Implementing the 5S Methodology for Lab Management In the Quality Assurance Lab of a Flexible Packaging Converter

by

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Abstract

5S is a Japanese methodology to organize and improve the efficiency of a shared workspace by incorporating seemingly regular tasks such as cleaning, sorting, and re-arranging the surroundings and method of operation within the workspace. 5S consists of five phases or activities with names starting with the letter S, and provides a basic foundation for any organization's Lean initiative for continuous improvement.

This paper documents a project undertaken by the author to implement 5S in the quality assurance lab of a flexible packaging converter. The study focused on implementing 5S activities in the targeted work area and documents results in form of photographs. The study also assesses its own approach, recommends alternative strategies for this project in the future and makes recommendations for expanding the scope of this exercise to other areas of the company and serves as a platform for achieving tangible and quantifiable gains in productivity.

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I would like to dedicate this effort to my grandparents for being my unquestioning fans all my life. I am thankful to my parents for instilling the value of education and hard work within me, and their constant encouragement in my endeavors. I thank my uncle Tushar and aunt Radhika for simply being there. Finally, all my friends whom I did not mention in person please know that you have my deepest appreciation.

Ameya Chitre

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Chapter I: Introduction

5S is a methodology for organizing a shared workspace such as a production floor. It is a component of lean manufacturing and philosophy for managing a work place or workflow with the intention of improving efficiency, eliminating waste, and increasing process consistency. It derives its name from the use of five Japanese words beginning with the letter S as the cornerstones of this philosophy. These words are: "Seiri" meaning Sort, "Seiton" meaning Set in Order, "Seiso" which implies Shining or Cleanliness, "Seiketsu" which means Standardize, and "Shitsuke" which implies Sustaining.

Belmark Inc. is a leading packaging manufacturer/converter based in De Pere, WI with an additional facility in Phoenix, AZ. Belmark consists of three business units – Pressure Sensitive Labels, Flexible Films and Folded Cartons. Belmark's technical competency includes a dedicated Research & Development team, a dedicated Quality Assurance (QA) team, in-line flexography printing, laminating, as well as a full-fledged graphics team and digital printing. Belmark's QA team is responsible for collecting run samples during production and testing these samples. Belmark's QA lab is fully equipped to perform tests such as Gas Chromatography, Tensile testing/Peel testing, Coefficient of Friction testing, and Heat Seal Profile testing.

Statement of the Problem

Although the QA lab appears to be extremely neat and clean, there is room for improvement. The current arrangement of testing equipment and apparatus used on the testing equipment does not always provide efficiency of motion. Clear identification of the lab equipment and apparatus could also be implemented. Moderately high amount of cleanliness and regular cleaning can be useful for this laboratory.

Purpose of the Study

The purpose of this study was to work with QA technicians and the Quality Process Manager to identify the areas for improvement in laboratory management. It aimed to apply the philosophy of 5S to organize, clean and manage the labs thus improving efficiency of movement and work.

Definition of Terms

5S. A philosophy based on five Japanese terms utilized to create a workplace suited for visual control and lean production.

Acetate. Clear plastic sheeting used to prepare overlays or used as a base for stripping films.

Caliper. An instrument that measures the thickness; the thickness of a sheet of paper or other material measured under the specific conditions.

Continuous Improvement. The ongoing improvement of products, services or processes through incremental and breakthrough steps; process of business management based on data tied to customer satisfaction.

Corrective Action. Implementing a solution resulting in the elimination or reduction of a known problem.

Coefficient of Friction. A scientific test performed to find out the minimal force required to move a two sheets or layers of material in contact with each other.

Densitometer. An instrument used for measuring the optical density of a positive, negative or printed sheet.

Downtime. The period of time in which a device is not working because the system is malfunctioning or under maintenance.

Estimating. The process of determining approximate costs, required quality and quantity, and projecting waste.

Film. Sheets of flexible translucent or transparent acetate, vinyl, or other plastic base materials that are coated with a photographic emulsion; any thin, organic, non-fibrous flexible material (usually not more than 0.010 inches thick) that is used as substrate in flexography.

Flexible Films. Very thin callipered transparent or opaque sheets of materials such as polyethylene or polypropylene used for a variety of purposes such as printing or making pouches for packaging. Usually they are supplied as large rolls.

Flexography. A rotary printing process that is characterized by the use of flexible, rubber or plastic plates with raised image areas and fluid, rapid drying inks and primarily used for packaging applications. Formerly known as: Aniline Printing.

Flow-chart. A pictorial representation of the steps in any process. It is generally drawn to better understand how the various steps in a process are interrelated and how the process can be simplified.

Folded Cartons. Boxes made from specially processed boards or papers to serve as packages for products.

Functional layout. The practice of grouping machines or activities by type of operation performed.

Future state map. An organization's vision that becomes the basis of a blue print for lean implementation by helping to design how the process should operate.

Gas Chromatography. A scientific test used to calculate the amount of evaporation of solvents and other chemicals used in printing and laminating flexible films.

Graphic Communications. The processes and industries that create, produce,

and disseminate products utilizing or incorporating words and pictorial images to convey information, ideas, and feelings. Graphic communications include the technologies of printing, publishing, packaging, electronic imaging, and their allied industries.

Hazard Communication Standard. A program required by OSHA that communicates chemical hazards, including the provisions that directly affect binding and finishing production.

Ink. A printing ink is dispersion of a colored solid (pigment) in a liquid specially formulated reproduce an image on a substrate.

Finishing. Manufacturing operations such as die cutting, sorting, folding, and numbering that are performed after the printing section on the same or different piece of equipment as part of the production process.

Kaizen. A continuous incremental improvement of an activity to create more value with less waste.

Kanban. A signaling device that gives instruction for production or conveyance of items in a pull system. It is a component of lean manufacturing.

Laminating. The process of using heat and pressure to apply a clear material to one or both sides of a printed piece for high gloss appearance.

Lead-time. The total time a customer should wait to receive a product after placing an order.

Lean Manufacturing. A production system that considers any production activity that does not add value for the customer as waste and aims to eliminate that activity from the sequence.

Material Safety Data Sheet (MSDS). A product specification form used to record information about the hazardous chemicals, health and physical hazards employees face in an

industrial work place along with guidelines for exposure limits and precautions.

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

Pallet. A portable horizontal rigid platform used as a base for assembling, storing, stacking, handling and transporting goods such as a paper.

PDCA cycle. A four-step "Plan-Do-Check-Act" cycle for quality improvement; also known as the Shewhart cycle.

Pressure Sensitive Labels. Product information labels made from either paper or film that are applied to the intended surface using pressure from an external source.

Preventive maintenance. An organized program of maintenance designed to prevent breakdowns and/or scheduled down times.

Quality Assurance. A set of activities or functions consisting of standard tests and procedures aimed at maintaining the quality of a product or service provided.

Quality Management. That aspect of the overall management function that determines, and implements the quality policy.

Quality Policy. The overall quality intentions and direction of an organization as formally expressed by top management.

