



A 6S EXPERIENCE IN A MANUFACTURING FACILITY

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ABSTRACT

Globalization of science and technology has caused competitive pressures to continue unabated in manufacturing business. Product prices continue to fall while production costs rise. In order to reduce production costs, some companies look to improved technology, employee layoff, facility relocation, etc. The search for operational excellence seems to be more intense with each passing day. Many companies have adopted Lean, Six Sigma or Total Productive Maintenance initiatives for improving operational effectiveness and efficiency. 5S is a traditional management technique that helps organize a workplace by making it clean and free of items not needed for the job. It is believed that such a work environment fosters higher employee morale, improves productivity and quality, and enhances safety.

This paper reports the implementation of lean 6S technique in a Parker manufacturing plant in Houston, Texas. Parker corporate management believes that 6s establishes the foundation for all productivity, quality, safety, and cost improvements of the future. The traditional 5S was expanded to 6S by adding safety awareness directly. The project involved several departments: maintenance, human resources, finance, janitorial, etc. In many of the departments prior to the implementation of this project, disorder was evident in workflow and document processing had hitches. After the implementation, we saw a cleaner workplace, better organized tool racks, faster document processing, etc.

Employee participation in the process right from the beginning was very important for the initial success of the project and is helping to sustain the gains. An on-going self-regulated program that instills a discipline to create, improve, and maintain a clean, well-organized, and safe work environment is in place. 6S philosophy has become one of the entire work-culture, thinking process, and everyday mode of operation from management to the manufacturing floor.

INTRODUCTION

The manufacturing business environment today is highly competitive. Product quality is taken for granted, prizes are in decline but manufacturing costs are not. Defective items and waste contribute to higher production cost. So is low capacity utilization and shift-to-shift output variation [1]. When product line change-over times are too long, the result is low utilization and productivity. The search for ways for reducing production costs through improved effectiveness and efficiency is never ending. Companies have tried improvements through different initiatives such as Lean, Lean 5S, Six Sigma, Lean Six Sigma, Total Productive Maintenance, better technologies, layoffs, etc. so as to remain profitable. 5S is a methodology based on 5 simple concepts aimed at achieving a clean, organized, and comfortable work environment. It is generally believed that 5S initiative is a foundation for more disciplined actions [2] and when properly supported, can build a culture of continuous improvement. Other possible benefits from active 5S and safety program include a) improvement and speed-up in communications, b) enhanced clean work environment, c) improved quality of life, d) reduced errors, product defects, and accidents, e) improved teamwork, and f) maximized work time and resources. It is

obvious that it is much easier to find tools and parts in a clean and well organized workplace. Similarly, it is much easier to spot emerging problems like fluid leaks, material spills, wear particles, cracks in devices, etc., in a clean and well organized workplace.

Manufacturing executives are well aware of the need for a clean, well-organized workplace for optimal manufacturing performance. Achieving it has not been an easy task, however. This is why 5S seems to have an advantage. 5S was developed into a methodology by Hiroyuki Hirano [3] who believed and taught five distinct steps or phases in establishing and maintaining an ordered, clean and optimized workflow. He insisted that the 5 steps should be implemented sequentially. Table 1 summarizes Hirano’s 5S and the English adaptation. Hirano maintained that companies who cannot successfully implement 5S program have little hope of integrating large scale changes such as JIT or re-engineering.

Table 1: Hirano’s 5S Concepts

Japanese Term	English Equivalent	English Term	Japanese Interpretation
Seiri	Tidiness	Sort	Remove un-needed and un-related materials from the workplace
Seiton	Orderliness	Set	Organize everything in proper place for quick retrieval and storage
Seiso	Cleanliness	Shine	Clean up the work place. Everyone should be a janitor.
Seiketsu	Standardization	Standardize	Standardize the ways of maintaining tidiness, orderliness, and cleanliness
Shitsuke	Discipline	Sustain	Commit to 5S and practice it daily: make it a way of life

Hirano major contribution was his delineation and insistence on the distinctiveness of 5S. When Toyota adopted Hirano’s approach, Set and Shine (orderliness and cleanliness) were integrated to obtain the 4S version [4]. This integration tends to avoid the trap of retrofitting tidiness or cleanliness into the design of a work area.

