A DEVELOPMENT AND MANAGEMENT MODEL FOR MODEL MAKING FACILITIES IN INDUSTRIAL DESIGN EDUCATION

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ARGUN TANRIVERDİ

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Approval of the Graduate School of Social Sciences

....

Asst. Prof. Dr. Alp Limoncuoğlu

Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Design.

....

Prof. Dr. Tevfik Balcıoğlu

Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adaquate, in scope and quality, as a thesis for the degree of Master of Design.

....

Asst. Prof. Dr. A. Can Özcan

Supervisor

Examining Committee Members

Doç. Dr. Murat Bengisu ....

Prof. Dr. Murat Günaydın ....

Asst. Prof. Dr. A. Can Özcan ....

ABSTRACT

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Tanrıverdi, Argun

MDes, Department of Design Studies

Supervisor: Asst.Prof.Dr. A.Can ÖZCAN

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The aim of this study is to create a model to help establishing a model making facility in an industrial design school from scratch or developing an existing model making facility. While creating the model, the study also aims to change the idea in people's minds in Turkey about model making facilities (and any machine facilities) that has been established as a habitude or even worse, a culture. To achieve this aim, the study emphasizes the importance of health and safety with the highest priority, effective planning and management, and as much contribution of faculty members as possible, which means the distribution of the responsibility. The study focuses mainly on the facility as the space and what features it should have, and the facility as the hardware in it. Important features of such facilities like ventilation, lighting, safety management is mainly emphasized followed by what types of facilities (e.g. woodworking and finishing) should be established is discussed. Management is the last but probably the hardest part of an establishment and development process that the study focuses on lastly. The applications of the study is done at the Izmir University of Economics Fine Arts and Design Model Making Facility, and is being developed as the facility has still been in establishment phase.

Keywords: Industrial design education, model making facilities, workshop, management and development.

ÖZET

ENDÜSTRİYEL TASARIM EĞİTİMİ İÇİN BİR MODEL YAPIM OLANAKLARI GELİŞTİRME VE YÖNETME MODELİ

Tanrıverdi, Argun

MDes, Tasarım Çalışmaları Bölümü

Danışman: Yrd.Doç.Dr. A.Can ÖZCAN

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Bu çalışmanın amacı endüstriyel tasarım okullarında sıfırdan bir model yapım olanağı kurma yahut var olan bir model yapım olanağını geliştirme çalışmalarında örnek alınabilecek bir model oluşturmaktır. Çalışma bu modeli oluştururken, ayrıca ikinci bir amaç olarak da Türkiye'de model yapım olanakları (ve makina atölyeleri) hakkında insanların zihinlerinde yıllar içinde bir gelenek hatta daha da kötüsü kültüre dönüşmüş olan kötü fikirleri değiştirmeyi amaçlamaktadır. Bu amaca ulaşmak için çalışma en büyük öncelik olarak sağlık ve güvenlik, ardından etkili planlama ve yönetme, ve olabildiğince tüm fakülte elemanlarının katılımını ki diğer bir değişle sorumluluğun dağılımını vurgulamaktadır. Çalışma olanaklara hacim ve yapı, ve üzerinde bulundurması gereken özellikler olarak, ve bu yapının içindeki donanım olarak odaklanmaktadır. Bu tip olanaklarda önem verilmesi gereken özellikler olan havalandırma ve ışıklandırmayı, ne tip olanakların (e.g. ahşap atölyesi ve son kat atölyesi) kurulması konuları üzerinde duruluyor. Yönetim ise çalışmanın vurguladığı son ama büyük ihtimalle de model yapım olanakları kurulumunun en zor bölümdür. Çalışmanın uygulamaları İzmir Ekonomi Üniversitesi Güzel Sanatlar ve Tasarım Fakültesi Model Yapım Olanaklarında yer almaktadır ve olanaklar kurulum aşamasında olduğu için de geliştirilmeleri devam etmektedir.

Anahtar kelimeler: Endüstriyel tasarım eğitimi, model yapım olanakları (yada makina atölyeleri), yönetim ve geliştirme.

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INTRODUCTION

1.1. Definition of the Problem

A design education model making facility is the right place to change the idea in people's minds about model making facilities and workshops, especially in Turkey. There are some reasons behind this choice.

The first and the most important reason is that these facilities are like the kitchens of traditional design education, as traditional design education is still built on craft (Kolko, 2006). So this means that model making facilities are essential facilities that can not be omitted from design education. Another reason for the choice of a design education model making facility is that, these places are generally used by big number of students at the same time like a small factory, but with workers without experience on the subject, so it is not feasible and secure to charge craftsmen to keep an eye on the whole place although it is still been applied in many cases. The author strongly believes that unless the attitude and mentality of craftsmen ("usta"), craftsmanship or managers that are managing these facilities change, the bad habitudes and accordingly the general environment of model making facilities would not change whether there is only one craftsman or many.

Another reason is that still in Turkey, the picture that is formed in most people's mind of a workshop facility is a place with a craftsman, who is called as "usta" in Turkish; but in a worse manner; sitting by the entrance with a cigarette in his mouth all the time, drinking tea and watching over the facility every single second like the ruler of his kingdom. The facility is generally a dirty place with old, dirty and ugly looking machinery and disordered management. All the rules and order come from the craftsmen's ancestors' time and management of the facility is generally run by instinct plus experience-based knowledge of the craftsmen. This mentality has been set by habitude of many years. The reasons of this may be argued, but the fact is obvious that there is a problem with that habit. The author and his colleagues believe that there has been a lack of concern on changing bad habits of a community on the subject that have been set in many years and that those habits have now been perceived as normal. With more concern, followed by better planning and also execution through an appropriate group of people, these kinds of bad habitude can be turned into good ones. Universities are probably one of the best places to execute such programs. Universities are the places that new knowledge is sought, interrogated and created; so they are the places to overcome experience-based and instinct-based knowledge to find the true knowledge to be used. It is also obvious that the best way to change bad or wrong habits of a community is to start educating the future community, which is formed by the students of today.

One of the key problems of the development program is the probable lack of continuity that may be faced during the process of development or after the program is set and running. The reason to establish a system of different modules of model making facility management is to overcome interruption by loss or change of staff who work on the development or management of the project. To eliminate the probability of such problems, the development program should be run by not just a person, but by a committee of people.

Another problem that can be faced through such a development program is the shortage of sources including combined knowledge to set up and manage such facilities. Besides the enormous problem of changing bad habits of a community, not being able to find guidelines on the subject is another issue to overcome before even starting the development process.

1.2. Aims of the Study

The main aims of this paper are:

1. Creating such development and management models for model making facilities in design education to raise awareness for whoever is in design education; from students and instructors to institutions; about the possibilities they have and may have in terms of model making in design education.

2. Finding methods to overcome the reality that turned out to be the habitude about model making facilities. The first aim, which is to try changing general

understanding of model making facilities as craftsmen's personal territory, is planned to be accomplished by eliminating the choice of charging a craftsman to take care of the facility in the first place. But, elimination of the keeper's existence in the facilities creates another problem, which is the huge responsibility that must be shared to manage the facility. That responsibility includes not just eye keeping on the place, but planning issues like security, health and safety, scheduling, maintenance and regeneration of the facility. The distribution of responsibility throughout the institution becomes essential in that sense and finding possible ways of gathering a working group of people with various professions, abilities or backgrounds like instructors, technicians, student assistants within an institution like a design education, to constitute a managing committee.

3. Trying to make up the deficiency of guidelines to help creating and developing model making facilities especially for design schools, or whoever is willing to establish such a facility. The reason behind this aim is that, the writer and his colleagues suffered from not being able to find appropriate references or guides that would help them to manage a model making facility securely, safely and orderly. The complexity of creating such a source is both accessing and combining necessary knowledge without missing essential parts, and knowing what to include and exclude.

1.3. Method of the Study

This study is an example of qualitative and experience research. The first part of the study will shortly describe the importance of model making in design education and design process, and will mention what kind of models and materials are used in the process of design practice.

Besides literature survey, the most important methods that will be used in the study are observations and feedbacks. Because this study is an applied study, observations and feedbacks from the facility users and managers are highly important. On issues like safety, security, signage, instruction manual design, theory may not be enough to come up with right solutions to certain problems. When theory is applied into practice, unexpected responses might be faced and so, process of development might come to a standstill or delayed. Before deciding on final problem solutions, whatever done should be tested on users and modified if necessary. The study's application is based on the works of the model making committee (Alex Velasco, Michael E. Young, Selçuk Gürsan and the author) in the Izmir University of Economics Faculty of Fine Arts and Design Model Making Facility. According to the curriculum of the Department of Industrial Design, the facility is being used from the first year with the course FFD142 – Model Making. In the context of the course, the students are trained[1] at the end of their second semester for the model making facility. In the second year, the facility is being used to make models for the courses ID201/202 – Product Design Studios. At the beginning of the third year, the students of the department choose a specialization area between product design and design management. Both groups may use the model making facility but the students of the product design specialization area spend more time in the facility as their projects require model making as a priority for the courses FFD301 – Furniture Design, PD313/314/409/ – Industrial Design Studios, PD498 – Graduation Project and

[1] See the section 4.3.1.

possible practice included elective courses in their last two years of their industrial design education.

Comparative models will be taken seriously throughout the study. Every important university's design faculties in Turkey, which are comparative models to the study's focus institution, have their own model making facilities.

CHAPTER 2

MODEL MAKING IN DESIGN

A typical design process has many issues to be taken care of. Those issues can be classified under a series of titles like pre-design, design and production, and post-production. Under these main titles, hundreds of interrelated subtitles can be found, but this study is only concerned with the model making stage which happens during the design and production and post-production stages of a design process. Even under these stages only, there are many issues like materials, production techniques, tolerances, and ergonomics to be handled. Model making is one of the tools to overcome these design related problems.

2.1. Model Making

For many disciplines; like mathematics, astronomy, computer sciences, art, and acting; or for many different aspects of life, like a process, people, system, the word model has a meaning. For example, a person, who has the ideal characteristics, is called a role model while scientists create scientific models to understand and explain the real world. Even from these uses of the word, it can be seen that the word represents ‘a simplified or idealized’ (Barlex, 1991) other than itself. There are many other situations where the word can find itself a place, but besides its various definitions, the Merriam-Webster online dictionary[2] defines the word as ‘a usually miniature representation of something’. This definition still has a deficiency when a proper meaning for the case of design is sought and, that is, a model can also be in one-to-one scale. Both Harrison (1992) and Archer (1992) describe the word as some kind of representation of something created for any purpose. This is a more proper definition in the context of design especially, although it may still seem like a really general definition.

Models and modeling in the context, have been in existence for nearly forty-six hundred years. Egyptians used to make models of house, furniture and some other objects to be buried with a deceased person, that they believe the person will be using in the next world (Knoblaugh, 1958). Today, from architecture as any type of buildings’ models are made for many purposes, to film production as in situations where scale models are used to shoot dangerous scenes, practice of modeling is used widespread. In the context of design, while a model is said to be ‘the essential tool’ (Denton, 1993), the act of model making (or modeling) would surely be an essential part of the design process, as Archer (1992) highlights model making as ‘the language of the Design area’ and Baynes in his study with children (1992) uses the words: ‘It is through the use of tools and materials that people are able to realize their design ideas’.

Kimbell, et al. (1991) and Murray (1992), as cited in Welsh (1998) classify modeling as modeling in the head, which is ‘cognitive modeling or imaging’, and ‘modeling

[2] Merriam-Webster (www.merriam-webster.com) is America's foremost publisher of language-related reference works. The company publishes a diverse array of print and electronic products, including *Merriam-Webster's Collegiate® Dictionary, Eleventh Edition*—America's best-selling desk dictionary—and*Webster's Third New International Dictionary, Unabridged*. (Taken from Merriam-Webster official website).

outside the head' which they call 'concrete modeling'. But, as it is hard to pick the most proper definition for the term model, it is hard to classify model types, if such categorization is required. First of all, models can be classified by the purpose that they are made for, that are study models, presentation models, mock-ups and prototypes (Knoblaugh, 1958); they can be classified by the time that they are made, that are models of process and final model (personal communication, Özcan, January 2009). Although diversity continues in classifying models as Baynes (1992) separates models as iconic, symbolic and analogue; nevertheless, with some small disparities, most commonly used classification method is to classify them as two-dimensional, three-dimensional, symbolic and computer as in figure 1 (Barlex, 1991; Evans, 1992; Harrison, 1992; Sparkes, 1993; Welsh, 1998).

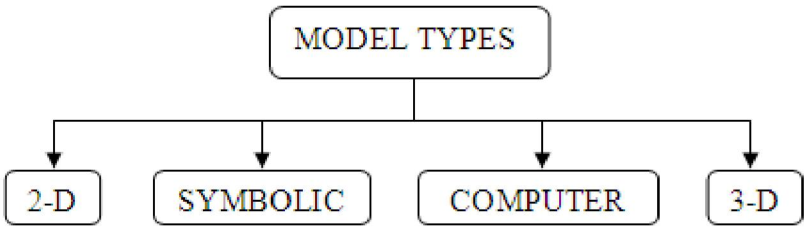

Figure 1: Model Types

1. Two-dimensional models generally include representation of a design on paper, such as sketches, renderings, exploded views, technical drawings.

2. Symbolic models basically include symbols that represent something else, like a mathematical formula. In his explanation for symbolic models, Baynes (1992) mentions 'abstract codes' that represents a 'selected aspect of existing proposed reality'. Barlex (1991) and Welsh (1998) add calculations, graphs, and diagrams that may be used to calculate mechanical problems to formulae for symbolic modeling.

3. Computer modeling is, as it shows, modeling that is done by software on virtual environment. Possible use of computer modeling include exploring different finishes, paints, textures on the design by both some three-dimensional modeling software (like SolidWorks®, Autodesk® Maya®) and illustration/paint software (like Adobe® Illustrator®, Photoshop®), exploring different forms by three-dimensional modeling software (like SolidWorks®, Rhinoceros®), working mechanisms as animation by certain three-dimensional modeling, animation software (like SolidWorks®, Autodesk® Maya®) and generating 'working drawings such as CAD packages). Besides three-dimensional modeling that can be done by software, Harrison (1992) mentions computers' ability of creating economical or technological models with the help of mathematical functions.

4. Three-dimensional models are models that actually have a mass and can be held in hands. While some professionals from the design community name all non-virtual model types as concrete models, Davies (1996) chose to name only three-dimensional models as concrete models, Evans, et al. (2000), Smyth (1998) and Breen, et al. (2003) use the term 'physical model' for non-virtual models and Powell (1990, cited in Evans, et al, 2000) uses the term 'appearance model' especially for models in the context of industrial design. It should be mentioned that the main emphasis of this study is on three-dimensional models and making of those models, and from this point, the term model implies physical three-dimensional models.

The essentiality of model making for a design process may still not be fully understood unless the effect that model making brings to a design process and on what purposes a model is made are mentioned. In a literature survey in the context of the subject, a reader/researcher would probably find a number of quite similar points from the studies of various numbers of writers. Although it can vary, the list would consist of the points below; those are the reason why models should be made and contribution that models make to a design process. It should also be mentioned that, separate items on the list are actually interrelated, which means there are ‘overlaps’ between these items (Harrison, 1992) and there may always be some other items to be added to this list:

- The first and maybe the most obvious contribution of model making to a design process and the model’s benefit for the designer is that, models bring design ideas into reality, something to touch, feel, look in details; it enables visualizing a designed product or its components to help the designer ‘obtain ideas about the finished appearance of a design’ (Liddament, 1993).
- Probably some of the most important purposes of the practice of model making are to develop and evaluate design ideas, identify faults on the designed object and find ways to reduce those faults and improve design. By saying that ‘some designers take decisions as they manually manipulate the material, modifying it accordingly’, Evans et.al (2000) points out this severity.
- In the context of education, teachers can follow and analyze the development of the modelers’ design ideas during the design process; who in the case are the students (Barlex, 1994). This can happen by seeing the evolution in consecutive models that are made by the students as can be seen in figure 2.

Figure 2: The development of a design through model making- Power hand tool project by Çağdaş Dorak in the context of the course ID201 instructed by Alex Velasco, 2008 (photography by Alex Velasco)

- Model making does not only help a designer to improve the quality of the design, it also enhances the skills and knowledge of designer on both materials and production methods, which Harrison (1992 cited in Welsh, 1998) points out as a return of modeling as the ability of 'predictive designing'.
- Models and model making work perfect in controlling and analyzing 'scale, proportions, weight and ergonomics of the designed object. Some kinds of model types (those will be mentioned in the following sections) enable testing such as the workability of the components of the product, performance and function of the product or a mechanism and may enable research and analysis.
- Models are great tools to explain and translate design ideas to a wider audience, via exhibitions or presentations and to get people's feedbacks.
- Working models or just appearance models are produced for consumer tests (Velasco, 2005).

Table 1: Physical models' contribution to a design process

	PHYSICAL MODELS' CONTRIBUTION TO A DESIGN PROCESS
1.	Brings design idea into reality.
2.	Helps evaluating and improving the design.
3.	Enhances skills of the designer as a designer.
4.	Helps analyzing physical properties.
5.	Transfers design ideas to others.
6.	Enables desingers to apply tests on the design.
7.	Helps teachers follow the development of the design during process.

2.2. Physical (3D) Models

Difficulty about classifying models continues with classifying models into types. The main difficulty is that, there are common terms that are used to classify models, but even those terms sometimes can not be separated from each other with sharp disparities. However, to be able to have a relatively clear idea about types of three-dimensional models, a list of terms should be compiled. A researcher would encounter the terms like: sketch model, mock-up, block model, dummy, appearance model, prototype, mechanical model, scale model, principle model, and final model when working on the subject. To narrow these terms to a logical list of model types, models can be classified according to both their detailing and the stage they are made during a design process as in figure 3.

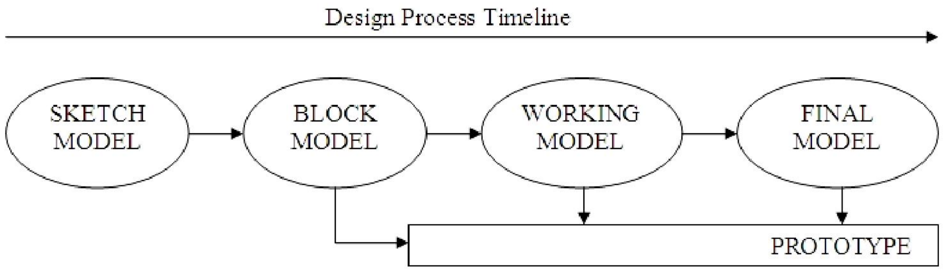

Figure 3: Model types in sequential stages of a design process

2.2.1. Sketch model

While the term sketch means preliminary and rough drawings, sketch model should be used for preliminary models and models without much detail that are generally made in the early stages of a design process by mostly using soft materials and basic tools, to get a first understanding of the design idea in a three-dimensional environment. In some sources, the term mock-up is used in similar use to a sketch model but, as well as this use of the term mock-up, it is also defined as 'a model or replica of a machine or structure for instructional or experimental use' in the Oxford online dictionary[3]. Knoblaugh (1958) uses the term 'study model' in a similar use with small differences.

2.2.2. Block model

The main difference between a sketch model and a block model is the amount of detailing and appearance on the model. According to Evans, et al. (2000), a block model is a model that is identical in terms of appearance and finish to the final product to be produced, but made out of a different material. Block models may not have all the functional details of the product to be produced. The term appearance model can also be used, meaning a similar model type. Knoblaugh (1958) uses the term presentation model for block models and adds the detail that such models should be one-to-one scale.

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[3] The website (www.askoxford.com) includes the online version of "Compact Oxford English Dictionary". 'The Oxford Dictionary (...) traces the usage of words through 2.5 million quotations from a wide range of English language sources, from classic literature and specialist periodicals to film scripts and cookery books (Taken from www.oed.com/about).

2.2.3. Working model

This type of models mainly emphasizes the functional abilities of the product to be produced. They are mainly made to show, test, and develop mechanisms on the design. They are not made out of the actual materials to be used in final production (Velasco, 2003). Mechanical model is another term that can be used for similar purpose.

2.2.4. Final model

As implied by the term, final model is made out of actual materials in one-to-one scale (Velasco, 2003) with all the functional details working. It is possible to come upon the term final mock-up with a similar use. The ambiguity of the use of the term mock-up can be seen in the situation, where it may be used as a preliminary model and also the final model. Instead of final model, Knoblaugh (1958) also uses the term mock-up as one-to-one scale, identical looking model that is made out of the actual material.

2.2.5. Prototype

The term prototype is used in several meanings in different areas. While in Oxford online dictionary the term is defined as 'a first preliminary form from which other forms are developed or copied', a more common definition as Luzadder (1975 cited in Evans, 2000) also defines the term as a one-to-one scale, working model that is made for testing and demonstration. Today, the term is generally used for pre-production models that are produced for final audits.

Besides the list of terms above, as it is mentioned before, one can encounter many other terms that mean similar things. The list may go on like this: clay model, details mock-up, scale model, see-through model, relief model, cut-away model, wind tunnel model, pre-production prototype, buck model (Velasco, 2003).

2.3. Materials

Although any kind of raw material can be used to make a model, not every kind is one hundred percent suitable for the purpose of model making. Material selection is an important stage of model making, as the material choice affects the whole model making process, equipment that are needed and production techniques that are used. Besides these issues, the material to be chosen should be suitable to manipulation towards the design idea, since not each kind of material is suitable for any kind of production technique or any design. The model maker should be able to decide on the right raw material before starting the process.

Because this study mainly focuses on soft model making, this section includes types of wood, plastics, polymer foam, paper, clay and their derivatives (figure 4), which are believed to be the most suitable materials for model making especially for preliminary models (Ashby and Johnson, 2005).

