space so that any anomaly can be easily spotted. Every designated area/space, every machine, working table, or garbage can should be identified with important information such as name of work station or areas. This will provide a standard visual reference to anyone using this lab.

An evaluation sheet as shown in Appendix E was created to standardize the procedure to identify and eliminate unnecessary items. The lab was checked for unnecessary items against this list and dust or dirt was to be treated the same way on a cleaning checklist. Any of the items so listed could be red tagged and identified for scrap during successive Sort phases.

Uniform signs and labels that focused on standardization were made and affixed to all ink cabinets and a color reference chart that was occupying a storage cabinet was moved to a more appropriate location on the notice board. This step clarified which items were stored in each storage cabinet. Similarly all the chemical bottles used in washout booth areas and at the blockout counter were labeled. After each step of assigning places for items, tools and machinery, the opinions of instructors and users were sought for feedback. Questioning the placement of items added valuable insight in identifying ways to decrease unnecessary movement, creating new ideas for placing tools, and developing designated storage as well as traffic areas of printing labs.

Sustain. This will be the final phase of the implementation, which is also called the critique phase. In this process, whatever was done so far has to be maintained. All the visual aids that the students and instructors came up with will have to be improved during meetings and later used as training. This is the 5S discipline that will motivate people to maintain the quality gains (Hirano, 1993).

The instructors and students will discuss all the duties and responsibilities of each and every staff member of the GCM program to make a more efficient lab. The following techniques must be considered to sustain 5S in GCM lab 130:

1. Visual Control
2. Comparing 5S photo display
3. Continuous Improvement

The first step to sustain the 5S implementation will be for the auditors/instructors to audit the checklist and judge whether or not the workplace is clean. If a problem is seen, it is imperative to point it out logically, so that it could be treated as constructive criticism and

remedial action could be taken.

The second action is to periodically photograph the lab and compare the before and after pictures. Informing all users to report anything seen as out of place on the photographs is imperative.

The third step will need commitment of all the instructors and students to engage in the continuous improvement of their assigned areas and also of the entire lab. Separate checklists could be prepared according to the type of workplace for different equipment or surrounding areas. They will give a detailed evaluation of the effectiveness of 5S in each workplace. This will help to keep 5S alive and results could be used as the basis for future improvement.

Summary

After completing four phases of the program, and laying the groundwork for the fifth the team checked the improvements by observing the differences through before-and-after pictures. Were the GCM labs cleaner than before? Are all the storage areas identified? Is equipment labeled? And what is the achieved level of general housekeeping? The GCM lab photographs and checklists created valuable records of the improvements. At the preliminary assessment made when this project was completed, there was marked improvement in the appearance of the lab. However for this effort to be deemed successful, the true assessment will only be possible once the school reopens for spring term and the lab is in regular usage. Only then will the efficiency of the workspace be evident for the project to be classified as successful. Another important point to be noted is that 5S is always a part of a larger continuous-improvement picture. The underlying true success of 5S will be if this effort is sustained and improved upon successively in the future. This entire project was a gradual improvement and creates new steps for improvement in the future.

Chapter IV: Results

Introduction

5S is one of the Lean tools that help to create, maintain and continuously develop a work area. This study was conducted to implement 5S methodology in the Graphic Communications Management (GCM) Program laboratory of University of Wisconsin-Stout. A visual inspection of the GCM lab 130 was done to analyze the current situation and propose a solution to improve working areas. Many unnecessary items— never-used frames, racks, cabinets, garment printer press, and work tables were eliminated. Part of 5S, namely the Sort and Set in Order phases, were utilized to determine the actual use of equipment and machinery in the lab. After implementing 5S and reviewing the results, it appears that the lab was much cleaner, and better organized. Finally, the results were seen and evaluated through before-and-after photographs while checklists were created to make specific 5S activities a habit and push for further improvements in the lab.

Benefits of implementing 5S

After the implementation of 5S, the results were documented in the form of photographs and checklists. Photographs and checklists gave visual evidence of the effectiveness of 5S in GCM lab 130. Current photographs can in turn be used as the basis for future continuous improvement effort. This methodology strives to achieve continuous improvement, maintain better work place efficiency, lessen mistakes, and to enhance safety by maintaining clean and tidy working areas.