Some Japanese companies like Toyota and Danaher have achieved remarkable successes with 5S and other programs. In North America, the story is quite different. Studies indicate that two-thirds of these initiatives fail to meet expectations of company’s leaders. The identified cause of this failure is the inability of companies to achieve culture change: getting workers to adopt new behaviors and daily practices that sustain continuous improvement. Culture change remains a significant challenge to 80% of companies in an Aberdeen Group survey in 2005 [1]. The inability of North American companies to sustain the gains of 5S has been attributed to a) incomplete implementation of 5S phases, b) cultural differences between Japanese and Americans, and c) implementation sequence or order of 5S [5]. According to Casey [5], many North American companies celebrate after implementing Sort, Set, and Shine but somewhat neglect Standardize and Sustain. He pointed out that Japanese culture cherishes conformity while American culture has strong sentiments for individualism but cherishes competition. Casey opined that 5S should start with Standardization and Systematization instead of Sort and Set. The process of defining standards and how those standards will be implemented and measured should

be left to the workers and project team members. This approach helped to achieve sustained interest in continuous improvement according to his report. Casey's report was on a company that has implemented 5S project previously.

The need for health and safety in the workplace is well recognized because employees are entitled to a reasonably safe workplace that is free of recognized hazards. Health is a state of freedom from disease, illness, pain, or injury and health issues may be physical, mental, or social. Safety is the state of being free from danger, damage, harm, or injury. Hazard is the potential for an activity, circumstance, condition, or changing circumstances or conditions to produce harmful effects [6]. Risk is a measure of both the likelihood and consequences of all hazards of an activity or condition. Incident is an unplanned event or event sequence that may or may not result in loss, harm, injury, illness, disease, or death. Incidents may require completing and submitting forms, travelling, record keeping, investigations, clean up, legal and medical services, hospitalization, rehabilitation, and recovery of public image. Accident is an unintended event or event sequence that leads to loss, damage, injury, or death. Losses from an accident include those of incidents and more. Additionally, there may be damage to property, equipment, tools, materials, and environment, cost of repair or replacement, disease, illness, injury, and death in an accident. Minimizing losses and costs associated with occupational safety and health is a key concern for manufacturing executives.

According to the National Safety Council statistics, there are about 4,500 work-related deaths each year, with a death rate of 3 per 100,000 (0.003%) for all industries. There are more than 3.5 million injuries involving one or more days away from work annually. Excluding cost of business interruptions, more than \$150 billion is spent annually on work-related accidents. Each worker loses approximately two days each year from job-related accidents. Workplace injuries result in more than 100 million lost days each year [6].

- Since 1970, workplace fatalities have been reduced by more than 65% and occupational injury and illness rates have declined by 67%. At the same time, U.S. employment has almost doubled [7].
- Worker deaths in America are down—on average, from about 38 worker deaths a day in 1970 to 12 a day in 2012 [7].
- Worker injuries and illnesses are down—from 10.9 incidents per 100 workers in 1972 to 3.5 per 100 in 2011 [7].

Although significant progress has been made in occupational safety and health, the toll in terms of dollars, lives, injuries, and illness are still too high. Beyond mere statistics, accidents have great personal impacts on individuals and their families [6]. Therefore occupational safety and health should be accorded its rightful significance in the workplace.

