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Introduction and Background

Cal Poly Space Systems (CPSS) is a club that has been building high powered fiberglass rockets since 1989. As a club primarily focused on complex projects, it has not seen significant improvement to its infrastructure in years. Recently the club's membership numbers has exploded and it is realized improvements in space utilization and safety is desperately needed.

CPSS occupies a section of building 4A, the old aircraft hangar-turned-machine shop. In this section, specifically rooms 04, 21, 22, and 23, members design, build and store rockets for biannual launch events. This space also holds numerous tools, bulky materials, workbenches and computer desks the club needs for its projects. Along with these club possessions, the space contains a lot of unused property of the college of engineering. If alternative storage can be found for the property, the space would immediately be put to use. As a sizable club, CPSS had to share room 106 with Dr. Tali Freed's RFID Lab to hold its officer meetings. Freeing up any space would permit the club to hold its meetings without disrupting other clubs' operations. Fortunately additional space is available in the hangar. There are three rooms, 20, 25, and 100H, full of derelicts and other non-value items. Furthermore, an open balcony was considered for prime usage soon after rails are installed around its perimeter. If CPSS get permission to remove the non-club property and gets the right to use these rooms, an improved infrastructure will be much more feasible.

Increasing space would see improvement in numerous areas of the CPSS- most importantly safety. Since CPSS members have no choice but to store material on the floor, there always exists a trip hazard. Material on the ground also creates an unclear fire exit. The risk to safety is especially apparent

when one considers all of the flammable materials that go into making a rocket. There are other safety issues one must be aware of when working in the loft: the walls are coated in asbestos; fiberglass, wood, and micro-balloon dust coat everything; flammable substances aren't stored properly; and safety equipment and procedures aren't readily available or apparent. By implementing big changes to the club's work environment, most of these safety issues will be addressed. The asbestos will be walled off; labels and caution signs will remind members to practice safe work habits; and rules will enforce cleanliness as a priority – reducing lung hazards, and making unforeseen jeopardy visible.

It is especially important to the Aerospace department for these safety measures to be implemented. Its introductory course, Aero 121, holds its fall lab in the loft. For many of these freshmen, this workspace is the first impression they get of their department. Increasing safety and improving aesthetics of the loft will go a long way for these students and the college of engineering. There are many other aspects of the workspace CPSS occupies that could also use improvement and most of these aspects will be addressed when this project concludes. It is apparent that many changes need to be made if Cal Poly Space Systems is to continue working in a safe and easy manner.

Literature Review

Figure 1 - Just a Few of CPSS's Projects

Cal Poly Space Systems could use the help of Industrial Engineering Tools. As a club focused on Aerospace projects (Figure 1), its members have relatively little interest in improving its workspace. Very few members of CPSS see the benefits improvements in space utilization, aesthetics, and safety would bring the club's productivity. Neither do they see such benefits as that much possible or sustainable. Indeed, as a club over twenty years old in a workspace half a century older, ages of dirt and clutter hide the opportunities to be had in their workspace. Before anything can be begun, a literature review is in order to introduce the tools that will be used.

The scale of the project will refer to fifteen respectable sources. Eleven will derive from published textbooks and novels, and four will be taken from online journals. In order as discussed in the review, introducing: Some of the best proof of the clubs need for improvements will be abstracted from "The Contribution of Space Syntax to a Comprehensive Theory of Environmental Psychology" [8], "Towards an environmental psychology of workspace: how people are affected by environments for work" [13], and *States of Mind: American and Post-Soviet Perspectives on Contemporary Issues in Psychology [6]*. As work for the project will be done around asbestos, the title *Asbestos: the Hazardous Fiber [1]* will be an invaluable resource. To ensure the modifications meet international building standards, *Building Codes Illustrated: a Guide to Understanding the 2009 International Building Code* [3] will be utilized. *Introduction to Ergonomics [2]* will also be very useful to make sure the new environment is designed for its members in mind. The project will entail design of a new layout so it will require aid from the *Facilities Planning* [12] text. To implement many of the layouts, *The Complete Photo*

Guide to Home Improvement [15] will be needed in construction of various additions to the workspace. And to ensure the additions are within budget, the project will use *Engineering Economy* [11] and *Financial and Economic Analysis for Engineering and Technology Management [9]*. To keep the project organized, *Project Management: the Managerial Process* [5] will be referenced time and again. The project won't be very well approved by its members if *5S for Operators: 5 Pillars of the Visual Workplace [10]*, *Visual Systems: Harnessing the Power of the Visual Workplace [4]*, and "an Investigation into Japanese 5-S Practice in UK Industry" [14] aren't used consistently. To run statistical analysis, *Applied Statistics for Engineers and Scientists: Using Microsoft Excel and MINITAB* [7] will also be referred to.

In general it is a good idea to improve working conditions. Evidence is mounting that employees may waste time and energy trying to cope in poorly designed workspaces. While students invested in a club aren't as directly tied to an organization's profits, as say a factory worker, their gain in experience is certainly valuable. It is true their extra time spent looking for a drill bit doesn't hold a product from being sent out to consumers, but isn't it true that part of a club's purpose is to prepare students for their careers? Therefore the following supportive information holds for a club's membership as it would for a company's workforce.

Environmental Psychology is one of the foremost promoters for spending resources to improve workspaces. Defined as the study of the interface between human behavior and the sociophysical environment, environmental psychology is well versed in the subject. Environmental psychologists' objective is to identify components of the physical environment which impede or facilitate people's behaviors and actions, or, search for ways to create positive, beneficial energies between people and places. They use surveys similar to the one that will be used in this project to assess what needs to be changed to bring environmental improvement in production and satisfaction. Limitations of what can be improved come from economics, power, and public opinion. As a result, only the most pronounced

survey results can be looked into. This project won't be trying any major initiatives that can't be afforded by the club and department within one year. [6]

How does the Environment influence human psychology? The next two paragraphs will address this significant point for the project. The influences are seen through six mechanisms: sensory access (what is seen, heard, etc.), attention (what is looked at, listened to, etc.), memorability (What is remembered and forgotten), behaviorable affordance (What one can walk, eat, etc.), affect (mood, comfort, stress, fear, aesthetics, etc.), and sociality (pedestrian flows, noise, eye contact, social distance, etc.). These mechanisms usually come in the form of physical barriers like walls that will be constructed in this project; and in the form of signage, which will be utilized as well. Mechanisms implemented correctly can make information easier to apply or lead to positive emotional responses like happiness and calmness. On the other side of the spectrum, not implementing mechanisms correctly can create opposite effects like harder application of information, or fear and anxiety as emotional responses as seen in Figure 2. The degree that an environment's parts differ from one another can also create emotional responses and affect productivity. Environments can be so differentiated that they appear chaotic and disorient employees. People like to comprehend their surroundings and it is much easier to attain comprehension when there is an overall pattern than can be understood as a single simple shape. Thus it is important to standardize the signs and make sure they can be seen throughout the area. See 5 S later in the Literature Review for clarification how it will be implemented in this project to reduce the effect. [8]

Figure 2 – CPSS Space shared by Engineering Department

Poor working conditions may also arise from ambient environmental conditions, furniture layout, ergonomics, and process issues. Working conditions influence employee feelings of satisfaction, sense of territory, ownership and belonging, and productivity. It isn't enough for people to be healthy and safe; they need environmental support for activities they perform. The workspace design also affects people's commitment to their employer and the design creates new knowledge in the organization. Surveys have found that people's preferences are affected by indirect lighting, mechanical ventilation rates, access to natural light, acoustic environment, and especially participation in decision making. Environmental psychology makes the claim that employee energy should be spent being productive and working, not trying to cope with these ignored preferences. Many employers forget that the sole purpose of a workplace is to support performance of work. To improve the workplace so that it can bring the most benefits, control should be provided to employees. They should also be trained so that they know where to find and how to use the control. The workplace needs to be adaptable so that it can take this new ownership of control without additional problems. It needs to cater to group territory along with individual needs – so boundaries must be appropriate. These two traits can be improved by considering a change of the floor layout. These problems will have a price tag, but they will be worthwhile. Environmental Psychologists have found that investing in ergonomic workspace and training in ergonomics had a payback of 5-months from the increase in work productivity. Data also suggests that illness rate decreased, while speed, accuracy, and idea generation increased. This is as opposed to ignoring these opportunities and allowing employees to develop learned helplessness and demotivation from lack of empowerment. [13]

Before Cal Poly Space Systems can see improvements in its environmental psychology, its safety needs to be addressed with regards to the asbestos that covers the walls. The Cal Poly Machine shop was once an Aircraft Hangar that held and repaired aircraft for the runway that are now baseball and soccer fields. This was in the 20's. Since then, increased standards have been developed to promote

safety for modern buildings. As it stands, the machine shop is condemned for its asbestos. However asbestos is costly to remove and it is unlikely the building will be torn down in the near future. Until funds can be gathered for the unfortunate operation, the building will continue to be used. Thus it becomes necessary to find ways to avoid contact with asbestos and find ways to deal with the flunked building codes.

It has long been known of the useful properties Asbestos has. Indeed, the fiber has been used by people since 2500 B.C. Apart from its harmful effect on humans; it really is a magical substance.