Before and After Pictures. Pictures can distinguish the state of the lab before and after the application of 5S. After implementation, the lab was much cleaner with more open spaces,

less congestion, and a proper place for all the tools and materials.

Red-Tagging. At beginning of this effort, several areas of this lab were disorganized and untidy. Many screen frames were not in a designated place, and the counter tops were spotted with ink. Figure 1 illustrates red tagging of unnecessary frames and racks in the lab. The purpose of red tagging was to identify unnecessary items that occupied space in the lab. The strategy was to create more space by better organizing the items and equipment in permanent storage places or disposing of the item if it was not needed. An appointed person inspected the red-tagged items and advised the team on what their next action should be.

- **Figure 4.1.** Red Tagged

Figure 4.1. Seldom used and excess frames and racks, which occupied space in GCM lab 130.

Figure 4.2 illustrates a temporary area for red-tagged items and equipment. These items were clearly identified on the tag. The tag also contains information about what action (discard

or move to new location or donate) has to taken with that item.

- **Figure 4.2.** Red Tagged Area

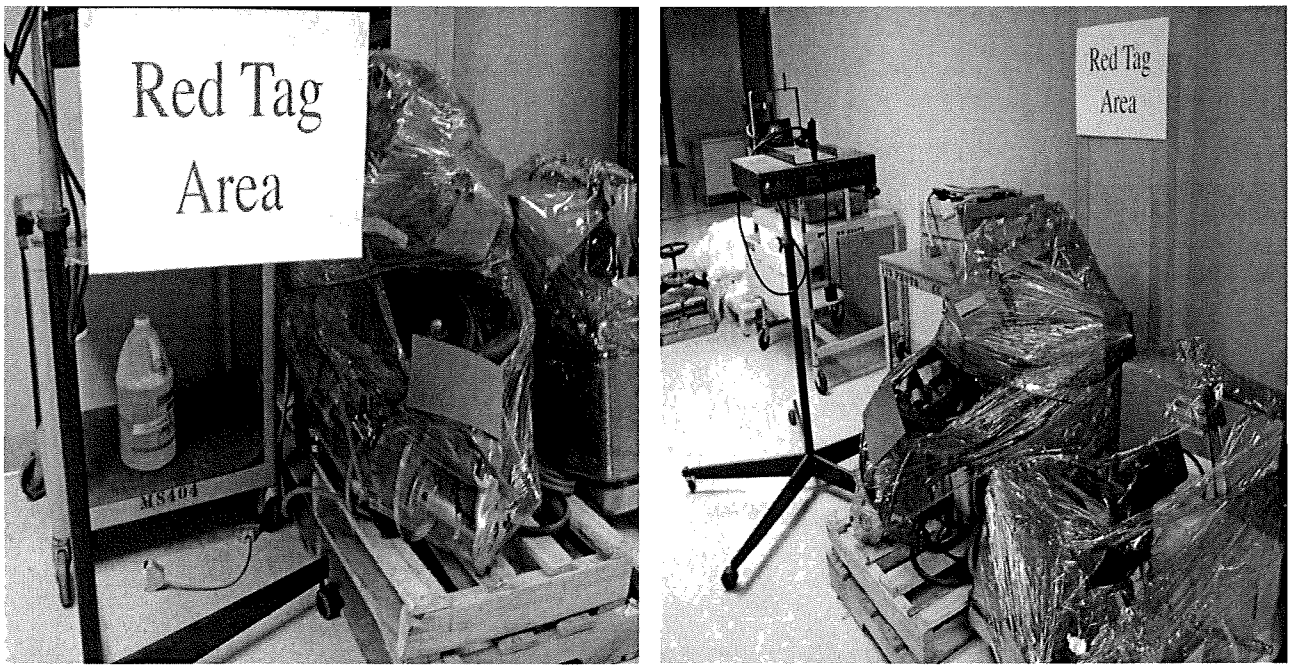

Figure 4.2. Red-Tagged area where all the unnecessary items from GCM lab 130 were temporarily stored. These may be later moved to another location as written on each item's red tag.

After all the red-tagged items and equipment were moved out of the Lab, extra space was generated in the lab. These areas were then utilized for smoother traffic flow and for the new equipment in the lab. There was more space on counters and in cabinets to store and properly organize useful articles, and tools as well as work. Figure 4.3 illustrates the lab with more space after moving out red-tagged items and equipment.