Quality Job Instruction (QJI). It is a method of performing work that is consistent from person to person, day to day and job to job.

Red Tag. A method of identifying potential junk items in a workplace and storing them temporarily till assignable action can be undertaken; usually the starting point of a 5S exercise.

Seiketsu. It is the fourth phase of the 5S process; it is a Japanese term that means to standardize something.

Seiri. It is the first phase of the 5S process; it is a Japanese term that means to sort or organize.

Seiso. It is the third phase of the 5S process; it is a Japanese term that means to shine or clean.

Seiton. It is the second phase of the 5S process; it is a Japanese term that means to set things in order.

Shitsuke. It is the fifth and final phase of the 5S process; it is a Japanese term that means sustaining whatever has been achieved in the first four phases.

Single Minute Exchange of Dies (SMED). It is one of the many aspects of Lean Manufacturing that deals with reducing waste while changing over from one product to the next during a manufacturing operation.

Six Sigma. A quality and business process improving strategy that aims to improve quality by reducing the number of defects per million produced.

Standard Operating Procedure (SOP). It is a method or a document describing the method of performing work that is consistent from person to person, day to day and job to job.

Standard Work Procedure (SWP). A sheet that is similar to an SOP but additionally also contains visual representation of how each operational step or activity looks like.

Tensile Testing. A scientific method of measuring the minimum force required to physically stretch a material to the point of breaking.

Toyota Production System (TPS). A manufacturing methodology for assembling automobiles by ordering only the minimum number of components required in order to save time and space, first developed by Toyota.

Total Quality Management (TQM). It is a management concept formulated by W. Edward Deming aimed at developing, deploying and maintaining organizational systems required for business processes.

Value Stream Mapping (VSM). It is a Lean Manufacturing tool that creates a visual picture or map of material and information flow through an organization.

Limitations of the Study

Apart from the laboratory discussed in the study, the R&D laboratory at Belmark would also benefit from the implementation of 5S Methodology. However this laboratory is not included in the scope of this study.

This study and project could also be extended to the other areas of the shop floor. The main production area as well as other areas such as inventory or maintenance division can benefit tremendously from this exercise. But at the present moment these are out of the scope of this study.

The author was employed as an intern at the client's facility for a period beginning January 2010 up to May 2010. The project had to be completed in that time period and beyond that sustaining the project was not in the scope of the author's work.

Chapter II: Literature Review

This chapter aims to review literature on Lean Manufacturing and 5S practices in industry. The purpose of this chapter is to understand the popularity of Lean Manufacturing as well as explore the concept of 5S and its implications on day-to-day operations. It aims to explore information about the beginnings of 5S, the basic philosophy and the larger picture behind this practice. Is 5S equally favored by organizations throughout the world? Why or why not? What are the misconceptions about this process? These are some of the questions that this chapter aims to find answers for through the review of the literature. Finally the chapter will elaborate on the five terms that form the core phases of 5S and the practices involved in implementing the same.

Lean Manufacturing

Any manufacturing process has hidden costs that are not easily uncovered at first (Lanigan, 2004). While Six Sigma aims at higher quality by increasing focus on all aspects of quality, Lean Manufacturing philosophy taps knowledge at all levels of an organization, involves people in reducing waste, controls what is controllable and keeps the product moving (Lanigan, 2004). Lean Manufacturing is a very popular trend in the manufacturing sector. It derives itself from the Toyota Production System or Just In Time (JIT) (Strategos, 2007).

Debashis Sarkar (2007) states that implementation of lean is no longer confined to the manufacturing sector and has moved on to service organizations too. According to him it is extremely beneficial to countries whose economies are dependent on services. Lean can not only provide the cost advantage but it can also improve organizational efficiency and with it, customer convenience. Banking, Aviation (particularly with the burst of low-cost airlines),

Healthcare, Information Technology, Media and Telecommunications can all relate to Lean and reap the benefits of Lean (Sarkar, 2007).

The practice of 5S

5S is a component of Lean Manufacturing. One of the fundamental steps to begin a successful Lean initiative is implementing 5S (Cooper, Keif, & Macro, 2007). Defined as the 5S System, the 5S concept was created by Hiroyuki Hirano (Lanigan, 2004) and it emphasizes neatness, cleanliness, simplification, and safety compliance throughout the organization is important for high performance in a work place (Cooper *et al.,* 2007).

5S stands for five Japanese terms: Seiri, Seiton, Seiso, Seiketsu and Shitsuke that are used as a platform for developing an integrated management system (Bamber, Sharp & Hides, 2000). For the sake of consistency these words, all starting with the letter S have been transliterated in English and an attempt has been made to find the appropriate 'S' term in English (Ho, Cicmil, & Fung, 1995). Summarizing and finding common ground from various authors' work it can be inferred that the five terms sum up as:

1. Seiri – implies Sort or Organize
2. Seiton – implies to Set in Order or Systemize
3. Seiso – means to Shine or Scrub or Clean
4. Seiketsu – involves Standardizing
5. Shitsuke – implies Sustaining and imposing self-discipline to maintain it

Typical examples of 5S activities are: "throwing away rubbish" or "individual cleaning responsibility", simple, self-explanatory activities which everyone should be doing in order to have a total-quality environment in their workplace (Ho *et al.,* 1995). There is nothing new about these activities, so people tend to not give them enough importance even though there is a

lot of rom for improvement. In a facility that has 5S functionality, out of place or missing items stand out and time spent for searching for items and tools gets essentially eliminated.

Some studies compare a Lean or 5S workplace to the kitchen in a well-respected restaurant – another highly competitive customer-driven industry (Cooper *et al,* 2007). In any world class kitchen:

1. Every pot and pan is clean and kept at an arm's length
2. Knives and other cooking tools are in clearly labelled open containers on direct line of of sight of each of the chefs
3. The area is well lit
4. Each chef is placed in a given cell that has all their necessary tools in the immediate area that reduces motion and efficiently utilizes the chef's time while avoiding unnecesary confusion

5S: Misconceptions and Perceptions

In Japan, the practice of 5S began from the manufacturing sector and extended to other industries and services sector (Gapp, Fisher, & Kobayashi, 2008). The Toyota Production System provides a well-known example of 5S in practice.

A widespread impression of 5S outside of Japan is that of "housekeeping" and many researchers and practitioners find it difficult to go beyond that scope (Gapp *et al.,* 2008). A study of Australian firms employing Continuous Improvement (CI) tools revealed that in a list of top 10 problem solving tools, 5S ranked ten (Hyland, Mellor, O'Mara, & Kondepudi, 2000). This study seemed to indicate that Australian firms had only basic understanding of the potential and importance of 5S as a CI tool. Van Patten (2006) claims to be extremely surprised at a lean

conference where consultants stated that they could not sell 5S anymore because it simply involved cleaning up a client's shop floor.