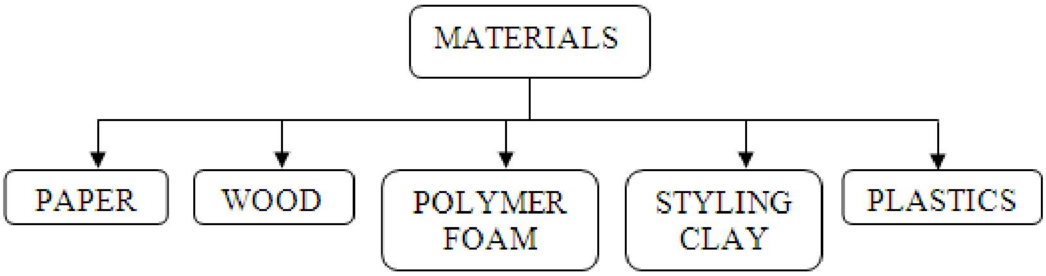

Figure 4: Types of commonly used model making materials

. However, in addition to these materials, metals and at least cold metalworking can not be omitted from a design education model making facility. The reason is that, there may always be need for simple metalworking techniques during model making from other materials. For instance, in order to make a final model of a furniture design, a user of the facility may be in need to bend a piece of metal tube.

2.3.1. Paper

Probably, paper is the most suitable material for quick and simple models with few details and plain surfaces. There are different types and thicknesses of paper for various purposes. The most important properties of paper as a model making material are that, as Liddament (1993) mentions, it is very easy to manipulate, but with a structural disadvantage, that is its vulnerability. However, it is possible to strengthen the structure by using paper in different directions or making joints. Another advantage of using paper and paperboard as model making materials is that, model makers can manipulate the materials easily with very basic equipment like knife, scissors, steel ruler and glue.

Paper and paperboard types are more commonly used in architectural models, but are also useful for some uses in the area of industrial design as in figure 5 (on the left). As an example project, toolbox design as in figure 5 (on the right) is a good way to use paper and understand constraints and characteristics of the material. While such a project pushes students to use different thicknesses of paper, it also trains them for possible future design projects with plastics, as they have to learn characteristics and production techniques of the material.

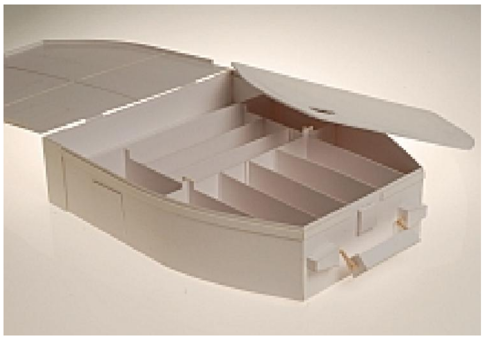

Figure 5: (On the left) A paper model by Gaus Baggermann, 2008 (photograph acquired from www.guusbaggermans.nl. Accessed 15 March 2009); and (on the right) a paper model by Çağdaş Dorak in the context of the course ID201 instructed by Alex Velasco, 2008 (photography by Alex Velasco)

The most common types of paper and paperboard that are being used for model making can be listed as follows (although there are many more types of paper and paper derivatives):

1. Cardboard (and corrugated cardboard)
2. Foam core (kappa board)
3. Poster paper
4. White board
5. Mounting board

2.3.2. Wood

For model making of each kind, wood is another widely used material. The most important reason is that there are many types of wood with specific properties for almost every purpose. Some good features of the material that make it one of the best model making materials can be listed as:

- To be able to make physical models, a model maker needs a material which can be shaped easily, sometimes without need of machinery, and also which is durable under physical impacts, shortly with high strength-to-weight ratio. In that sense, wood is probably the best material that can be manipulated manually. Various types can be shaped with only some hand tools and sand paper.
- Another advantage of wood as a model making material is its weight. In most cases, a wood physical model would be in approximate value in weight to the actual object to be produced. This is a good feature to test user reaction and ergonomics.
- Wood types can be painted or finished in a very high quality to give the appearance of an actual finished product. This feature of the material is sometimes very important especially for appearance models and aesthetical issues.
- Damaged wood can be repaired easily either with screws or glues, and can be worked on after the repair.
- Wood's resistance to oxidation, acid, saltwater and other corrosive agents can be considered as important characteristics (U.S Department of Agriculture, 2002) especially for long term uses of the model.

Woods are classified under two main categories, which are softwood and hardwood. While hardwoods are technically dicotyledonous[4] and anatomically porous, softwoods are botanically gymnosperms[5] and anatomically nonporous and do not contain vessels (U.S Department of Agriculture, 2002). In contrast to their categories, some kinds of softwood are harder than some types of hardwood and vice versa. Irrespective to categories, although wood is a good model making material, not every type is suitable. The most important characteristics for wood as a good model making material are fine and straight grains, few knots, and no cracks. The most suitable solid wood types for model making are summarized below.

1. Balsa (*Ochroma pyramidale*): One of the best types of wood for model making. It is very light and soft, but strong in grain direction. Because of its porous composition and low density, it can even be carved by fingernails. In contrast to its light weight and softness, it is classified under hardwoods. Figure 6 includes good examples of models made out of balsa wood in one-to-one scale.

Figure 6: Balsa models by Irmak Yiğit, 2007 (on the left) and by Ekin Zileli, 2008 (on the right) in the context of the course ID201 instructed by Alex Velasco (photography by Alex Velasco, 2008)

[4] Dicotyledons, or "dicots", is a name for a group of flowering plants whose seed typically has two embryonic leaves or cotyledons (definition is taken from the Wikipedia – The Free Encyclopedia website: http://en.wikipedia.org/wiki/Dicotyledonous).
[5] Gymnosperm (Gymnospermae) is a group of spermatophyte seed-bearing plants with ovules on scales, which are usually arranged in cone-like structures (definition is taken from the Wikipedia – The Free Encyclopedia website: http://en.wikipedia.org/wiki/Gymnosperms).

2. Lime (*Tilia*): This type of wood is also known as linden in some part of Europe, and basswood in North America. It is a light and soft wood type that is good for model making with straight grains. In contrast to its light weight and workability with tools, it is a strong wood. It is also classified under hardwoods like balsa.

3. Mahogany (*Swietenia mahagoni*): American mahogany is easy to work with hand or machine, and it is especially a great choice for high quality finish and appearance (U.S Department of Agriculture, 2002). The wood generally lacks voids, which prevents cracking during machining.

There are also wood sheet types that are used for model making. In addition to sheets of raw wood like balsa sheets, there are other man-made materials such as plywood, chipboard, MDF (Medium Density Fiberboard). They are generally used for straight surfaces on models because they can not be bent manually.

2.3.3. Polymer (Solid) Foam

Polymer foam is another good material especially for quick sketch models, while it is also a good material for detailed block models. Because of material's light weight, relatively high strength-to-weight ratio and easy-to-manipulate structure, it is a good choice for model makers. Other reasons for polymer foam to be chosen as material are that it can be found in different block sizes so that gluing may not be needed, there are no grains or knots unlike wood and some types' structure enhances paintability and finishing. The biggest drawback of the material is probably its low resistance to loading. This drawback can be precluded to a certain level by coating and painting.

The most widely used polymer foam types are polystyrene (PS) and polyurethane (PU) foam types which are also used for insulation in constructions. Both materials have low porosity, but PU is denser than PS, so is relatively more rigid than PS and PU can not be recycled (Ashby and Johnson, 2005). Both materials can be cut with a blade and sanded to even most organic shapes as can be seen in figure 7.

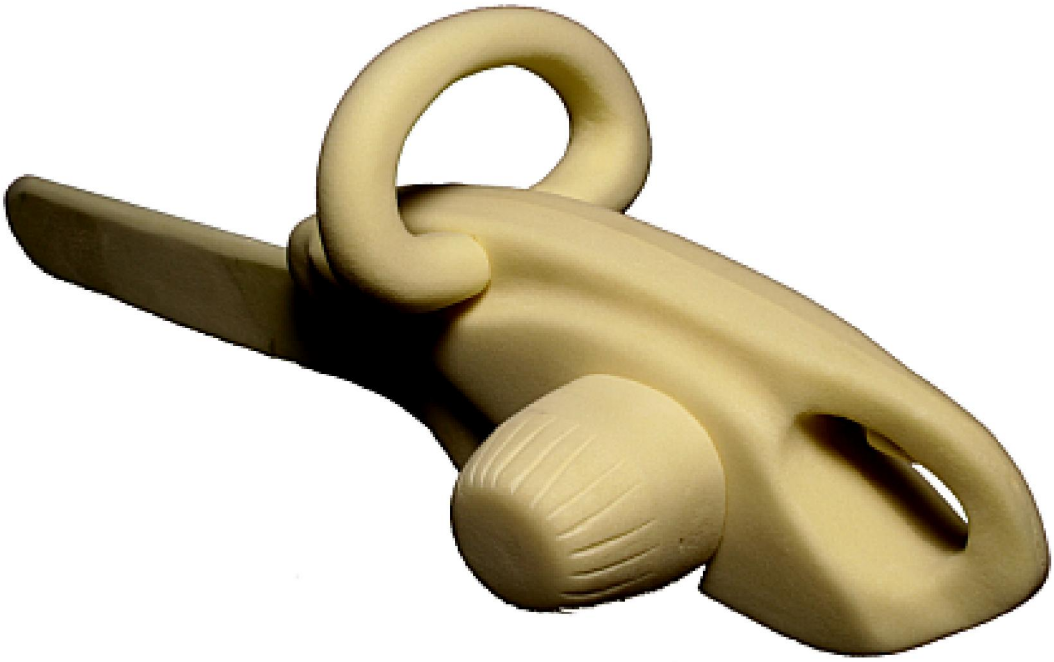

Figure 7: A polystyrene foam model by A.Tolga Örnek in the context of the course ID201 that is instructed by Alex Velasco, 2007 (photography by the author, 2007)

2.3.4. Model Making (Hard Styling) Clay

Clay is another widely used material for model making besides its use in sculpture and ceramic industry. It is an important and widely used model making material especially in the automobile industry (figure 8, on the left) since the 1930's (Şenyapılı, 2005). The elastic and soft structure of the material makes model making easier with even bare hands. With the help of tools, from geometric to the most organic shapes, it is possible to manipulate the material. Because the material can be reshaped, it gives the model maker great freedom of trial and error during model making, and in contrast to most model making materials, the model maker has the opportunity to both add and subtract material at the same time (personal communication, Velasco, 2009). Good examples of the use of hard styling clay in industrial design can be seen in figure 8.

Figure 8: Hard styling clay and examples of its applications in industrial design. Pictures are acquired from Sparke, 2003 (on the left); the webpage www.hp9825.com/html/industrial_design.html (on the right. Accessed in 15 March 2009)

There are different types and special trademarks of clay, which can be listed under main types as firing clay, oil-based clays (instead of the term oil-based, the terms Plasticine™, Plastilina™, Plasteline™ can be seen, which are the trademarks of oil-based clays), polymer clays and paper clay. For industrial design, oil-based clay types also called as industrial design clay or hard styling clay are suitable because unlike water-based natural clay (firing clay) they don't dry in the air and lose their ability to be reshaped but they soften when reheated even with a hair dryer. Hard styling clay types can be found in a range of firmness for different purposes, they can be manipulated to even the sharpest details and be polished to a glass-like finish (Chavant Inc., 2006).

2.3.5. Plastics

When it comes to computerized model making which is called rapid prototyping, plastics are the material to be used. Although there are types of plastics that can be also be used for manual model making, they are generally not considered as the number one choices because there are other materials like wood and polymer foam which are more suitable for manual model making,

With growing importance and widespread use of rapid prototyping, some types of plastics are being used to make models both in education and in various types of industries. It must however be mentioned that the term plastics covers a huge number of different materials and only a small percentage of those types can be used today with current rapid prototyping technologies. Thermoplastics are the type of plastics that are used in rapid prototyping technologies or any other model making methods like vacuum forming. Most widely used types of thermoplastics can be listed as:

1. Acrylonitrile butadiene styrene (ABS) (for fused deposition modeling)
2. Polycarbonate (PC) (for fused deposition modeling)
3. Photopolymers (for multi jet modeling and stereolithography)
4. Polyamide (PA) Epoxy resins (for rapid prototyping)
5. High Impact Polystyrene Sheeting (HIPS) (vacuum forming)
6. Polyvinyl chloride (PVC) (general model making)

CHAPTER 3

MODEL MAKING FACILITIES

In design education, because practice of design is as important as theory or even more important, model making facilities are essential parts of the design process and also design education. Besides the facilities' benefit of implementing design ideas into reality, they are also places of education. As mentioned in the previous chapter, there is a big amount of learning through the practice of design except its theory, and that is why the facilities are important not only in making ideas visual but making students learn more about several details of design.

Besides educational purposes, these facilities can also help, shape, orient and develop the industry and other schools in its region. In addition to model making, these facilities can become places of research for materials, production technologies, some other design related issues like color, texture and many other subjects that are related to design and manufacturing.

In this chapter, general knowledge about model making facilities is defined together with more detailed information on separate facilities independently.

3.1. Space and Layout

Space (and the architecture of the facility) is the first important issue in a model making facility establishment process and it is also the first thing with the layout of the facilities to be planned. There are two probabilities that can be faced about the space, which are the necessity to establish the facility in an existing building, or constructing a new building for the facility. Although the situation of establishing a model making facility in an existing building is more probable than constructing a new building for the facility, some important details to keep in mind in constructing a new building should be mentioned briefly. Some features that are valid for a model making facility that "The Production Handbook" (1958 cited in Moore, 1962) lists are: simplified design for flexible environment, concrete floors (epoxy coated today) for strength, being nonskid and some other reasons, large windows in addition with anti glaze equipment (however the trend today tends to a windowless, artificially lighted facilities), ceilings higher than approximately 3 meters especially when a crane is to be located in the facility. In addition to these items, the doors need to be sized according to possible big machine transport in and out of the facilities. A higher probability is the necessity to establish a model making facility in an existing building. When the facility needs to be established in an existing building and layout of space available, some problems may occur. The most important problem that may occur is the impossibility of separating facilities. In such a situation, the planning group should focus more on the ways to reach the ideal model making facilities, but to use the available space as efficient as possible. Kobu (1999) defines necessary documents and information to be collected and analyzed in order to make minimum number of mistakes in the establishment process, and those items are: the architectural plan of the building that shows gates, sections, windows, stairs and elevators; infrastructural plans that show heating-cooling, electricity, pressurized air layout and capacity; situation of the outside environment.

In both situations when the model making facility needs to be established either in an existing building or in a new building, it may consist of separate sections or one section (in accordance with the space available). The ideal situation is to especially separate certain facilities from each other such as separating woodworking facility from metal working facility, as metal working can create sparks which can cause a fire or even explosion in contact with wood dust and chips. Most big workshops follow this pattern and separate most facilities from each other, but if that is not possible, the modules should be kept as close as possible as they are pieces of one body. Keeping modules close would benefit in some ways like, especially in case of an intense production period which involves machining different types of materials, a model maker may be in need of using different facility modules simultaneously, and long distances between facilities would expand the model making duration. Another benefit of keeping facilities close, regarding safety and security issues, is the opportunity to monitor them and control the use of the facilities without much need of many personnel or equipment.

Facility layout problem is an important issue for the industry mainly because of the efficiency of not just space use, but also people and energy use (Meyers, 1993 cited in Logendran and Kriausakul, 2006) and it has been studied scientifically for many years. Although it may not be seen as an important issue for a model making facility in design education, it should still be planned considering the main logic. According to Moore (1962) layout problems in industries generally develop because of product-design change, new product, changes in volume of demand, facilities becoming obsolete, frequent accidents, poor worker environment, change in the location or concentration of markets and cost reduction. Not all of these issues are concerns for a model making facility, but still there are some main constraints considering a model making facility layout problem like dust collection, electricity, entrances of a facility, circulation, lighting and materials handling (especially in situations where a crane is included in the facility (Moore, 1962)). Before all those constraints, it should be mentioned that there is never a perfect layout solution for any type of facility, but there are possible solutions. One reason behind this is that, every facility has its own restrictions; another one is that it is not possible to predict the future of the facility since after the establishment process the facility may need new equipment in time with the changing concept and vision of the institution; another one is that with new experiences with the facility, new knowledge about using such facilities may be acquired and according to them the facilities may need to change. This list may grow but the main idea behind those points is that such facilities need to be as flexible as possible in order to enable the managers to make changes.

Considering the constraint mentioned above, there are some points to follow to achieve a good layout of the machinery:

- The location of the plumbing and washbasin determines where processes with water should be done, like plaster making or ceramics model making. Logically, some stone tables or watertight material covered tables should be located close to water for wet manual work. For this wet space, the flooring is also important. To avoid slipping, the floor should be non-slippery, by either using non-slippery mats or grills on the floor.

- The power lines may determine machine layout at some points. Before that it should be mentioned that if the space is designed to be a model making facility, power lines should be capable of taking big loads of electricity at the same time, and it should not be forgotten that most industrial machines work on 380 volts or more (more than normal mains voltage: 230 volts). There are two solutions when considering power lines in a model making facility. The first one is to have overhead power lines with dropping power sockets as in figure 9. The advantage of the system is the detachable dropping power lines. There are sockets on the power line, so it is possible to change the location of a dropping power line. This system is a good solution especially for facilities where hand tools and power hand tools are used frequently. The disadvantage of the system is that, especially for a facility where there are too many immobile machines all around the facility, it is not a good solution to drop power lines, because they may prevent the movement of big parts and that could cause dangerous situations. It would also end up causing lots of power lines dropping from the ceiling which is not suggested. The other system is to hide power lines with cable trunking systems (also known as cable raceways) as can be seen in figure 9. There are again two types of cable trunking systems, which are on-the-floor type and underground type. On-the-floor types are cheaper to apply because they do not need any construction with the floor but they may still be damaged under too heavy loads; underground types need cavities on the floor to place cables and this requires either construction or planning in advance and leave those cavities during the early construction of the facility. The advantage of underground type is that they are more secure, not visible and do not affect carrying stuff on the floor negatively.

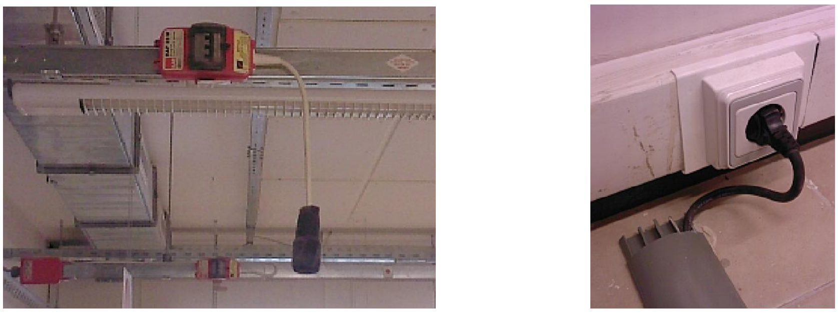

Figure 9: Overhead electric (power) lines and cable trunking systems (photography by the author)

- Dust collection may be another constraint on the layout of machinery if a central dust collection unit is used in a facility. If only local exhaust ventilation (LEV) systems which are local dust collector machines next to each machine, is being used, the layout problem would be to locate machines next to dust collectors which are not in the way. In facilities with central dust collection units, the ideal situation is, as will be mentioned in coming sections, to have one main overhead pipe and branches coming down to machines as in figure 10 (on the left).

Figure 10: (From left to right) Connection of a machine to the central a central dust collection system (Photography by Alex Velasco taken in Politecnico Di Milano) and a LEV connected to a thicknesser (photography by the author from the model making facility in IEU FFAD)

In order to be able to connect machines to the dust collection pipes, the machines should be located accordingly. If the facility is being constructed from ground, the layout of the machines and central dust collection lines should be planned together in the planning stage. If the central dust collection unit and pipes exist before establishing the facility, then the layout should be designed according to those pipe lines.

- The sequence of machine use can also be another consideration for machine layout. Some machines are generally used one after another, like a panel saw cuts panels of wood into manageable pieces, then a thicknesser slims the pieces and then at last a planer (jointer) planes the pieces. It would not be wise to locate these three machines far away from each other, which would cost time, energy and may create dangerous and unhealthy situations while carrying workpieces from one machine to another.
- Entrances and exits of a facility are essential in terms of abstraction of the user, evacuation of the facility and safety. Machines and general layout should be in a way that in emergency the users of a facility should be able to evacuate without much distraction. This means, in addition to proper layout; pathways, evacuation lines and emergency exits should be marked in a visually striking way. In addition to exit signage, every doorway or passage that could be mistaken for an exit should be marked with “Not Exit” signs. Another detail, which may not be seen as important as other constraints, is the possibility of an accident by sudden distraction of a machine user if his back is towards the entrance (when there is one entrance) and another user reaches him/her from behind. The user may injury him/herself by a reflex act.
- Workbenches and hand tools should not be located randomly, but there must be logic. It is recommended to locate workbenches as far as possible from machines as noise and dust exposure should not affect users around those workbenches. Being able to approach a workbench from all four sizes is better than being able to reach it from fewer sides, so an isle of workbenches away from walls is a better solution than

pushing them against walls. If a settled location for hand tools is the way that all hand tools are kept in one facility (in separated facilities, each one might need to have their separate hand tools) then workbenches should be located as close as possible to hand tools area. Otherwise, there would be a lot of traffic of passengers in the facility, and it would be harder to control and prevent loss of tools. If other choice to keep hand tools is picked, which is to keep hand tools inside mobile carts specially designed for the job, keeping tools and workbenches too close would not be an essentiality.

- Location of the storage area may have some affects on the layout of certain machines. As an obvious example, a vertical panel saw or a table saw should not be located far away from the storage area because the machines' main purpose is to cut big wooden boards into smaller pieces. The distance between the storage area and those machines should be kept as short as possible to reduce energy and time cost and possibility of dangerous situations.
- A general safety related issue about facility layout is about visibility of certain objects. If there are fire extinguishers or a fire hose, warning signs should be hung on locations that are visible from any place in a facility, if fire extinguishers can not be located in visible zones. Any other warning signs should be located to visible zones and they also should not block visibility or placed on movable objects like doors or windows. Also, Occupational Safety and Health Administration (OSHA) recommend maximum travel distances to fire extinguishers in relation to the extinguisher's type. For class A extinguishers, which are used for ordinary combustibles, the distance should be 22.9 meters or less; for class B extinguishers, which are used for flammable liquids and gas fires such as oil, gasoline, the distance should be 15.2 meters (based on appropriate); for class C extinguishers, which are

used for live electrical equipment fires, the distance should be decided on the same pattern with class A and class B fire extinguishers. Like fire extinguishers' visibility, the first-aid kit's location (in case there is one) should be clearly denoted, which means either the kit itself should be located in a visible zone or facility users should be directed to the kit with proper signage.