- **Figure 4.3.** Work Table Area

Figure 4.3. The figure illustrates before (left) and after (right) views of red-tagged working tables. This is work-in-progress of 5S implementation. At right, a large area has been opened up.

Visual Workplace

Before implementation of 5S, garbage cans, recycle bins, mops, and brooms did not have designated places. Other items such as the flash cure units were blocking an emergency door, which posed a safety hazard. The labels and signs for an ink and chemical storage cabinet were not in a prescribed order.

The result of the set-in-order phase is a clear layout plan. In the standardize phase specified labels were used for items and equipment identification to add efficiency, improve the organization of the workspace and create a visual workplace using 5S. An advantage behind

creating a visual workplace is that any person can easily access each piece of equipment, storage space, or related tools quickly, perform his or her task and put things back to assigned places. So, it stays standardized, and is in place and ready for the next time it is used. This implementation achieved a place for everything and everything in its place.

Clear Layout. All the items and equipment in use were clearly separated using lines and labeled. This step emphasizes the requirement of using specified places to store tools and materials so that they are always in order. Figure 4.4 illustrates the impact of this action on the screen fabric holder.

- **Figure 4.4.** Screen Fabric Holder

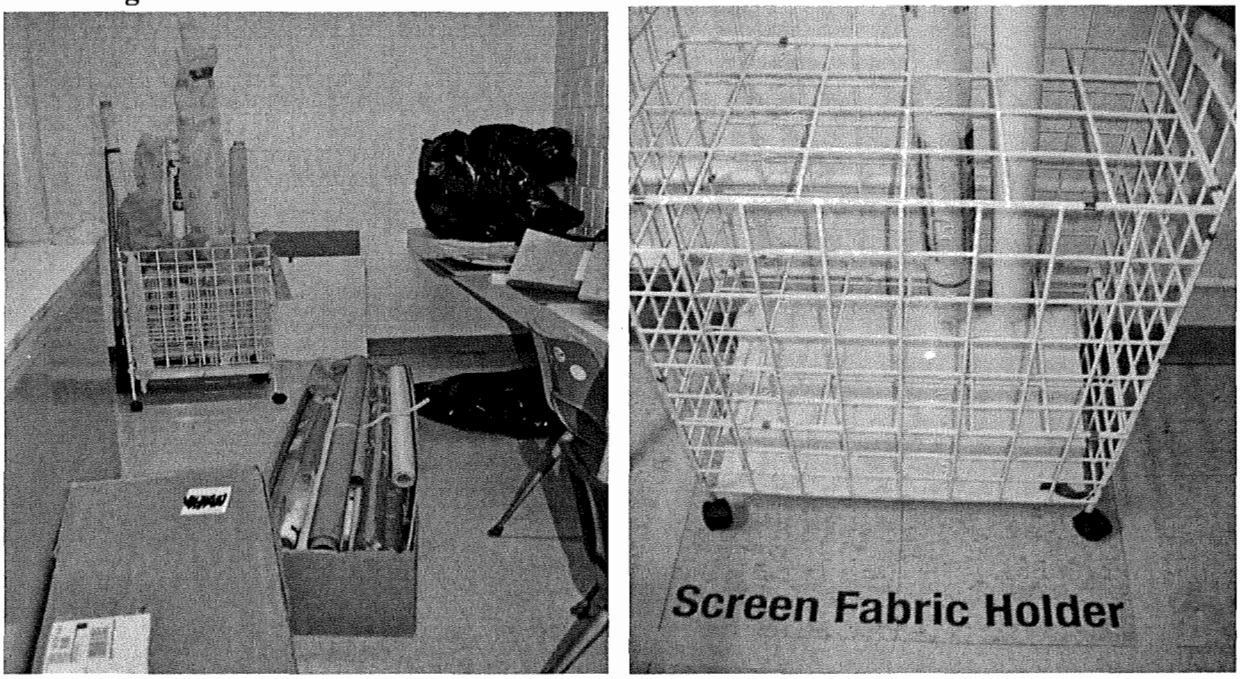

Figure 4.4. At left is the unorganized storage of screen fabric. At right it is contrasted by a labeled, designated area so students can easily access and put it back in the proper location.