6S at Parker Hannifin Corporation

Parker Hannifin corporation is the world's leading diversified manufacturer of motion and control technologies and systems, providing precision-engineered solutions for a wide variety of mobile, industrial and aerospace markets. Parker's engineering expertise spans the core motion and control technologies – aerospace, climate control, electromechanical, filtration, fluid & gas handling, hydraulics, pneumatics, process control and sealing & shielding. The management of the company decided to go lean production and wanted 5S to be the spring board. Lean project

management can help companies improve the manufacturing process by reducing labor costs and cutting down on lead times. 5S addresses the wastes generated through disorganization and provides a way of eliminating that disorganization. A successful 5S program will eliminate everything unnecessary from a company and ensure all essential tools, materials, and resources are located so they can be used most effectively. A team to implement the lean 5S project was formed with the goal of reducing waste. We were to adapt lean thinking, tools, and techniques to reduce non-value added activities, cost and cycle time, while improving quality, customer satisfaction and the business operations. A 5S program normally involves several units in a facility, so it provides a great opportunity for emphasizing occupational safety and health. Many rightly believe that an ordered and clean work area leads to a safer workplace. But a poorly designed and or implemented 5S can undermine safety [5]. Therefore, it was decided that safety be considered as a distinct component but integrated into 5S in our project. The safety component would be a general education phase on occupational safety and health. The goals are to inform, encourage, and promote general safety awareness among the workforce and to specifically review traditional 5S steps from a safety perspective at all phases. This integration of safety into a traditional 5S program transforms it into a 6S program. Table 2 summarizes our adaptation of the traditional 5S into a 6S project.

Table 2: Parker’s 6S Concepts

English Term	Interpretation
Sort	Remove un-needed and un-related materials from the workplace
Set	Organize everything in proper place for quick retrieval and storage
Shine	Clean up the workplace. Everyone should be a janitor.
Safety	Make the workplace safe and free of recognizable hazards
Standardize	Standardize the ways of maintaining tidiness, orderliness, and cleanliness
Sustain	Commit to 6S and practice it daily: make it a way of life

Phase 1: Sort

The objective of the phase was to create a working environment where just the necessary items are available to perform the job. The goal was to achieve a 50% reduction in used items. When unnecessary items collect around work areas as debris and unused objects build up, productivity tends to drop. Frustrations mount when workers find that they are unable to satisfactorily finish the task at hand. Therefore, it is vital to implement a workplace sorting system that can effectively identify needed and un-needed items. We used “Red Tagging”, an effective visual method of identifying un-needed items in this phase. In this method, labels or signs are used to identify two areas:

1. One area for the collection of unused items. If the item is not needed to do your job, discard it.
2. One area for tools or other items that are needed.

When searching for items, we looked at horizontal surfaces such as floor, top of tables, etc. and vertical surfaces like walls, doors, drawer fronts, etc. We also looked at inside office furniture such as file cabinets, bookcases, desks, junk drawers, etc. Items removed included paper copies now available electronically, old files and magazines that were no longer relevant, catalogs, and books. Others were binders, old disks, outdated manuals, remnants from previous people or previous jobs, broken office supplies or equipment, no longer used supplies or equipment, old

parts or sample parts that are old and will never be used again, etc. Team members were told to contact their supervisors if they had any questions regarding discarding something.

The area for needed items was sub-divided into (a) frequently (b) occasionally (c) rarely used items. Separate labels were used to indicate potentially hazardous materials. After the unused items were gathered, they were moved to “Red Tag” area. Clearly visible labels and signs were used to make the purpose of this area clear. Signs described the process of turning in items for collection. An evaluation was performed on the items in “Red Tag”. Items that are potentially useful were subsequently labeled for cleaning and storage. But tools or implements that were no longer useful were discarded immediately. Plate 1 shows an office before the Sort phase. The same office is shown in Plate 2 after the Sort phase.



Plate 1: Before sorting



Plate 2: After sorting

With the completion of the Sort phase, we realized three main results:

- Increased productivity – the purpose of individual work areas were more apparent, leading to a highly efficient workflow.
- Workers were more satisfied with their environment – employee morale has increased as junk items and materials that were potential health hazards were identified and removed.
- Product quality improved as full attention can be paid to production. Employees no longer focused on tangential tasks such as locating tools or implementing their own organization systems.