In summary, good facility layout means low energy, effort and time cost, better working conditions, increased productivity, easier access to facility and in the facility, increased flexibility, less accidents, easier supervision (Moore, 1962).

Table 2: Model making facility layout checklist

MODEL MAKING FACILITY LAYOUT CHECKLIST		
1.	Plumbing and washbasin	
2.	Powerlines	
3.	Dust collection lines	
4.	Sequence of the use of machines during processes	
5.	Entrances and exits	
6.	Workbenches and hand tools working	
7.	Storage area	
8.	Safety equipment' visibility	

In the case, the model making facility had to be established in an existing building so the managing committee did not have a choice to separate facilities. The space, that was decided by the collaborative work of the university management, the architect of the university and the faculty people in charge, can be seen in figure 11.

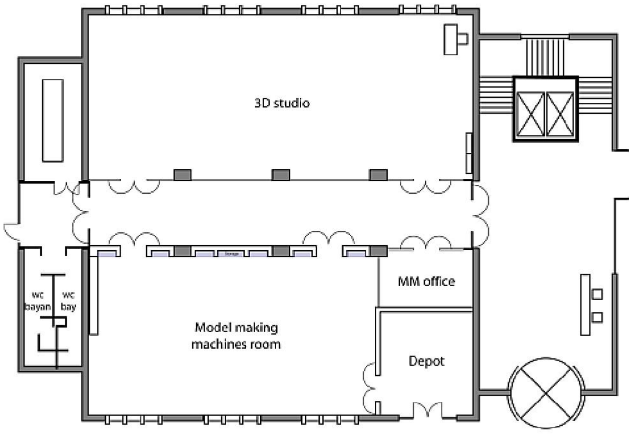

Figure 11: Architectural plan of the model making facilities in IUE FFAD (not to scale)

The managing committee faced fewer constraints from the list above, because there was not a central dust collection unit, dust collection was handled with LEVs in addition to central ventilation, hand tools were thought to be used in another room from the machines room, which was named as 3D studio, so there were not workbenches in the machines facility. Except those two constraints, other constraints were considered during the process of the facility layout. The location of washbasin determined where the granite tables should be located and storage room (shown as depot in the architectural plan) determined where table saw, planer and thicknesser should be located. The reason why those three machines' locations were thought as one is another constraint which is sequence of use of those three machines. Power lines were the other important constraint. There were three overhead power lines, so accordingly machines were aligned under those power lines. Still, in order not to have many dropping power lines, which could block workpieces' movement, machines were located accordingly and some machines were connected to electricity with on-the-floor cable raceways and some with dropping lines. Other constraints that are relevant to safety were also considered and so, the pathways were left free in order to secure safe evacuation and user traffic in the facility, fire extinguishers' and first-aid kit's location were chosen to provide visibility and entrances were freed from any kind of obstruction. According to what is mentioned above, the layout of the machines room was decided in the way shown in figure 12, but the facility managing committee left a possibility for flexibility in case a new machine will be bought for the facility.

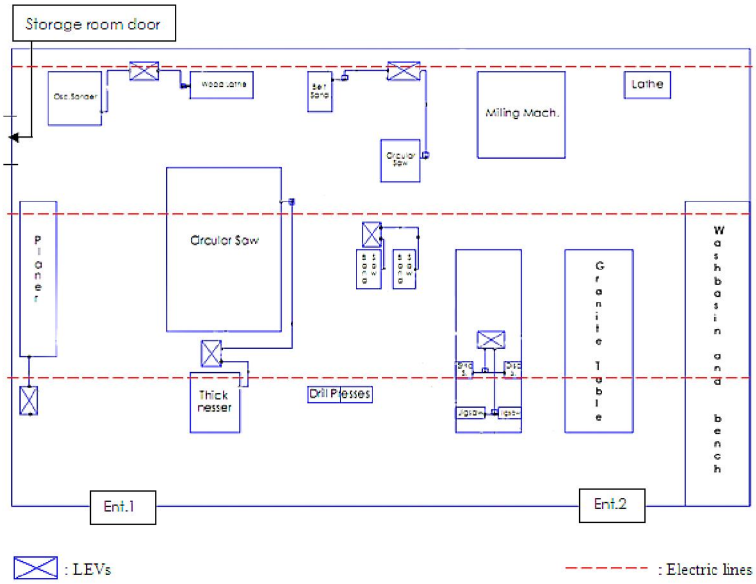

Figure 12: Layout sketch of the model making facility machines room in IEU (not to scale)

3.2. Equipment Selection

Just like in a factory, machinery and other equipment' selection (which can possibly be named together as technology selection (Kobu, 1999)) is an important issue to be determined before the establishment of the facility. Not because of the cost of machinery only, but also because the machinery selection can change the whole program of the education in terms of practice. For example, a traditional machinery selection may not let the instructors assign their students with organic shaped design projects; or with small scale machinery selection, one-to-one scale production may not be possible.

Like there has to be logic between equipment selection and a company's strategy in manufacturing (Yurdakul, 2003), there has to be logic between tool selection and the objectives of the design education program. In today's industrial world, when selection of equipment for big manufacturing establishments is considered, systematic mathematical approaches are used. One of them is analytic hierarchy process[6] (AHP) which combines various criteria for choosing the right equipment (Yurdakul, 2003). There are also other researches and models that come out of those researches on the subject of equipment selection; which can be categorized under three titles as heuristic approaches, optimization techniques and combination of both (Almutawa, et al., 2005). If the model making facility to be established is a big investment like a new factory, then these methods can be applied by professionals but if not, those systems would be too complicated to establish a design education model making facility. Although, when complicated mathematical models are out of the question, during initial stages of a model making facility establishment, the similar logic and principles of those models should be used to get the right solutions for the facility equipment and machinery selection. For a model making facility equipment selection, probably the most important constrains are the objectives and foresight of the design program and managing instructors. According to the facilities that managing committee (or the institutional administrators or a special committee) decides for establishment, the next step is to decide on the technology. The committee may decide on establishing only traditional model making facilities with traditional machinery like bandsaws and milling machines; or the committee may decide on establishing only more technological facilities with more technologically

[6] Analytic hierarchy process is an approach that 'has the capabilities to combine different types of criteria in a multi-level decision structure to obtain a single score for each alternative to rank the alternatives' among the available multi-attribute approaches that is used in equipment selection.

advanced machines like CNC machinery and rapid prototyping machines. In addition to the vision of the managing committee, there can be other concerns like economical issues. While traditional machines are relatively cheap, it is possible to establish the facilities with less expense. But still in general, most widely adapted way is to include both. For an educational institution, as the main purpose of the facility is teaching, traditional hands-on production can not be ignored, especially in design education. When selection of technology is decided, the next step is to choose equipment. The most essential equipment for certain types of facilities will be mentioned in the coming section.

Another important issue about the purchase of equipment is safety (Blake, 1963). Although today manufacturers of machinery, tools and facility equipment consider safety as an important design detail, there are still cheap and low-quality products on the market. Those low-quality products may do the job that higher-quality ones does, but in an unsafe way. If picking up and purchasing the equipment for the model making facility is left to the purchasing department of the university/institution, it would be a bigger possibility that the purchasing department chooses the cheaper equipment. So, in order to prevent the facility being filled with cheap, low-quality and unsafe equipment, the managing committee should take the responsibility to choose the right equipment for the facility. This would not be an easy job because it needs a lot of study as any other issue about establishing a model making facility. In the case, the right brand, model and number of the equipment are picked and the list is then sent to university purchasing department.

3.3. Facilities

When it comes to a new model making facility establishment, there can be different types of limitations to the design of the facility, by either outside or inside influences. As examples to those influences, the school/university may be built on an existing old building so that the space available for the facility may be set and there are constrains that you have to fit yourself in, or the institution may have limited plans for the facility at the beginning, or the objectives of the design program may limit the practice part of design process. This study focuses on situations when a model making facility needs to be established on an existing building, although most possible types of facilities in a design education will be defined.

It is obvious that, if started with a vision and a plan for the future of the facility and the program, also pointed out by McDermott (1947 cited in McConnell, 1951) as these facilities should be designed according to the objectives of the program at the start, the right steps would be taken, like good ventilation of the facilities which is essential for health, good lighting for safe workability, good layout for access between modules or most importantly what type of facilities to establish. When there is a chance to construct a new building from ground, the ideal way of planning is to gather qualified people from certain fields. Electrical infrastructure, flooring, air conditioning or even door sizes are some important details that should be designed right in order to have the facilities right. Another tough part about planning facilities and the reason why there should be qualified people in planning process is that, different facilities may need different hardware or equipment. For instance while a woodworking facility should have a powerful air conditioning system that is capable of sucking dust, a clay model making facility needs a less powerful air conditioning but good plumbing which a woodworking facility does not need to have. An ideal planning group of people should also include representatives from the faculty/department for which the facilities will be used by, as it is always recommended to include people that will use what is being planned to the planning process. One reason behind this is, that the users' contribution to any kind of planning makes them fell more involved which will end up making them embrace what is being planned. Representatives from the educators' side should also mention their needs and ideas about the facilities.

In a model making facility, there should be more than one facility for different types of materials. This study focuses on soft model making and as defined in the previous chapter, wood, plastics, clay and paper are the materials that the emphasis is on.

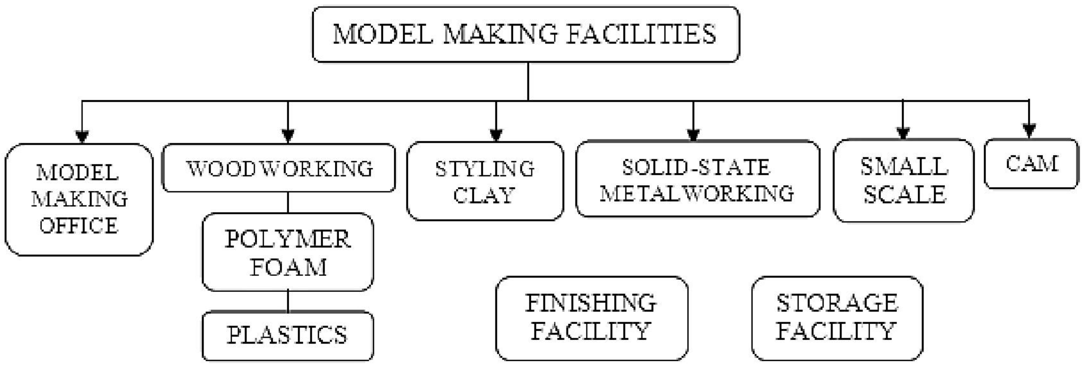

Figure 13: Model making facility types

However, a metalworking facility can not be omitted. For this reason in this section, only woodworking, plastics and polymer foam working, clay model making, computer aided manufacturing, painting and finishing facilities and their equipment will be overviewed. However, this should not be mistaken that in addition to the materials and facilities that are mentioned in this study, there are not any other kinds of model making facilities or materials that are used in model making practice. This study covers possible and essential facilities for a design education model making facility during its establishment process.

3.3.1. Model Making Office

This section basically summarizes the ideas and experience of the author and the model making committee about a model making office for the model making facilities. According to the outcomes of those ideas, the model making office has several purposes. These purposes can be listed as:

- The technician or the person(s)-in-charge is located in this room. The office should be in a location that the person-in-charge can observe the model making facilities and users for safety and security issues, and he/she should also be able to access to the facilities quickly. It is best if possible to locate the office in a central location.
- The office should have opportunities for visitors/supervisors like a separate desk and computer with internet connection, so that they can come here, study or do their research.
- This is also a meeting office for especially the managing committee. Regarding this, the office should have a meeting table for a minimum number of the members of the committee.
- The office is the center where all the information/knowledge for/about model making and the facilities is gathered and managed. Regarding this, the computers

should store virtual information and also have access to relevant information channels. In order to store and manage information easily, the computer(s) should be equipped with database software[7]. The office can also have a physical library that stores books, catalogues and other kind of written documents.

3.3.2. Woodworking Facility

Woodworking is probably one of the oldest techniques of making anything out of a material, in addition to techniques that involve using stone and mud instead. From the earliest periods of human existence until now woodworking is accepted as one of the easiest and most preferred technique of model making. Today, it has still not lost its importance and it is widely used in the area of model making, mainly because of the benefits of the material properties that was mentioned in the previous section and the appropriateness of the material for manual manipulation.

If an institution's plans include traditional model making in their design curriculum, a woodworking facility is a "must have" facility. Having a woodworking facility may sound like a hidebound idea for the 2000s when there are lots of high-tech methods for model making (like 3-dimensional printing), but to be able to manipulate a material during the design process by feeling its every single curve is a great way of learning a material and learning design, and also traditional techniques enable model makers to add or subtract material during design process which can not be achieved with computer aided model making techniques.

[7] See section 4.2.4.

In order to have a good woodworking facility, there are a couple of important details that should be stressed on. The most important problem in a woodworking facility is the output of wood machining which is wood chips and dust. Generally woodworking machines have dust outlets on them which enable the users to use dust collection systems. But, although when every machine is connected to dust collection system (some machines may still not have dust outlets, like some small scale woodworking machines or wood lathes), it is almost impossible to collect all the dust that comes out of the machines. For this reason, the facility should be equipped with a powerful central ventilation system alongside with LEVs. According to Health and Safety Executive (HSE), the maximum exposure limit of hardwood and softwood dust is 5 mg/m^3 (8 hour-time weighted average). To be able to achieve this, during the planning period of the establishment, the machines and equipment that is planned to be used in the facility and how much dust those machines produce should be calculated and a ventilation system should be designed accordingly by professionals. The ideal set up for a woodworking facility includes both a central dust collection that is connected to the facility with large diameter pipes attached on the ceiling with branches going down to machines in smaller diameter pipes and a separate central ventilation unit. One important detail to achieve good suction is to minimize number of corners that air must pass on its way from a machine to dust collector, because in addition to the distance between machines to dust collector, turns and corners slow down the air which is equal to the decrease in suction. Another danger that comes with wood dust is a less known one, which is the possibility of explosion of wood dust. According to Health and Safety Executive (HSE), when the particle size is less than 200 microns and when as little as 10% of dust mixture is in particle size less than 80 microns, there is possibility of explosion when it is somehow ignited. In the case, the facility has an air conditioning system that is designed for an ordinary gathering environment. With the major dust producing machines connected to dust collectors, the lack in central ventilation capacity could be minimized. It could also be a good idea to even separate the biggest fine wood dust producing process sanding (and also wood turning) from other woodworking processes. With an isolated sanding room with powerful dust collection and ventilation system like in Academy of Art University Industrial Design Department, where there are sanding machines, linishers, downdraft tables, lathes and hand power sanders are used, other woodworking facility users could also be protected from wood dust exposure while they are working on other machines. Below are the sine qua non machines for a woodworking facility (with pictures of the machines in figures 14, 15 and 16):

1. Table saw: Also known as circular saw or horizontal panel saw (also can be considered as separate machines), table saw is used to cut especially large wood panels into manageable pieces, which can be seen as the first step of wood model making. It can also be used to cut almost any kind of wood except pieces thicker than the radius of the cutting blade.
2. Bandsaw: A woodworking bandsaw is generally used for purposes like resawing[8], miter cutting[9], crosscutting[10] and cutting irregular shapes and curves. A powerful bandsaw can be used to cut thick wood pieces, and with a good quality blade, it is possible to have fine and precise cuts.
3. Thicknesser: Also known as thickness planer or moulder, thicknesser is used to slim down a wooden block including straightening the surfaces all along the piece.

[8] Resawing is defined as 'the process of slicing a tick piece of stock into several thinner pieces' by a bandsaw in the Woodworking Glossary Website (www.woodworkingglossary.com/page7.htm)
[9] Miter sawing can be defined as the process of cutting at an angle to the saw blade.
[10] Crosscutting is defined as the process of cutting across (or perpendicular to) the grain of the wood in the Woodworking Glossary Website (www.woodworkingglossary.com/page2.htm)

4. Planer: Also known as jointer in the USA, planer is an essential machine to obtain flat surfaces of wood pieces.

5. Drill press: Also called as pillar drill, drill press is an essential machine for any size and any type of workshop facilities and is used for making holes on the material.

Figure 14: (From left to right) Jet Tools® JTAS-12XL50-5/1 table saw, JWBS-16B bandsaw, JWP-15DX thicknesser and JDP-17DX drill press (pictures are acquired from woodworking.jettools.com. Accessed in 02 April 2009)

6. Sanders: The most widely used types of sanders are disc, belt (also called as linisher), drum, oscillating spindle sander and combination sander which combine more than one type of sanders. They are all used to achieve better surface finishes after machining the material.

Figure 15: (From left to right) Jet Tools® JDS-12B Disc sander, EHVS-80CS horizontal belt sander, 22-44 PLUS drum sander and JOVS-10 oscillating spindle sander (pictures are acquired from woodworking.jettools.com. Accessed in 02 April 2009)

7. Miter saw: This type of saw is especially used in carpentry with its ability to make fast crosscuts and mitre cuts.

8. Scroll saw: A scroll saw can be imagined as a miniature bandsaw. It is a small machine in sizes generally used to cut more detailed cuts, especially with more curvature. Differently from a bandsaw, a jigsaw blade is a small and thin blade that makes a reciprocating move.

9. Wood lathe: A wood lathe is an essential machine in machining objects with symmetric cylindrical cross sectional area. With additional parts, a wood lathe can duplicate a turned[11] object automatically.

Figure 16: (From left to right) Jet Tools® JMS-10CMS miter saw, JSS-16 scroll saw and JWL-1642EVS wood lathe (pictures are acquired from woodworking.jettools.com. Accessed in 02 April 2009)

Besides these most essential woodworking machines, there are other ones that can be had in a woodworking model making facility like panel (vertical) saw, mortis(c)er, buffing machine and combination machines which combines two or more woodworking machines that are mentioned before like a planer-table saw combination machine. Another essential machine, which must be had in a woodworking facility without central ventilation system, is dust collector.

[11] Turning is a machining process which is defined as 'a forming by use of a lathe' by the Merriam-Webster online dictionary.

3.3.3. Cold (Solid-state) Metalworking Facilities

As it was mentioned before, a cold (or solid state) and plastic state metalworking facility (or at least metalworking machines) to a certain degree is another “must have” facility for a model making facility. Simple solid state metal forming techniques like bending, shearing, and plastic state metalworking techniques like rolling or hammering can always find a use in a model making facility, so it would be wise to have at least some simple metalworking machines. In addition to metal forming machines, metal machining machines like a drill press, grinder, and bandsaw, and the simplest metal joining machines like spot welding machine can meet a metalworking facility’s primary needs.

If the managing committee’s plans include only solid state metal forming machinery for the metalworking facility, the metalworking machines can be located together with other facilities’ machines as these metalworking machines would not produce sparks that would create dangerous situations in contact with wood, plastics dust or fume and finishers’ fume. But still, it would not be wise to keep those machines together as the dust that is produced by other machines (especially by wood machines) could damage or especially corrode metalworking machines in time. When spark producing machines are considered, those machines must be separated from other machines. If welding, which is probably the biggest spark producing metalworking technique along with high speed cutting, is considered in the facility, generally there should be a separate room for welding not just from other material working facilities but also from other metalworking machines. In that area, a gas welding system or a shielded-metal arc (SMAW) system (also known as stick welding (Lesko, 2007)) would be enough to meet the needs of facility users. Soldering equipment should also be considered in a metalworking facility.

The author believes that, especially during the start-up phase of a model making facility, simple metalworking machines that aims to help other model making facilities, would be sufficient. In respect to this point of view, most essential metalworking machines that should be included in a metalworking facility can be listed as (with the pictures of the machines in figures 17, 18, 19 and 20):

1. Cut-off saw: Like a woodworking mitre saw, a cut-off saw is used to cut long metal pieces like tubes or pipes into manageable shorter pieces.
2. Bandsaw: There are two types of bandsaws which are horizontal and vertical. Vertical metal bandsaws look the same with a woodworking bandsaw. Horizontal metal bandsaws are more widely used in the industry for all types of cutting purposes.

Figure 17: (From left to right) Jet Tools® JCS-14 cut-off, 20'' vertical and HVBS-7MW horizontal bandsaw (pictures are acquired from industrial.jettools.com. Accessed in 02 April 2009)

3. Bench grinder: An essential machine for any kind of facility as the machine is also used to sharpen any type of metal tool like chisels or knives.

4. Buffing machine: This is a finishing machine in order to achieve good finish on a workpiece.

5. Drill press: Like all other drill presses, it is used to cut holes in one axis.

Figure 18: (From left to right) Jet Tools® JBG-200 bench grinder, 577110 buffing machine and GHD-20T drill press (pictures are acquired from industrial.jettools.com. Accessed in 02 April 2009)

6. Press (hand) brake: The machine is used to bend metal sheets.

7. Foot shears: The machine is used to cut big pieces of metal sheets with a long blade in one go.

8. Bending (slip) roll: The machine basically used to bend metal sheets by moving the sheet in adjustable metal rolls.

Figure 19: (From left to right) Jet Tools® HB-1697H hand brake, FS-1636 foot shear and SR-2236N slip roll (pictures are acquired from industrial.jettools.com. Accessed in 02 April 2009)

9. Tube (pipe) bender: As it can be understood from its name, the machine is used to bend pipes into desired angle. Various capacity pipe benders in various dimensions can be found in accordance with the capacity of the work.

10. Spot welder: The machine is used to join more than one piece of metal sheets by clamping them between two electrodes that create a current and melt the metals to join them together (Lesko, 2007). Today, even hand-held ones can be found.