Safe and Organized Work Stations. 5S intends a safe, organized workplace with standards that eliminate hazards and improves effectiveness. In the lab, the IR Flash Curing units were kept right next to an emergency exit which could be dangerous as per Occupational

Safety & Health Administration (OSHA) recommendation. The study intended to provide a designated work area for all three IR Flash cure units. Figure 4.5 illustrates before and after photographs of IR Flash Curing Units with labels calling out equipment locations.

Cleanliness and Organization. This was another step of 5S implementation, which

- **Figure 4.5.** Flash Cure Unit

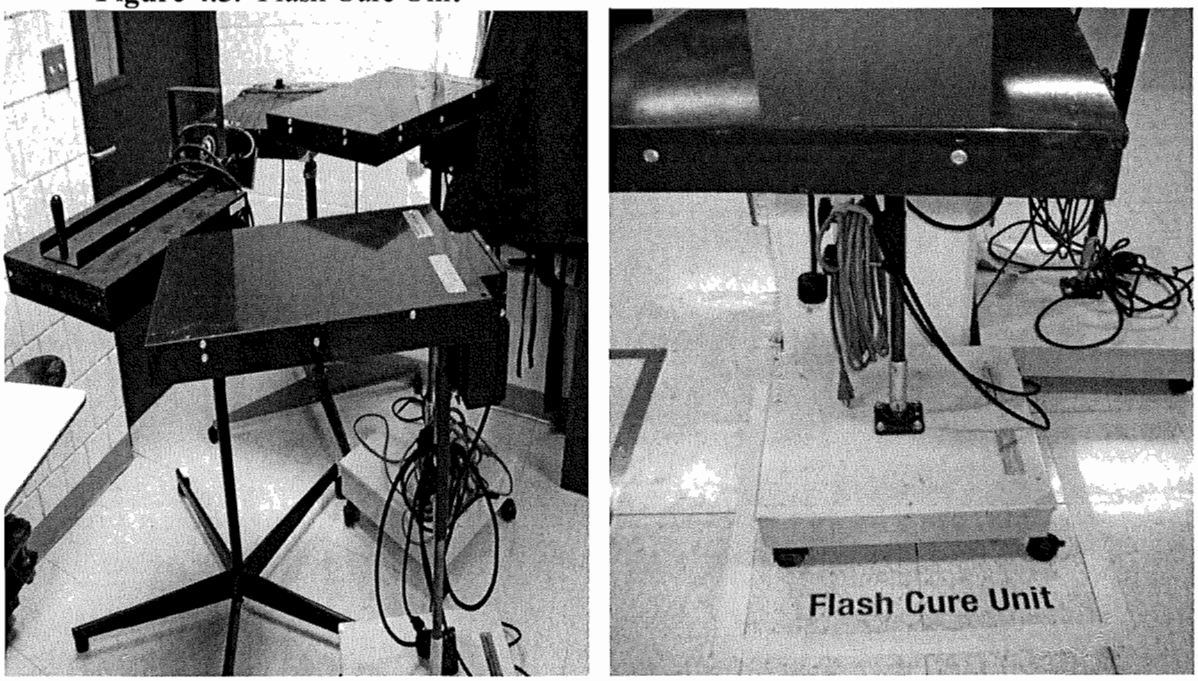

Figure 4.5. The before (left) and after (right) locations of the Flash Cure Unit labeled, so students can easily access it easily and put it back in proper spot and it also does not pose a safety hazard as evident on the left.

served as a deep-clean effort. Locations and order lines were confirmed and all items were placed in their correct location. Figure 4.6 and Figure 4.7 on the following page illustrate before and after photographs of cluttered washout booth areas and direct-stencil coating-supplies of the blockout cabinet. Two more figures illustrate the same point included in Appendix D.