Figure 3 - Asbestos covers the workspace CPSS must use

However this review will only focus on the properties that apply to the project. The asbestos on the hangar walls were likely applied to protect it from fire. Asbestos integrity can be maintained under temperatures as high as 800 degrees Fahrenheit. As one would expect, this keeps the steel walls of the hangar standing longer while fire fighters can arrive on the scene. Less known about asbestos is its resistance to abrasion. The fine diameter fibers have a higher degree of tensile strength so anything covered with it can be expected to survive rust and launched particles (it is a machine shop). The last property of notice is its ability to absorb sound waves. A running plane motor and power tools produce a lot of dangerous levels of noise on the ears. One can appreciate the positive effects of asbestos. However the benefits are far outweighed by the effects it has on health according to the Federal Government. The Asbestos Hazard Emergency Response Act states that any amount of asbestos is hazardous. It can affect the body through the skin, the lungs, and the digestive track. While data of the risks of contact to asbestos is inconclusive with respect to skin and digestive track, the respiratory track still remains a relatively high danger for people that process the material on a daily basis. Death from Asbestosis, Bronchogenic

Carcinoma, and Mesothelioma, all diseases of the lungs, rarely strikes people that don't work around the substance. It is estimated only 1 out of 100,000 people (1985) die each year to Asbestos where as Motor Vehicle fatalities make up 1,600 deaths (1975). The Asbestos in the hangar won't affect anyone working around whether or not it is disturbed. Regardless, the fibers are still considered a threat to safety. [1]

The next consideration in the project is how well the workspace follows building codes. Building codes are designed to create a safe environment for a building's occupants and to a lesser extent to preserve its non-biological items. Building codes is a vast topic designed to cover every building type. As such, this section will focus only on those codes that pertain to the project. Perhaps the most influential hazard in building design comes from its perceptibility to fire. While there are no fire sprinklers in the hangar, a fire extinguisher is made available for use. Members will also have enough time (rated 1 hour) to egress down the two exits and if need be, over the 9' high balcony. In terms of egress, the mezzanine meets all but one code. It does not have a safe and quick means for handicapped occupants to leave the building. Since either a ramp or a lift would need to be installed, this is an issue that is far too large in scope to tackle in this project unfortunately. However, a handicapped person would likely not be up in the mezzanine to begin with. To highlight the proper route for egress, this project will have exit routes designed and visible for members. An exit sign will be hung to alert occupants of the location of an exit as well. At the time being, a door is blocked by a cabinet while things are moved for preparation of the project. Once complete, the door will no longer be blocked so that occupants won't have a false exit. Lighting is an issue that this project will try to address. Codes enforce that sufficient lighting be provided to stairwells.

Figure 4 - No Handrail

As the workspace has two, two lines of lighting may need to be installed for times when members work late. However since members don't usually work late and the cost of installing wiring may be prohibitly expensive, this issue may not resolved in this project. Another issue comes from the lack of handrail on the mezzanine (figure 4). Handrails must be designed to resist a single concentrated load of 200 lbs or 50 lb per lineal foot. The Handrails that will be designed in this project will exceed these requirements to ensure students can trust them. By following proper building codes and meeting Asbestos requirements safely, CPSS members can work on their projects in ease and the school won't attract negative attention. The next section will address the importance of ergonomics in a workspace. [3]

Figure 5 - Benefits of clean floors and floor tape as illustrated by shipping area of company senior interned with.

The human body is an adaptable machine. But like all machines, it degrades faster from improper use. Expecting the body to operate as productively in poor lighting is like expecting a car to have peak performance with flat tires. The purpose of ergonomics is to study and improve the interaction between the human machine and its environment. It searches to eliminate inefficiency, work fatigue, accidents, errors, user difficulties, and bad moral. To address inefficiency, the workspace will be designed so that time isn't wasted walking to and looking for tools. Accidents will be avoided when everything else is given an identifiable location (figure 5). User errors, although unavoidable, will be reduced by properly labeling locations of tools and having manuals readily available and known to members. Users won't have as many difficulties as a result of the changes mentioned above and more. Poor morale certainly won't be an issue once members know what they're responsible for and they see the bright painted walls. These ergonomic changes are but the tip of the iceberg. Signs will be designed for colorblind members (the club has at least one). They will be appropriately sized, colored and contrasted with the environment. Lighting may be added to improve illumination for both direct and indirect needs. In terms of noise problems, ear plugs will be made more available. The possible enclosure to be built should also reduce the effect of indirect noise that would otherwise bounce off the metal exterior walls. It should be obvious that Ergonomics share many similarities with Environmental Psychology. Both fields correspondingly also have many of the same benefits. Investing in ergonomics

usually pays itself off within one year. Making changes to the way employees lift heavy loads can significantly cut the thousands in losses incurred from a single employee having back injury- a very common accident. Ergonomics will play a major part in this project because of its affordability and results. [2]

When the human factors have been taken into consideration, it becomes necessary to design a layout that satisfies those factors. Since 1955, 8% of the GDP has been spent on new facilities. If the projects are planned with minimum error, the investment should mean billions in profit. This figure highlights the importance of facilities planning. As mentioned previously, a facility must meet many building codes and OSHA requirements. It should also be designed with the work and employees in mind by being ergonomically sound. The plan should follow a 9-step process to meet success: 1. Define the objective; 2. Specify the activities that must be performed to accomplish objective; 3. Determine interrelationships of all activities; 4. Determine space requirements for all activities; 5. Generate alternative plans; 6. Evaluate alternative plans; 7. Select plan; 8. Implement plan; 9. Maintain and adapt plan. When the process isn't followed, unnecessary expenses accrue that will grow larger as the project progresses. The project will use Google Sketch Up as the primary layout program. The tool will give the designer a visual overlay of the workspace that will let work flow be established with minimal travel waste. It will also let a viewer virtually walk through the environment and get a perception of the changes before any are made in the real world. Please consult with the Layout section to see changes that will be made. [12]

It has been discussed time and again in the review of construction being undertaken in this project. Construction of an enclosure and railing will make up most of the expenses of the project so it is necessary to ensure they be completed correctly to avoid costly mistakes. In this project, walls, rails, and flooring will be worked on. Before construction can begin, the building department needs to be

contacted and okay the plan. They're most aware of the regulations that must be met. Once approved, members will start basic and add more detail as the project progresses. In terms of the walls, the frame must be completed before the drywall can be installed and the paint applied. On a similar note, floors should be completed after the walls are installed. To build the walls, the floors must first be marked for where the walls will rest. This will prevent a wall from being built too long or short by accident. Next, partition studs will be nailed together 16" apart with a nail gun as is standard in industry. The walls will then be fastened to the floor with nails. Access will be given to reach electrical outlets. Once in place, drywall will be cut to shape and nailed into studs. Corners and joints will then be taped for seamless transition between boards. Similar work will be done for the railing around the balcony. The difference is a wider spacing between studs, more secure fastening to the floor, and the use of plywood instead of drywall. The floors will next need attention. They will be sanded of epoxy and residue, and given paint to brighten up the workspace for its members. The walls will receive similar treatment with a paint roller. They will get a few coats of primer, and paint each. [15]

Is this project economical? Will it be worthwhile in the long term and will it be financially feasible in the short? Many of the jobs of the senior project involve large amounts of funds relative to the club's budget, many of which might not be possible this year to implement. The key to determining the value of an investment is to analyze its alternatives. In the case of the walls, the project's largest expense, if the walls aren't purchased, the club will dedicate more of its budget to its certification program or annual project. As the club's primary goals are to achieve industry recognition and to continue to grow, investing in growth will run parallel to supporting the goal for each member to have their own rocket, and investing in a huge project like this year's 20,000 ft. altitude competition may get support from aerospace companies if the club wins. Obviously more can be attained when club members can spend more on their rockets by purchasing better materials and electronics. The depreciated method will be used to determine which investment holds more value. As a possession

ages, it loses value due to inflation, and availability of newer technology. Walls have seen little innovation for ages. Their purpose is to separate areas and nothing obtains this goal better than studs, plywood, and nails. On the other hand, the club workspace is littered with many incomplete projects. Parts in a rocket would be reused if lighter, stronger, and more reliable alternatives didn't exist for relatively little cost. They've depreciated to the extent that they're not worth salvaging. Obviously such equipment holds more value for its first few years. And since the club goes through new membership every 4 years, attracting new members every year with exciting projects is a big part of the club. It becomes apparent that established accounting tools are needed to put a value on each alternative. [9, 11]

The budget is but a small portion of a project. This section will focus on the tools that will be used to manage the project from beginning to end. In addition to the requirements for the project, there are even more ways to make a project effective. A project can more or less be broken down into four stages throughout its life. A project needs a problem that it must be defined before anything else can be completed. This step involves setting SMART Goals, determining responsibilities for numerous tasks, and formulating specifications. Next stage followed is the planning of the many elements in a project. This involves setting a schedule and budget. It requires each responsibility to be manned by an employee, and for risks and current resources available to be established. The third stage involves the difficult work with executing the plan. One needs frequent status reports and forecasts to stay on top of how the project is proceeding. It needs quality controls that aren't too strict to prevent often inevitable change. The last stage involves delivering the project's results to the customer whether that is inside or outside of the company. Customers are trained, documents are transferred, resources and staff are released, and lessons are learned. For this project, defining and planning should take the longest time as it is supposed to be a new project which the senior is unfamiliar with. Executing will come as a close second followed last by delivery. Handing off the project should be easy considering much of the project

is focused on sustainment of its principles (see 5S in next section). Although the senior is the VP, it is still important for him to consult with the club with most aspects of the project to prevent an implementation gap. This will also keep funding for the project visible. The project will use a Work Breakdown Structure, Responsibility Matrix, and Communication Plan to keep it organized, members familiar with tasks ahead, and in touch, respectively. A risk assessment form is a good way to decide what actions to take given a negative condition happening. However the primary means to reduce risk likely involve reducing scope when something can't be afforded. And an important part of any project comes from the manager directly. If a manager can effectively lead a team, they stand a substantially better chance of being successful. But team manager isn't the only piece. A manager must juggle top management, customers, government agencies, other managers, and other stakeholders. It's important to reward various stakeholders with several currencies available to give away. A manager can give away resources, personal assistance, and information, and be cooperative. He can promote, recognize, or make visible employees, or he can introduce the person to others in his network. He can give others a vision to continue towards and a chance to do what's right. There are many other currencies. The fact is there are many ways to reward people and gain their trust and cooperation in turn. To determine if the project was successful, the same survey given in the beginning will be again sent out to club members. If progress is properly tracked throughout the projects cycle, results can be used for future club projects to avoid mishaps that might have occurred and practice what might have been productive the first project. [5]

Saving the best for last, 5S is a critical yet affordable piece of the project that will bring the most profound changes to the club. First some background: Industrial Engineering has been helping industry since the 19th century Europe and North America. After World War II, Industrial Engineering principles were shared with Japan as part of the Allied Economic Recovery initiative. Some suggest that without the principles, Japan would not now have the 3rd highest GDP in the world. Japan not only adopted the

principles, but provided the catalyst for the tools to evolve. What came out was 5S, a well established quality technique.