On the contrary, 5S can deliver tremendous potential, and the cleaning up is actually a mere by-product, and so it needs to be understood and implemented as much more than a clean up (Van Patten, 2006). It is an idea that reshapes how you think about a workplace and provides the foundation for future improvement initiatives. According to a study by Ansari and Modarress (1997), practicing 5S has actually enabled the Boeing Company to reduce accidents.

The 5Ss are often referred to as the foundation blocks, or pillars, upon which a company can build its lean initiative (Lanigan, 2004) because 5S creates a good visual factory. Kaizen events can be effective but they are many times only imaginary gains that get nullified with time. Some of the improvements noted at a manufacturing company 12 months after a 5S program included (Lanigan, 2004):

1. Work-in-progress reduced by 60 percent
2. Cycle time reduced by 70 percent
3. 4000 sq. ft of manufacturing floor space freed up for more projects
4. Changeover times reduced by 40 percent

Ho *et al.,* (1995) surveyed companies in the UK and Japan to see if 5S could be considered as a starting point for total quality management. The study proved that 5S played a significant role in establishing a TQM environment and concluded that 5S provides an essential base for successful TQM implementation. The survey also concluded that many UK companies were actually practicing 5S without realizing it, and it would be beneficial to formalize the 5S practice (Ho *et al.,* 1995). Another study by Warwood and Knowles (2004) in the UK established that 5S was less popular as an improvement initiative in the service sector as

compared to the manufacturing sector which is also the case in Japanese industry (Gap *et al.,* 2008). In 2004, Unilever Best Foods was practicing total productive maintenance (TPM) for five years. It comprised of 5S, autonomous maintainance, and kaizen.

Regardless of the organization size or type, 5S can be used for improvement activities within environments such as homes, schools, communities and workplaces (Gapp *et al.,* 2008). By emphasizing 5S principles, TQM noted marked performance improvement at public hospitals in developing countries (Withanachchi *et al.,* 2007). This study confirmed that significant improvments were achieved following 5S-based TQM implementation and that a 5S-based TQM can stimulate organizational management changes.

Lean and 5S in graphic communications

Recently there have been some issues in the economic condition of the printing and packaging industries (Cooper *et al.*, 2007). As in any business, lowering the costs rather than increasing the prices is a better way to increase profits. Over the past five years, more printers and packaging converters are looking to adopt Lean practices. According to Cooper *et al.,* (2007), while Lean is a good fit for the printing industry, it is not an easy fit. This is because it requires an open mind that not only applies a tool but also stresses on issues such as principles of empowerment, training, long-term goals and a focus exclusively on customer value.

Automation has provided a lot of relief to printers in that it has reduced the make-ready times and set-up times. Set up reduction can dramatically affect the company's bottom line by differentiating its process from its competitors and by directly converting the saved time into sellable hours (Cooper *et al.,* 2007). 5S, the systemeatic organization of the workplace is completely valid in a print shop. Practices like Single Minute Exchange of Dies (SMED) can be easily applied to printing and *just-in-time* (JIT) can be effectively used as a tool for inventory

reduction. Three fundamental things to keep in mind while developing a 5S program are (Cooper *et al.*, 2007):

1. 5S employs visual management and enables a person to recognize abnormalities at a glance
2. 5S is about consistency and continuity
3. 5S is a systematic method for involving and empowering employees

The same principles can also be applied to a graphic communications workplace engaged in a 5S program:

1. Operators can cosely reach the board containing wrenches and ink knives that they know will be there
2. A single glance at the ink storage area can indicae the required ink is stored on the shelf clearly marked
3. Press operators keep the press clean and take pride in that
4. Job stock (paper/material) is stored on clearly marked pallets in designated areas on the floor close to the press
5. Each employee/worker knows where every tool, rag, ink can, chemical, job ticket, job stock is located and places them at the respective place after use
6. Printed stock is moved to bindery/post press area and stored in defined holding areas where personnel working in those departments can see them clearly

Starting the 5S process

Seiri (Sort). The first step of 5S is to differentiate between what you need and what you don't. What is essential and what is not. The first step in the process is to decide how essential

the articles in the work place are (Van Patten, 2006). To do that effectively, any production team needs to know what they make there, who the customers are and what the customers' requirements are. They need to eliminate unneeded materials, tools or equipment from the work place. However this is more than just a clean up process: this is an opportunity for any team to re-evaluate the tools at their disposal and make sure that they are using the best available tools for their process (Cooper *et al.*, 2007). Cooper *et al.*, (2007) and Lanigan (2004) endorse the credo "When in doubt, move it out."

The Sort process involves taking a tour of the target area and mark with red tags those items that appear out of place or unnecesarry (Bullington, 2003; Cooper *et al.*, 2007; Lanigan, 2004; Van Patten, 2006). Simultaneously a designated area can be identified on the production floor where all the unneeded or unnecessary items can be moved to and stored. This area can be identified as the Red Tag area and should be clearly marked so that everybody can understand and identify it. While questionable items could be left in the holding area for some time, the items that are absolutely unwanted can be disposed in a suitable manner. According to Bullington (2003), 5S sort stage can also be advantageous for supply-base consolidation to reduce waste in purchasing.

Seiton (Set in Order). Once sorting has taken place, efficient storage methods must be enacted so that items are easy to locate and use, as well as put away (Hough, 2008). The logic behind this stage is that everything that is needed to do a job should be placed where it can be easily accessed (Howell, 2009). Every tool, every Standard Operational Procedure (SOP) and Material Safety Data Sheet (MSDS) manual must be designated a place where it can be found easily when needed.

In process industry changeovers, this can reduce the downtime of the machines because changeovers become faster (Howell, 2009). Having the right tools in clear line of sight (Howell, 2009) near to the workplace where they are required creates more efficient movement of people as well as materials (Cooper, *et al.*, 2007). Drawing current and future-state maps (Cooper *et al.*, 2009) is a good way to identify material position and plan on how things can be re-arranged to make the movement more effective and efficient. A commonly recommended way to execute this phase of the 5S process is (Bullington, 2003; Cooper, *et al.*, 2007):

1. Label equipment and storage locations clearly so that all employees can identify them
2. Draw borders that can distinguish different work areas
3. Draw lines around specific equipment and highlight the traffic and transportation lanes
4. Identify safety hazard issues and arrange items so that possible negative effects are countered

Seiso (Scrub or Shine). This phase assumes that everything unneeded is thrown away or disposed and all the tools now available are organized for efficient use (Howell, 2009). This phase means thoroughly clean up clutter, fix things (Hough, 2008) and involves checking and inspection of everything to not only clean up the work place but also to eliminate the root cause of that problem (Van Patten, 2006). Some 5S projects put more emphasis on cleaning, and in the process useful information can be lost in the sweeping. Thus it is imperative that the cleaning process is done not by an outside contractor but by the team members who are focused on interpreting information that the cleaning process is generating.