- **Figure 4.6.** Washout Booth Area

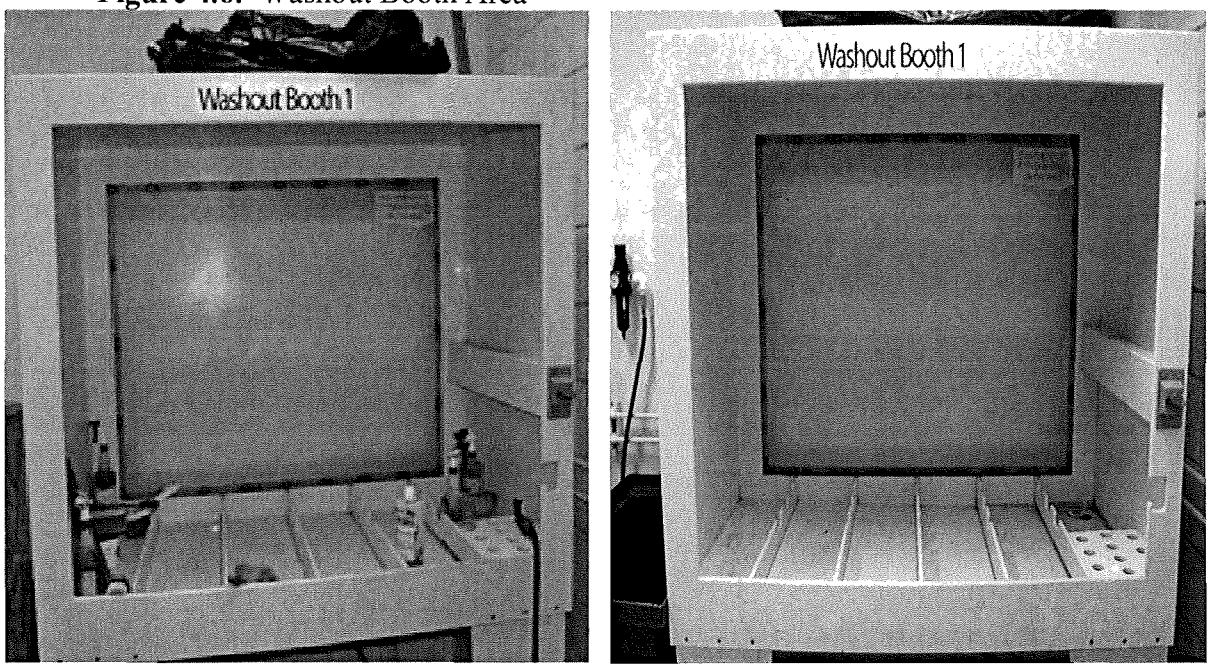

Figure 4.6. The before (left) and after (right) state of washout booth area where students prepare stencils. On the left the booth is dirty, ink-spotted and the fabric and stencil-preparation chemical bottles are also lying in the booth. On the right all the ink spots are cleaned and stencil preparation chemical bottles were placed on their own station.