The Goal of 5S is to create a workplace that is cleaner, safer, and organized. It achieves the goal by proper implementation of each S: seiri, seiton, seiso, seiketsu and shitsuke. Their English equivalents are Sort, Set-in-Order, Shine, Standardize, and Sustain respectively. Sort is the process of separating items that give value to a product or service from non-value items. Non-value items will be either tossed or recycled in another part of the facility. Removing stuff that would otherwise take up space actually saves the organization money. Space not being used productively could otherwise be used to hold another machine that could run full time, or be used for storage of slack inventory. Normally any space in a facility has a cost. And often, non-value items hide what is needed and they can make daily searches for needed parts a reality. Once non-value items are gone, space is now available to see what one has to work with for the next step. Set-in-Order takes the space now available and moves valued items into it. These items are placed so that material and tools used more frequently is the first to be accessed. This step may very well involve changing the entire layout of a facility. The third step, Shine, is the ritual cleaning of the workspace so that nothing is hidden by dirt. As with all steps of 5S, all personnel from the operators to management must practice shine. The idea for the 4th concept, standardize, comes from the belief that a worker shouldn't have a difficult time adjusting to working in another job. Except for specific tools, each workstation should be organized the same as its neighbor. This way, if a tool is missing, someone can borrow one from another. Or that someone can cover for a coworker if sick. Now that the workspace is more efficient with regards to space, cleanliness, and standards, the only step that remains is to keep it that way. Sustain, one of the hardest steps to implement, involves changing the culture of the organization to continue previous 4S's. Signs need to be hung to constantly remind people, people need to be educated in new standards, audits need to be performed each month (figure 6), and management

5S's/VISIBILITY CLIPBOARD CHECKLIST

AREA	DATE	LAST SCORE	TODAY'S SCORE
Small Parts		0	21.5

SCORING GUIDELINES

0	1	2	3	4	5
ZERO EFFORT	SLIGHT EFFORT	SQUEAKS BY	MINIMUM ACCEPTABLE LEVEL	ABOVE AVERAGE RESULTS SUSTAINED FOR AT LEAST SIX WEEKS	OUTSTANDING RESULTS SUSTAINED FOR AT LEAST SIX

DESCRIPTION	*SCORES*		
SORT			
	03/01/08	07/27/10	New Score
1. Only the required **supplies and raw materials** are present at the work place. All non-required items, to make the current product, are removed from the work place.	0	1.5	
2. Only the **required tools and gages** are present at the work place. All non-required tools and gages, to make the current product, are removed from the work place. Required tools and gauges	0	1.5	
3. Only the required **paper work** is present at the work place. All out-dated posters, memos, announcements, reports are removed from the work place. out-dated posters, memos	0	0.5	

Figure 6 - Example 5S Audit Form

needs to support 5S to its fullest. There is a reason why Toyota has become one of the foremost car companies in the world. Indeed, after applying 5S, many people find they have 60% more floor space. They find that employee morale is improved since they no longer spend countless hours every week looking for lost tools. They find that customers prefer their company over competition's because a clean, organized workspace looks more productive and professional. They will also find that employees become more agreeable to more lean techniques after seeing the results of 5S. After 5S is applied, statistics will need to be run to assess the worth of the project. [4, 10, 14]

As most of these changes are going towards an organization that's goal is to finish club projects and not to turn a profit, traditional measures of success of this project improvements won't be seen without the use of surveys and statistics to analyze the subjective opinions of its members. In the beginning, club members were asked to complete a voluntary survey that asked what they felt about the CPSS workspace. After the projects gone its course, the same survey will be given out again and changes in responses will judge how successful it was. The study will be statistically valid because there will be over 20 samples each run. Answers on the survey will be completely numerical as statistics can't make anything of comments and opinions. With the data, hypothesis's can be run to prove with confidence the effectiveness of the project. Future students and others considering improvements to their environment will know how much value the project has. [7]

From the tools in Environmental Psychology, Ergonomics, and 5S, Facilities Planning to efforts in Safety, to ensuring the project is successful financially, productively, and within schedule, the scope of the project will require much planning to make sure it is successful. These 15 textbooks and journals will be invaluable sources of information that should make application of the plan much more feasible.

Design and Methods

Increase Space

> Note: This section relies on knowing rooms by their room numbers as they don't have a title yet. Refer to the building map and photos in Appendix – Photographs for reference.

The first plan of action was to find new space for Cal Poly Space Systems. The club was outgrowing the rooms it occupied on the second floor and it was realized it needed someplace to serve as a storage site for its projects. Another club also took over CPSS's conference room, 115, the previous year so finding a place for officers to meet was a priority. Dr. Freed recognized the problem and gave CPSS permission to use her RFID conference room 106D until the club found a more permanent location. It should be mentioned that CPSS only officially has room 4 in its name despite its long history. The club's advisor, Dr. DeTurris, was worried that taking over more rooms might attract negative attention. She became an invaluable partner once she was convinced of the definite need the club has for more space.

There were two rooms, 20 and 25, seemingly abandoned on the second floor that looked like potential solutions. Dr. DeTurris used her influence to gain access to these rooms. Room 20 was a pristine office seemingly abandoned years ago. Room 25 was an extremely dirty, packed room used for storage. The club was immediately brought on board to the project once members saw the potential for the rooms. After observing the results, the club's president found another room on the first floor, 100H that was quickly taken over as the club's electronics room.

Initial Sort

The second part of the plan was to begin 5S by removing non-valued items. Room 20 was relatively easy because it was only filled with office supplies. Still, care had to be taken to not toss things that might belong to the previous occupant, Dr. Gould. Her things were stored in boxes and placed elsewhere until she was able to be contacted. Room 25 was much more challenging. Respirators were worn to not breath in the dust thickly layered on the items in the room. 40% of it was obviously trash and was tossed; the remainder required contacting their owners. Dr. Eugene Judd had a number of boxes filled with old projects in the room that he helped remove. Dr. Peter Lee was once the Dean of Engineering and had many boxes that could not be discarded. He could not pick up the boxes or have them thrown out so it was decided to move them elsewhere. The rest belonged to the College of Engineering. The Associate Dean and DeTurris had to go through dozens of boxes to ensure no important documents were mistakenly being thrown out or not shredded first.

The initial sort process also included clearing unused things in CPSS's previous rooms. As CPSS's primary room, 22 held most of its tools, materials, and projects. However about 30% of the room was filled with the possessions of the professor Dr. Bill. He could not be contacted, but because he was the one to initially give the club access to the room years before, throwing away his things were not an option. His possessions were temporarily moved into the hallway until more permanent storage could be found. The balcony was the last major zone needing to be sorted. Since it would be the area for the railing project, it had to be cleared of everything. Fortunately no search for its owners was necessary because all of the items belonged to CPSS. Some of it was tossed, but most of it had practical or historical value that required temporary storage while construction commenced. Most of it was placed in the now-cleared room 25.

Initial Set in Order

The second phase of 5S is putting valued items into an easily accessible location. Over a weekend, room 20 became the club's conference room for most of the year. Next, room 21, the club's office, gained a few computers that were in room 4. They would help new members design working rockets and would allow officers to draft up documents for the club. Room 22 saw a major make-over. Tables were pushed towards the wall to free up walking space, completed rockets were moved into room 4 where they wouldn't be in the way, and tools were better organized on a newly acquired shelf that was moved out of room 20. For a room that has always been stuffed, being clear and organized really had a positive influence on member's morale and productivity. Many of the things still took up space, but they were in better managed, less inconvenient locations, until final sort could be completed.

Funding

The project was not just about 5S. It also had parts that involved pricey construction. Because the club was involved with another expensive project, funds were not available to purchase needed supplies. The IME Student Fee Committee was the first source approached because it was an IME Senior Project. They were first asked for $1000.00 to purchase supplies for the railing and asbestos enclosure. They did not approve the request because there were concerns that the asbestos was unsafe for the students, there was no Building Permit from Facilities Services, and because the workspace belonged to the Aerospace Department. Naturally, the Aero Student Fee Committee was the next source approached. They approved $500.00 for construction because they saw the direct benefit it would have for the department's Aero 121 class that shares the manufacturing floor Fall Quarter. They did not approve of the rest because they felt since it was for an IME Senior project and that IME should fund the other half. $500.00 was enough to build the railing, but the project still required at least $1000.00. The

IME SFC was approached again Spring Quarter for $500.00 but they rejected the plan because they were still concerned with asbestos exposure to club members while building the enclosure.

Railing and Enclosure

On the manufacturing floor, there is an exposed balcony that overlooks the rest of the hangar. Building a railing around the balcony would prevent a student from falling nine feet down and it would free up more space for club members to work. The first step was to remove the railing that partly blocked off the balcony. These segments were then used as components for the final railing. The design borrowed from the current railing in the hangar. It had to be strong enough to withstand a student charging at it, so it was best to design around a proven concept.