The benefits of this phase are a) freed-up workspace, b) cleaner work area, c) discarded unnecessary items. It should be noted that workplace sorting also included cleaning out and organizing electronic databases.

Set Phase

The objective of this phase was to achieve an efficient functional work environment layout by placing everything in a specific place that will minimize search hassle when needed. A 30 seconds retrieval time was the goal. The set phase focuses on effective storage and organizational methods. It leads to a work environment that resists clutter and aids long-term productivity. In order to set the workplace in order, we had to determine:

- What items or areas we needed for the job.
- Where items should be located based on frequency of use so as to reduce searching time.

As mentioned in the last section, items were divided into frequently used, occasionally used, and really used. Items used daily or weekly were considered frequently used and they were to be kept handy and readily accessible. Items that were used once or twice a month were considered occasionally used and were kept or stored near their place of use. Items used once or twice a year were considered rarely used and were labeled, packed up and stored offsite. Where tools and materials seemed excessive, we returned to the first phase of Sort and removed more items not necessary for the job. Once we had identified the most commonly used tools and materials, we found accessible locations for them. If the tool storage area was located at some distance from actual work location, we considered ways to make the toolset more portable. Some other strategies to effectively set things in order include:

- Marking spaces, installing modular shelves and cabinets. Floor markings are appropriate for warehouses with otherwise insufficient boundary marking systems.
- In workspaces with extensive interior wall space, signs and labels should be used to help orient workers and assist workflow. For example, small overhead maps “You are here” and legends can be printed on both labels and signs and affixed to walls.

All items placed in storage were clearly labeled since they may not be used in every work shift. In many cases, it was appropriate to affix *RTK* (Right to Know) labels and other warning labels to containers used in storage areas. It was also important to consider installing shelves and cabinets that were easily accessible and could be adjusted as necessary. Because production requirements could change frequently, it was important to implement an organization system that was customizable. Labels and colors were employed: label markers were used to label binders, shelves, drawers, file cabinet drawers, etc. Color codes for items and folders were implemented. Also colored paper for specific uses allowed quick identification. Dedicated zones or spaces were created in work centers. For instance, one drawer or shelf for closed projects; one drawer for active projects, one shelf for catalogs and reference materials; hot projects were put right on desk, clearly identifiable spaces were made for incoming and outgoing correspondences, and contact information and phone numbers were loaded in Lotus Notes database.

Plates 3 and 4 show the outlook of some maintenance and workshop tool stations after the Sort and Shine phases. Easy identification of tools and buttons are obvious in these stations.



Plate 3: Maintenance

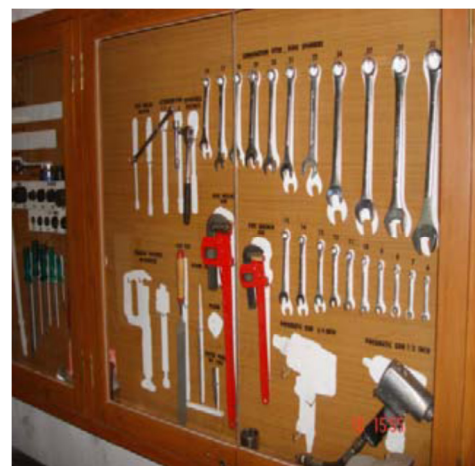


Plate 4: Workshop

The benefits of this phase included a) fast retrieval of needed items, b) elimination of unnecessary searches, c) elimination of “lost” items, d) efficient work environment, and e) effective utilization of visual cues.