- **Figure 4.7.** Direct Stencil Emulsion

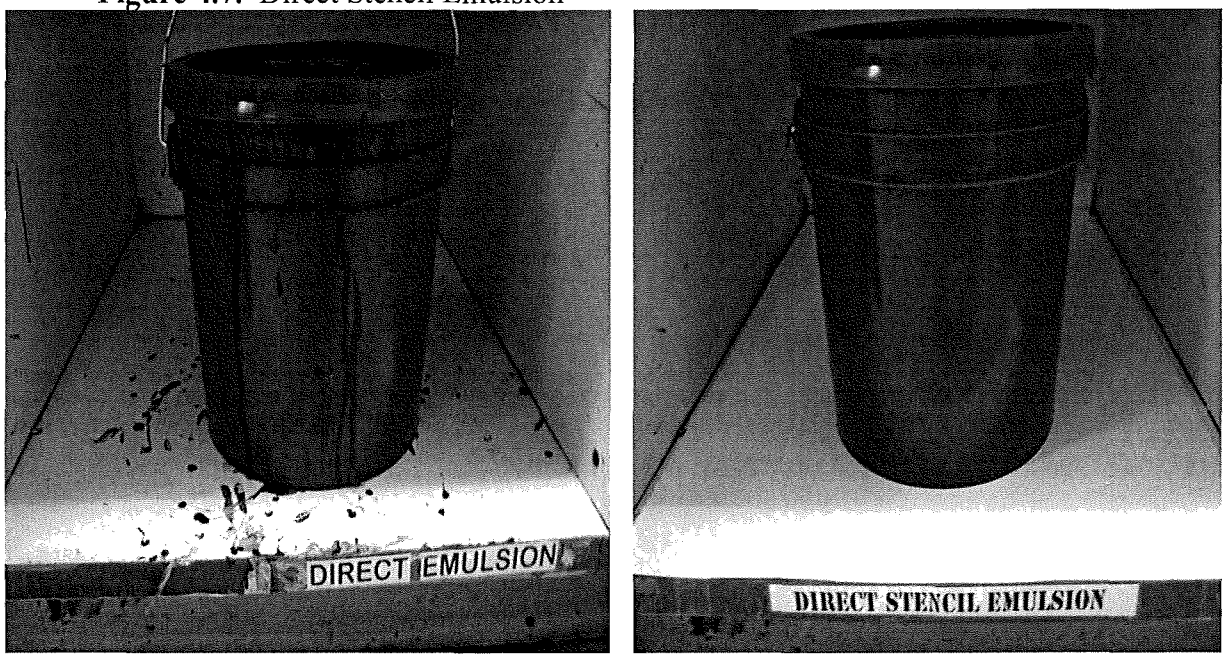

Figure 4.7. The before (left) and after (right) condition of emulsion in the blockout counter. At left is the emulsion-spotted bucket and in the second figure the cleaned emulsion bucket after the work was done.

It has been shown that 5S is applicable in this printing lab. The intended results of the GCM lab adopting 5S were to increase the efficiencies and safety while working in that lab space. In addition to maintaining a clean environment, it is hoped that the students will learn and develop an interest in Lean methodologies. With the printing industry facing constant challenges from digital media, following this exercise should prepare the students for adapting and applying Lean methodologies in a real-world work place. How beneficial it can be, will only be known when the students come to school and the lab is used regularly. This project was in the early stages of 5S development and implementation, but the progress towards a higher level of efficiency will be possible when it is sustained over time.

Chapter V: Discussion

5S means sort, set in order, shine, standardize, and sustain which derives its name from the five Japanese words Seiri, Seiton, Seiso, Seiketsu, and Shitsuke. The process is a structured program to achieve, and most importantly, maintain overall cleanliness, eliminate waste, and achieve standardization in the workplace according to short-term and long-term scheduled efforts.

The GCM lab 130 at UW-Stout provides workspace for instructors and students in the graphic communications management courses. The lab was an inefficient workplace because of unnecessary items and unorganized equipment. After implementing 5S in GCM lab 130, a well-organized, safer, more efficient, and cleaner workplace was achieved. It is expected to boost the morale of the students and instructors, promoting a sense of pride in their work and ownership of their new 5S responsibilities. This chapter will review the purpose and limitations of this study. The conclusions and recommendations for continuous improvement of the lab over the current situation will also be covered.

Purpose of Study

The purpose of the research was to implement 5S methodology in this lab and make suggestions for continuous improvement for unorganized and chaotic areas. The desired results and benefits the GCM lab layout gained were to organize, label, and store efficiently all needed tools, equipment, and materials. It was also important to fully utilize all available space in the lab, and improve the flow from printing to drying and reclaiming the frames in the washout booth areas. Future labs would be able to reference this study to evaluate decisively the advantages of implementing 5S methodology.

Furthermore, this study shows the potential of 5S methodology as a Lean Manufacturing

tool. Another important purpose of this study was to focus on continuous improvement actions.

Limitations

These implementation results pertain to the GCM lab 130 of UW-Stout only during a period of time from September 2010 to January 2011. This study and project could also be extended to other areas of the GCM lab or other work areas on campus. Other universities could possibly reference this study for their own initiatives but the safety-conscious environment and level of cooperation here at the UW-Stout may not be considered to be equivalent always. The limitations of this study were:

- The study and results of 5S methodology were specific to GCM lab 130 only.
- This research exercise for this lab may have been limited by its current layout, processes, and lab flow patterns, which may be improved upon in the same workspace environment in successive 5S attempts.
- The proposal as to what the 5S methodology was capable of doing, may not be accepted as actionable information from the viewpoint of a new researcher in a different lab or workspace elsewhere.

Recommendations

The study focused on one of the many tools of the Lean Manufacturing philosophy. Implementing 5S in the GCM lab 130, not only set up a more efficient workspace to support students' lab experience, but it is also assumed to help in building a culture that will ease the implementation, sustainability and improvements in GCM labs now and in the future. The specific recommendations may not be completely relevant as pieces of equipment may be taken out or added in, which would change the process being conducted in the lab. Different needs would necessitate different 5S results. This highlights an area that will have practical

applications now, and through sustaining efforts, will improve.