Figure 20: (From left to right) Jet Tools® JHPB-20 hydraulic pipe bender, Telwin digital modular 230 spot welding machine and Telwin PTE 18 400V (pictures are acquired from companies' official websites. Accessed in 02 April 2009)

3.3.4. Plastics and Polymer Foam Facilities

A plastic and polymer foam working facility can be established as a separate facility because of possibly different waste output after thermoforming, but especially considering the machining of the material, the facility can also be combined with a woodworking facility for the possibility of using the same machinery.

Just like a woodworking facility, one of the most important details to take care of in a plastics and polymer foam working facility is the waste output from machining of plastics and polymer foam, which are fume and dust. Mechanical machining of polymer foam generally produces macroscopic polymer foam dust and chips, like wood dust is produced by machining wood. The similarity of the waste output continues with the way of ventilation of these polymer foam wastes. A proportion can be sucked by LEVs in relation to particle size, and for very tiny particles a powerful central ventilation system is needed. Again, just like wood can be burnt by too much friction between the workpiece and the blade, polymer foam can be melted by friction but more easily than it happens with wood. When polymer foam and plastics are melted; fume, which is dangerous in contact with eyes, nose and lungs, is produced in addition to chips and dust. According to HSE, a central ventilation system should be capable of more than six air changes per hour for a healthy plastics and foam working environment. A cheap and easy way to prevent direct contact of a rapid prototyping or vacuum forming machine user and fume in situations, where there is not enough ventilation, is using a fan to blow fume away from the user to an open window possibly (that window should not face a gathering environment or such).

As it was mentioned before, most mechanical woodworking machines can also machine polymer foam and plastics. For example, a woodworking bandsaw is a good polymer foam and plastics cutter with its original blade, although there are special types of blades for polymer foam particularly: or a disc sander with a sand paper for wood on the machine can also sand polymer foam and plastics (however machining foam and plastics decreases sandpapers' physical life), but with a possibility of melting the material. Besides the woodworking machines that are mentioned in the previous section, there are machines just to be used to manipulate plastics or polymer foam. The most essential ones are (with the pictures of the machines in figure 21):

1. Vacuum former: Vacuum forming (also known shortly as vacuforming) is a type of thermoforming where, sheet plastics are used to produce shells in the shape of one sided mold that is produced in advance. The plastic sheet is vacuumed on the

mold after being heated to a certain temperature. Vacuum formers have various types in relation to their mobile and stable parts (e.g. heater stable mold movable)

2. Hot (wire) bender: This thermoforming machine is used to bend plastics by heating a certain line of a plastic sheet by a high temperature wire. The machine is widely used especially to bend acrylic.

3. Hot wire cutter: Another plastics and foam manipulation machine that is used to cut polymer foam. Basically, a hot wire cutter works in the same principle with hot wire bender and does the job of a bandsaw, but the advantage of a hot wire cutter over bandsaw is the quality, precision and the convenience of the cut. There are two types of the machine, which are vertical and horizontal hot wire cutters. Besides desk top machines, there are also hand held hot wire cutters that look just like a coping saw.

Figure 21: (From left to right) Formech Compac Manual vacuum former, Manix ABM-700 hot wire bender, Proxxon THERMOCUT hot wire cutter (photographs are acquired from companies' official websites. Accessed in 19 April 2009)

3.3.5. Clay Model Making Facility

Clay is, as mentioned in the previous chapter, another good material to make a model for both educational and professional purposes. A clay model making facility is a bit different from woodworking and plastics working facilities as the facility would lack machinery but many manual hand tools. One important issue, like for woodworking and plastics working facility, is ventilation. Natural clay contains crystalline silica which is freed as fine silica dust in many ways like, biscuit brushing without LEVs, glaze spraying without LEVs, fettling of dried material or crumbling of dried material. According to HSE, exposure to silica dust should not exceed 0.3 mg/m^3 (averaged over eight hours). However, the clay model making facility that is mentioned here is a facility where hard styling clay is mostly used which does not contain silica. Although during clay model making in industrial design education, students may not face long exposure to dust that is produced during shaping of the clay, a central ventilation system is still needed for such a facility. Under intense dust producing machining, personal protection equipment (PPE), especially respiratory protection equipment (RPE) should always be used.

3.3.6. Computer Aided Manufacturing Facility

Computer aided manufacturing (CAM) is in fact a very broad term that includes any type of production that is controlled by computers and so, any type of machine that is controlled by a computer is a part of CAM processes. For a model making facility of an educational institution like in the case, the sizes and the capacity of such a facility can be limited only by the objectives and vision of that institution. If the institution's visions target towards a high-tech model making, the one and only model making facility of that institution can be called the CAM facility. There is also something else to consider which is, in addition to education aims, as Brown and Stier (2001) point out, the institution could also become a center in its region and give service to other school with this type of a facility.

It should also be mentioned that any type of facility, including woodworking or plastics working facilities, may have computer numeric control (CNC) machines, which in turn also makes those facilities a CAM facility, but the author chose to title a separate facility with the name, especially for CNC model making machines using plastics as raw material. This does not mean that other facilities should not have CNC machines, but certain machines like laser cutter should not be kept in the same facility with dust producing machines. Machines that are widely used for model (prototype) making purposes, which are listed as below (with the pictures of the machines in figure 22):

1. Laser cutter: A laser cutter uses a laser beam to cut materials either by melting, vaporizing or burning them. There are both 2-dimensional and 3-dimensional laser cutters, but for educational purposes generally 2-dimensional laser cutters are used. A mid-range laser cutter is capable of cutting any kind of fabric, paper in several thicknesses, wood up to certain thickness and some other soft materials (in relation with laser power), and also engrave these materials.
2. Rapid prototyping machines: Rapid prototyping is a process where products are additively produced directly with computerized data (a 3D model) by certain technologies. There are various types of rapid prototyping, which are selective laser sintering (SLS), fused deposition modeling (FDM), stereolithography (SLA), laminated object manufacturing (LOM), electron beam melting (EBM), 3D printing (3DP), wide area thermal inkjet (MJM) and single jet inkjet[12] (MM). The managing

[12] For more information about rapid prototyping technologies: http://www.turkcadcam.net/rapor/autofab/appl-eng-prototyping.html (in Turkish).

committee has the responsibility to choose the technology. With changing technologies, the capabilities and in relation the prices of the machines vary.

3. 3D scanner: Also called a digitizer, a 3-dimensional scanner is a reverse engineering[13] machine which scans a three dimensional physical object and imports data about its geometry into a computer in order to manipulate the geometry in three-dimensional computer environment. There are small hand-held ones, desktop ones and big ones that can scan a whole human body. Considering educational purposes, small desktop scanners are the most appropriate ones.

4. CNC milling machine (router): Milling machines can machine a solid material in more than 3 axes, because the machines are capable of moving the workpiece and their cutters at the same time. While a common milling machine can drill, cut radius, plane, shape, engrave, carve, make pockets and islands; a precision CNC milling machine can apply these and even more on a small piece of material in 3-dimensions. Another good feature of milling machines is that they can be found in various sizes, from table top milling machines to milling machines in almost a floor height.

Figure 22: (From left to right) Universal Professional PLS 6.120D, Güngör Makina CNC milling machine and ZPrinter® 450 (photographs are acquired from companies' official websites. Accessed in 19 April 2009)

[13] Reverse engineering generally means analyzing the features of a finished product in order to duplicate it. In here, the feature is the geometry and the aim is to input the geometrical data to 3D CAD environment.

To create a healthy working environment where such machines work, there are some points to take care of. As for any other facilities, ventilation is again a crucial issue. All of the machines listed above manipulate a material in an enclosed space and have extraction outlets to extract the fume that is produced by thermoforming of plastics. With a good LEV, it is possible to get rid of a big percentage of the fume, but still a user would face the fume coming out of the machine when its enclosed space is opened to take the model out. Especially if the room that those machines are kept is too close, the fume may disturb whoever is in that room. For this reason, either the CAM facility is small or big; there is a need for central ventilation system that is capable of sucking fume. As mentioned in plastics and polymer foam working facilities section, according to HSE, the nominal amount of ventilation should be six air changes per hour for a healthy environment.

Generally with these machines, there is not too much possibility of an accident unless they are not used right, for example with their doors, guards are closed and with proper equipment used. According to HSE, 75 percent of accidents with these types of machines happen because of either inadequate guarding or defeated interlocks.

3.3.7. Finishing (and Painting) Facility

Before defining how a finishing (and painting) facility should be, what is meant with finishing in this study needs to be explained shortly. When the term finishing is pronounced, instead of mechanical finishing processes like buffing, grinding or sanding; chemically additive finishing processes like painting, coating and polishing are meant. This is because, unlike mechanical finishing processes, when chemicals come into play, similar but different concerns about health and safety loom large. Handling exposure of chemicals like solvents, need powerful ventilation units and different types of PPEs.

The managing committee has two choices about setting up a finishing facility. The first choice is to create a corner for finishing in an existing facility and the second choice is to create a separate finishing facility. If space is not a limitation for the facilities, the ideal situation is to have a separate facility for health and safety issues. The most important detail to take care of during finishing processes is to reduce exposure to hazardous solvents that are in paints, varnishes and other oil based finishes. Especially when spray painting is considered, a very powerful ventilation unit is definitely needed. Generally spray painting need is handled with spray booths. A spray booth can either be selected from various sizes of booths (as in figure 23) in the market or constructed up to the size. While it is possible to place a small table top spray booth on a corner of a facility, it is also possible to have a room size booth that can take a full size automobile. Industrially manufactured spray booths come with exhaust fans and some with also water screen unit on them, so it is easy to buy one, extend the exhaust line to outside environment and use the booth. Ready-to-use spray booths are capable of sucking most of the sprayed paint, but it is still recommended to use certain PPE like breathing masks, safety glasses and a painting coat while spray painting.

Figure 23: Spray booths in various dimensions. (From left to right) Tamiya spray-work II, Amaco no.1 and Elboy Makina Wet Line (photographs are acquired from companies' official websites. Accessed in 10 April 2009)

In addition to spray booth, other equipment that is needed to be able to spray paint are compressor and spray gun. Spray guns have three different spraying technologies, which are conventional, airless and electrostatic spray paintings. These three technologies differ in the way of spraying the paint. The conventional spraying technology mixes paint with air and sprays; airless technology sprays pure pressurized paint; electrostatic painting (can only be applied to metals) technology electrifies both the paint and the object that is painted and when paint is sprayed, it sticks on the object. In addition to spray painting, a finishing and painting room also needs to have equipment and consumables for traditional (brush) painting. A wide range of painting brushes, rollers, roller trays are the most important equipment, while a wide range of finishing and painting consumables should always be had in the inventory.

Another issue to pay attention is the flammability, combustibility or explosiveness of finishes. Paints, thinners, adhesives, varnishes and some other solvent based substances are flammable or combustible under certain conditions (which may not be extreme conditions) and when thinner vapor mixes with air in a certain ratio it explodes with ignition (personal communication, Tanrıverdi, 13 April 2009). In order to secure them; they should be kept away in a metal flammables cabinet. Those cabinets are specially produced to meet safety standards in order to store flammables; they are usually painted in yellow and have warning signs like “Flammable – Keep Away”. In order to minimize the danger and damage in an incident, finishes should be kept in such a safe cabinet and away from other facilities (especially metalworking facilities). To be able to work in the facility, according to the size of the facility a couple of workbenches; and also for cleaning water basin and plumbing infrastructure are needed.

3.3.8. Small Scale Model Making Facility

For making small scale object models, industrial machines like a regular table saw, thicknesser or a disc sander may not be precise enough. More importantly than precision of the machines, it would be too dangerous to machine a piece that is smaller than a certain level (generally industrial machines’ instruction manuals warn users about the minimum dimensions that the machine is capable of machining). Furthermore, a design student may be in position to make a small model, for example a salt and pepper shaker; for such situations a model making facility needs small scale working machines. Instead of establishing a separate facility for these machines, the managing committee could choose to distribute them in other facilities in relation to the raw material they can machine. A small scale working facility can include hand held and table top machines from brands like Proxxon® and Dremel®.

Figure 24: (From left to right) Proxxon® FKS/E table saw and Dremel® 1120-8 hand hobby tool (photographs are acquired from companies' official websites. Accessed in 14 April 2009)

3.3.9. Hand Tools

The author decided not to mention hand tools in each facility's section above. The reason is because, except some hand tools that are specific to certain model making techniques (like a jackplane is specific to woodworking), most hand tools are used in every type of model making facilities (like a universal hammer). Still, when those specific hand tools are listed, their applications will also be mentioned. Another reason to mention all hand tools together is that, hand tools are generally kept together either in a separate room or in a specific area in a facility.

There are two basic ways of storing hand tools; either in a fixed storage area or in mobile carts. Both have their own advantages and disadvantages which means there is not the perfect way for the issue. The facility management committee should decide which way is more feasible for their facility.

- The first choice alone, which is to have a fixed storage area (figure 25 on the left), is a good solution for smaller facilities. Without use of tool carts, users would have to go to the storage area, get the tools they need, turn back to their workbench and start working. In a larger facility, this would mean loss of time and energy, including more tool losses when users need to do this tour more than once. This can be prevented by having more than one fixed hand tools storage areas far from each other or use hand tool boxes to take tools from the storage area and carry them to work place. Another disadvantage of this choice is that, especially in big facilities with large number of users, it would be even harder to keep track of where each tool is being used. Losses of tools are possible in such situation. However, the advantage of this way of storing is the order of tools. Every tool has its own location in the storage area, so losses and declines in number of tools can be conceived easily and every tools can be scanned with one look which is a good thing for supervisors and facility managers, especially while stock taking.

- The second choice is to store hand tools in mobile carts (figure 25 on the right). Today, there are great tool carts with drawers, and these drawers can also be furnished with tool slots, so that every tool has its own slot. Some facilities, like Politecnico Di Milano workshop facilities uses this way of storing hand tools. The advantage is mobility in the first place. When a user or group of users need hand tools, they can get a tool cart, take it with them and they don’t need to worry about any other missing tools. When their work is finished, all they have to do is to take the tool cart back to its storage area. With this way, a tool cart can be assigned to the user who wants to borrow it, and so that user can be charged from any losses or damages. Another advantage is that, because the tools stay together in a cart, it is less probable for a tool to get lost, which means it is easier to keep track of them. However, a disadvantage of this way of storing is that there may be some hand tools like big F-clamps that a tool cart can not store. For those tools, still a storage space is needed.

HAND TOOLS STORAGE

FIXED TOOL RACK

MOBILE TOOL CARTS

+ Good for small facilities	+ Good for large facilities
+ Easy to check tools	- Hard to check tools
- Immobility	+ Mobility
- Loss of travel time to get tools	+ No time loss to get tools
- Hard to keep track of tools	+ East to keep track of carts

Figure 25: A fixed tool rack of Design Continuum in Milan workshop and mobile tool carts in Politecnico Di Milano and thier advantages and disadvantages (photography by Alex Velasco)

Hand tools, either manual or powered, are sine qua non parts of any type of facility. While the phrase hand tool covers a large number of tools from the most basic knife to an orbital sander, every type of hand tool (like hammer or saw) has various types under the same name, which makes the number of tool types even larger. For this reason, it is believed that a study like this can not cover all the hand tools, but may be able to cover the most essential ones. A list of those hand tools[14] is given below in order to give the general idea of what type of hand tools can be obtained for a model making facility; and in addition to this list.

[14] See the Appendix E for a sample list with pictures of the tools that is created by the author.

The most widely used and essential manual hand tools for a model making facility can be listed[15] as (some hand tools in the list are used to manipulate certain materials only, others are for general use):

Table 3: Essential manual hand tools for a model making facility

Cutting Tools	Saws	Universal
		Backsaw
		Keyhole
		Coping (and deep coping)
		Hacksaw (and mini hacksaw)
		Mini utility
	Knives	Hobby
		Utility
		Swivel blade plastic cutter
	Planes	Jack
		Bench
		Block
	Snips and Shears	All purpose snips
		Aviation snips
		Bolt cutter
		Plastics profile cutter
	Rasps and Files	Engineers files
		Needle files
		Wood rasps (and mini)
		Surform (for foam and clay)
	Others	Woodworking carving tools
		Clay model making tools
		Plastics tools
Striking Tools	Hammers	Claw
		Sledge
		Club
		Engineers (machinists)
		Mallet
	Chisels	Cold
		Wood
		Lathe
		Clay

[15] During the preparation of the list, The Stanley Works – Stanley Tools and İzeltaş websites was taken as the example for the categorization of the list and the use of terminology.

	Marking Tools	Punch sets
		Nails
		Scriber
		Marking gauge
Measuring and Layout Tools	Rules	Tape measure
		Stell rules
		Folding
	Squares	Carpenters
		Combination
		T-bevel
		Steel squares
	Others	Levels
		Vernier calipers
		Height-depth-thickness gauges
Fastening Tools	Pliers	Combination set
		Slip joint set
		Diagonal set
		Locking set
		End cutter
	Clamps	Spring
		F
		C
		Corner
		Band
	Wrenches	Adjustable
		Locking set
		Open jaw
		Combination
		Socket set
	Screwdrivers	Variations of tips
		Variations of sizes
		Insulated
		Hex key sets
	Others	Staple gun
		Riveter

A model making facility should also have the most essential power hand tools ready and the list would include items that are in table 4 as below:

Table 4: Essential power hand tools for a model making facility

Cutting Tools	Saws	Jigsaw
		Circular
		Keyhole
	Planers	Planer
	Routers	Fixed-based
		Plunge
	Hobby tools	Hobby rotary tools
		Foam rubber cutter
		Universal cutter
Abrasives	Sanders	Orbital
		Belt
		Random orbit
	Grinders	Hand grinder
Fasteners		Hand drill
		Screwdrivers
		Hot glue gun
		Soldering gun
	Air Tools	Air drill
		Air screxdrivers
		Heat gun
		Staple gun
		Rasp

3.3.10. Material Storage Room (Depot)

Storage room (depot) is another important part of a model making facility, because there is no point in having the greatest facilities unless you have raw material to machine. A storage room needs to be planned like the rest of the facility before the establishment. The model making facility managing committee may once again have two choices about where to store raw materials. First choice is to store all the raw material together in one room, the other choice is to have separate material storage rooms for every separate facilities (woodworking facility has its own storage room and plastics working facility has its own). Available space is the constraint here. If there is enough space to create storage rooms for every separate facilities, which would be the better solution, because it would reduce the distance a piece of raw material needs to be carried to be machined.

Certain issues to take into account while planning the storage room can be listed as:

- While the capacity is to be determined, the managing committee should not plan considering short term objectives because with growing facilities in the future, the storage room may not be enough to store enough raw materials and it would not be feasible to have more than one storage room in separate areas (unless each facility has its own storage room as it is mentioned before). The space that is needed for storing raw materials needs to be calculated carefully.
- Another issue to take care of is related to the type of material to be stored in the storage room. In accordance to the type of raw materials; type of storage systems, racks, cupboards, shelves and their amount (capacity) need to be determined (for example, in order to store big wooden panels vertical racks are needed, in order to store finishes metal cupboards are needed). Again about this issue, the managing committee should not stick with their short term plans.
- The location of the storage facility is an important issue. If there is going to be one storage room while the facilities are distributed, then the storage room needs to be as central as possible in relation to other facilities' locations. If that is not possible, the managing committee should decide on the best location, and that best location may be decided according to possible raw material piece sizes. If wooden pieces come to the facilities in the biggest sizes relatively to other raw material pieces, then it would be logical to locate storage room next to woodworking facility.

CHAPTER 4

MANAGEMENT OF THE FACILITY

Probably the hardest part of a model making facility establishment process is the last part, which is the management of the facility. It is hard because of many reasons; safety is an important issue, managing the big number of students that uses the facility is an issue, training those users is an issue and there are many other issues to be handled properly to have a safely working model making facility. In this chapter, management is analyzed under three headings which are facility managing committee, facility coordination, and health and safety management.

4.1. Constituting a Facility Managing Committee

A model making facility in design education is a complicated facility to manage. There are many issues to be thought, taken into consideration and planned before the facility starts running. Safety, signage, training, scheduling and updating are just few examples for the issues to be managed. Expecting one person to manage all these issues alone would be too optimistic and a bit imaginary. The author finds the idea of constituting a managing committee essential in terms of creating a well-managed facility. The most important reason is that, committee system works efficiently in terms of distributing responsibility to a group of people instead of giving the whole responsibility to one person. The experiences of the author and his colleagues show that, when the management of a model making facility is assigned to one person only, that facility turns out to be just a workshop of that one person in charge's territory. The habituation in the country strengthens this idea greatly.

Before getting into subject, the questions of what a committee is and why committees are essential, needs to be answered. In Merriam-Webster online dictionary, a committee is defined as 'a body of persons delegated to consider, investigate, take action on, or report on some matter'. As mentioned in the definition, committees are constituted to manage issues that can not be and, also that should not be managed by one person only. According to Wikipedia: the free online encyclopedia, committees are constituted to handle different issues, which are governance, coordination, project management and, research and recommendations. A model making facility managing committee would be a mixture of some of those, a bit of coordination, a bit of project management as the whole establishment process can be called as a project and lots of research. This detail shows that the job and the responsibilities of the facility committee is not an easy one.

Each institution may have its own difficulties and rules about constituting an official committee, which is not one of this study's concerns at this point. Because, starting a model making facility establishment process does not require an official committee at the beginning of the whole process. In the author's case, a managing committee is constituted voluntarily by faculty instructors, which may seem a better way at the start-up. Starting with an unofficial voluntary committee has its own advantages and disadvantages at the same time but, before coming to the advantages and disadvantages, what points are important about choosing the members of the committee should be mentioned first. The most important specification that the members to be chosen should have, is enthusiasm; about the idea of constituting such a committee, about voluntarily contributing to actions, about sparing time and energy on the issue. There is not any other way of perceiving people's enthusiasm but having their ideas on the subject by talking. If there are any instructors or member in the institution who are experienced on model making facility management or such issues from their previous jobs, they should be the number one choices for membership. But, as mentioned previously, they must still be enthusiast about the subject and willing to spare their time for the committee. Another essential detail in choosing members for the committee is that, people from various backgrounds, various qualities or from same backgrounds but with various areas of interest, capabilities or specialties, can make a big difference in the capabilities of the committee, in terms of handling different issues like machine selection, managerial issues, safety. This should not be forgotten that forming the committee with the right people (quality) is always better than forming it with many people (number).