Shine Phase

The objective of this phase was to achieve a clean and neat work area through routine clean up. Each worker was to clean and maintain a pleasant work environment on a daily basis. Once we had eliminated the clutter in the work areas in the previous phases, it was important to thoroughly clean the areas and the equipment in them. Leaks, squeals, and vibrations involving clean equipment can often be easily detected. A dirty workplace tends not only to be distracting but often allows equipment faults go unnoticed. Clean workplace conditions are also important to employees’ health, morale, and safety. As might be expected, initial cleaning was done after the Sort phase to immediately clear debris and dirt. During this initial cleaning, employees noticed areas that seemed to especially attract garbage or spills. Team members took note of these areas because team members were asked to specially look for areas that were still dirty after the initial cleaning. This might indicate the need for stronger cleaning solvents or tools. Detected abnormalities were tagged using; a) Red Abnormality Cards or b) Green Abnormality Cards.

Plates 5, 6, 8, 9, and 10; show some offices and workstations after the Shine phase. Plate 7 shows an almost completed Sales office during the Shine phase. These cases are presented as samples as many of the departments in the facility have several offices.



Plate 5: IT office



Plate 6: Café

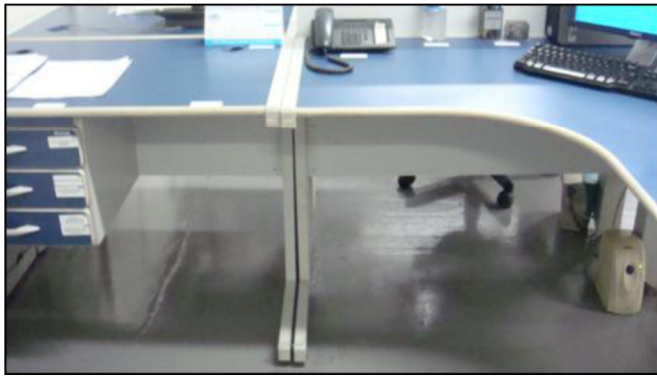


Plate 7: Sales office (In progress)



Plate 8: Accounting office



Plate 9: HR office



Plate 10: Janitorial tools station

The Shine phase was considered very important and team members had to really focus not only on cleaning the area, but also finding the root cause(s) of contamination. They were to find and document the root cause of the un-cleanliness problem in each workplace so as to help eliminate the problem. When a team found a dirty area, members were to ask themselves: how can we prevent this from getting dirty again? Similarly, at the discovering of oil leaks, lose or missing covers; this question was rehearsed so as to identify opportunities to improve or eliminate the problem. The purpose was to create awareness and help team members develop root cause analysis skills. In this way, a little effort in the beginning could reduce the necessity for deep cleaning later. As employees clean their work areas, they become familiar with the basic functions of the tools and equipment and enjoy greater safety and higher productivity. Cleaning operations can coincide with equipment evaluations in order to ensure that proper care and maintenance are done.

After the cleaning is done, special care was taken: a) to reorganize problem areas, b) fix equipment that may be leaking, c) take steps necessary to ensure that the problem will not persist in the future. Each workplace was evaluated as to its ability to be kept clean. Some pertinent questions asked included: 1) are the areas for cleaning equipment storage properly marked? 2) are cleaning supplies replenished and marked with instructions for use?, 3) are there enough

waste receptacles, and are they clearly labeled? By the end of the Shine implementation, a work area must be brought up to a level of comfort, cleanliness, and orderliness not previously seen. We all benefit from a cleaner space and when a surface or area is very clean, it is likely that no one would feel comfortable throwing something on it.

Safety Phase

The objective is to prevent occupational diseases, illness, injuries, and deaths. The goal is to ensure that workers are constantly aware of the value of safety and health in the workplace and therefore adopt preventive measures against recognizable hazards. After the first 3S phases, the change in morale and attitudes was quite evident. It was felt that such a state offered an appropriate time for engaging everyone on occupational health and safety. In the 6S project, focus was on general safety and health education. This deals with basic fire safety and importance of drill exercises, basic office and shop safety [8, 9], basics of hazardous substances and safety precautions, and hazard recognition [9, 10]. It is important that all new employees be given a general occupational safety and health orientation at first time of hire. This should be followed by specific job-related safety and health training that includes hazards associated with equipment and tools and how they can be prevented. In general, occupational safety and health education can be achieved by [6]:

- Training workers how to perform a job correctly and safely.
- Training workers how to use equipment/tool safely.
- Teaching workers about safe procedures and practices.
- Teaching workers what hazards are associated with a product, process, or task and how to take appropriate protective actions.
- Teaching workers about hazard recognition.