- There are currently four lab assistants who assist the students routinely. Consolidate daily activities, such as cleaning procedures, by ordering cleaning supplies. Make targets to be cleaned, such as storage areas, equipment, and surroundings, and give responsibilities to each lab assistant for their areas in certain processes with certain methods. This will facilitate better cleaning areas, the right tools and equipment in the right place and maintain the order of necessary items such ink, paper, tape, and screen frames.
- There are currently 400 screen frames stored in eight different racks in the lab. The required frames for an average use in the lab were determined to be 200 frames. A reduction to 200 screen frames from 400 is needed to eliminate the clutter and space wasted.
- The quantity of supplies purchased and carried in the lab should be adjusted and controlled. Some items presently have inventory levels above the levels required for two weeks' usage and also above the minimum order quantities. For this lab to be more organized and better, inventory amounts must be carefully analyzed and controlled. The quantity ordered at any one-time buying whether it is ink, paper, tape, or chemicals should be reduced. The maximum and minimum stock levels should be clear at a glance.
- Adding wheels on the two remaining worktables will make flexible space for one more garment printer in the lab. This will add space for traffic in busy areas and will also provide a moving counter next to the dryer.

- The observations should address the possible inspection by the team of instructors or assigned lab assistant regularly to sustain 5S implementation. Several unknowns should be examined to truly determine the best system, such as checkpoints for each workplace. There should be a regular tour of inspection every month by instructors or concerned patrol team. They should visit every section in the lab and evaluations given by the patrol team should also be announced.
- Instructors will have to establish 5S training and discipline users in habits to avoid disorganization, and preventive cleaning through regular inspection of the workplace. It is important for lab users to understand all the weak points of the lab, focus on efforts to improve them, and develop strengths to sustain the effort. Instructors should motivate and encourage students and all the lab users to make continuous improvement to their workplace on a day-to-day basis.

Conclusions

The literature review emphasized that management support plays a strong role even though this was an exploratory study of a 5S implementation. The recommendations made to further improve the work place were summarized along with the changes made in the current lab. The recommended changes will make the lab run effectively and efficiently. This will result in lower traffic management issues due to a more organized work place, less material handling, and more efficient lab use.

5S methodology needs to become an established practice in the lab with active support of the faculty. Any problems that may occur regarding the sustaining of 5S should be addressed through proper training and participation. Understanding 5S and building a culture helps to develop 5S into a management strategy. Taking 5S to higher level is only possible when the

benefits of 5S can be fully valued and this can only be done by involving the whole team. Teamwork will be another valuable lesson learned by the students for their professional life.

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Appendix A: *List of Items in GCM Lab 130*

UNIT	Number of Units	CHECKLIST PROPOSED		
		Frequency of Use		If it's inventory, is this the minimal amount needed to keep up with the production schedule?
		Regularly(R)/ Occasionally (O)/ Rarely(E)	Is it Critical (C) or Unique (U)or Not needed (N) for the Lab?	
1. Frame Drying Cabinet	1	R	C	
2. Screen Frame Clamping Unit (Work Table)	3	O	U	
3. Ultra Violet Curing Unit	1	O	C	
4. Screen-printing clamps	1	E	U	
5. Screen Stretching Clamps	1	R	C	
6. IR Curing Unit	1	R	C	
7. Table with 4 cabinets on each side	1	O	U	
8.Garment printing press-6 color	1	O	C	
9.Garment printing press-4 color	1	R	N	
10. Flash Cure Units	4	E	C	
11. Solvent Storage Cabinet (Fire/Safety Cabinet)	1	R	C	
12. Counter Table	1	R	C	
13. Counter Table	2	R	C	
14. Tools Cabinet	I	R	C	
15. Ink Drawer/Shelves	1	R	C	
16. Storage	2	R	C	
17. Blockout cabinet	1	R/E	C	
18. Screen Reclamation Area	2	R	C	
19. Screen Storage Racks	3	EOR	C	
20. Long Table	1	R	U	
21. Vacuum Frame	1	R	C	
22. Screen Exposure Unit	1	R	C	