There are both advantages and disadvantages for the model making committee being unofficial at the beginning as can be seen in figure 26. Some examples of the disadvantages can be listed as:

- An unofficial committee has no authority to assign people out of the committee with action items and just like the committee itself, everything that is and will be done, must be done by volunteers.

- Because the committee is an unofficial one, people, including the members, can behave a bit lax about issues concerning the committee and model making facility, like not showing up for meetings, delaying actions to be done. One reason behind such delays or indifference is that, every member in the committee might also have other priorities, like teaching or research. In time, during semesters when those tasks get intense, it can be harder to find spare time for issues like voluntary committee membership. But, still the good thing about being unofficially assigned to a job is the ability to be flexible. When priority tasks of some members get more intense, action items can be allocated to the others, and when every member is busy with priority tasks, the whole committee actions can be re-planned and re-scheduled.
- Other members of the institution can be left unaware of the existence and the works of the committee. This may feel like an advantage in some ways, but in some situations that may also harm the facility, because like a workshop, things need to be planned in advance. But, by the lack of information flow in the institution, coordination may not be established as it should be. Another situation that can happen by the lack of unawareness for the committee and its works is that, people who can help issues with documents, experience, happenings or any other way about managing the facility are kept unaware. This may sometimes delay the development process of the facility.

There are also advantages for the committee being unofficial besides its disadvantages:

- Probably the most important advantage of the committee being unofficial at the beginning of constitution process is that, the committee does not have to waste time with bureaucratic issues, which can be bothersome. Thanks to this, the committee can ponder issues regarding the facility.

- Another advantage, which may turn out to be a disadvantage when it becomes a habit, is the ability to be flexible. Being too flexible can delay things too much sometimes but, other enthusiasts' existence can stop this from happening. The way to get rid of too many delays is basically to assign a member to push the whole committee to work. 'One goal' of that member will be to 'motivate' other members (Hedlund, 1989).

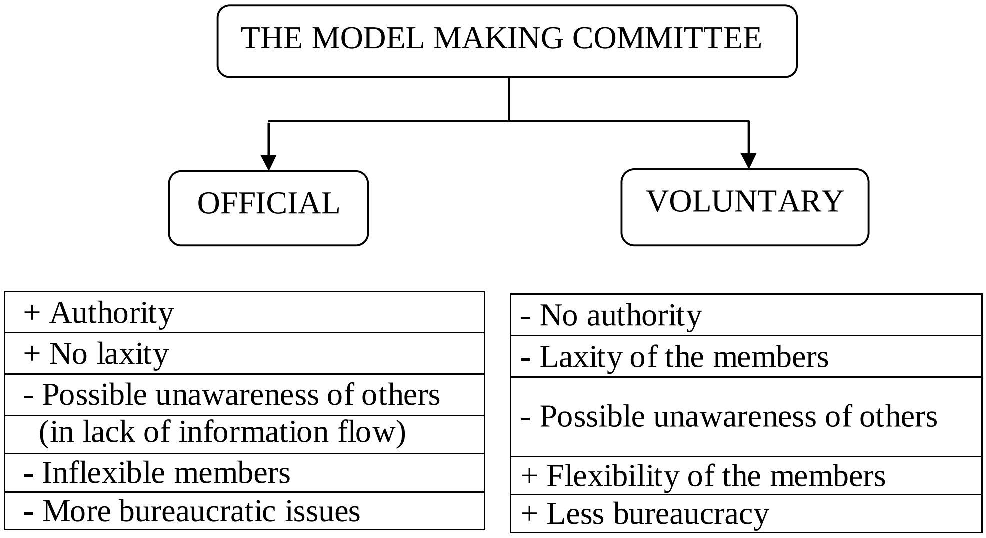

Figure 26: Comparison of official and voluntary committees

The facility managing committee is basically the brain, the heart and all the muscles of a model making facility, if it runs correctly. All the management activities are centralized on the committee, which are planning, doing, checking and acting (Keuning, 1998). Especially, when it comes to transforming the committee from unofficial to official, there are some points to pay more attention to:

- A model making facility managing committee is an organization in a sense, so it must have an organizational structure, which can not be as complex as big companies. However there are issues that affect selection of an organizational structure like ‘variety of activities’ and ‘the nature of the environment’ as described by Keuning (1998). For a model making facility managing committee, the organizational structure should be simple and horizontal. According to the institution, members on the structure may change. In the case, concerning that the institution is a design faculty and the model making managing committee is directly connected to the faculty dean, the organizational structure should be as shown in the figure 27. The rest link to the university management is from the dean of the faculty to the head administration of the university, according to the organizational structure of the university. There should better be a secretary of the committee, responsible from the information flow, scheduling, reporting. In the case, the author of the study and the person-in-charge from the machinery lab was also the secretary of the committee. In this structure, the dean of the faculty should just be the decision maker.

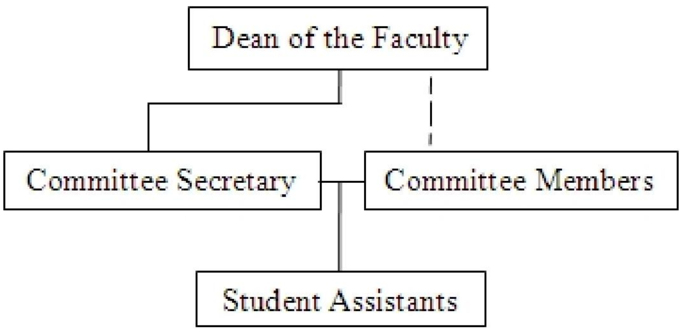

Figure 27: Organization structure of the model making facility managing committee in the case

- Planning the division of work is another issue during transformation to being official. ‘Where in the organization do which decisions have to be made?’ is the way Keuning (1998) asks about this important detail. During the start-up phase of committee transformation, the division of work may not be well structured. In time, as the committee and the model making facility grows and everything starts to settle, the organizational structure would possibly change with members assigned to certain tasks and better division of the work, like it is being done in big organizations. Although it may be hard, especially for people from teaching background (which is mentioned to emphasize they are from a non-managerial background), to determine such points, that will help the committee to be able to represent itself to the whole institution in a more detailed way.

- Determining out the aim of the committee, which means why there is a need for such a committee, needs to be answered well. Only in relation to the vision of the creators of the idea of establishing a model making facility and a managing committee, the aim of establishing the facility and the committee can appear. The aim of the committee can always expand in time, but at the start-up of the process, the aim and the vision should be kept realistic, at least for the short term. While deciding the aim and vision of the committee, every member or possible members of the committee should be aware of them and should agree on them.
- After becoming an official committee, a model making facility managing committee becomes accountable for the facility, the whole work that is done in the facility, creating all the procedures, manuals, regulations and controlling whether they are properly applied or not, all the incidents, events going on in the facility. This means, the responsibility gets even bigger.

In the National Court Appointed Special Advocate Association (CASA) website, a list of things to pay attention to in order to make a committee work is posted and they are as in the table 5.

Table 5: Points to pay attention in order to make a committee work

1.	Make sure that the committee has a real purpose for existence.
2.	Make sure that everyone on the committee knows what the purpose is, and agrees on it.
3.	Have only the right people on the committee: interested, capable, and willing to work.
4.	Remove committee members who are not right for the committee or who do not participate.
5.	Don't hold meetings without a clear reason.
6.	Call a full committee meeting only when it is the best way to accomplish the task.
7.	Give advance notice of meetings, complete with a distributed agenda and reading materials.
8.	Encourage everyone to participate during the meeting. Utilize seating arrangements that encourage equality of participation. Use name cards if attendees do not know one another. Discourage members who monopolize the discussion.
9.	Set norms for behavior at the first committee meeting, and stick to them.
10.	Don't have more than eight people on a committee without breaking it into sub-committees.
11.	Be very specific about tasks and deadlines.
12.	Don't discuss, re-discuss, and continue to discuss items.
13.	Double-check for agreement on important issues. Seek opposing points of view.
14.	Don't allow unrelated discussions during meetings.
15.	Make sure everyone gets credit for the accomplishments of the committee.
16.	Allow some social time following each meeting.

The list summarizes important points about how to make a committee work efficiently, but the items in the list are prepared for official committees, so there may be too strict points for an unofficial model making facility managing committee. It should not be forgotten that still, the more items from the list applied by a committee, the more efficient work achieved. In the end, model making facility managing committee is a committee that is constituted to do work.

4.1.1. Decision Making

Decision making is described as ‘the process of developing and analyzing alternatives and making a choice’ in Dessler (2004) and ‘a process which is made up of successive phases which begin the moment the information becomes available that indicates a problem and lasts until the chose solution is implemented’ in more details in Keuning (1998). Decision making, its nature, its processes, techniques, tools. are all subjects of many researches for many years, but the author believes that, in the case of a model making facility managing committee during its early establishment phase, to be jammed into such details would be nonsense and wrong. Instead, the committee should focus on problems, lacks and their solution, and how to make decisions and implement them as quickly as possible with a minimum number of mistakes. This is why the section and the study do not include details like methods, techniques, philosophy of decision making process. In order to establish a model making facility and get things going, as it is similar for all organizations, some decisions have to be taken and not only taking decisions, but until the very last applause, finding right solutions and proposing them to decision maker or decision unit making are the tasks of the managing committee.

There are various ways of categorizing decisions, but the most widely-used one is probably classifying decisions as: strategic, organizational/administrative and operational (Keuning, 1998). There is another way of classifying decisions, which the author finds more suitable for the case in its early establishment phase, and that is classifying decisions as programmed and nonprogrammed decisions (Dessler, 2004). Programmed decisions are the ones that can be handled with the existing procedures or rules (Simon, 1971, cited in Dessler, 2004); nonprogrammed decisions are the ones that need to be handled in non-prognosticated situations. In the establishment phase of a model making facility, there is a bigger chance for the managing committee to face situations that would require immediate decision taking. This is because; every possible detail about the facility may not be prognosticated. To handle decision making processes more easily, the managing committee should create its own procedures, rules and regulations. For example, if the managing committee sets a rule and procedure about borrowing a tool from the facility in advance, then the supervisor of the facility at that moment wouldn't be forced to take a decision by himself/herself, or he/she wouldn't loose time to learn the rules to be applied in the situation. But, there would definitely be times when the managing committee is forced to take immediate decisions. In those situations, the steps of decision making process should be followed as listed in the online article of Harris (2008) as in figure 28.

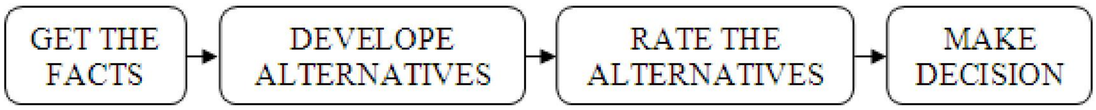

Figure 28: Steps of decision making

This list may be diversified and expanded as these four items are from the SM-14 formula[16] for the general pattern of the scientific method which is used for every kind of problem solving and decision making (Edmund, 2008):

- The first step, recognition of the problem can be done by anyone, either by a committee member or by another member of the faculty. If someone recognizes a problem about the facility, or if there needs to be a development/improvement in the

[16] SM-14 (scientific method 14) is a problem solving and decision making process that has 14 steps. For more information visit www.scientificmethod.com.

facility, the information should be conveyed to the committee (to achieve a better information flow and communication within the institution, the procedures should be clearly set and everyone in the institution should know about them in advance). After this point, it is important to define the problem in as much detail as possible for the sake of the whole decision making process. To be able to define the problem as clear as possible, enough information should be collected about the problem. It is also good to have clear objectives to reach with the decision to be made.

- After the first step is complete, the problem is defined and enough information is collected; then it is time to find solutions. The issue can be put in the agenda of a regular meeting or a special meeting if it needs to be and with a brainstorming[17] session or some more, as many alternatives for solution as possible shall be found in the end of the session. In some situations, the managing committee may find adding people from outside the committee into decision making process useful. Those people should especially be the ones who would possibly face and deal with the outcomes of decisions that are taken. Besides the contribution of members of the institution, consultation from professionals can be another addition in some situations (e.g. a technical problem about operating new machinery). But, one thing to bear in mind is that, too many contributors and/or consultation may slow down the decision making process (Hudson, 1999). When the alternatives are listed, the next phase is to eliminate them to a minimum number. The reason of elimination is that, the decision maker/decision unit making doesn't need to know the whole background of the issue and most of the time, he/she/they doesn't/don't have the time to pass through every detail. The managing committee should think about the consequences to pick the better decisions. This is explained in Dessler (2004) with these words:

[17] Brainstorming is defined as 'a group problem-solving technique that involves the spontaneous contribution of ideas from all members of the group' in the Merriam-Webster online dictionary.

‘you make them (decisions) today, but you feel them tomorrow’. It is a tough part of decision making process as it needs to be far-sighted.

- When every step is complete up to the phase of decision taking, the committee’s next task is to come to a conclusion and prepare a report accordingly with every essential detail to be presented to the decision taker. But, first detail to keep in mind is that, decision making process is not a linear process. It means that there can always be turning back and forth during the process as can also be seen from figure 29 (Keuning, 1998). The second detail to keep in mind is that, although the managing committee may not be able to take a decision by itself, the decision unit taking/decision taker should not be bothered for every detail or routines as it is said in the principle of exception[18] as ‘only bring exceptions to the way things should be to the manager’s attention’ (Dessler, 2004).

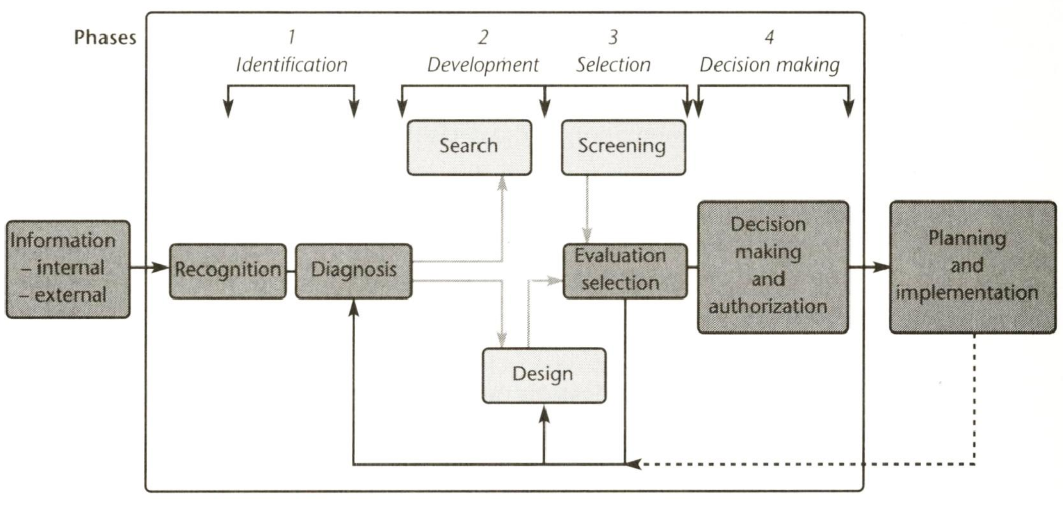

Figure 29: The extended phase model of the decision making process (Keuning, 1998)

In the case, the model making facility managing committee can not be the decision unit making about every issue as it is an informal committee and also, more

[18] Priniciple of exception or ‘the exception principle (also known as management by exception) states that managers should concentrate their efforts on matters that deviate significantly frm the normal and let subordinates handle routine matters’ in the WikiAnswers.

importantly the university doesn't let another decision unit making in its constitution. In the structure of the faculty that the managing committee is bound to, the committee is still in charge of everything about the facility, but acts like a consultant on some issues. An example of how the decision making process runs in the case follows: when an incident takes place in the model making facilities, the managing committee gets together in a regular/special/emergency meeting or has face-to-face talks according to the seriousness or urgency of the incident, and agrees on either taking action to prevent the same incident from happening again, or not. If the committee agrees on taking action, possible solutions are considered and ratiocinated in a meeting, and then alternatives are eliminated until the committee comes with a conclusion. At this point, the task of the committee is to suggest possible solutions to the Dean of the faculty and assure him. The Dean of the faculty can send the proposal back for further study on the subject. If the proposal is approved by the Dean, it is then sent to university administration. However, it should not be understood that the mentality is authoritarian in decision making but, because the actual decision unit making is the university administration at the final point, each level of management has to be followed in order to keep in the university bylaws. Like every organization, the university has various management levels and for every decision to be implemented, it needs to pass through every management level. The decision making and the implementation process can be summarized as in figure 30.

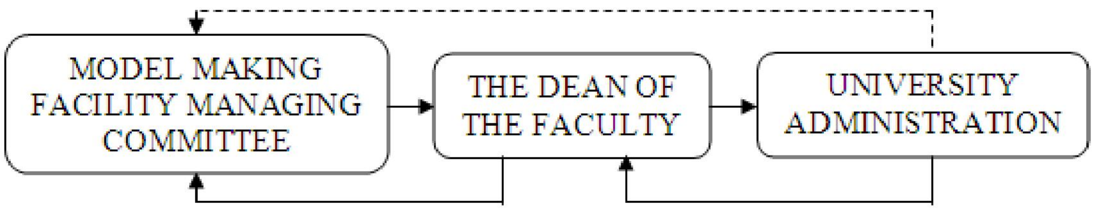

Figure 30: Chain of decision making in the model making facility management in the case

4.1.2. Meetings

Meetings are another essential part of management of a model making facility, just like they are essential for any other type of organization. Although Galbraith (n.d. quoted in Forsyth, 1998) implies that 'meetings are indispensible when you don't want to do anything', in fact they are indispensible to be able to take decisions and find ways to overcome managerial problems for a facility. In a situation that a managing committee exists to manage the facility in stead of a person-in-charge, meetings are not just indispensable, but they are absolute musts.

There are some important points to know about meetings and how to make them as efficient as possible. As meetings are beneficial for a committee to take decisions about the facility, they can turn out to be wastes of time if they are not managed well. The advantages of arranging good planned meetings are basically:

- They are great opportunities for communication and face-to-face relation between members of an institution.
- They are good occasions to find solutions for problems, uncertain situation.
- They increase involvement of people into the subject and make them share the responsibility.
- They are good occasion for information exchange.

It should not be forgotten that, having both too few and too many meetings can be wrong (Forsyth, 1998). Having too many meetings may end up being waste of time, unless there is an agenda; and having too few may end up with unfinished action items, loss of concentration of the members from the subjects. Also, there may be some situations when a meeting is unnecessary, like when a problem can be solved or a decision can be taken by a face-to-face conversation, a telephone call, e-mailing without getting everyone together, there is no point in having a meeting and waste more time that the situation needs. When the committee is formed by volunteers whose prior job is something else, time is a more important issue to be taken good care of.

Board/committee meetings can be classified in various ways; by the target outcome of a meeting as ‘conversation of possibility’, ‘conversation for possibility’, ‘conversation for action’ (Imperato, 2007); by the purpose of a meeting as ‘information meetings’ or ‘decision-making meetings’ (Haynes, 1997); by the scheduling of a meeting as regular, special and emergency (Minnesota State Collages and Universities, 2007). Types may also be diversified for different types of organization or even different industries. But for the case, the most appropriate way of classifying meetings is by scheduling of the meetings as in figure 31..

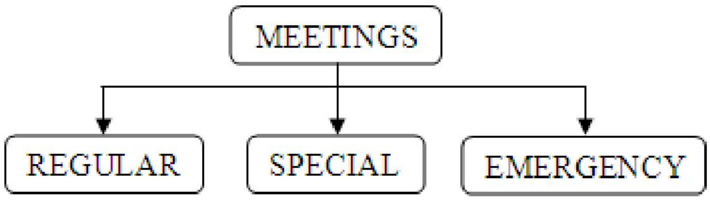

Figure 31: Types of meetings (in relation to scheduling)

1. Regular Meetings: A board/committee, especially a formal one, should schedule regular meetings; like organizations have at least an annual board of directors’ meeting and those meetings are defined in organizations’ bylaws (Mancuso, 2005). There is not a rule determining the regularity of meetings for every

different type of organization, but there are factors that define the regularity. Scott (2007) points out those factors as the number of staff, complexity of operations, wellness of the operations and competitiveness of the staff. During the start-up phase of a committee (or an organization), meetings should definitely be kept more dense than a normal situation, as there would be lots of issues to manage and decisions to be taken. In such situations, weekly meetings may be appropriate, together with emergency meetings in need. When things start to settle into shape, which the period can be called as the youthful phase of a committee (Hudson, 1999), the number of regular meetings may decrease. Still the interim between two meetings should not exceed a month, in order to keep action items being finalized, avoid decline in members' enthusiasm. This should be mentioned once again that, the decision of regularity of meetings rests with the committee in accordance to the works to be done.

2. Special Meetings: Special meetings are basically the meetings that are not held in the regular schedule of regular meetings. They may be called by the head/president of a board/committee or by a majority of members of a board/committee for a specific purpose. The main differences of special meetings from emergency meetings are that, they must be announced at least 24 hours before the meeting and no other subject should be discussed from the subject announced (West Hills Community Collage District Board Policy, 2003). For example, new machinery arrives at the model making facility just a couple of days after the last regular meeting but training sessions must be organized, safety and instruction manuals have to be prepared for that machinery only. This situation may need a special meeting to talk on the issue and take decisions. An agenda should be sent to managing committee in the same way to a regular meeting.

3. Emergency Meetings: These are the meetings that should be held when abnormal situations are faced. Jennings (2007) suggests asking following questions in order to find out if there is a need to hold an emergency meeting: ‘Does the crisis affect the majority of school community? Is it possible for the crisis to get worse? Does the response to the crisis require outside resources? Does the situation surrounding the crisis risk spinning out of control? Is the crisis creating or likely to create rumors and hysteria?’. The procedure of holding an emergency meeting is the same in general terms with a regular meeting, but it needs quicker arrangement. Jennings (2007) also suggests having a prepared ‘meeting agenda template’, which can help in emergency situations most. As an example, when an accident happens on the use of a machine during a time that, that machine must also be used by other users, the managing committee may want to review the safety issues on that particular machine immediately, which would cause an emergency meeting to be held. But, this should not be forgotten that, the idea of emergency may change from person to person, so one should think with a clear head before announcing an emergency meeting. It would not be wise to trouble everyone for a situation that can be solved with a few telephone calls or face-to-face talks.