Half way through construction, Facilities Services notified the club that this kind of work requires a building permit. It was known that the Asbestos Enclosure needed one, but it was believed that the railing project wasn't significant enough to require Facility Approval. Mr. Hogan, Cal Poly's Construction Inspector, over several weeks, worked to get the subproject going again properly. To safely construct the rails and use the balcony, he required an extensive plan and proof that the room's ceiling below (electronics room) was rated strong enough to support foot traffic. However no proof could be found. Since the alternative was tearing up the floor boards and doing structural analysis on the ceiling's strength and possibly reinforcing it, the railing subproject had to be scrapped. Doing analysis was a senior project alone and it would have been outside the budget. Unfortunately this meant the balcony could no longer be used for storage purposes either. The next few weeks were spent putting up railing to close off the balcony (Figure 7).

Now that Mr. Hogan was on board with the Senior Project, he worked to ensure proper plans were submitted for the Asbestos Enclosure. Note: the Building Permit Request can be viewed in the Appendix. He had to be sure that the project was safe for students and that it met California regulations

for Government Property. He spoke with the Fire Marshall over concerns that the wood studs might be a fire hazard and he talked to Cal Poly's Chemical Safety Specialist over concerns with Asbestos - neither of whom found any issues with the construction. Still one issue remained: the construction was occurring on a building that was not handicap assessable. According to the American Disabilities Act, a building can't have any major modifications unless it is made accessible first. This problem shut down the Asbestos Enclosure because, like the railing, building a ramp to reach the second floor was outside of budget and the scope of the project. Estimates for a ramp ran over $15000 and it would have taken up space that doesn't exist in the hangar. Figure 7 shows what the ramp might have looked like in the hangar. It also would have taken over one of Cal Poly's Automobile clubs' spots.

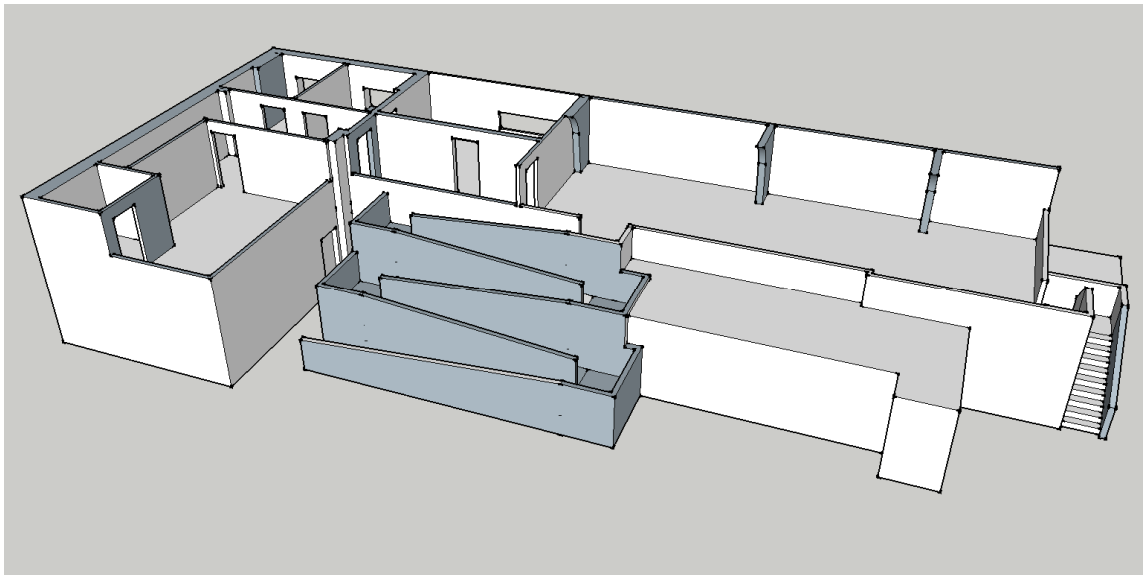

Figure 7 - Modeled Handicap Ramp

Research Temporary Storage

Due to having to keep the boxes owned by Dr. Lee, and Bill, it became necessary to find a place for them until they could be picked up. There was no room on the second floor without being in the way so rooms in the neighboring building were considered: 114A, 114B, 214, and the throughway to 214. 214 looked like it was the least used and most secure so all of their things were carried across. Clearing these boxes freed up approximately 100 square feet and made the area look much more professional.

Give before survey

The initial survey was intended to be given before anything was done on the project. However due to other setbacks, it had to be given about halfway through the project. This should not have affected the reliability of the survey because photographs of the area were taken before anything was done. Sixteen members took the first survey anonymously, and helped give the project direction on what to focus on. It made clear the importance of cleaning the workplace and taking measures to improve how professional it is. The survey results can be seen in the Appendix.

High Pressure line installation

Using the budget from the ended railing subproject, a high pressure hose line was installed to give Cal Poly Space Systems the benefits of pneumatic tools. The hose hooked into a nozzle in the Electronics Room that was part of the hangar's pressure system, and it was strung up to the second floor. The line should given CPSS the capability to sand fiberglass faster, cut more efficiently, and vacuum bag parts more effectively. It should also cut down on the annual expense of replacing broken electric tools that can't stand up as well to abuse.

Final sort

The step of final sort involved removing non-valued materials owned by CPSS. This step was tricky because at any one time, several projects can be worked on under one's nose and be tossed accidentally. The goal was to only remove useless scrap, broken rockets that have no historical significance and other trash. All historical items and questionable material was moved into the electronics room for next year's officers to decide upon. The purpose of this is to serve as a red tag. If one item had no use the previous year and it has no use the current year, then it doesn't need to be here. Fortunately the electronics room is rather spacious and can fulfill the role of a storage room.

Final Set in Order

Many changes were made since the initial set in order. Since the club now had room 25 free to use, it meant rearranging and repurposing current rooms. To determine which room would satisfy which club requirement, analysis had to be made on what a room could provide. Rooms 20, 21, and 22 had doors sealed off from the loud and open machine shop. The club required a quiet and spacious conference room and a quiet office so it only made sense that room 22 became the conference room. 21 was already the club's office and so it was conveniently kept the same. The club's tool room did not require quiet, only space. This is why room 25 would become the new tool storeroom. All that was left was room 4, 20, and the electronics room (the manufacturing floor would obvious stay the same). The electronics room was kept the same because it had free outlets and was quiet. Room 4 was far from club activities so its best use was continual storage of the club's completed projects and event supplies. Room 20 was decided based off the need for personal cubbies. There are many member projects and often time's parts can become lost or tubes can be mistaken. It did not need to be quiet, but it had to be clean and of sufficient space. Room 20 already had shelves perfect for serving as cubbies so it became the club's personal rocket storage space. The work for each room is detailed below:

1. Office: The office was simply cleaned since the initial set in order.
2. Conference room: For room 22 to become the conference room, all of the desks, rocket supplies, tools, and nuts and bolts had to go into room 25. And all of the chairs, and whiteboard had to come out of room 21.
3. Member storage: A shelf from room 22 was moved into this room to serve as a cubby for club members and the room was cleaned well.
4. Tool Storeroom: Because the tool storeroom overhangs a machine shop, it collects a lot of dust. Since the last sort, the room had to be cleaned again before it could become operational. The second floor of the hangar is also home to half a dozen desks, 3 of which were used as a service to hold supplies for the tool storeroom. Once the storeroom was cleaned and its tables, desks, and shelves were in place, the contents from the old tool room were given logical places. Tools were placed on one shelf, epoxy and cardboard was placed on another. Movable lights were located in one corner, rolls were placed on a slanted table for easy access, foam was placed on top of a table, nuts and bolts were placed on a desk, and similar odd and ends were placed in desk drawers. Refer to photographs in appendix to see the scale of the project.
5. Manufacturing floor: Because the asbestos enclosure was never completed, the manufacturing floor did not receive as much attention. However, there was a lot of scrap beneath a table that was organized for future use. And PVC pipes used for rolling tubes were given a place on shelves. In addition, much of the lumber purchased for the railing had to be stored on a table since the material had a lot of potential for future club projects.

Shine

Shine is one of the harder parts of 5S to maintain. It requires workers to clean up after themselves dutifully, generally at the end of the day. As a result, it usually can make one feel like its directly preventing an early workday. However it is amazing how simple yet powerful keeping a

workspace can be. It still requires a change of culture for members to clean up not only their space but keep an idea on the workspace in general. It really requires dedicated management, in this case officers, to enforce a cleaning policy each week. This project worked to start up this change of culture by creating a shine zone in the tool room. The first thing a member sees when walking in to grab a tool are all the brooms, dust pans, and cleaners for keeping the workplace clean. It's to remind them and make it easier for them to clean up. This project also involved putting up a sign reminding members to clean and give them suggestions on what they could do.

Standardize

Traditionally, Standardize's purpose is to make it easy for employees to find things and do their job no matter where they work in a company because each workstation is nearly identical (e.g. pens in top drawer, tape in bottom). Since CPSS's layout and size is different where there is only one location for something (tape in tool storeroom), this project interpreted Standardize to mean labeling the locations where things belong. Normally only one or two officers know where everything is in the club. With labels, everyone can find the tool or material they need to do their job without 1. Bothering an officer, 2. Wasting time looking for something, and 3. Putting something back in the wrong place. For the project, each room has a sign reading its name. Now members can say "John is in the Electronics Room," rather than "John is downstairs." The tool storeroom has labels on shelves and drawers reading what they contain. The Member Storage Room has labels for members to write their name to claim a cubby and each of their rocket body tubes are named to avoid mix ups.

Sustain

Like Shine, Sustain is a hard S to follow. It involves everyone's cooperation and a cultural shift in the club's thinking. The purpose of Shine is to maintain the changes made without falling back into mess and disorder. For this project, the officers were spoken to about the importance of sustaining the

changes made. They decided on creating a new position titled “Organization Lead” who would be in charge of enforcing this policy in addition to practicing “continuous improvement.” The club was also sent an email to summarize this project and making it clear the importance of following 5S. A copy of the email was included in the Appendix.