This phase not only provides a clean work environment for working but many times broken pipes or damaged wires are found and this helps to fix safety hazards (Hough, 2008). For a printshop, a clean workplace means less paper dust and debris that will eliminate many of the

defects that are a direct result of a dirty environment (Cooper *et al.*, 2007). Less waste means more revenue. This is one of the most difficult to accomplish and that is why cleaning procedures such as sweeping the floor and wiping down equipment should be made part of the daily routine. Daily audits by a designated team are highly recommended.

Seiketsu (Standardize). Standardizing involves working with the team in such a way that the team members without exception agree to implement the new way of working as the normal way of working (Van Patten, 2006). It is important that gains made by the first three phases are not lost by allowing the procedures from breaking down (Howell, 2008). This can be used to reinforce procedures or practices that will be key in driving improvements in the future.

Some of the points that can help better the standardize process (Cooper *et al.*, 2007) could be listed as:

1. Write down the procedures for the first three phases and make them part of the daily routine
2. Use visual aids and visual management (shadow boards, labelled shelving, tagged bins etc.,) as much as possible because that will make abnormalities stand out
3. Schedule 5S activities as often as possible
4. Consider an official 5S agreement that outlines expectations, roles and responsibilites before starting the implementation of the program

Shitsuke (Sustain). Most studies (Bullington, 2003, Cooper *et al.*, 2007; Hough, 2008; Howell, 2009; Van Patten, 2006) identify the fifth phase as the most difficult phase to be executed in the process. It is important not to go back to the comfort of old methods of doing things (Hough, 2008). The root cause of this problem is that changing long-standing practices and behaviours can be difficult. It involves making 5S philosophy as the way of life in an

organization (Howell, 2009) and personal discipline to follow agreed upon new standards (Van Patten, 2006).

According to Van Patten (2006) most organizations fail to support their 5S teams in this final step even though they might have completed the first four steps extremely successfully. The culture of the organization is a very big factor that dictates how this phase turns out for an organization (Cooper *et al.,* 2007). It takes a very committed effort to keep 5S alive.

Chapter III: Methodology

This study involved the application of 5-S methodology in the laboratory management process. This implementation is likely to benefit the QA technicians and Quality Process Manager to increase the efficiency of managing the lab. In the long run it is expected that a stronger work ethic and build up of the idea of ownership would result in a much more productive effort.

Identifying the Problem

The first step of this process was to identify the areas where the problem existed. The lab to be used for this study had been identified by the client. The lab is currently the Quality Assurance (QA) lab used extensively by Belmark. Specific areas of the lab that appeared cluttered, disorganized or unclean had to be identified. These included areas such as chemical cabinets, working tables, drawers, general-purpose cabinets and various shelves.

Photographs

Many areas of the lab were photographed. These photographs served two purposes. One, they aided in identifying the problem areas in case the human eye missed some. Secondly, before-and-after photographs helped to contrast the two conditions of the labs and gauge the effectiveness of the study.

Limitations

The author was employed as an intern at the client's facility for a period beginning January 2010 up to May 2010. The project had to be completed in that time period and handed over to the quality assurance team at Belmark for sustaining the project.

Method

Seiri or Sort. Once the problem areas had been identified, the next task was to identify articles, tools, and materials that were either not required at all or were only used occasionally. Another group of items could be the items that were required but were being currently stored in the wrong place. Such items were red tagged. This was done by clearly marking them with a large red paper tag, and if applicable, writing down details on the tag for easy reference. An area of or near the lab, in this case a general purpose cabinet within the lab itself, was identified and clearly marked as red tag area where these items would be moved and stored until decision was made for further action.

Many of the items stored in the lab and red tagged included old heat-sealing equipment, toolboxes and cases, miscellaneous items like keys, gloves, wires, and cable ties. Many drawers also had junk articles such as old, expired coffee creamers, garbage bags, and sugar packets. Some cabinets had old test material (such as large rolls of printed and unprinted films), while some had outdated copies of test methods. All junk articles were thrown away. Other items were red tagged.

Seiton or set in order. Everything that is needed to process a job should be placed for easy access. The items that were needed were put at their point of use – where they would best support their function. Many items like the old heat sealers were left in the red-tagged area with the tags. The Technical Services (TS) group who foresaw use for these heat sealers reviewed these. The TS team was to carry these to the research and development (R&D) lab once the new lab under construction became ready. This proposed action was clearly recorded on the tags used on these items. Many items were such that the maintenance team could use them more

productively. After reviewing these with the quality process manager, these were handed over to the maintenance team.

To evaluate which items would be directly utilized in the lab, the quality technicians and quality manager were shown such items and asked to point out their specific use. Such items were stored in the drawers or cabinets closest to the intended area of work. Tools such as weights or cutting instruments were grouped according to the application or use and then stored accordingly. One huge cabinet was being occupied by a small quantity of printed film rolls and empty pouch samples for QA checks. A quality technician suggested that these could be stored much more economically in one single drawer. The lead press operator required space to store printed rolls used for testing ink color and the cleared cabinet space would be extremely suitable for this purpose. As a result the printed rolls and empty pouch samples were shifted to a set of drawers under the oven where they were most frequently checked and used. Bottles of chemicals used for labs were labeled again with new labels and all relevant information such as material safety data was clearly identified.

Material Safety Data Sheets (MSDS), training manuals and Standard Operational Procedures (SOP) were provided dedicated shelves within a cabinet in the lab. This cabinet was identified clearly in the Standardize stage of the project when the labels were applied. Certain machines such as the Gas Chromatography (GC) tester required large numbers of auxiliary or related apparatus for day-to-day use. Hence, an entire chest of drawers was dedicated to store the apparatus for this machine. This was again done in the chest of drawers directly under the machine in question.

At this stage the author performed a walk-through of the lab area with the Technical Services Manager, Product Development Managers and Quality Process Manager to review the

progress of the project up to this point. Once this group expressed its satisfaction at the project's progress, the author reviewed his proposed action for the next phases of the exercise with them. On receiving their approval of this plan, the author progressed to implementing the shine phase.

Seiso or shine. 5S states that this phase is not just about shining or cleaning (Van Paten, 2006). It is actually a process of collecting data to know the root cause of waste, dirt, and damage. In case of the QA lab the chief cause of dirt was dust, which had not been cleaned from the surfaces. In one instance, like in the case of the tensile tester, chief cause of the dirt was the grease being used to lubricate the columns on which the machine jaw would move up or down. This grease would become easily spreadable due to repeated movement of the machine and get lodged on the surface of the machine. This had to be cleaned off.

Another interesting observation that exemplifies the point made by Van Paten (2006) was made while cleaning the oven. The oven is used mainly to dry washed glass vials being used in the GC tester, check samples for a defect called tunneling, and to carry out any other specific test. It was found that the stainless steel inside part of the oven door appeared yellow. On rubbing the surface using a wet wipe, it was observed that the area of rub actually became cleaner as compared to the rest of the door. This indicated that all of the solvents and materials being dried in the oven were not being evaporated and were actually getting deposited in small amounts on the stainless steel interiors of the oven. This was a vital piece of information for the sustain stage of the cycle. This deposit build-up had the potential to negatively impact the working of the oven, and over time had the potential to mar any experimental observations and results being carried out using that oven.