Employees were made aware that they are responsible for following proper safety procedures including the use of personal protective devices. They were encouraged to report hazards or perceived hazards to their supervisors. The importance of Material Safety Data Sheets (MSDSs) was emphasized and where they can be found was discussed. MSDSs are required and must be supplied by manufacturers of hazardous materials. This is mandated by the Hazardous Communication Standard. Workers are to have respect for personnel restricted areas and be cautions on wet and oily floor areas. Workers were shown how to recognize “*Imminent danger situations*” [8] such as electrical hazards, fire and explosion hazards, leaking chemicals, gases, poisonous fumes, smokes, unsafe storage of non-compatible materials, unguarded and un-barricaded trenches and excavations, cave-ins, sink holes, etc. Other potentially dangerous situations are high pressure vessels and compressors, reactors etc. Each work center developed a safety checklist for each critical and or hazardous equipment/material.

Resolving unsafe conditions:

- Doorways should always be free of obstructions, to permit egress in case of an emergency.
- Always use a ladder or step stool to retrieve anything above shoulder level.
- Keep razor blades, tacks and other sharp objects in closed containers.
- Use the proper tool for the job at hand.
- Secure electrical cords and wires away from walkways.

It is clear that the previous 3S are very useful in providing a clean attractive workspace for the installations and inspection of equipment. Workers should thus consider cleaning as an inspectional aid, and when done thoroughly at first, it will be much easier to keep the area clean later on. Slip, trip, and fall are common accidents that can be avoided easily and cleanliness helps. Cleanliness contributes to making the work area safer and the people who work in it tend to be happier. Happiness is a critical ingredient of quality work; hence product quality tends to get better.

Standardize Phase

The objective is to streamline and consistently follow the first 4S principles so that the results of these stages are maintained and improved on. Successful standardization and adoption work best when the workers are in charge of its design and development. Realizing this, we tried to involve everybody from the beginning of the 6S project. The project team members went around the departments and asked for everyone's input. Team members worked with work centers and their staff became involved in defining the work standards and they created a process in which they could self-measure. For instance, at the start of the project, people documented materials and information flow in their work centers. This got people excited and everyone wanted to get involved. For successful programs we must try to involve everyone in the organization. The people principle and leadership principle (ISO 10018) are quite relevant here. People at all levels are the essence of an organization and their full involvement in the business processes enables their abilities to be used for the organization's benefits (People Principle). Leaders establish unity, purpose, and direction for the organizations. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives (Leadership Principle). Leaders should create environment in which people can influence decisions and actions that affect their jobs. Communications is a major factor for this because it is used to explain goals and promote shared understanding and involvement in an organization [11].

Generally, there are usually standard procedures for critical job activities and when routinely followed, result in high proficiency. However, many other job activities are done by particular workers that have no procedural documentation or standardized techniques. Therefore, workers were requested to develop work procedures and checklists for their activities on a daily and weekly basis, where there were none. Similarly, supervisors were to develop weekly and monthly checklists for their work centers, where none existed. Where complex work areas existed, standard procedure for cleaning was required so as to ensure consistency. The procedures and checklists were reviewed by peers and 6S team members for safety issues. Corrections and changes were made where necessary and appropriate. Where appropriate, safety checklists were also prepared. These documentations helped to provide information for the continued monitoring and improvement hoped for.