Results

			Initial Results	Final Results	Percent Improval
1	How safe do you feel in the workspace?	1 2 3 4 5 6 7 8 9 10 Unsafe Safe	6.7	8.5	27% good
2	How comfortable are you in the workspace with respect to temperature?	1 2 3 4 5 6 7 8 9 10 Uncomfortable Comfortable	5.5	7.8	41% Void
3	How comfortable are you in the workspace with respect to noise?	1 2 3 4 5 6 7 8 9 10 Uncomfortable Comfortable	4.1	5.7	40% good
4	How professional-looking is the workspace?	1 2 3 4 5 6 7 8 9 10 Unprofessional Professional	3.6	6.6	82% good
5	How sufficient is the lighting in the workspace?	1 2 3 4 5 6 7 8 9 10 Insufficient Sufficient	4.3	7.0	65% effect of shine
6	How clean is the workspace?	1 2 3 4 5 6 7 8 9 10 Unclean Clean	3.8	7.1	89% good
7	How organized do you do you think the club is?	1 2 3 4 5 6 7 8 9 10 Unorganized Organized	6.1	7.1	17% good
8	Do you believe the lack of cleanliness affects how much work you get done?	1 2 3 4 5 6 7 8 9 10 No Yes	6.8	2.5	-63% Poorly Worded
9	What do you believe should be the club's main focus? If other, write down here:_____	1 2 3 4 5 6 7 8 9 10 Team Projects Personal Projects	3.3	3.7	12% Neutral
10	How often do you think the club should meet each week?	1 2 3 4 5 6 7 8 9 10	1.7	2.4	39% Neutral
11	What percent of the stuff in the workspace do you think actually belongs to CPSS? (leave blank if 0%)	10 20 30 40 50 60 70 80 90 100	61.9	82.3	33% good
12	When did you join CPSS? (Month, Year)				
13	On average, how long do you spend looking for tools, parts, etc.? (in minutes)		9.5	6.8	29% good
	Please rank the importance of the following projects	Unimportant Important			
14	Installing walls over aspestos	1 2 3 4 5 6 7 8 9 10	7.3	6.5	
15	Installing railing around balcony	1 2 3 4 5 6 7 8 9 10	8.1	6.5	
16	Building personal lockers for each member	1 2 3 4 5 6 7 8 9 10	4.4	6.5	
17	Painting the floors	1 2 3 4 5 6 7 8 9 10	2.8	2.2	
18	Painting the railing	1 2 3 4 5 6 7 8 9 10	3.3	3.4	
19	Creating a mandatory clean up period each meeting (5-10 minutes)	1 2 3 4 5 6 7 8 9 10	7.4	7.5	
20	Setting up additional lighting	1 2 3 4 5 6 7 8 9 10	7.4	6.8	
21	Installing a high-pressure line (for pneumatic tools)	1 2 3 4 5 6 7 8 9 10	5.0	6.2	

Figure 8 - Survey Results

At end of the project, CPSS members were given the same survey to fill that they did earlier. The initial survey results and final survey results can be seen in figure 8 where

$$Percent\ Improval = \frac{\text{Final Results} - \text{Initial Results}}{\text{Initial Results}} \times 100\%.$$

There are 3 results to note:

1. Question 2 influenced by change of season. First survey given in winter, second in spring.
2. Nothing was done to influence lighting in the workplace for question 5. This improvement is likely a side effect of cleaning the workplace.

3. Question 8 is admittedly poorly worded. It was meant to get member's opinion of the importance of cleaning, and they probably interpreted it to mean how clean they think the workplace is because of negative word.

In other words, no result decreased as a result of the project. Members felt safer and more comfortable. They thought the workspace looks more professional, is cleaner, is better organized, and is better utilized (33% more ownership by the club). In addition, club members spend 29% less time searching for tools. These incredible results lend credit to the power of 5S.

Shortcomings

In the beginning of the year, this project had a grand plan to bring changes to every aspect of CPSS. It really was an attempt to improve CPSS in every way. However, due to various constraints, the scope had to be slashed in order for it to meet its deadline and stay within the budget. The project also ran into issues with Facilities Surfaces. They were by no means rude, cruel, or unprofessional – they just could not let certain aspects of the project continue for safety and regulatory reasons. Below is a list of shortcomings that the project had. It may seem like a large list, but that is the nature of project planning over a long period of time.

1. Scope too large
    a. Didn't put as much attention on downstairs rooms
    b. Didn't include furniture in layout plan – chose final positions based on experience
    c. Didn't do 5s on tool cabinet on manufacturing floor
    d. Utilized current tables, desks, and shelves available for storing material, tools, and member storage rather than build them myself. Looks less professional, but it works
    e. Only painted the railing
    f. Didn't lay walkway tape
    g. Didn't build/purchase a Fiberglass dispenser
    h. Didn't organize tool storeroom nuts and bolts. Estimated time = 5 hours
    i. Didn't organize office cabinet and books
    j. Didn't make shadow boxes or boards as part of standardize
2. Limited budget
    a. Didn't pursue flammable material storage. Very expensive. Club owns old ammunition boxes that it keeps its flammable materials in.
    b. Didn't buy Epoxy dispenser

c. Didn’t buy tabletop covers

3. Facilities Services Constraints

    a. Didn’t set up lighting because of electrical issue

    b. Couldn’t build interior asbestos enclosure because the building isn’t handicap accessible

    c. Couldn’t build the railing because the floor isn’t proven strong enough to support students

Recommendations

Fortunately, this project will continue next year with the club's new Organization Lead and President. There is no doubt that the project changed people's priorities on the importance of keeping a clean and ordered workplace. Therefore, the recommendations listed below aren't wishful thinking, but reliable goals. This list was created as a result of the increase in scope and awareness as the project commenced. Some items were too expensive this year, while others would've taken too much time.

1. Make clean up mandatory
2. Organize nuts and bolts in tool storeroom
3. Better organize tool storeroom and tool cabinet
4. Paint furnature to improve professionalism of workplace
5. Install more pressure lines and switch over to pneumatic tools and vacuum
6. Clean up electronics room
7. Acquire key for non-cpss storage room
8. Clean up room 4
9. Install lighting in non-cpss room
10. Invest in epoxy dispenser, table top cover, flammable material storage
11. Certify that balcony floor is stable and build railing around it if permissible by ADA

Conclusion

As written in the abstract, the goal of this project was to increase the usable space for the club Cal Poly Space Systems to work on its projects, improve the safety for its members, and reduce the time it takes to manufacture its products. The project demonstrated the effectiveness of 5S in improving a workspace. Club members were measurably more comfortable in the work environment and spent less time looking for tools. Current rooms were made more professional by ridding the workplace of non-valued items and finding sensible locations for high-traffic possessions. Additional rooms were added and should unquestionably support club projects the upcoming year. Workspace safety was improved by building a railing to block off a dangerous balcony, and by hanging exit and fire safety signs. Workspace performance was enhanced by installing a high pressure air line for the club to use pneumatic tools. With minimal budget and star results, the project was a true success.

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Appendices

Unsummarized Survey Results

			Initial Results Unsummarized																Final Results Unsummarized												
1	How safe do you feel in the workspace?	1 2 3 4 5 6 7 8 9 10 Unsafe Safe	5	7	6	5	7	8	10	4	5	9	9	6	4	6	7	9	10	9	9	9	10	7	6	8	10	7	9	8	8
2	How comfortable are you in the workspace with respect to temperature?	1 2 3 4 5 6 7 8 9 10 Uncomfortable Comfortable	4	10	5	5	5	4	7	4	4	5	6	3	5	5	8	8	10	9	8	8	10	6	2	7	9	7	9	6	10
3	How comfortable are you in the workspace with respect to noise?	1 2 3 4 5 6 7 8 9 10 Uncomfortable Comfortable	2	6	3	3	4	4	4	3	3	7	4	2	4	5	4	7	2	6	4	7	5	6	3	4	8	8	7	5	9
4	How professional-looking is the workspace?	1 2 3 4 5 6 7 8 9 10 Unprofessional Professional	4	3	3	3	5	5	8	1	4	3	4	4	1	4	3	3	10	6	4	6	5	8	4	6	9	7	8	7	6
5	How sufficient is the lighting in the workspace?	1 2 3 4 5 6 7 8 9 10 Insufficient Sufficient	4	4	5	3	4	4	6	1	4	5	4	6	2	4	5	7	10	6	6	6	4	8	6	7	9	7	9	6	7
6	How clean is the workspace?	1 2 3 4 5 6 7 8 9 10 Unclean Clean	4	4	3	3	5	4	6	1	5	3	4	4	1	4	3	6	10	6	5	6	10	8	6	6	8	4	9	7	7
7	How organized do you do you think the club is?	1 2 3 4 5 6 7 8 9 10 Unorganized Organized	4	5	6	4	7	5	9	7	8	6	7	5	4	7	4	9	8	7	7	8	10	5	4	5	9	5	9	8	7
8	Do you believe the lack of cleanliness affects how much work you get done?	1 2 3 4 5 6 7 8 9 10 No Yes	7	10	7	7	6	5	10	4	10	10	7	4	4	10	5	3	3	2	2	6	1	3	3	3	2	1	2	3	2
9	What do you believe should be the club's main focus? If other, write down here:___________________________	1 2 3 4 5 6 7 8 9 10 Team Projects Personal Projects	3	5	1	4	3	4	4	3	5	1	3	4	5	1	3	3	4.5	5	3	3	1	3	4	5	2	5	3	5	4
10	How often do you think the club should meet each week?	1 2 3 4 5 6 7 8 9 10	1	2	1	1	1	1	2	1	2	2	5	2	1	2	2	2	1.5	2	2	7	7	2	1.5	1	2	1	1	1	2
11	What percent of the stuff in the workspace do you think actually belongs to CPSS? (leave blank if 0%)	10 20 30 40 50 60 70 80 90 100	60	10	40	40	80	60	60	90	0	90	70	60	90	90	90	60	80	70	90	80	100	80	70	70	90	90	90	80	80
12	When did you join CPSS? (Month, Year)																														
13	On average, how long do you spend looking for tools, parts, etc.? (in minutes)		10	2	10	10	5	10	10	8	5	15	10	8	10	30	3	8	2		10	10	5	5	5	20	5	10	2.5	5	2
	Please rank the importance of the following projects	Unimportant Important																													
14	Installing walls over aspestos	1 2 3 4 5 6 7 8 9 10	7	8	8	8	6	8	2	10	8	7	9	7	9	8	9	2	7	9	8	7	1	7	7	2	7	7	7	7	9
15	Installing railing around balcony	1 2 3 4 5 6 7 8 9 10	10	9	8	8	8	5	8	10	7	9	9	7	8	6	9	9	5	9	10	7	1	8	6	6	4	7	6	6	9
16	Building personal lockers for each member	1 2 3 4 5 6 7 8 9 10	6	9	5	6	3	5	1	5	4	3	8	2	5	4	3	1	6	6	3	8	10	8	4	3	9	8	8	8	3
17	Painting the floors	1 2 3 4 5 6 7 8 9 10	3	4	4	1	5	2	1	5	4	2	5	1	3	1	3	1	3	3	1	2	1	2	2	2	2	1	6	2	1
18	Painting the railing	1 2 3 4 5 6 7 8 9 10	3	3	4	1	5	2	7	5	4	2	5	2	5	1	3	1	2	3	8	2	1	2	2	2	3	6	8	2	3
19	Creating a mandatory clean up period each meeting (5-10 minutes)	1 2 3 4 5 6 7 8 9 10	7	9	6	5	7	7	9	10	6	6	9	4	10	10	10	3	10	7	3	10	10	8	5	4	8	8	7	8	9
20	Setting up additional lighting	1 2 3 4 5 6 7 8 9 10	8	9	6	8	8	7	3	10	7	5	8	4	10	9	8	8	7	7	7	7	10	5	6	5	6	8	7	8	6
21	Installing a high-pressure line (for pneumatic tools)	1 2 3 4 5 6 7 8 9 10	5	3	6	6	5	5	1	5	5	5	9	5	5	3	5	7	4	5	10	6	5	2	4	6	9	5	8	6	10