A large amount of dust and dirt had accumulated behind the testing equipment and this had to be cleaned. All the surfaces of the working platforms had to be cleaned. All cabinet and

drawer surfaces had to be cleaned. Many showed some accumulated dirt over time and this would have to be scrubbed off. All equipment had to be dusted and cleaned. This would have to be a regular activity during the sustain stage. It has already been observed during the literature review that working in a clean environment instills a more enthusiastic approach towards work. The author would like to observe here that for the most part the working environment in Belmark's lab was clean. A very minute amount of neglect did exist and this exercise aimed at making that environment cleaner than it currently was.

Seiketsu or standardize. It was important to communicate the working philosophy to the lab management team. Thus a new work standard was to be established in order for this study to be successful in the long run. The author suggested to the team who agreed upon a new method of working that would keep the work place organized, clean, and functional. These included:

1. Prioritize the use of tools and equipment found in the work place
2. Find a location of these tools for easy access so that work flow is not disrupted
3. Identify and document the sources of dirt or waste and how to keep them from recurring
4. Identify clearly all equipment to make it a visual work place

The first point from the above mentioned list had been initiated in the "Sort" and "Set in order" stages of the implementation. And point two had been initiated during the "Set in Order" phase. The team had also learned point three from the "Shine" phase. While learning from these points was extremely important, it was even more important that these be an integral focus of the team during the final cycle or the "Sustain" stage of the implementation.

The marketing department at Belmark was consulted with regards to the final point of identifying equipment. It was vital to keep the signs and boards in accordance with Belmark's

existing identity and so consultation with the marketing department was required. Making the lab a visual workplace by using standardized signboards would not only provide an organized appearance of the new workplace but would also be a ready locater guide for someone new or even for experienced workers new to the re-arranged lab. The permission of the Technical Services Manager was sought to purchase the signs.

It was decided in concurrence with the Quality Process Manager that uncontrolled copies of Quality Job Instructions (QJI) and test methods would not be stored in the lab. One master record of controlled QJIs and test methods would be with the Quality Process Manager. Any person wanting to conduct a test could easily print out a copy from the Belmark intranet. The digital versions on Belmark's intranet are always updated and this would eliminate the possibility of an expired or out-of-date procedure being employed to run a test.

Shitsuke or sustain. It is not enough to implement only the four steps of 5S because the entire 5S effort would be futile if they cannot be sustained. "Practicing" 5S is more important and difficult than implementing it (Lanigan, 2004). The lab management team at Belmark will have to discipline themselves in order to achieve constant efficiency using a 5S model. They will have to do what is required on a regular basis rather than take stock every few weeks and implement the first four phases all over again.

This will need attention to simple things like cleaning or dusting the equipment before they use it for the first time in the day. Noticing small things like accumulated deposits on surfaces and dealing with those at the same moment. It may be difficult initially but as they do it again and again, their time efficiency will also increase. Moreover, it is extremely important for them to ensure that the Quality Interns are initiated in this process and follow it too. That will be the best

way to sustain this work standard. Hopefully, the interns will pick up a new dimension to add to their professional lives.

Chapter IV: Results

5S, a component of Lean manufacturing is a methodology for organizing a shared workspace with the intention of improving efficiency, eliminating waste and reduce process unevenness. It derives its name from the use of five Japanese words: "Seiri" meaning Sort, "Seiton" meaning Set in Order, "Seiso" which implies Shining or Cleanliness, "Seiketsu" which means Standardize, and "Shitsuke" which implies Sustaining.

Belmark Inc., is a leading converter that has three business units – Pressure Sensitive Labels, Flexible Films and Folded Cartons. Belmark's technical competency includes a dedicated Quality Assurance (QA) team responsible for collecting and testing run samples during production. This study was undertaken to work with QA team to identify the areas for improvement in laboratory management by applying the philosophy of 5S to organize, clean and manage the labs thus improving efficiency of movement and work.

Item Analysis

The results of this study have been documented principally in the form of photographs. These photographs serve the purpose of contrasting the state of the lab or equipment *before* and *after* the study was implemented. This will provide a ready visual understanding of the immediate impact initiated by this study. The photographs will also highlight the advantages that can be incurred by keeping the lab or equipment in the new state. While the author has included some photographs to explain the changes due to the study, other photographs that highlight similar changes have been included in the appendix. The highpoints, limitations and recommendations thereof will be summarized in Chapter V. The author has recorded his observations and recommendations in Chapter V. Examples of additional forms recommended by the author have been added as appendix.

Red Tagging

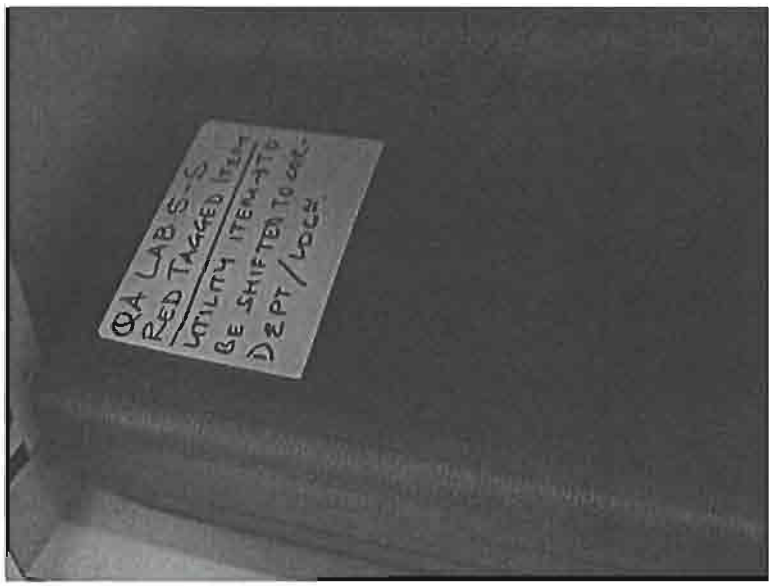
The purpose of red tagging was to identify articles, items or tools in the lab and assign a proper action or place of storage for them. These items were identified and tagged, with the tag containing information such as why these were tagged and what needed to be done. All these articles were stored temporarily in one cabinet in the lab itself till they could be assigned or the proposed action carried out. Figure 1 illustrates a red-tagged item. The name of the project, and purpose of red tagging are clearly identified on the article. The articles in Figure 1 are of questionable utility value. Due the fact that the purpose of red tagging has been clearly identified on the tag, the concerned person or department can inspect the item and advise the project team on what their next action should be.

Figure 1. *Red-tagged items of unknown utility value*

This figure shows red-tagged items of unknown utility value. These may be later discarded if no use is seen for them in the future.

Figure 2 also illustrates a red-tagged item but these items have a known utility value. Again this fact has been clearly identified on the tag, as has been the proposed action to be taken. This leaves no room for confusion or ambiguity regarding that article in question.