Sustain Phase

Sustaining and improving on the gains of 6S is a real challenge and all efforts should be made to help everyone in keeping to each S-principle at all times. It should be recognized that this phase is a never ending one. For effectiveness and success of 6S, workers should be allowed to assume ownership of 6S. This is very important because ownership of a lean 6S project gives the workers pride and a sense of achievement. Usually, they would want to sustain what they have

accomplished [5]. Through standardization, people had opportunities to get involved in deciding the work processes, their measurements, and metrics. This created an environment that allowed team spirit to flourish. Teamwork and collaboration occur when people work together for a common goal. It develops when there is mutual trust and respect between members of a team. Teamwork results from people working together in creative and productive relationship.

The project team established a self-auditing system that finds out if any additional prevention is needed to avoid contamination and decay of an area. The team did not recommend external audits, since they tend to send a wrong message to people. The team preferred "Autonomous Quality" in which people are empowered to define the quality of their work and assume the responsibility of growing that quality at all times. Each worker was encouraged to fully participate and implement the principles and standards of the 6S program. Everyone was to:

- hold himself or herself accountable for achieving his/her goals.
- belong to a 6S team in his or her work center.
- start and grow relationships that help each other focus on achieving the 6S goals.

Commitment to the standards of 6S was secured by requesting workers to sign a commitment slip. A 6S team leader was put in charge of a work center for daily review and audit of activities. The team leaders were to ensure that 6S principles and standards were being followed and to record failings. We noticed that when people are given ownership of something, they seemed to take more pride in it. For example, if people are responsible for ensuring that clean tools are placed back on the peg board, they can usually find those who fail and ensure they start doing the right thing. By assigning people to cleaning stations, a dramatic impact on the cleanliness of the work area was made.

Like any progress we achieve in life, it is critical to do all that it may take to preserve it. At Parker, during the time of closure of each project, members write and say what their commitment would be in order to preserve and enhance the improvement accomplished. Organizations should continually improve people involvement through recognition and reward [11]. Recognition and rewards reinforces people's behavior and understanding of the value their efforts have created for the organization. It shows the organization values its people and cares about their success, which boost employee pride and self-esteem. Teamwork is encouraged by rewarding the team rather than individual team members.

Making 6S Personal

Usually, most people like progress and success but not all are often willing to make the necessary sacrifices. Some people might say, well 6S sounds nice, but I do not have the time to implement it! Naturally, people create time for what is important to them. Hence making 6S personal may be achieved by recognizing how much gain one could enjoy through it. At the personal level, you could experience less stress, cleaner office/workplace, attractive layout of tools and equipment, better health and happiness, higher productivity, etc. Therefore:

1. Decide to dedicate 15 minutes a day to work on 6S.
2. Start with Sort and have a goal of getting rid of 50% of your stuff.
 - a. You can throw them away or give them to someone who needs them.
 - b. You could start by re-arranging your email inbox or pencil drawer. Work on the first 'S' until you have cut down everything by half or close to half.

3. Move to the next S – Set in order.

Move frequently used items to “point of use” and then label your binders, drawers, etc. Consider for instance: a) how you handle your incoming mail. Can you make it easier on yourself? b) starting a new project: setup the new project the same way as your other projects. c) receiving a new magazine: store it in the same place as the others or consider purging the old edition when the new edition comes in. d) expecting a new catalog: ask yourself, do I really need it? If not, call and cancel. If so, then file it where the old ones are.

You can set up a daily work routine:

- Get your mails and process them
- Check your inbox and voice mail
- Clear off desk and arrange work materials not finished for the next day
- Remove any items on the floor and keep it clean
- Develop “to do” list for tomorrow before leaving office

On the Shine phase, make it straight forward with this motto: “Keep Your Work Area Clean”. This means when you are done using tools, clean them up and place them back where they should be. If you are done working at a certain workstation, clean the area and place everything back in its appropriate place. It is upsetting for instance to go into someone's work space to help out and it is in a mess. It is very hard to work in an environment with clustered tools and materials. Consider the stress and frustration associated with misplaced tools, lost items, uncleanliness, etc. Think on how to make your workplace safer. Identify hazards that can be eliminated or minimized. Ask yourself: are there better ways of doing your tasks that saves time, improves quality or reduces cost? As you proceed through each S, you will find yourself getting more and more organized. Gradually, you will see a difference. Remember that developing a new habit requires time, practice, and patience.