To achieve more effective and successful meetings without losing much time, they have to be planned in advance. Duncan (n.d.) in her article summarizes this with a list of some questions to be asked before starting to plan a meeting, which are: ‘What outcome do we want to achieve by the end of this particular meeting; to achieve the desired meeting outcome, what must we do during the meeting and how much time will each item realistically require; what idea-building process would be useful; who needs to attend the planning meetings; what should we send participants in advance and what information should we have available at the meeting; what's the best way to set up the space; what equipment will make the meeting run more smoothly'. The most important detail that has to be taken care of before holding a meeting is the aim; there must be a reasonable aim to hold a meeting. When there is a reasonable aim, then an agenda has to be set, which consists of subjects of discussion, points from the last meeting, auxiliary documents to help contributors prepare themselves for the meeting if necessary, location and time of the meeting (Forsyth, 1998). In addition to these items, if time is too limited for members, duration for each topic should be included in the agenda, to inform contributors more precisely about the prescribed progress of the meeting. The agenda of a meeting should be circulated between contributors in advance, so that everyone can add items that they would like to discuss in the meeting, if they will. One detail to make a meeting run more smoothly is to put agenda topics (discussion points) in good order (Çetin, 2008). Leaving the most important topic towards the end of a long meeting would be a bad idea, as contributors may get tired or ask to leave. Everything should be planned and set clear, from objectives and topics to duration and even break times.

There are also some points to take care of during a meeting:

- The first points are starting and finishing time. The contributors other than the ones with excuses should be at the meeting room at the time. When this is not achieved, there would always be delays. With every late comer, a short summary would be told to them in order to inform them about what was discussed and this would take minutes of others. Just like the starting time, the finishing time should be set. Meetings can always be finished before the set time, but should not exceed that limit.

- In every meeting, there should be a person-in-charge and a person to take notes. Even in informal meetings, a “chair” should manage the meeting for order. The chair should not be perceived as the leader of the group or the contributor with the highest place. He/she should be chosen by the committee according to his/her character and abilities, and also the chair can change from meeting to meeting. The main aim of the chair is to direct and control the progress of a meeting, provide the focus on subjects.

As told above, probably one of the two most important contributors of a meeting is the writer, who is responsible from taking notes of issues discussed during a meeting. He/she is important because, those notes he/she takes form the minutes of a meeting, which is essential for the continuity of the process from decision making to implementation of those decisions. In Çınar (2008), taking notes on a white board as the meeting continues is suggested in order to make everyone see them and add missing parts at the moment of writing them. According to Forsyth (1998) minutes of a meeting is essential because it acts like a reminder for actions, a link to next meetings and a record of what decisions were made. To achieve this, the minutes of a meeting should be prepared by a member (most likely the writer of the meeting) as soon as possible and circulated, so that each contributor can add missing parts and be reminded again for their action items and responsibilities until the next meeting. The minutes of a meeting should be clear, brief and should include key points. Also, having a standardized layout for every document including the minutes of a meeting help to structure that everyone in the institution is familiar with. It is mentioned in Free Management Library website that, in stead of a writer taking notes, a small voice recorder can be used to record the meeting and then, key points can be typed into a minutes of the meeting by a member of the committee.

- At the end of each meeting, a brief summary of what has been discussed and what decisions have been taken during the meeting should be repeated in order to emphasize key points and action items; agenda, date and time should be decided for the next meeting. These are responsibilities of the chair of a meeting. These details can help committees, especially informal ones, concentrate on the issues once again and take things more seriously.

Figure 32: Basic elements of a meeting

In the case, the model making managing committee is formed by four confirmed members, which simplifies decision making and having easily managed meetings. Still, some problems with paying attention to starting times and focusing on the subjects could arise with lack of a chair, especially at the start-up phase of the establishment. The meetings are held in the model making office next to model making workshop facility. This helps committee members get the points with an instant on-site examination in the facility, such as locating warning signs or how the training will take place. As in official committee or board meetings, there is always a member taking notes and turning them into minutes of a meeting. The minutes of the meting is circulated through each committee member (who attended that meeting) to prevent missing parts, and then is sent to all members. Below is an example of a part of minutes of a meeting.

MINUTES OF MEETING No.7

Date: 10.07.2008 Started at: 10.38 Finished at: 12.30
Place: [illegible]
Present: [illegible]

(Discussions under subject heading for clarity, as follows)

FIRST AID – HEALTH&SAFETY

SG More students should be trained in first aid.
MY Every supervisor (who will be using lab) must be trained.
AV Supervisors include, instructors, research assistants, and student assistants.

Figure 33: A sample part of a 'minutes of a meeting' in the case

There are other options for having discussions when contributors can not get together because of intense schedules or because contributors locate at different places. Virtual meetings, which consists of telephone and online meetings can provide contributors with the possibility of holding a meeting from their offices or even houses with the help of a telephone or a computer, an internet connection and a provider or a software program. Today, in most institutions and organizations, members and employees are connected to each other via networks. Through this opportunity, online meetings can take the place of traditional face-to-face meetings in abnormal situations. The reason behind the use of the phrase "abnormal situations" is that, the author believes that face-to-face meetings are more effective in terms of being able to understand each other, communicate effectively, share knowledge. Cameron (2005) lists disadvantages of virtual meetings in a similar point of view as: conflicts are harder to be solved when people are not in the same room face to face, brainstorming and having creative discussions are harder, interaction between contributors is slower, difficulty in understanding if every contributor agrees on issues, possibility of some contributors' unnoticed fail in contribution to the meeting (lurkers), and possibility of technological fails. Beside these disadvantages, online meetings have advantages over traditional ones like; every action, every discussion is automatically saved, so there is no need for a writer and not even a single word can be left missing; nobody has to move from their offices or houses, so that a meeting can be held in holidays or weekends; contributors can share documents easily and everyone can modify a document at the same time; can be time efficient.

There are several online services and software, some free to use, some that must be paid. The basic mentality is similar in both software like Microsoft® Office Live Meeting and Adobe® Acrobat® Connect™ Pro and online services like Dimdim® and GoToMeeting®. These opportunities let users to share their desktops, show slides, chat, broadcast via webcams synchronously. Besides these highly functional topical software and services, an online meeting can be organized easily with instant messaging software, especially in situations like the case, when contributors are generally not more than 5 members of the committee and the committee is an informal one (still, this must be mentioned that, the committee in the case has never experienced such an online meeting). With software like Microsoft® Windows Live™ Messenger and ICQ®, people can share documents, create chat rooms that enable getting more than 10 people at the same time, so that every contributor can see what others say. But, capabilities of software are too limited in comparison to the software and services which are designed for the purpose of online meeting or web conferencing only. They may be helpful just to make small and instant discussions, document sharing. Other types of virtual meetings are listed in Cameron (2005) as: audio conferencing, which only needs a telephone as mentioned in the beginning of the title and video conferencing, which enables almost face to face discussions and is usually used by global firms.

4.1.3. Communication

Communication is defined as ‘a process by which information is exchanged between individuals through a common system of symbols, signs, or behavior’ in Merriam-Webster online dictionary. In many writings about communication, it is mentioned that communication is one of the most important tools for better organized, more effective organizations. The importance of establishing a proper internal communication system in an organization is described as ‘making sure your car runs smoothly and is serviced regularly’ (Hume, 2001). There are a couple of ways of categorizing communication, the broadest way is to separate communication as interpersonal and organizational. Interpersonal communication can be separated into verbal and written, or one-way and two-way communication; organizational communication can be separated into downward, upward and horizontal communication (figure 34).

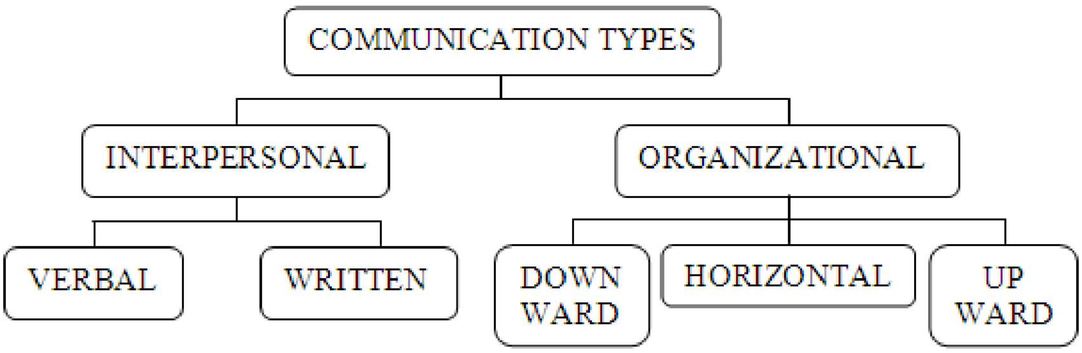

Figure 34: Communication Types

Before getting into details about communication lines in the case, certain principles of effective communication, both verbal and written, need to be pointed out. The most basic but important principle of effective communication is that a message needs to be clear and simple with enough details. It must be clear because the receiver may not know every detail the sender knows, so a message needs to cover all missing details; it must also be clear because people perceive differently and this may create misunderstandings (Bateman and Snell, 1999). It must be short and simple because of some reasons like, the receiver may not be capable of receiving all the details for several reasons (Rowntree, 2000), or too much detail may create inconsistencies in the message itself or may just bore the receiver. Beside these basics, communication needs to be designed considering the receiver profile; a message that is send to a professor may need to be different from a message that is send to a student, in terms of language or content.

Regarding model making facility management, there are mainly two possible types of communication in relation to the participants; communication among committee members, and between the committee and faculty (or university). Communication among members may include verbal communication methods like face-to-face and telephone conversations, and committee meetings. Communication between the committee and the faculty (and university) would be more by written methods, as relationship needs to be more formal (and sometimes needs to be recorded) than it needs to be among members sometimes. This doesn't mean that there should not be any kind of verbal communication between university administration and the committee; for example in situations when an immediate response is needed or a decision needs to be made, verbal communication would be essential as it is possible to get the answer at the moment by a face-to-face conversation or a telephone call. In addition to this, a formal presentation to a group is a verbal communication channel and it is a valid way to transfer information to a group of outsiders (not-committee or university members). Written communication can be in several methods in the case, both among the committee members and between committee and the rest; reports of any kind, like minutes of a committee meeting, procedural and instructional manuals, decision documents and any in-house publications. An in-house journal about facility and committee activities could be a useful communication channel, especially for a facility and committee establishment period in order to familiarize people about the issue.

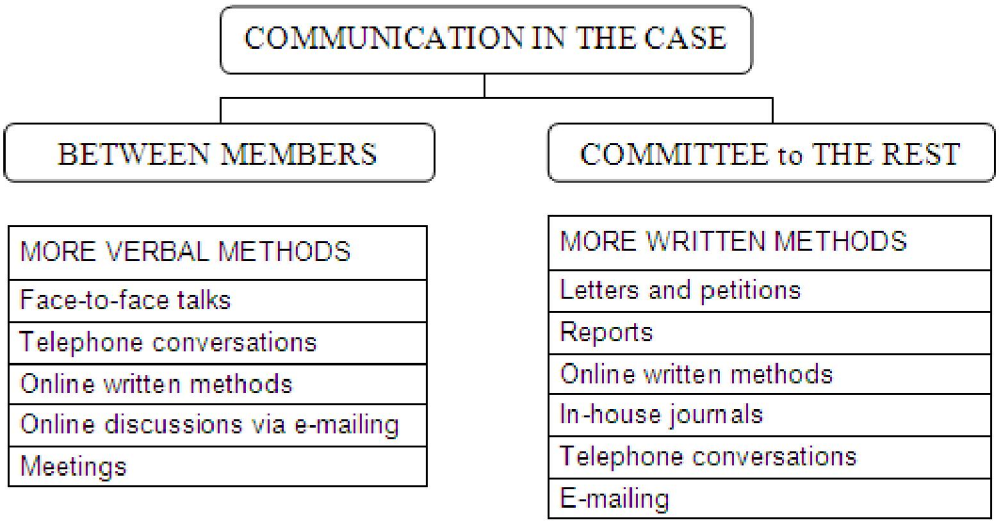

Figure 35: Communication in the case and possible communication methods

Bateman and Snell (1999) open a special category other than verbal and written communication channels, and that is electronic media. Today, for communicational purposes virtual environment is used probably more than real world communication channels, thanks to computer technology. Electronic mailing (e-mail), tele-audio-video-conferencing are ways of communicating via electronic media in addition to online meeting opportunities. These are direct communication channels, but communicating to the outside community via websites is also a valid way. Generally, members of an organization are interconnected via a network which enables members to send direct e-mails. It is an effective way to transfer especially low and medium urgent information, communicate to a group of people at the same moment like a meeting arrangement issue within the committee members. Advantages of electronic media as the communication channel also saves a lot of time, especially when a meeting needs to be arranged. However, a disadvantage of e-mailing is that, the sender can not be sure if the receiver reads the message (unless the sender uses an e-mail software and turn the “notify me when the message is read by the receiver” preference on). However, in the huge amount of e-mailing traffic, a receiver may open and read a message without paying an attention to it. That’s why studies on communication commonly suggest not using e-mailing for urgent or important information transfers. One responsibility of the managing committee is to choose which communication channels to use, how much information to transfer and how often information should be transferred.

In the case, which is the situation when the model making committee has existed for less than a year, communication within the committee members was running good mostly by e-mailing, face-to-face conversations and committee meetings. The advantage that the committee had is the number of members (only 4 members) and closeness of the member’s offices. These make communication easier, but one disadvantage was that, except one member (which was the facility technician (the author)) other members were volunteers and their primary task was teaching at the faculty. For this reason, the committee had hard times to get together. Communication between the committee and the faculty could be considered as efficient. When time went by, the committee has started to get more awareness from the faculty members, especially after the first presentation to faculty members by the committee. Communication between the committee and the rest of the university has not grown stronger until the time this study was written, as the university administration was still not aware of the committee and its works. Another reason was that, until the model making managing committee was established, there has not been a committee that is established to control a university facility.

4.2. Facility Management

When control and coordination of a model making facility is considered, it is quite different from a production facility besides its similar parts. One important detail of the two is the user profile. In a model making facility in design education, the biggest percentage of the users are students. Another important difference is the type of institution that the facility is bound to, education instead of industry. The problem with this difference may be felt from the mentality or understanding of the facility by the institution and users also. What is meant with this is that, in the industry everyone knows how to behave, how to approach to such facilities this way or another; but the same things can be quite different in an educational institution. Establishing the culture with rules and procedures, changing people's behaviors can be quite a struggle at the beginning.

4.2.1. User Profiles

In a design education model making facility, there should be various levels of users, just like the way it is in a production facility but with different titles. In the production facility of a factory, there are generally varied titles of employees, like blue-collar workers, production chiefs, operations manager. In a model making facility, the similar method of user profiles should be applied to define which group has what responsibilities, what capabilities in terms of facility use.

In the case, there are two basic user profiles, which are supervisor and user.

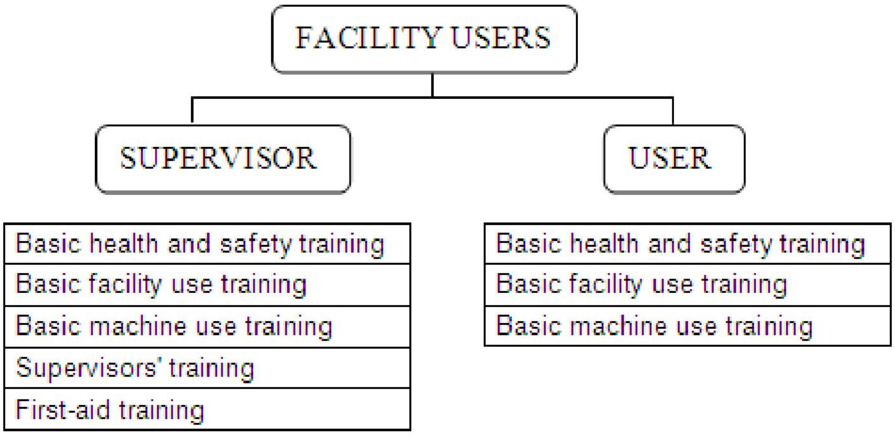

Figure 36: Facility user types and training types that they must get

1. Supervisor: The supervisors group consists of, first of all, the model making facility managing committee members. To the committee members, faculty instructors are added, after the procedures to become a supervisor are completed. The most important requirement of being a supervisor, besides being a faculty instructor, is to attend the whole training sessions, plus the first-aid training. The details of the training are going to be described in following sections of this study. The biggest responsibility of becoming a supervisor is to help the facility grow and spread to all faculty members; like training users, making research to develop the facility in the direction of their professions, finding new opportunities, machines. The mentality of decentralizing from the beginning of establishing a model making facility should never change. In the same work sharing logic, supervisors are expected to share

supervision of their students while they are working; not like a guard waiting for them.

2. User: The user group basically refers to students, including anyone who is qualified and wants to use the facility. Users, just like workers in factories, have to attend orientation program which is basically training. The main difference between supervisor and user training is that, users do not attend to first-aid trainings and they are not trained to train other users. Every user is responsible from his/her training.

While creating user profiles is the first step of managing users of the facility, the next step is keeping record about users. This is possible by creating a database of users manually or digitally. While keeping record manually on paper needs a lot of pre-working (in terms of creating tables or layouts), database[19] software have templates that can be used

4.2.2. Policies and Procedures

Policy is defined as 'a high-level overall plan embracing the goals and acceptable procedures especially of a governed body' and procedure is described as 'a particular way of accomplishing something or of acting' and to be more precise for the case, a standard operating procedure is described as 'established or prescribed methods to be followed for the performance of designated operations or in designated situations' in the Merriam-Webster Online Dictionary. These definitions display that there are several differences between policies and procedures. Shortly while policies reflect the goals, objectives and mentality of a company/institution (in ANSI/ASQ ISO

[19] See the section 4.2.4.

Q9000: 2000 document[20] section 3.2.4, quality policies are defined as overall intensions and directions of an organization); procedures are implementations of policies (UC Santa Cruz Policies and Procedures Team, 1994).

In order to set standards for good practice, policies and procedures are essential tools, both for the users and supervisors of a model making facility. The reason is that, while policies reflect the general mentality of the institution and try to, procedures provide anyone who is not in the managing committee with the information of how a job should be done; they supply the deficiencies of clarity, consistency and continuity of management of the facility, and policies and procedures together are tools to create a culture in the environment. The work about writing especially procedures does not end when a procedures manual is prepared. Because model making facility is not a stagnant facility but an evolving facility, the procedures especially may need to be revised with any single change or new procedures may need to be written. The best thing to keep the policies and procedures up-to-date is to review them either semi-annually or annually at least. A sample procedure in the case can be found in appendix A.

There are some important details about writing procedures. Above all the features of effective policies and procedures; simplicity, consistency and ease of use are the most important ones. UC Santa Cruz Policies and Procedures Team (1994) lists important features that policies and procedures have as below.

[20] The information is acquired from a forum as the ANSI/ASQ ISO Q9000:2000 – Quality Management Systems: Fundamentals and Vocabulary is a fee charging document. The forum can be reached from: http://elsmar.com/Forums/archive/index.php/t-3868.html

1. Good policies;

- Should address the rules not how to implement the rule.
- Should evince their authority clearly.
- Should, as a body, represent a consistent framework.

2. Good procedures;

- Should be tied to policies.
- Should be created in favor of the users of the facility.
- Should be written with the collective work of facility users, so that they can embrace the procedures.
- Should be understandable to everyone.

4.2.3. Scheduling

The word schedule is defined as ‘a plan for carrying out a process or procedure, giving lists of intended events and times’ in the Oxford online dictionary, and scheduling is basically the process of creating a schedule. Schedule of a model making facility is as important as any other managerial issues about the facility, because the schedule is directly related with the usability and efficiency of the facility. Universities all around the world generally have online published procedures about scheduling their facilities that is created by various types of committees like scheduling office, office of the registrar, alumni office or facilities coordinator. From those procedures, it can be seen that, there is not one way for scheduling the facilities of a university but there is a common orientation about putting the facilities in commission and that is to book a facility in advance.

A model making facility scheduling process may be a bit different from scheduling of a classroom or a conference hall. First of all, the schedule of a model making facility may vary in relation to the purpose and the use of the facility; for example if the facility is used for courses, then the schedule has to be adjusted accordingly, or if the facility is open for non-university users, then that has to be considered. In addition, scheduling a model making facility does not only include scheduling of the facility for use, it should also include scheduling of the trainings of the users[21], maintenance[22] and cleaning of the facility. Managing the schedule the facility for use may be assigned to the university administration, but scheduling maintenance and trainings should be handled by the facility managing committee. Clean-up should be planned in communication with the cleaners of the university in a way that cleaning time would not coincide with other programs. According to the intensity of the use of facility, cleaning can be done once a week or more. In addition to these weekly cleanings, it would be logical to schedule detailed cleaning of the facility at the end of each semester.

A plan (or a system in time) should be made by the model making facility managing committee for the use of the model making facility during each term in collaboration with the course instructors, especially studio courses' instructors. It is not an easy task because it needs planning. The course instructors have to decide on their course projects and the schedule of those courses. When all these are planned and decided, the model making facility managing committee can create the schedule and spread it to the faculty.

[21] See section 4.3.1.
[22] See section 4.2.5.

Today, scheduling can be handled in virtual environment by software like Mimosa® and EZFacility®EDU. Although it is possible to keep the schedule manually, it would need lots of preparation of tables and such, and someone to fill those tables when needed. Software lightens these kinds of paperwork with their templates, tables and forms. All the person or commission that is in charge of scheduling has to do is to input data. It is also possible to reach the schedule and book the facility online by software like EZFacility®EDU and Digirez®, as well as it is possible by the help of intranet[23] of universities.