Building Permit Request

CAL POLY
San Luis Obispo
Facility Services

SERVICE REQUEST

FOR MAINTENANCE OR CHARGEBACK FACILITY NEEDS

For emergencies call:
Facilities Work Center at 756-5555
Fax: 756-6114
facserv@calpoly.edu

Date: 12/3/10	Name of Requestor (First and Last Name): Dianne DeTurris	
Department: Aerospace	Phone: (805) 748-7020	Fax:
Email: ddeturri@calpoly.edu	Location of Work/Building/Area: 04 Rooms: 22, 23	

Description (*please be specific; attach plans as necessary*): ***For a Senior Project, we will be constructing an interior wall to enclose the asbestos that line the outer walls of rooms 22 and 23 in building 04. To ensure that no asbestos is disturbed, we would like to have Facilities fasten the walls we built to the ground. We also need railing (that we'll build) to be installed around the exposed parts of the mezzanine in room 23. Please refer to attached plans.***

If this is not a maintenance request, please provide Chartfield String:

FUND (5 digits)	DEPT ID (6 digits)	ACCOUNT (6 digits)	PROGRAM (5 digits)	GRANT/PROJECT (6 digits)	CLASS (5 digits)
		617001			

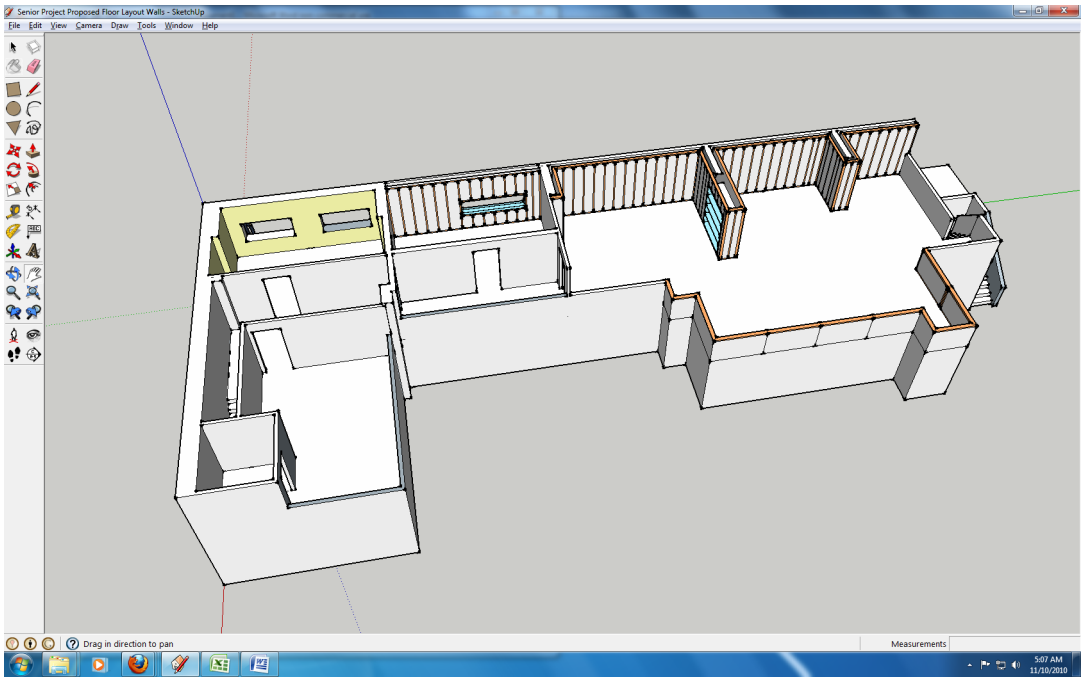
- Would you like an estimate? ☒ Yes ☐ No
- Actual costs will be recharged monthly based on project progress until all expenses are recovered.
- Call Facility Administration at 6-5555 with any questions regarding this process.
- Estimates are valid for six (6) weeks.
- If a Cal Poly Corporation account is used and the project estimate is $20,000 or greater, a Memorandum of Understanding between the University and the Corporation will be required.

Authorized Signature _____ Date _____

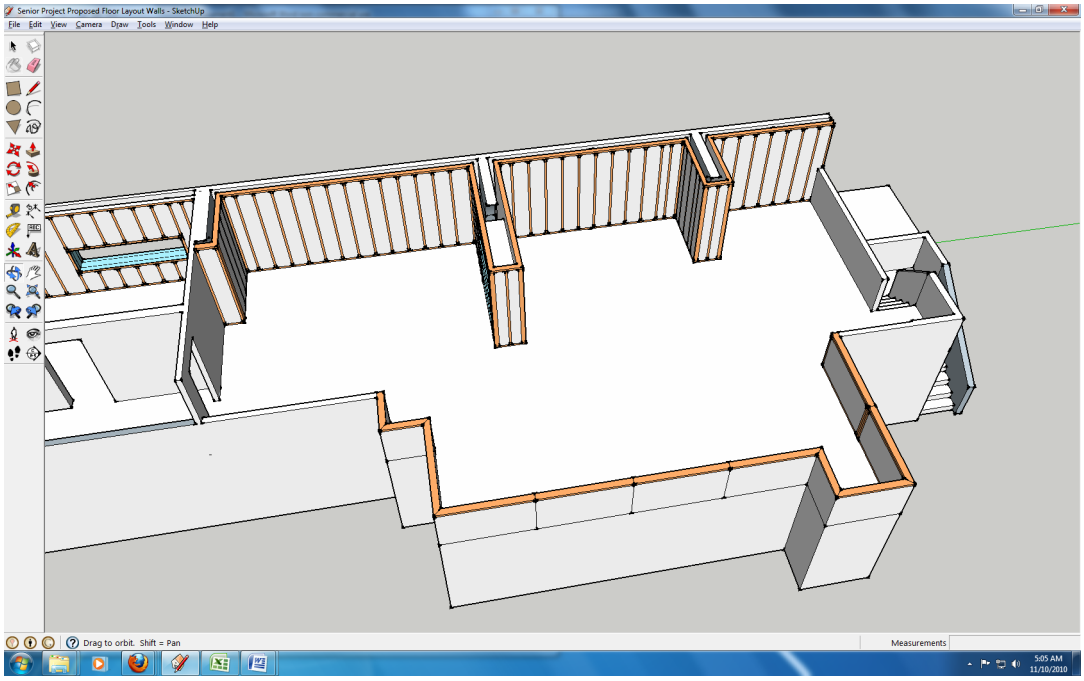
Type or Print Name _____

Note: A confirmation email will be sent to Requestor.