Figure 2. *Red-tagged items of known utility value*

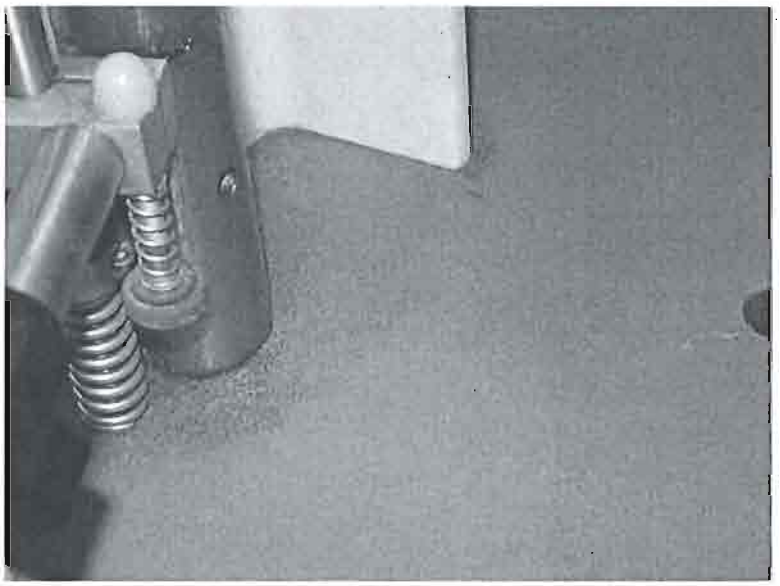


This figure shows red-tagged items of known utility value. These may be later moved to another location as required

Cleanliness

As mentioned in the literature review, the purpose of the Shine stage is more than simply cleaning up. There fore cleanliness becomes not only a data collection tool but also provides a better environment to work. It creates a sense of ownership towards the workspace and incorporates it as a discipline in day-to-day work. Figure 3 on the next page illustrates one such unclean piece of equipment. It is contrasted with Figure 4, which depicts a clean piece of equipment and illustrates the ideal state in which the equipment should be kept. Two more figures illustrating the same point are included in Appendix D.

Figure 3. *Unclean lab equipment*



This figure shows dust and grime accumulated on the surface of lab equipment. This can affect the functioning of equipment.

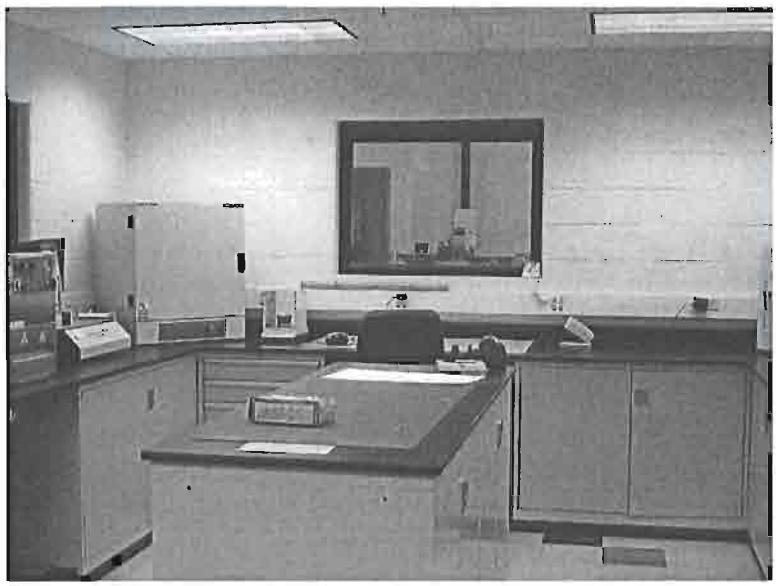
Figure 4. *Cleaned lab equipment*

This figure shows lab equipment that has been cleared of dust and grime.

Visual Workplace

The intent behind creating a visual workplace was that anyone new to the lab's surroundings would be able to locate each equipment, storage space, and related tools quickly to perform his or her task. People accustomed to working in the surroundings can use this as a standardized workspace that appears more organized and better to perform work in. In Figure 5 the walls of the lab are devoid of any identification boards.

Figure 5. *Unidentified equipment in the lab*



The equipment in the lab is not identified. In Figure 6 below, each piece of equipment has been identified keeping providing easy location of articles.

Figure 6 contrasts the one above. Appendix D contains further illustrations of standardization before and after implementation of the 5S project. The photographs show how drawers and cabinets can be marked or identified to standardize the workspace. Another advantage of such standardization is that once used or when not in use, articles and tools will get stored at the correct places without fail. This will save time each time a task is performed.

Figure 6. *Clearly identified lab equipment*

As seen, the pieces of equipment in the lab are clearly identified with boards bearing their names on the walls.

Organization

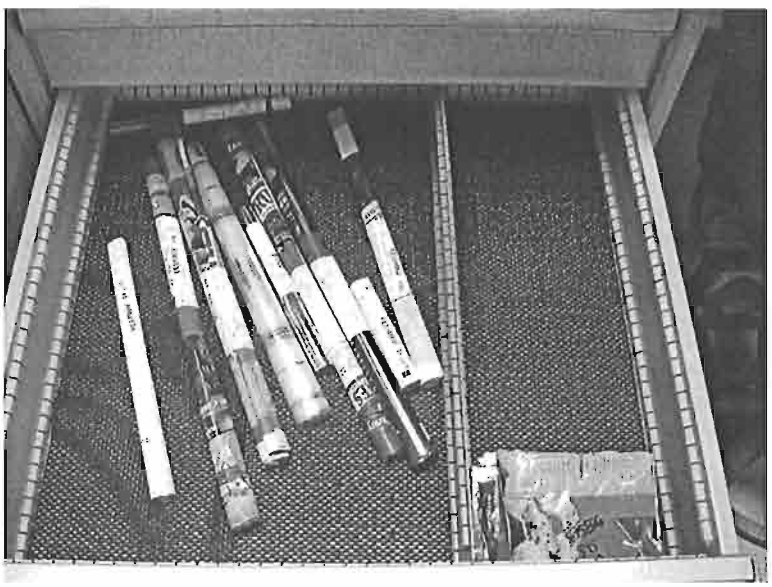
The standardize phase also includes organizing the workspace and its components. As will be seen in the following photographs, Figure 7 shows how a small number of samples were occupying a rather large cabinet. In the Set in Order phase these samples were moved to a smaller drawer and that drawer was clearly identified. The space that became available was utilized to store some large printed rolls being used for testing inks and colors.

Figure 8 shows the samples stored in a smaller drawer. Appendix D shows how the same principle can be applied to other drawers used for storing tools that are used frequently.

Figure 7. *Uneconomical utilization of storage space*

This figure illustrates how a small number of samples were being stored in a relatively large storage space

Figure 8. *Economical utilization of storage space*



This picture shows how the same samples from the one above are stored more economically.