Appendix B: *Red-Tag sheet*

Red Tag

Person Completing Tag:

Category	1. Raw Material 2. Work-in-process 3. Sub-assembly 4. Product 5. Machine/ Equipment 6. Die/Jig 7. Supplies 8. Other
Item Description	
Reason for Tag	1. Not Used/Obsolete 2. Excess/Surplus 3. Broken 4. Rarely used
Quantity	
Proposed Action	1. Dispose 2. Recycle 3. Surplus 4. Storage for intermittent use 5. Return to station 6. Repair
Date	**Value (if known):**

Appendix C: *List of the Supplies on the Blockout counter*

Location	Name	Fill Quantity	Time to Re-Stock Quantity
Left side:			
	Top Shelf:		
	Safety glasses	8 Pairs	
	Middle Shelf:		
	3" by 3" cards for spreading blockout	100-200	25
	One quart Blockout	2	2
	Gallon Blockout	1	1
	8" soft rubber roller	1	1
	Bottom Shelf:		
	Table Paper	500-1000 sheet	50
Center Cabinet:			
	Top Shelf		
	Stirring Sticks	1	
	Wooden Spoon	1	
	Rubber Spatula	1	
	Middle Shelf:		
Red-Tag	Scoop Coater	0	
	Bottom Shelf:		
	Gallon of Direct Stencil Emulsion	1	1
Right Side:			
	Top Shelf (empty)	0	0
	Bottom Shelf:		
	24 OZ, Comet soft cleaner/soft scrubs (left side)	2	1
	White scrub pads (left side)	1	1
	21 OZ. AJAX with bleach cleaner/miscellaneous cleaning materials (right side)	2	2
	15 oz. Polyken 41 Natural Citrus cleaner (right side)	1	1
	15oz. Lemon Johnson shine up furniture polish (right side)	1	1
	1Lb. 2oz. TnT foaming disinfectant Cleaner (right side)	1	1
	Corrugated box- 3" by 3" cards for spreading Blockout	2500	500
Red-Tag	Scrub brush	0	0

Appendix D: *Cleaning Responsibility Sheet.*

Cleaning Responsibility Sheet for Lab Users

Cleaning Schedule		Dept. Sect.:	GCM lab 130		
		Person:	ABC		
S.No.	Area	Checkpoint	Yes	No	Comments
1	Sink	Is sink spotless of ink?			
		Is sink clean?			
2	Counter Tops	Is counter spotless of ink?			
		Is counter clean?			
3	Washout Booths	Are all the stencil in proper place?			
		Are washout booths clean?			
4	Trash & Recycle	Are trash cans on the specified area?			
		Are recycle bins on the specified area?			
5	Sweeper/Garbage removal	Are full garbage bags removed from lab?			
		Is floor is swept after work is done?			
6	Mops &Broom	Is dustpan on the specified storage rack?			
		Is broom on the specified storage rack area?			
Comments:					
Checked by:					**Date:__/__/__**

Appendix E: *Evaluation Sheet.*

GCM Lab 130			Date:	
Checker:		Auditor:		
No.	Checkpoint	Check		Action (Inc. deadline)
		Yes	No	
	Sort			
1	Are there any unused items in Lab 130?			
2	Is there anything in the aisles which is not in use?			
3	Are there any unnecessary machines?			
4	Are there any unnecessary items on or under the shelves?			
5	Are there any unnecessary items around or under the machines?			
	Set In Order			
1	All tools, equipment and counters are labeled, in their designated locations, with locations clearly labeled, no peeling tape			
2	Storage areas and drawers are clearly labeled and organized			
3	All movable items and equipment are in place in order			
4	All movable items and equipment are within printed lines and clearly labeled			
	Shine			
1	Tools and equipment are in safe working condition			
2	Work surfaces are free of excessive wear and damage			
3	All internal and external storage areas clean and free of dust includes toolboxes, ink cabinets, and blockout counter			
4	Work areas, tables and equipment are clean and neat			
5	Washout Booth area, floor and mats are clean and neat			
	Standardize			
1	All processes are documented and obtainable			
2	Standardized cleaning/ maintenance plan and schedule are posted, documented and up to date			
3	Visual controls guide all item placement standard work is accurate and current			