DISCUSSION

This project was done in a Parker Hannifin manufacturing facility in Houston where the first author is an employee. He was a project team member during the 6S implementation. He is also a student in the department of the second author who was his supervisor in an independent study course (MFG 433: Manufacturing Technology Problems). The 6S project was used as a case study in the course in the 2013 spring semester. In the independent study course, a student is required to submit a project proposal to the supervisor for approval at the beginning of a semester. A project proposal is assessed on its potential to provide opportunities for a student to develop specialized technical knowledge and skills. Other criteria are managerial/supervisory experience, teamwork, communication, and writing skills. Actual projects in industries are preferred. The supervisor took interest in the 6S project because of the idea of directly treating safety as a distinct phase. Students are required to provide a monthly report on the progress of the project during the semester. Phone calls and emails with a contact person on site provided in the proposal are used to monitor and verify the student’s involvement in the project. A final report at the end of the semester must be submitted. The final report includes the project proposal, monthly reports, and a summary of the experience which must highlights the skills gained.

The decision of Parker Hannifin Corporation executives to undertake lean 6S project was motivated in parts by operational effectiveness and efficiency. 6S project is an extension of the

traditional 5S projects. The introduction of safety as a distinct phase in the traditional 5S is what makes it a 6S project. The two are similar, using the same principles and methods of implementation. The goals of 5S can be fully realized in 6S if properly implemented. Implementation must take account of local facility's issues, situations, and resources and emphasis may change from phase to phase. Since safety is a concern for both management and employee, making it a distinct phase in 6S projects provided an opportunity for all to be reminded of the roles and responsibilities they have towards better and improved safety and health in the workplace. Generally, the project was well received and almost every body became part of it. There was real excitement with time as the workplace became cleaner and more attractive. Recognition and rewards by management infused more enthusiasm and support for the project. Since it was the first time Parker was experimenting with 6S, it was a great learning experience. The emphasis on employee participation was a departure from previous projects. This however, brought more interest and hence encouragement in participating in the project.

CONCLUSION

Parker Hannifin Corporation decided to go "Lean" and chose 6S as a spring board. The 6S project brought different departments together in a unified effort for a clean, better, and safer work environment. In many of the departments prior to the implementation of this project, disorder was evident in workflow and document processing had hitches. Employee participation in the process right from the beginning was very important for the initial success of the project and is helping to sustain the gains. An on-going self-regulated program that instills a discipline to create, improve, and maintain a clean, well-organized, and safe work environment is in place. 6S philosophy has become one of the entire work-culture, thinking process, and everyday mode of operation from management to the manufacturing floor. Team members were able to adapt lean thinking; tools and techniques to reduce non-value added activities, cost and cycle time, while improving quality, customer satisfaction and business processes. Team members acquired the skills needed to improve speed, flexibility, throughput and productivity and to reduce costs.

As the 6S program was implemented, the organization workplace became so clear and obvious that anyone walking through the plant could spot when something is out of place. This immediate visual feedback is critical to a 6S program and lean in general, as it ensures adherence and sustainability of the program. After the implementation, we saw a cleaner workplace, better organized tool racks, faster document processing, etc.

Sustaining 6S is a never ending task, since each new day is a valuable opportunity to improve something. Success needs to be celebrated and in a brief "ceremony", the team and a top management group met for about one hour for celebration. In this closure ceremony, the team leader presented the accomplishments of the project and explained the direct and secondary positive effects realized. There was a mutual commitment to follow up on the purpose and support of the project. As people see results and management recognition and rewards, they are encouraged and so it becomes easier to sustain and improve on 6S gains and successes.

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