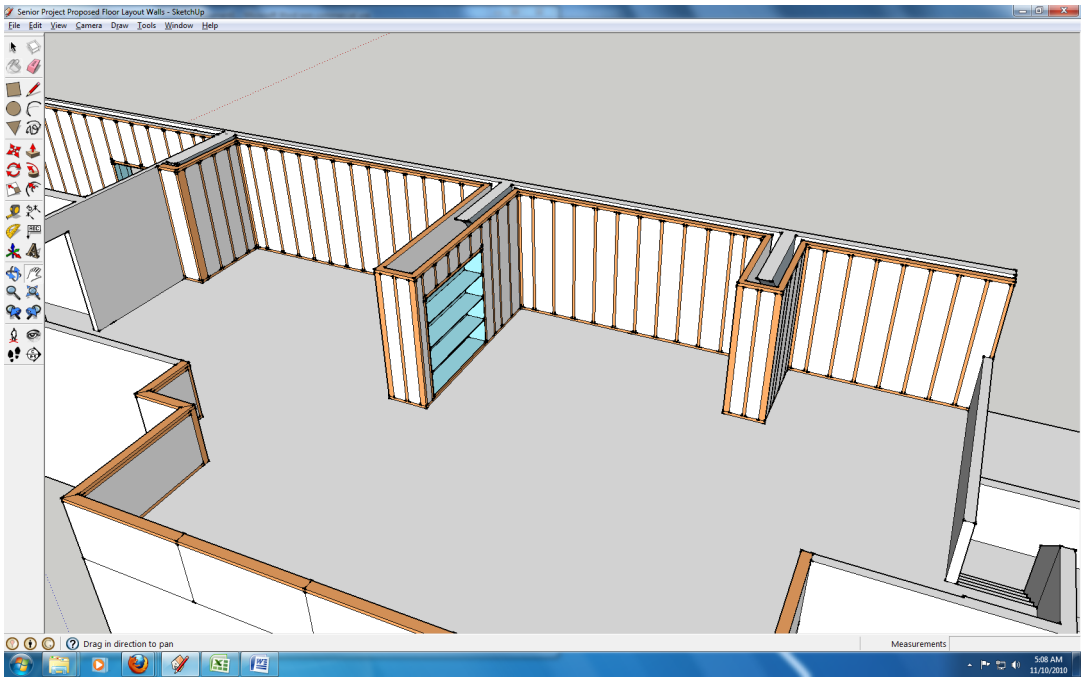
Rev 10/10 FAC-7



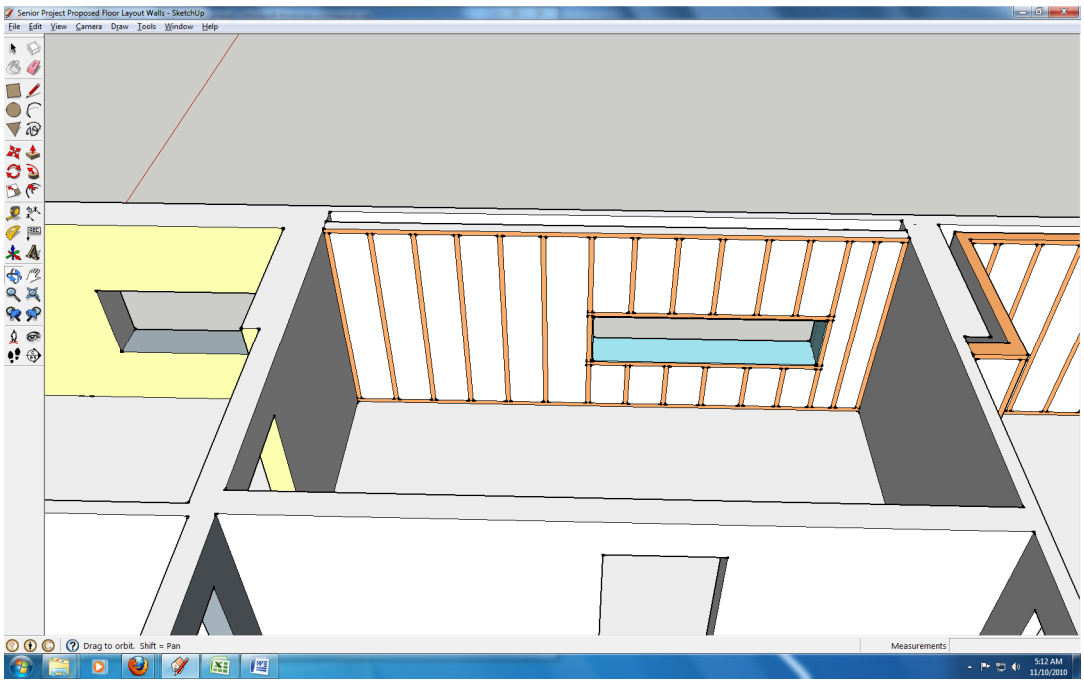
Overall view of CPSS Workspace. Please ignore yellow room



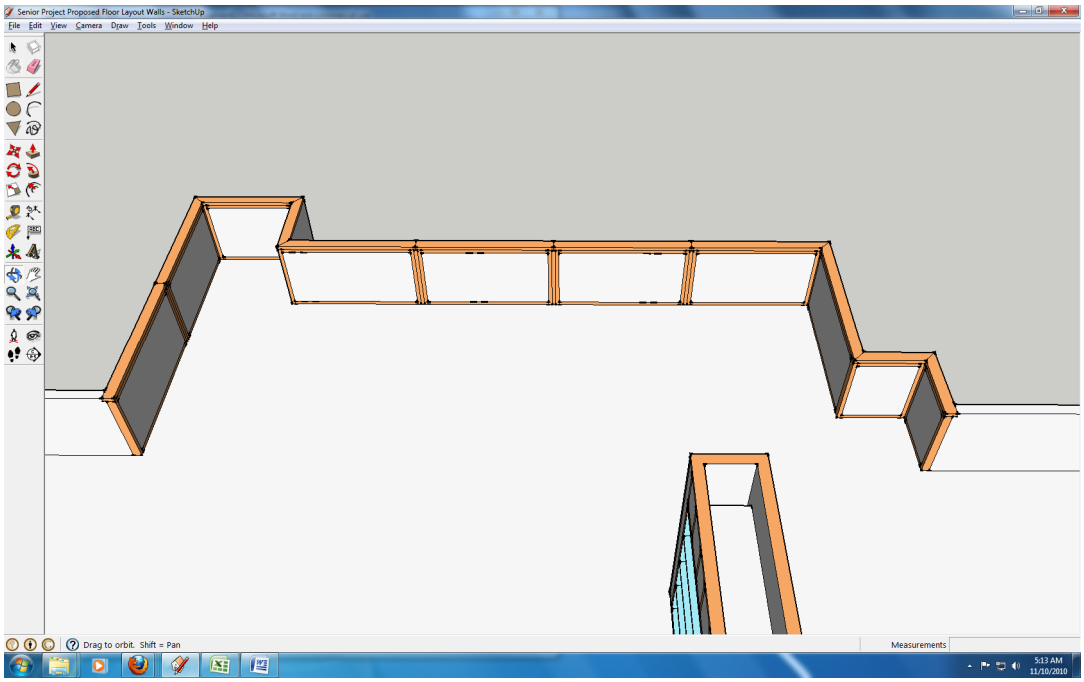
Closer View of Work Area, room 23. To follow how room 20 and 21 are enclosed, the new wall will be 5” away from outer wall.



Construction of Inner Walls. Orange Lines indicate studs that we will build and hopefully you can install. Blue surfaces show where we are going to build a bookshelf. The protruding shelf will also serve to keep the walls from tipping.



View of Inner wall that we want to build in room 22. Blue surface indicates the window we hope to expand. The window already exists, but we want a safe sealed off access to it just like the other windows in yellow room.



Rails we want to put up around exposed balcony. If we can't put them up, then we want to at least build them and then have you install the railing

Email to CPSS

Dear Members of CPSS,

This year was phenomenal. While we did not have a successful launch or a complete cert. program, we learned a great deal about working together and the process of seeing a high-tech project from start to finish. Indeed Jessica and Charlene from Orbital were much impressed with our accomplishments!

As all of you are probably aware, I was busy working on my own project this year. First, I want to sincerely thank everyone that helped me with it. I realize it was pretty difficult working with me. I imagine it seemed like I was just asking for you to do busy work at times when I would pull one of you to the side to help me move heavy and dirty stuff from room to room. I must confess that it's difficult to gauge the value of a newly claimed room like our new tool store room. You may remember just how dirty and jam packed it was when we first opened it up. I just knew that all that stuff had to come out before I could get a sense of what to do next!

The project did run into a few obstacles. After removing a perfectly good rail, Facilities Services asked me to put it back up because the balcony floor was not proven sturdy enough to support foot traffic. Not only did I have to build a new rail to close off the balcony, I had to find a place for all of its contents. It was a facility design-learners mistake that while inconvenient, it taught me a valuable lesson of what is the best research to do before committing to a major project. Now the club has a good place to start next year: a clear objective of proving the floor is strong enough to support students, and enough building material to complete the rails. In addition, the asbestos enclosure plan I got everyone excited about had to be rejected by Facilities Services because the building is not handicap accessible. According to the American Disabilities Act, a building can't have any major modifications until it is made accessible to disabled people. It's a true bummer, but understandable nevertheless.

Despite the setbacks, I think I did a fair job. The project's goal was to increase the space available for CPSS to operate (check), improve safety for all members (check), and make it easier to get the job done with easily accessible tools and materials (check check). As a result of my project, we now have 8 rooms to call our own. We have the:

- Manufacturing floor where most of our work gets done.
- Tool Storeroom that contains most of the tools and materials. This room rests above the machine shop where much foam and wood sanding occurs. I can't stress enough the **importance** of dusting this room monthly
- Spacious Conference room where officers and other club members can plan the day and year in quiet
- Office with computers for designing rockets
- Member Storage Room that contains personal cubbies for members to keep their projects and respirators
- Electronics room for working on electronic-related projects. I stored many club possessions in this room that I couldn't assess for value. With permission from the club's next president and Dr. DeTurris, I recommend clearing out most of this stuff next year.
- Non-CPSS Storage Room all the way across in the other building. Most of you shouldn't be concerned with this as it contains all the non-CPSS stuff I removed from our tool storeroom and conference room.
- Original CPSS room 4 on the first floor. This room contains finished rockets, room keys, supplies for trips (Fresno, Mohave), old CPSS projects, and temporarily the possessions of the professor Dr. Eugene.