Chapter V: Discussion

5S, a component of Lean manufacturing and a methodology for improving efficiency, eliminating waste and reducing process unevenness by organizing a shared workspace derives its name from the use of five Japanese words meaning sort, set in order, cleanliness, standardizing, and sustaining.

Belmark Inc., a leading converter for pressure sensitive labels, flexible films and folded cartons having technical competencies such as a dedicated QA team recently had this methodology implemented in the company's QA lab. This study was undertaken to work with QA team to identify the areas for improvement in laboratory management by applying the philosophy of 5S to organize, clean and manage the labs thus improving efficiency of movement and work.

Limitations

As stated at the beginning of this paper, apart from the laboratory discussed in the study, the R&D laboratory at Belmark would also benefit from the implementation of 5S Methodology. However this laboratory is not included in the scope of this study.

This study and project could also be extended to the other areas of the shop floor. The main production area as well as other areas such as inventory or maintenance division can benefit tremendously from this exercise. But at the present moment these are out of the scope of this study.

The author was employed as an intern at the client's facility for a period beginning January 2010 up to May 2010. The project had to be completed in that time period and beyond that sustaining the project was not in the scope of the author's work.

Observations and Recommendations

Implementing 5S in the QA lab will contribute to a more efficient work place, but in order to harvest the maximum benefits of 5S, this philosophy should be implemented as part of greater, formal Lean program. Making it a part of a formal Lean program extended to main production areas will enable Belmark to gain benefits in tangible and quantifiable monetary terms in addition to qualitative benefits.

In order to achieve such results, it will require a high level of commitment from management at not just championing this cause, but also to motivate people and have a high level of human involvement. This is extremely important in order for this initiative to succeed and yield the desired results. The author encountered this problem while implementing this study. While the individual unit managers were willing to extend support, the interest level of employees for involvement was low. Regular members of the QA team - the quality technician and quality intern were reluctant to work beyond their normal working hours on this project. This may be because they viewed 5S only as a housekeeping exercise. It has to be the responsibility of the managers to convey the importance and prospective gains of this exercise and motivate participation.

Due this problem, the author executed activities alone on numerous occasions, particularly in the Shine phase. This resulted in slow progress of the project and the basic notion of cleaning up during this exercise was not effectively conveyed. Also owing to the shift duties of the quality technicians, the author was required to separately communicate his actions and progress to the team each day. Thus there was no real communication between the two technicians.

This aspect of the exercise has the potential to become a problem in the final stage. It is possible that in this stage, the project may not be able to sustain the momentum and the gains made in the first four stages will be lost. It is important to note here that after standardizing, it is vital to keep looking at improving from the current base line in order to achieve continuous improvement.

One way of overcoming this barrier would be to approach the problem as a formal project. Taking a formal project management approach to this event will enable the company to accurately gauge the scope of the exercise, its limitations, and more significantly, investments needed in terms of costs, time and effort in order to achieve success. It will also compare the gains with costs incurred to either justify or reconsider the implementation of this exercise.

Using a form such as Lean Event Scope Sheet is a good way to achieve this objective. Typically such a scope sheet would have information such as:

- The name of the event, and dates of importance for that event
- Event sponsor, facilitator, team lead, all members and respective department names
- Current situation or problem
- Event description and scope of activities and achievements
- Customer requirements and key metrics that want to be improved upon
- Costs

A template for the Lean Event Scope Sheet is included in Appendix C. It is for illustrative purposes only.

Another good way to gain improvement by way of improving human efficiency rather than machine productivity would be to develop Standard Work Procedure (SWP) sheets. A SWP lists not only the procedures in a step-by-step order but also carries image references of these

steps. The list of SWPs should be developed and maintained using a pre-defined protocol such as assigned numbers, date of last update, or departments/machines where applicable. Such information should be communicated to the entire team who are likely to use a particular work area frequently. A template for a SWP is also included in the Appendix B for illustrative purposes.

An improved approach for the activities like red tagging will also result in a more effective project. Having a central red tag area where the red-tagged items are stored is highly recommended, as is the need for this area to be open and visible for all in the work place. A good idea in this regard would be to have a printed red tag that identifies basic information about the item such as item description, work area in which it was found and the date that it was red tagged. The red tag can also be designed to contain more detailed information about the item. This information could include the category of the item such as raw material or finished goods, the reason it was red tagged, and disposition action to be taken. It is important to enforce strict guidelines for red tagging such as action to be taken in case an item fails to be claimed or identified by anybody and the last date by which such items should be disposed. A possible template for a red tag has been included in Appendix A.

This study followed the conventional sequence of 5S activities. Interchanging the sequence of the Set in Order and Shine phases might possibly save some more time in context of the actual activity. The results of this study emphasized both, the Set in Order and Shine phases of 5S through comparative pictures taken before and after the exercise. This is an effective way to visually highlight the improved appearance of the workplace. These results can be reinforced by recording measurable criteria such as time taken to locate items or cost of training personnel

in a better-organized work place versus the previous. These are however long-term benefits and the results may not be apparent immediately.

An improved strategy for approaching the Standardize phase would be to get each team member to have clearly-defined responsibility for carrying out each of the activities. The team will have to establish the standardized practices and maintain them through visual controls like checklists and color-coded charts. This approach will be vital to the sustaining of this program in the fifth and final phase. It is important to for the management to motivate and involve the employees to be involved in the process. Workers should be encouraged to make improvements to their workplace on a regular basis. Continuous Improvement has to be incorporated as a part of day-to-day routine.

Conclusions

The team at Belmark can improve tremendously on this effort by following some of the recommendations stated above. One of the shortcomings of this effort was that the author was reviewing his work plan with the quality process manager and quality technicians at different times due to different schedules. This has to change to a team-meeting approach if there is to be any hope of sustaining the effort. Another seems to be the lack of involvement of other technicians. Management can take advantage of future quality interns for some of the legwork, but to be successful, floor-level workers/technicians must take ownership of the process. They must contribute their own ideas and suggestions for improvement, carry them out, see benefits, and motivate other workers. Only then will the effort be sustainable. Personnel from other areas who use the QA lab for work or as an office space need to be involved and made aware of the potential benefits of this exercise. If they work on them, they will discover new ways to improve on the 5S process as well as their own production processes.

References

Bamber, C. J., Sharp, J. M., & Hides, M. T. (2000). Developing management systems towards integrated manufacturing: a case study perspective. *Integrated Manufacturing Systems , 11* (7), 454-461.

Bullington, K. E. (2003, January). 5S for Suppliers. *Quality Progress* , pp. 56-59.

Cooper, K., Keif, M., & Macro, K. J. (2007). *Lean Printing Pathway to Success.* Sewickly, PA, USA: PIA/GATF Press.

Deemer, J. (2008). *Glossary of Graphic Communication* (Fourth Edition ed.). Sewickley, PA, USA: PIA/GATF.

Gapp, R., Fisher, R., & Kobayashi, K. (2008). Implementing 5S within a Japanese Context: an integrated management system. *Emrald Insight , 46* (4), 565-579.