In the case, scheduling of the model making facility was not held by the university coordination/scheduling center, mainly because the facility is a new facility and is not used properly, and it is an exceptional facility from the other facilities. Until this study is completed, the scheduling of the facility was held by the author who is also the person in charge of the model making facility. There has only been one course that the model making facility was booked before the start of the semester and during the hours of the course the facility is being closed to other uses. However, there are other courses (that can be seen in table 6) that need to be directly in relation to the model making facility for the part of their context as model making such as furniture design, industrial design studios and product design studios courses. Other than the course duration, the facility has been open to individual and group uses with reservation in advance. The reservation process is accomplished after the users of the facility fill an application form, which is prepared by the university administration, and submit it to the facility technician. However, by reason of the lack of a proper written procedure about scheduling the facility, a proper scheduling system could not

[23] Intranet is defined as 'a network operating like World Wide Web but having access restricted to a limited group of authorized users' (university students and members in the case) by the Merriam-Webster online dictionary.

have functioned. But still, lack of proper scheduling the use of the facility has not been a problem, mostly because there has not been intense use of the model making facility.

Table 6 – The curriculum of the Department of Industrial Design and related courses highlighted in the case

Curriculum						
1st Year Fall Semester						
Course Code	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS
CS 100		Introduction to Computer and Information Systems	2	2	3	4
ENG 101		Academic Skills in English 1	2	2	3	4
FFD 101		Art and Design Studio 1	2	6	5	8
FFD 111		Drawing and Representation	0	4	2	3
FFD 121		History of Art and Design 1	2	0	2	3
HUM 103		Principles of Social Sciences I	3	0	3	3
IUE 100		Academic and Social Orientation	0	2	1	1
SFL 1013		Second Foreign Languages I	2	2	3	4
1st Year Spring Semester						
Course Code	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS
ENG 102		Akademic Skills in English 2	2	2	3	4
FFD 102		Art and Design Studio 2	2	6	5	9
FFD 104		Computer Aided Technical Drawing	2	2	3	4
FFD 122		History of Art and Design 2	2	0	2	3
FFD 142		**MODEL MAKING**	0	4	2	3
HUM 104		Principles of Social Sciences II	3	0	3	3
SFL 1024		Second Foreign Languages II	2	2	3	4
2nd Year Fall Semester						
Course Code	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS
HIST 201		Principles of Atatürk and History of Rev. I	2	0	2	2
ID 201		**PRODUCT DESIGN STUDIO I**	2	6	5	11
ID 203		COMPUTER AIDED INDUSTRIAL DESIGN	2	2	3	4
ID 205		HUMAN FACTORS	2	0	2	3
ID 207		Materials and Production Technologies I	3	0	3	4
SFL 201		Second Foreign Languages III	2	2	3	4
TURK 201		Turkish I	2	0	2	2
2nd Year Spring Semester						
Course	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS

Code						
ECON 100		Principles of Economics	3	0	3	4
FFD 202		Advanced Design Presentation	1	2	2	4
HIST 202		Principles of Atatürk and History of Rev. II	2	0	2	2
ID 202		**PRODUCT DESIGN STUDIO II**	2	6	5	10
ID 208		Materials and Production Technologies II	3	0	3	4
SFL 202		Second Foreign Languages IV	2	2	3	4
TURK 202		Turkish II	2	0	2	2

3rd Year Fall Semester (tasarım yönetimi)

Course Code	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS
BA 101		Introduction to Business	3	0	3	4
BA 320		Consumer Behaviour	3	0	3	5
BA 340		Entrepreneurial Skills	3	0	3	4
DM 301		DESIGN PROJECT MANAGEMENT I	1	4	3	4
ELEC 001		Elective Course I				
ID 301		History and Theory of Industrial Design	3	0	3	4
SFL 301		Second Foreign Languages V	2	2	3	4

3rd Year Fall Semester (ürün tasarımı)

Course Code	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS
BA 101		Introduction to Business	3	0	3	4
ELEC 001		Elective Course I				
FFD 301		**Furniture Design**	0	4	2	3
ID 301		HISTORY AND THEORY OF INDUSTRIAL DESIGN	3	0	3	4
PD 313		**INDUSTRIAL DESIGN STUDIO I**	2	6	5	10
SFL 301		Second Foreign Languages V	2	2	3	4

3rd Year Spring Semester (tasarım yönetimi)

Course Code	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS
DM 302		Design Project Management II	1	4	3	4
ELEC 002		Elective Course II				
FFD 304		Branding in Design Industry	2	0	2	0
ID 302		Contemporary Issues in Industrial Design	3	0	3	4
MMC 220		Theories of Communication	3	0	3	4
PRA 202		Interpersonal Communication	3	0	3	4
SFL 302		Second Foreign Languages VI	2	2	3	4

3rd Year Spring Semester (ürün tasarımı)

Course Code	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS
ELEC 002		Elective Course II				
ID 302		Contemporary Issues in Industrial Design	3	0	3	4
PD 312		Design Enginnering	3	0	3	4
PD 314		**INDUSTRIAL DESIGN STUDIO II**	2	6	5	10
PD 316		**Design for Sustainability**	3	0	3	4
SFL 302		Second Foreign Languages VI	2	2	3	4

4th Year Fall Semester (tasarım yönetimi)						
Course Code	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS
BA 490		Marketing Research	2	2	3	5
DM 401		Design Project Management III	1	4	3	9
DM 403		STRATEGIC DESIGN PLANNING	2	2	3	4
ELEC 003		Elective Course III				
ID 451		Applied Workshop in Industrial Design I	1	2	2	4
SFL 401		Second Foreign Languages VII	2	2	3	4

4th Year Fall Semester (ürün tasarımı)						
Course Code	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS
ELEC 003		Elective Course III				
FFD 401		Design Semiotics	3	0	3	4
ID 451		Applied Workshop in Industrial Design I	1	2	2	4
PD 403		Design Research	2	2	3	4
PD 409		**INDUSTRIAL DESIGN STUDIO III**	2	6	5	10
SFL 401		Second Foreign Languages VII	2	2	3	4

4th Year Spring Semester (ürün tasarımı)						
Course Code	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS
BA 422		Intellectual and Industrial Property Rights	3	0	3	3
ID 452		APPLIED WORKSHOP IN INDUSTRIAL DESIGN II	1	2	2	4
PD 404		PORTFOLIO DESIGN	2	2	3	4
PD 494		Graduation Thesis	2	2	3	4
PD 498		**GRADUATION PROJECT****	2	6	5	11
SFL 402		Second Foreign Languages VIII	2	2	3	4

4th Year Spring Semester (tasarım yönetimi)						
Course Code	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS
BA 422		Intellectual and Industrial Property Rights	3	0	3	3
DM 404		PORTFOLIO DESIGN	2	2	3	4
DM 494		Graduation Thesis	2	2	3	4
DM 498		**GRADUATION PROJECT**	2	6	5	11
ID 452		APPLIED WORKSHOP IN INDUSTRIAL DESIGN II	1	2	2	4
SFL 402		Second Foreign Languages VIII	2	2	3	4

Elective Courses						
Course Code	Prereq.	Course Name	Lecture	Laboratory	Credit	ECTS
FFD 311		Design Competition Project	2	2	3	4
FFD 320		Innovation Management	3	0	3	0
ID 320		3 Dimentional Mechanical Design	2	2	3	4
ID 322		**Innovative Design Strategies**	2	2	3	4

ID 330	Modeling in Clay and Plaster	2	2	3	4

Detailed maintenance of the machinery in the facility is handled by professionals (the machine companies) once a year, periodical checks are handled by the facility technician and cleaning is planned to be done on Fridays regularly.

4.2.4. Facility and Inventory Security

In workshops, laboratories (and libraries) where there are tools and equipment (and books), security of those items against loss and theft is an issue. A model making facility is open to these kinds of circumstances as there are lots of tools and equipment in sizes that enable them to be chucked in a bag and taken out. Diminution in number of tools can be overcome and lost or stolen equipment can be replaced according to value of the loss but the loss could reach to big numbers if the problem is not taken into account.

It is sad but true to say that generally facility users would be the primary source of losses, especially when the situation is a model making facility that only specific (trained) users are allowed to get in. Theft and loss prevention can be considered as one and should be managed with a security system. There may be many reasons for a user to steal from the facility, but the main emphasize should be on finding ways of creating an environment of trust and honesty. That should be the first aim of the managing committee, but trust should not exceed a certain limit. According to Iacob and Lile (2008), superfluous trust can create security breaches, especially considering longtime employees in small firms. In time, some users, like longtime employees, can become like partners and can have access to keys, records or security details. To prevent this from happening, the roles and limits of responsibilities of managers, supervisors and users, rules, procedures and penalties for violations should be clearly defined and fixed on written documents, and every user of the facility must be aware of them. It is however important to keep in mind that unrealistic and unreasonable rules and penalties can be worse than having poor procedures (Iacob and Lile, 2008). Furthermore, recordkeeping is also important in order to keep track of borrowed equipment and also keep track of losses. At this point again, the importance of procedures shows itself. With clear procedures in place; losses, thefts would decrease in numbers with accidents and faulty practice. Iacob and Lile (2008) even suggest creating a ‘written code of ethics’ to be signed by new employees in small firms; but in the situation, the training and the contract at the end of the training that confirms users and supervisors commitment to the training should fulfill the need. The next step to take in order to prevent equipment losses should be establishing a system of internal controls and distribution of the responsibility, after creating clear procedures and an environment of trust and honesty. For example, all users of the facility could be reminded that they are all responsible from losses, thefts and would bear the consequences equally. Nevertheless, procedures must clearly point related issues out.

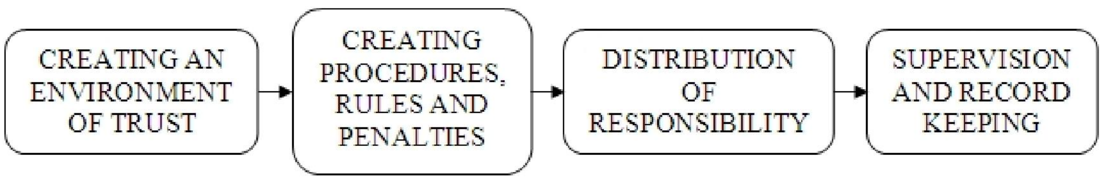

Figure 37: Steps for security of the inventory in a model making facility

Even when an environment of trust is created, clear procedures, rules and penalties are written and system of internal control is established, there is always a probability of equipment losses and thefts. Keeping every tool in locked cupboards or display panels could be a way to prevent them from getting stolen or lost (Koh et al.,2003), but not for a model making facility as equipment are used constantly. This is the point when security systems come into play. According to Stack (1998), security systems (theft detection systems in his words) have been in use since the late 1960s and such systems today offer loss reduction of 85% (in libraries). Today most widely used systems that are used to prevent especially library and retail theft are electromagnetic (EM), acousto-magnetic (AM), radio frequency (RF) and radio frequency identification (RFID) technologies. These technologies may somehow be adapted to a model making facility although they would not be as feasible as they are for libraries or retail stores. All technologies operate with similar principle as can be seen in figure 38; there are three elements, an antenna that generates a detection field, tags that are fixed on the tool and field nullifier when checked properly (Stack, 1998).

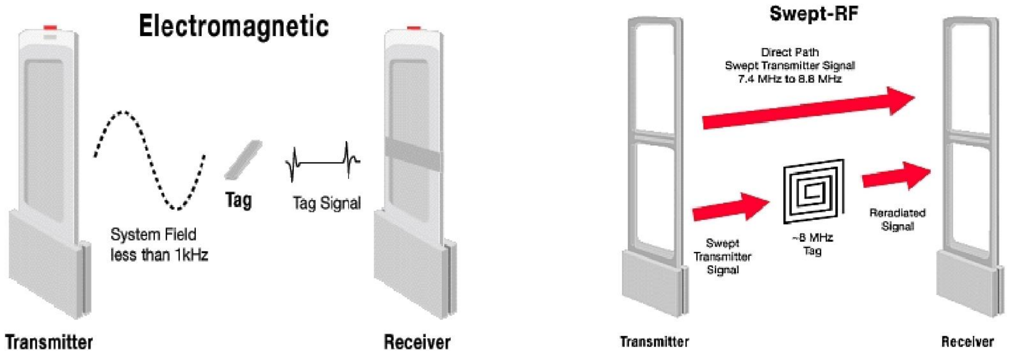

Figure 38: Operation principles of EM and RF technologies (pictures are acquired from “how anti-shoplifting devices work” webpage on www.howstuffworks.com. Accessed in 13 May 2009)

However, RFID technology is a bit different from the others with its operation principle. Every user has an identity card that carries a RFID chip inside, which can be programmed with cash or permit access to buildings, rooms and facilities. In order to get access to opportunities, the card owner has to scan his/her card over a reader. When this system is connected to a network and database system, the system can control if the user is allowed to utilize the opportunity and keep the record of user entrances and exits (if there are turnstiles) and borrowed equipment.

One issue that complicates the adaptability of these technologies as a model making facility inventory security system is that, in such facilities there are always tools that are too small or in organic shapes that can sometimes makes sticking electronic article surveillance (EAS)[24] tags that are shown in figure 39 on impossible. Also, tags and strips are stuck on the objects, which mean they can be detached from the objects.

Figure 39: Most commonly used EAS tags. Left-top: AM tag, left-bottom: RF tag, right: EM tag (strip)

The difficulty in sticking tags on facility equipment would not be the only problem about adapting one of those systems to the situation. The question of where to locate the antennas (transmitter and receiver in figure 38) in a model making facility can be tricky, especially in situations where there are more than one exit or more than one

[24] Electronic article surveillance '(EAS) is a technology used to identify articles as they pass through a gated area in a store. This identification is used to alert someone that unauthorized removal of items is being attempted' (How Stuff Works. Available from: http://electronics.howstuffworks.com/anti-shoplifting-device2.htm).

area that facility equipment can be taken for work. The managing committee should find proper locations before installing the system.

These security systems can decrease the number of thefts and losses when they are used without any integration with other technologies, but their efficacies enhance with other security technologies like closed circuit television (CCTV)[25], motion detectors, railings, entrance gates and turnstiles (Koh, et al., 2003 and Stack, 1998). Turnstiles or locking gates can help with the control and record keeping of entrances and exits, but the managing committee should be careful not to violate safety related issues while concentrating on inventory security and record keeping too much. In an emergency, the gates should be convenient for evacuation and nothing should be blocking exits.

4.2.5. Information Management

Information is considered the fourth resource after people, money and physical resources today (Seetharama, 1999), and its importance can not even be measured when an educational institution is the situation. In the situation of the management of a model making facility, there are lots of information input and output that should be managed; like procedures, safety issues, facility use manuals, outcomes of meetings. In addition to all these, the model making facilities should not be just a facility that is used to make models but it is a facility of learning. One of the aims of the idea of a model making office[26] is to include a physical and a virtual library that anyone who

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[25] 'Closed circuit television (CCTV) is the use of video cameras to transmit a signal to a specific place, on a limited set of monitors. CCTV is often used for surveillance in areas that may need monitoring

[26] See the section 3.3.1.

is in need or interested could come and study. This means, the office should be a center of information and that information should also be managed. It is important to manage and record all necessary information for the development of the facility during the establishment phase and for easier management during the following phases, as Rowntree (1996) emphasizes the importance of managing information as ‘Unless it’s available in the right form at the right time and place, the best information in the world is valueless’. One important thing about managing information is that it is a never ending task as can be seen from the figure 40 below.

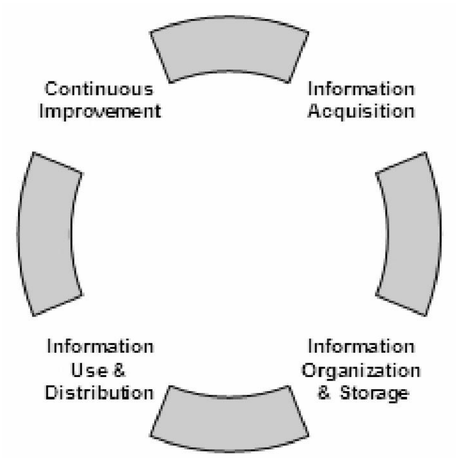


Figure 40: Information management life cycle (Willey, 2005)

There are various types of management terms and according to Robertson (2006), there is a lot of confusion about the definition of information management terms. For example, while coordination of information from internal and external sources is called information management (IM) (Cronin, 1985 cited in Seetharama, 1999), the sum of all the information is called management information system (MIS) and it is defined as a method that is used to acquire, process, store, retrieve and report information (Kirkpatrick, 1987). However, the author chose to use the term “information management” for all the data-information-knowledge management in the case.

It can be said that there are mainly two types of information in the case, which are information that is related with management (like meeting reports, procedures and user forms), and information that is related with the use of the facility (like safety documents, how-to-use manuals and timetables) as in the figure 41.

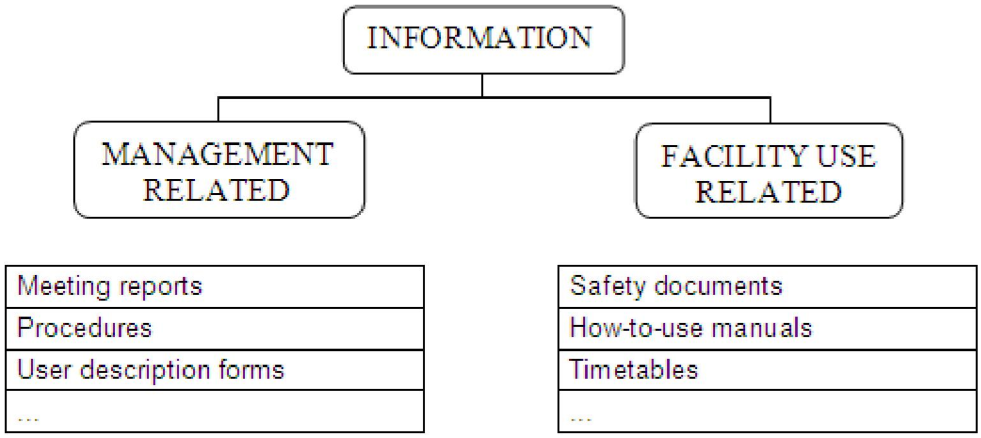


Figure 41: Information types in the case

In order to manage information and information flow, there are various ways which are manual, electromechanical and electronic data processing systems according to O'Brian (1979 cited in Kirkpatrick, 1987). During start-up phase of a model making facility, it would be understandable to manage information manually, but in time it would almost be impossible to manage growing amount of information in traditional ways. That is the time when a computerized information management system is essential to be applied. These systems also enable managers (or managing committee in the case) to distribute information online to all users. There are lots of advantages of online information sharing and some of them can be listed as: accessibility, ease of updating and consistency of information (Kostur, 1998).

Database software (and web-based databases), internet and intranet are three virtual management and communication tools of the modern world. With database software, managers are able to control users, inventory, scheduling of the facility and many more issues about managing a facility. It is even possible to keep record of the use of facility and which users use the facility with a database that is connected to an entrance and exit control system at the doors of the facility (like pay gates). It is however important not to block gates with such systems in case of emergency like a fire. Internet is the number one tool to keep in touch with the rest of the world; it is possible to access a huge source of information via library databases, academic e-mailing lists and other private source websites. It is also a tool to spread information via websites in addition to accessing information. Intranet can be considered as a small-scale version of internet with limited access. It can be defined as ‘a private network, owned by the organization that it serves and only accessible by permission. In general, all members of the organization have access to the intranet, but access to some areas may be restricted, for instance to managers or certain employees’ (Bansler et al., 2000). Intranet could especially be effective on the managing the managerial information.

In the case, a proper information management system was not yet developed due to the facility and managing committee both being new constitutions. Still, as results of discussions with the university’s IT (information technologies) department, preliminary work has started with creating virtual “user description forms[27]” by the software Microsoft® Office Excel and inventory lists as the first step of creating a database system. Other information like managing committee minutes of meetings,

[27] See the Appendix B for the “user description form” that is created by the author.

certain forms (like facility in-outs forms and laser cutter parameter form that was created by committee member Michael E. Young), purchases, supplier lists and instruction manuals are kept in the computer in the model making office. In the long term, the plan of the managing committee about information management-communication-documentation is to create a comprehensive database that can be reached by faculty members, students and visitors (to a limited amount of information).

4.2.6. Maintenance and Regeneration of the Facility

Maintenance of a facility is essential for both safety related issues and the continuity of functioning of that facility; a model making facility is not an exception. In order to provide a smoothly running facility to users, the managing committee needs to maintain the machines, tools, equipment, safety devices and any other elements of the model making facility. Under the term maintenance there is more than just keeping machines in good condition; Payant and Lewis (2007) lists what maintenance includes as (also can be seen in figure 42):

1. ‘Preventive and predictive maintenance: Preventive maintenance is all practices and systems to prevent failures and breakdowns; predictive maintenance is an addition to preventive maintenance’s efficiency and cost-effectiveness for future failures and breakdowns.
2. Routine maintenance and minor repairs: These are the daily upkeep of the facilities and may include minor repairs of buildings (floor, roof), equipment.
3. Major repairs: These are the repairs of big break-downs of facility or

equipment.

4. Emergency repairs: These happen with unexpected breakdowns that have to be fixed immediately.

5. Alterations and improvements: While alteration is the transformation a facility's, equipment's or system's function, improvement is the increase of the functions of a facility, equipment or a system.