Now that we have all of these rooms, it's extremely important we keep them clean after every Saturday meeting. Once a year spring cleaning isn't enough as I believe our workspace should be presentable at any moment for us to give representatives from Orbital and other companies tours of CPSS. And of course it's not healthy or visually appealing for us either. I hope that everyone will do a little bit extra after each meeting to not only clean up their own space, but spend a few minutes tidying up and dusting the Tool Storeroom, sweeping up the Manufacturing Floor, or vacuuming the carpets in the conference room.

Earlier in the year and just recently, I asked you to fill out a survey that I used to judge the effectiveness of my project. I appreciate all of your honest feedback. Although there were a few questionable entrees (who wants to meet 7 times a week?), I believe I can safely rely on the data. I've attached the survey results for those of you that are curious. Future officers and organization lead, you may want to use the data to ask yourself questions like should we meet just once a week, and use the data to judge what club-structure projects should be worked on next year. For instance, looking at the data, you can see that members don't appreciate the loud noise in the hangar. Maybe we should provide earplugs like we provide rubber gloves?

I'll end this email with a few observations I've had of my time with Cal Poly Space Systems. I've met many talented and determined people at CPSS. All of you astound me with your drive to design amazing and sophisticated rockets while juggling difficult schoolwork assignments. Most of you come to Saturday meetings to express your creativity and build really cool things with your hands. And it is this intimate involvement with our creations that companies look for from Cal Poly Grads. But admit that oftentimes we're so exhausted from a long day of sanding that we feel like we can't pick up that discarded piece of sandpaper that missed the trashcan. It's easy to be so involved with our projects that everything else is put on the side. And it's easy to fall into the mentality of "the place is messy already so it shouldn't hurt

if I leave this Popsicle stick here." I think the best advice I can give is to remember that the club is yours. As a member, you alone are responsible for how nice the workspace looks. Take ownership and you'll be much more proud to be a member of Cal Poly Space Systems. It may sound silly, but a clean and ordered workspace tells Orbital and other companies that we are responsible adults and potential professionals. Just by cleaning and organizing, you told me through my survey that CPSS looks 82% more professional!

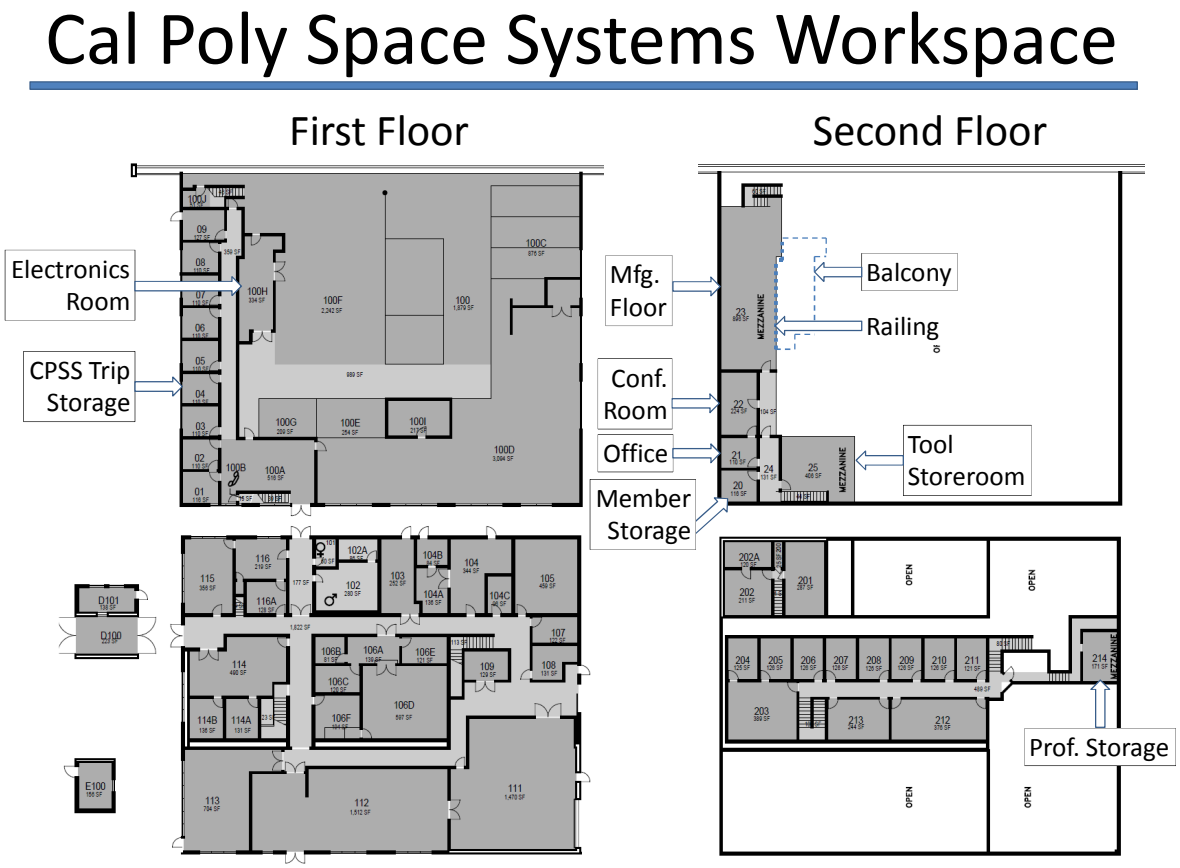
If you got through this email, thank you, and thank you again for your patience and assistance with my project.

Sincerely,

Tyler Richier

Photographs

Please refer to this map for identifying locations of the rooms below:



Manufacturing Floor

Before

Figure 9 - Balcony View 1

Figure 10 - Balcony View 2

Figure 11 - Tool Cabinet

Figure 12 - Manufacturing Floor View 1

Figure 13 - Clutter behind a table that was removed

Figure 14 - Manufacturing Floor View 2

After

Figure 15 - Manufacturing Floor View 1

Figure 16 - Clutter behind table cleared up - replaced by building material intended for rejected railing/enclosure project

Figure 17 - Pressurized hose for pneumatic tools

Figure 18 - Clear exit sign

Figure 19 - Manufacturing Floor View 2. Note Painted Railing

Figure 20 - Cleared Balcony. Some railing left over for potential of new railing project

Tool Storeroom

Before (initially room 22)

Figure 21 - Asbestos covered room intended for enclosure

Figure 22 - Cluttered epoxy cabinet

Figure 23 - Tool Storeroom View 1

Figure 24 - Tool Storeroom View 2. Everything under tarp does not belong to CPSS

Figure 25 - Tool Storeroom View 3. Note potential trip hazards

Proposed Tool Storeroom before cleanup

Figure 26 - Tool Storeroom View 1. Extreme levels of dust from years of being left undisturbed

Figure 27 - Tool Storeroom View 2. None of these boxes belongs to CPSS

Figure 28 - Tool Storeroom View 3. Their proper owners had to be notified before I could throw any of it out.

Figure 29 - Tool Storeroom View 4

Figure 30 - Tool Storeroom View 5. Shelf

After

Figure 31 - Tool Storeroom Shine Area. First thing a member sees when entering room

Figure 32 - Tool Storeroom. Everything has a place

Figure 33 - Labeled locations for tools

Figure 34 - Labeled location for glues and tubes

Figure 35 - Established location for rolls

Figure 36 - Each cabinet has a label to easily find supplies

Figure 37 - One remaining piece of clutter. Organizing these nuts and bolts in recommendations section

Conference Room

Initially room 115 (current robotics lab), 106D (RFID lab), and 20 (CPSS Member Storage Room)

After

Figure 38 - Conference Room View 1. Everything not CPSS's removed and room intensively cleaned. Room would have had asbestos enclosure built, but members will have to make do without it.

Figure 39 - Conference Room View 2. White board for club administration purposes. Room for anyone that wants to come to club meetings

Personal Rocket Storage Space

Before (kept in various locked cabinets on manufacturing floor)

Figure 40 - Member Storage View 1. Very unorganized and seemingly mixed

Figure 41 - Member Storage View 2. objects in rear are not readily visible.

Figure 42 - Member Storage View 3. Second Cabinet similarly cluttered

Proposed new personal rocket storage space before cleanup

Figure 43 - Proposed Member Storage View 1. Office once belonged to a professor that seemed to have disappeared

Figure 44 - Proposed Member Storage view 3. This room was temporarily the conference room, but it was much too crowded

Figure 45 - Proposed Member Storage View 4

Figure 46 - Member Storage View 5. Useful Whiteboard.

Figure 47 - Member Storage View 6. Useful shelves

After

Figure 48 - New Member Storage Room. Owned tubes claimed by blue tape in accessible location

Figure 49 - Clearly marked "cubbies" in clean environment

Figure 50 - Marked Respirators waiting to be reclaimed and placed into a cubby

Office

Before

Figure 51 - Office View 1. Random objects lieing around

Figure 52 - Office View 2

Figure 53 - Office View 3

Figure 54 - Office View 4

After

Figure 55 - Used space to store hybrid rocket motor components.

Figure 56 - Brought computer upstairs so that 3 people can learn about rockets at once

Figure 57 - Much better order. Keys also have clearly marked tags that match new rooms

Electronics Room

No Photographs of Electronics Room because it was a room brought in by the club president

CPSS Storage Room

Before

Figure 58 - CPSS Storage room. Relatively empty

Figure 59 - CPSS Storage Room View 2. As a storage room, there is no reason why it can't be more packed

Figure 60 - Computer and nuts/bolts that were brought upstairs

Figure 61 - Another computer that Broke later in the year

After

Figure 62 - A much better utilized storage room

Figure 63 - View 2

Figure 64 - Possessions of a current professor. These are temporarily being stored in this room until he has time to go through them.

Non-CPSS Storage Room

Before – see “before” tool room, proposed tool room, balcony, etc.

After

Figure 65 - Room much too dark for photographs