Ho, S. K., Cicmil, S., & Fung, C. K. (1995). The Japanese 5-S practice and TQM training . *Training for Quality , 3* (4), pp. 19-24.

Hough, R. (2008, Summer). 5S implementation methodology. *Management Services* , pp. 44-45.

Howell, V. W. (2009, August). 5S for Success. *Ceramic Industry* , pp. 17-20.

Hyland, P., Mellor, R., O'Mara, E., & Konepudi, R. (2000). A comparison of Australian firms and their use of continuous improvement tools. *The TQM Magazine , 12* (2), pp. 117-124.

Lanigan, J. (2004, May). 5S Provides Competitive Lean Foundation. *SMT Magazine* , pp. 70-72.

Sarkar, D. (2008). *Lean for Service Organizations and Offices.* Milwaukee, WI, USA: American Society for Quality.

Strategos. (2007). *Lean Manufacturing History.* (Strategos - Engineers, Consultants & Strategists) Retrieved October 03, 2009, from Strategos Books and Videos: http://www.strategosinc.com/just_in_time.htm

Van Patten, J. (2006, October). A Second Look at 5S. *Quality Progress* , pp. 55-59.

Warwood, S. J., & Knowles, G. (2004). An investigation into Japanese 5-S practice in UK industry. *The TQM Magazine , 16* (5), 347-353.

Withanachchi, N., Handa, Y., Karandagoda, K., Pathirage, P. P., Tennakoon, K., & Pullaperuma, D. (2007). TQM emphasizing 5-S principles: A breakthrough for chronic magerial constraints at public hospitals in developing countries. *International Journal of Public Sector Management , 20* (3), 168-177.

Appendix A: Example for Red Tag Template.

5S RED TAG
Date:
Item:
Utility/Description:
Category (Mark all that apply):
Raw Material
Work in Progress (WIP)
Finished Goods
Tools
Customer Item
Maintenance
Office Supplies
Files
Surplus
Junk
Other
Proposed Action:
Scrap
Return to supplier/customer
Return/Move to _____
Store
Scrap
Dispose by _____ **Responsible Person** _____

Appendix B: Example for Standard Work Procedure Template

STANDARD WORK PROCEDURE		
PROCESS NAME:	**DATE CREATED/REVISED:**	
DEPARTMENT:	**TIME REQUIRED:**	
	FREQUENCY:	
TOOLS REQUIRED:		
SAFETY PRECAUTIONS:		
DESCRIPTION OF ACTIVITIES		
DAILY Step 1 Step 2 Step 3		
BI-WEEKLY Step 1 Step 2 Step 3 Step 4		
MONTHLY Step 1 Step 2 Step 3 Step 4		
VISUAL REFERENCES		
Reference 1	Reference 2	Reference 3
Reference 4	Reference 5	

Appendix C: Example for Lean Event Scope Sheet Template

LEAN EVENT SCOPE SHEET	
Event Name:	**Start Date:** _____ **End Date:** _____
Event Manager:	
Champion/Sponsor:	
Departments Involved:	**Facilitator(s):**
Current State/Problem:	
Event Description/Objectives:	
Customer Requirements:	
Key Deliverables & Baseline:	
Event Costs:	

TEAM MEMBERS		
NAME	**DEPARTMENT**	**ROLE PLAYED**

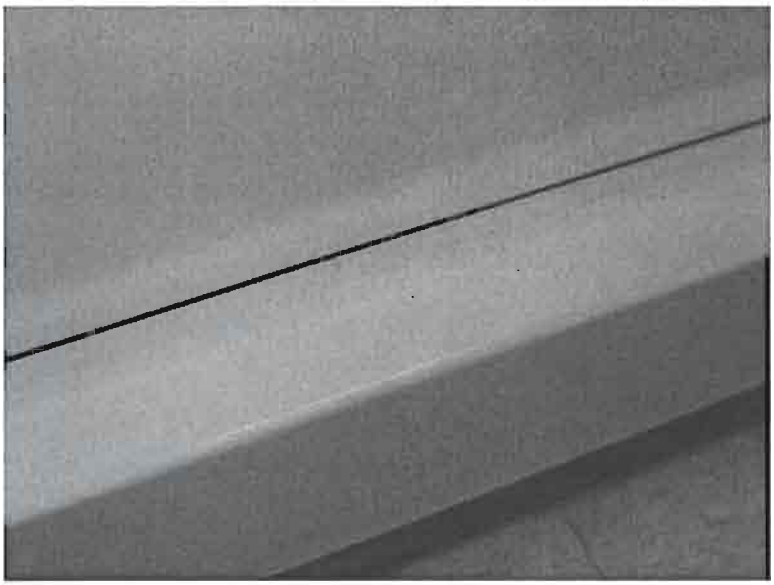
Appendix D: Pictorial representation of stages of 5S

The following pictures provide more examples of before and after conditions of the workspace as a result of various 5S activities such as Shine, Set in Order and Standardize.

This picture shows another example of unidentified workspace. This cabinet is not marked and can be used to store things randomly.

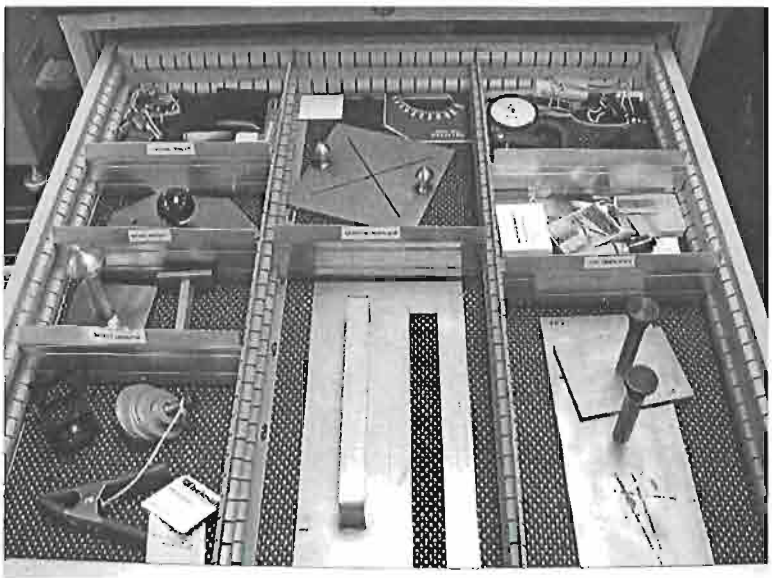
This picture shows a clearly identified cabinet. Anything stored in here will have to go back there once used and is less likely to be misplaced resulting in saved time.

This picture shows dust and grime collected on the surface of storage spaces like drawers.



This picture shows the surface of storage spaces free from dust and grime. This part of the Shine phase.

This picture shows how the storage space illustrated in Figure 7 is being more economically utilized by storing large articles of regular use.



This picture shows how a drawer can be organized and labeled to store tools and supplies for daily use.