6. Housekeeping: It includes janitorial services, maintenance of grounds and operating services.'

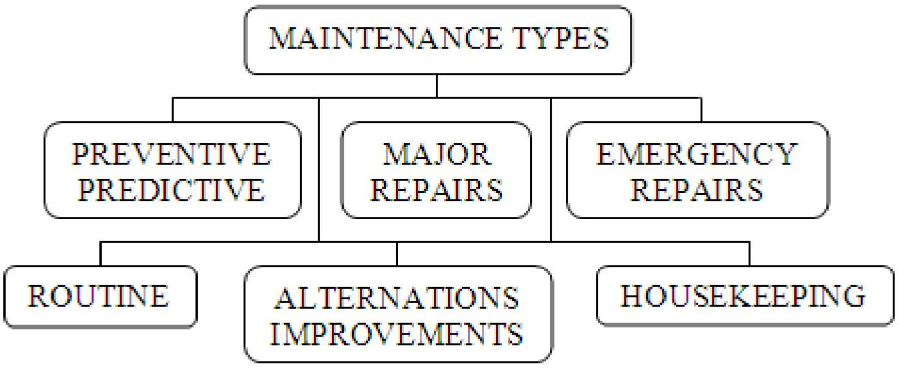


Figure 42: Maintenance types in a production facility

Maintenance is sometimes an overlooked issue in the industry, especially for small firms. But for a facility whose managing committee's biggest priorities are safety and good practice, maintenance should be handled with much care. For this reason, it is believed that except daily upkeep of the facility and the machinery, the maintenance should be handled by professionals. It would be logical to let the manufacturers of the machines in the facility upkeep their products in the first place. When it comes to maintenance of manual and power hand tools and other less technical issues, the managing committee should handle them. A working group or a technical person can be assigned to the job. Another issue about maintenance is the scheduling of the maintenance. It should be planned logically; in addition to daily inspections while some tools need monthly upkeep, some other tools may not. If a schedule can be set, it would not just make things easier for the managing committee, but changes of people-in-charge would not affect the consistency of the program.

Regeneration of the facility is a medium and mostly long-term issue. As time goes by, organizations may sometimes need to change because of many reasons like economical reasons or changes of goal of the organization. Need for change in the situation of a model making facility in design education is quite different as a university is not a profit making organization or a manufacturing plant, but still in time a model making facility may need to change with reasons like new production technologies, curriculum changes of the faculty or the change of plans of the institution about the facility (the facility may start serving outside researches and companies).

4.2.7. Budgeting / Cost Management

'A budget is a formal, quantitative statement of the resources required for carrying out activities over a period of time' (Weaver, 1998) and it is another important issues to be managed to be able to keep things running without any halt in the model making facility. It is also as tough as it is important, especially at the start-up phase. But, things may get easier if there is anyone in the committee with such experience.

There are various reasons for creating budgets, but for a model making facility, the main reason is to be able to have resources, materials, and equipment at the right time. For example, if there is not any screw in the facility, then nobody would be able to assemble their models. The example was for an easy to solve issue, but there may be harder situations to solve at the moment it needs to be solved.

Creating a budget does not only help to keep the facility running without any halt, it is also an impulsion for the committee to plan the future. As mentioned in Weaver (1998) as, creating a budget serves for the items in table 6.

Table 7: Contribution of budgeting in organizations

1.	Setting organization objectives
2.	Forcing managers to plan and look ahead
3.	Set targets
4.	Coordinate activities
5.	Establish areas of responsibility
6.	Encourage the communication of ideas

These points overlap on way or another with the reasons of creating a budget for a model making facility and it is quite complicated. As examples, for the short term, the committee should be able to plan what kind of and how much/many raw materials, consumables, spare parts for the machinery are going to be needed for the semester, which also requires coordination with the course lecturers; for the mid and long term, what kind of facilities, machinery, equipment are going to be needed for future assignment projects what will be given in courses, which again needs coordination; for long term, if any collaborations are going to be made and if yes, what services, equipment are going to be needed.

As previously mentioned, budgeting is a tough process, especially at start-up phase of a facility and if there is not any experienced member in the committee. To be able to create a foolproof budget without minimum missing components and to be more precise, it would be better to set main titles in the budget separately. In organizational issues, these are called as subsidiary budgets, which mean detailed budgets for every area of an organization, like sales, production, capital expenditure, departmental and master budgets (Maitland, 2000). When model making facility's needs are considered, each ordinary budget type may not be taken into account as the model making facilities can not have a sales budget at the start-up phase. The facility budget should have its own headings as table 7 in the case, in relation to the plans of the committee. In the case, the committee decided on titles below:

Table 8: Main budget headings for the model making facilities for the case

Production Related	Machinery
	Power Tools and Hand Tools
	Spare Parts
	Consumables
	Raw Material
	...
Health and Safety Related	Safety Equipment
	First-Aid Training for Supervisors
	Dust Collection
	Signage
	Miscellaneous (Cleaning equipment, etc.)
	...
Space Related	General Furniture
	Storage
	...
Staff Related	Travel expenditures
	...

Some of those items may be delisted after the start-up phase, but new ones will be added to the list such as maintenance, renewal of tools, machines, equipment. When the main elements of the model making facility are set, the committee should start to create annual budget or at least budgets for each semester separately for elements like consumables, raw materials and equipment that must be renewed.

According to the financial system of the institution that the model making facility is bound to, budgeting system may vary. In the case, the system of the university can only let creating an annual budget for consumables, spare parts and small needs. The rest purchases are done by bidding system by university purchasing department in help of the model making facility managing committee. In this kind of situations, excluding institution's financial contribution to the budget, the managing committee should come up with suggestions in the subjects. One good way of creating income is collaborations with industry, which can be called as sponsored budget (Sunami, 2002). The issue of collaboration with industry will be mentioned in coming sections.

4.2.8. Networking/Industry Relations

There are two choices about a model making facility's use. The institution and/or the managing committee may choose to open the facility to only its faculty's students to make their models for course projects, or they may choose to create a living facility where the facility can serve not on as a model making workshop but more than that. This title is especially for any institution/managing committee that chooses the second option and want to create a living and growing facility.

As it was mentioned before, while universities have been (should have been) the main centers of research and knowledge production, industry has been the main center of support to technological and as a result economical growth (Kiper, 2004). Universities have also been (should be) the impulsion of development of its region, and then its country. Today, in addition to their usual roles, universities are also producers of commercially important innovations (Heikkinen, 2004) and Silicon Valley and Oxford models show the success of universities' contribution to countries' innovation systems (Tang and Llerena, 2007). These are all essential notions for companies (especially small and medium-sized enterprises - SMEs) to survive in today's industrial and economical state of the world, and that is why university-industry relation/collaboration is more important than ever. Networking is another aspect of the relation between academia and professional and industrial world. Universities have long been considered as being away and remote from the real world (Leonard and Barber, 1998). But this obscurity is not any beneficial for the university, its students and academicians and for the rest of its country. As innovation and knowledge production is important for university-industry collaboration, design universities can be considered to be behind in development of innovation supporting activities compared to in technology producing universities like engineering and medicine (Heikkinen, 2004), but this does not mean that design universities should be disregarded. Especially, as the importance of design for competitiveness has started to be understood more widely, even countries have started to create their own design policies and strategies (Sotamaa, 2004). Companies are not exception in that sense; in today's industrial world of competitiveness, design is one of the most important details that can make a difference for a company in the positive way.

In order to establish working and successful relations between universities and industry, first of all, both sides should benefit from the collaboration, and there are many ways of creating relations between the two sides as in table 8 (University of California Office of President, 1989).

Table 9: Ways of collaboration between universities and industries

1.	Direct funding of research costs
2.	Gifts and endowments
3.	University-industry exchange programs and student internship
4.	Programs by the university on education and training of professionals
5.	Cooperative projects including the use of specialized facilities
6.	Use of university facilities on a fee-for-service basis
7.	Research and development facilities of industries housed on university property (industrial parks and techno parks)
8.	Sponsorships

This list can always grow with the goals and needs of both sides and it is again limited with the creativity and capabilities of the sides. Generally the usual collaboration way between design universities and industry is through collaborative term projects, but according to Heikkinen (2004), inventions or innovations in these kinds of term projects can not be commercialized and utilized by companies. This point of view is true at a certain point, but with serious collaborative partners and a good structured planning and briefing of the project. With cooperative projects, the universities can expose students with real world problems (like manufacturing constraints) and industry can access to future professionals and ideas directly (Santoro, 2002).

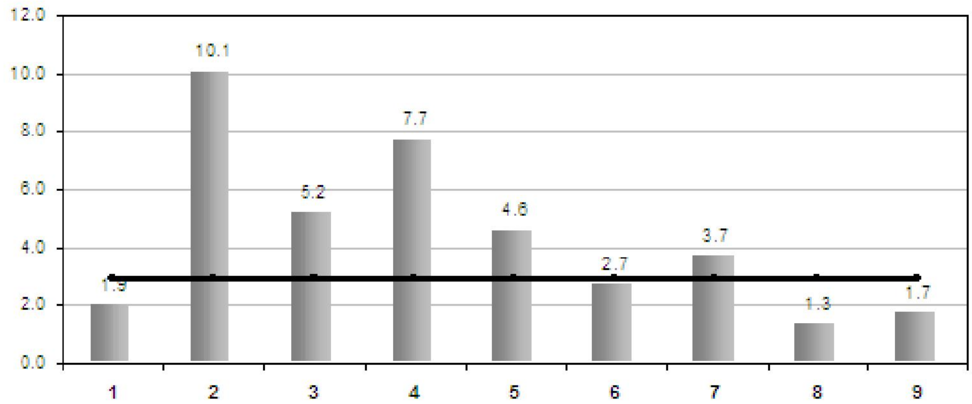
In the case, mainly because the model making facility was a new constitution, there was not any facility-industry collaboration at the time this study was undertaken, but the committee was working on a sponsorship file in order to create procedures for industry collaborations. In addition, from the previous contacts of the committee members and the department of industrial design, there is actually a wide list of industrial relations that has not yet turned into formal collaborative studies. For the case of a model making facility and industry relation, there may be some different ways of collaboration from any other sides of a collaborative project. As an example, Georgia Tech Advanced Wood Products Laboratory 'can act as a demonstration center for wood products manufacturing industry with CAD/CAM driven automated wood products manufacturing[28]'. Training and development programs are possible activities that professionals from the industry train students and instructors on issues related to design, manufacturing, materials, safety and other related issues of both the facility and the industry, and also academician specialists can train industry participants from the region on new techniques, safety and again any other issues regarding the needs. The use of facilities, either the university facility or the facility of partner firm, is another widely used way of collaboration in projects. This can be two-way collaboration; one is to facilitate small firms in the region that has not enough opportunities with either research facilities or manufacturing facilities, and the other one is to create opportunities for students when it is not possible to meet students' needs within the university itself. These are just some examples of collaboration between the model making facility and industry, and as it is mentioned before, the way of university-industry collaboration is only limited with the needs, capabilities and creativity of the sides.

4.3. Health and Safety Management

According to 2008 report of TÜİK (Turkish Statistical Institute – Türkiye Istatistik Kurumu), last year 2.9% of workers have had workplace accidents and 5.2% of these accidents, which is the third biggest percentage (mining: 10.1% and electricity, gas and water: 7.7%), have taken place in manufacturing sectors as in table 9.

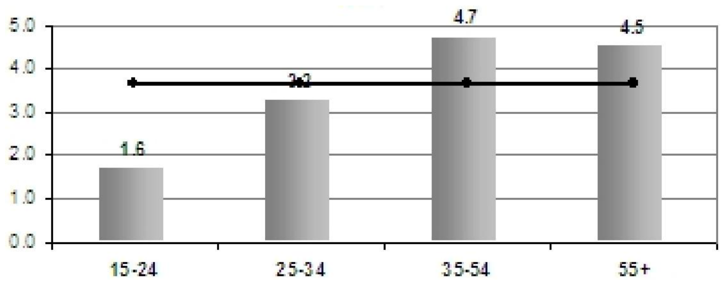
[28] Georgia Tech Collage of Architecture Advanced Wood Products Laboratory website. Accesed from: http://www.coa.gatech.edu/awpl/demos.php

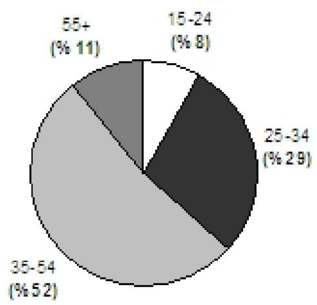
Table 10: Accident rates depending on industries (TÜİK report)



In addition to accidents, 3.7% of workers suffer workplace related illnesses. Although the percentages might seem small, these statistics show that workplace accidents and hazards are still important issues which are still not featured enough. There are also good details from these bad statistics and these statistics (table 10) also show that, only 0.9% of those accidents have happened to higher education graduate workers (although the numbers are not given in the research, the number of higher education graduate workers is probably relatively too low to the number of primary school graduate workers) and only 1.6% of workers, that have suffered from workplace illnesses, are between ages of 15-24 (the age gap of also model making facility student users).

Table 11: Ilness rates depending on age gaps (TÜİK report)





Accidents and unsafe behavior may happen because of a wide range of factors as in shown in figure 43 (Sanders and Shaw, 1988 cited in Sanders and McCormick, 1992).

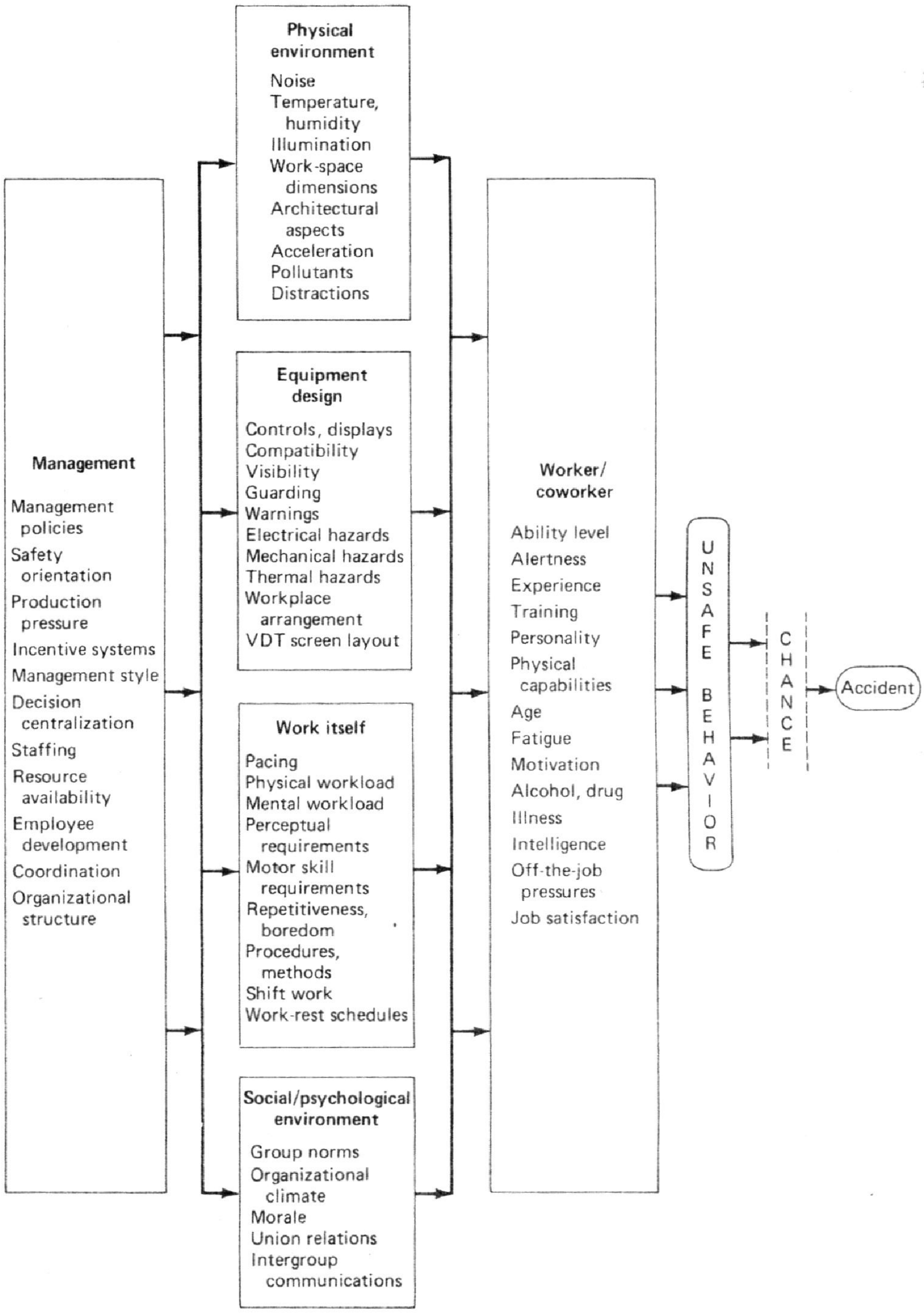


Figure 43: 'A model of contributing factors in accident causation (CFAC)' (Sanders and McCormick, 1992)

HSE implies that managing health and safety is different from managing other issues, as it needs risk assessments, but it can be handled in five steps and list them as in figure 44 below.

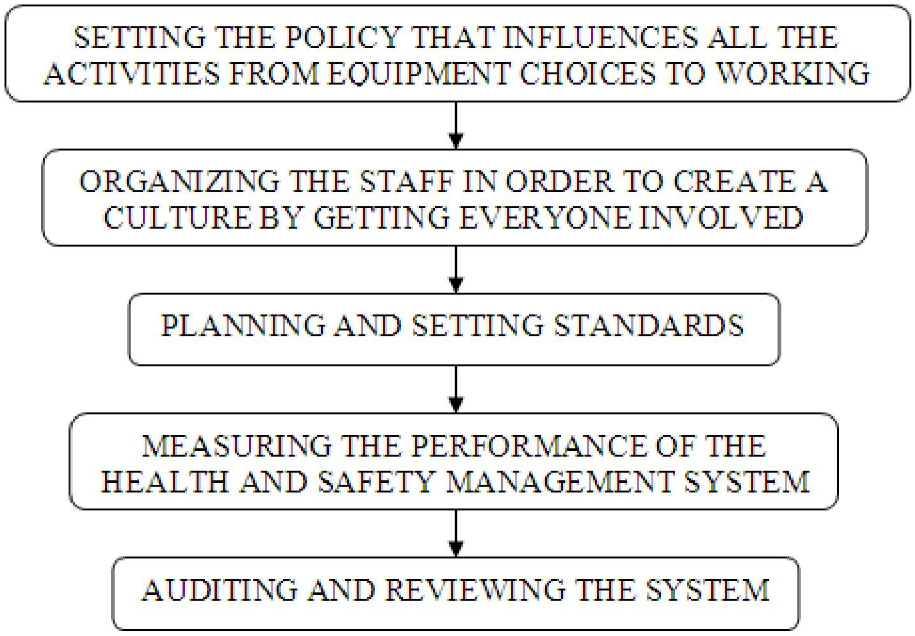


Figure 44: HSE's five steps of creating a health and safety system

When a model making facility in design education is the focus point instead of an industrial factory, there are different issues to take notice of from the issues of an industrial facility. The most important one is that, users of the facility are university students, which means that they may be faster learners, but also may tend to be impassible at some points. The result of the users of the facility being impassible may happen to having hard times to settle discipline in the facility, which is probably the worst thing about safety and security. In despite of the difference in the user profile, health and safety management in the model making facility should be not any different from a regular industrial production facility. The reason is that, the author believes that, a model making facility in design education should be considered as a small production facility, with all the safety regulations, procedures and the mentality.

Managing health and safety in the model making facility is the responsibility of the managing committee, unless there is a university health and safety committee or such, which is responsible from the university's health, safety and security. There are main responsibilities of the health and safety management committee that are listed in table 11. OSHA and HSE set these responsibilities as (items, which are valid for design education model making facility, are picked):

Table 12: Responsibilities of a model making facility managing committee about safe and healthy working environment

1.	Providing a healthy and safe workplace (lighting, ventilation, temperature, clean, room size and layout) and a written health and safety policy
2.	Planning, organizing, controlling, monitoring and reviewing preventive and protective measures
3.	Providing adequate training and access to health and safety advice for users, and consulting about the risks at work and how to protect from them
4.	Providing health and safety related signage (notices, floors and traffic routes, etc.)
5.	Keeping record of work related accidents, incidents and illnesses

4.3.1. Training

Literal meaning of the word train is given as 'teach (a person or an animal) a particular skill or type of behavior through regular practice and instruction' in the Oxford online dictionary. Both Kirkpatrick (1987) and Bateman and Snell (1999) need to differ training and development from each other, as development is the process of providing oneself with broader skills for future jobs. Bray (2006) also mentions that learning and training should not be confused, and he defines learning as 'a process that enables someone to acquire new attitudes, skills or knowledge…*so that they can do something they couldn't do before, or do it more effectively*' and defines training as ‘any form of process designed to facilitate learning in the target audience’.

Training is a serious issue about the safe use of a model making facility, so it needs to be planned seriously. Because of this and the mentality of the author and the model making committee in the case, the health and safety has the highest priority, and training is the heart and soul of the whole model making facility management. According to HSE, training (especially health and safety training) does not only reduce the numbers of accidents in a workplace, but creates a culture of good practice and a healthy and safe workplace. To achieve that level however, training needs to be planned and designed carefully. There are issues to take care in order to provide good training. Bateman and Snell (1999) mention that, a training design process should follow these main steps below:

1. Before anything else, the first step to take is to decide on certain issues, like who will be assigned to designing process of the training, who has what roles and responsibilities, setting deadlines and key dates, and agreeing on budget (if necessary). In order to finalize the plan successfully, roles and responsibilities need to be clear and in accordance everyone has to fulfill their roles, and finally key dates and deadlines should not be missed or delayed.
2. Secondly, what Bray (2006) and Kirkpatrick (1987) calls training needs, need to be decided. Training needs may include choosing the group who needs training and what points should be mentioned kind of issues. As an example from the case, training on some machines that will not be used (the decision is made by the managing committee according to course needs) are excluded from the user training.

3. The content of the training should be assumed at this point and the methodology should be picked. There are two main types of training: trainer-led and self-study. The case would probably be a mixture of both. The biggest ratio would be trainer-led, but after that phase the users of the facility should start self-study phase, which is actually using the facilities. According to the content and the methodology, the scheme and flow of the training should be decided.

4. At this point, the first draft of the training needs to be complete and ready for a test run in order to achieve proper training sessions. This test run should be done to get feedback from non-training designers, like a group of supervisors or some students. Training a group of future users of the model making facilities in the test run is a good idea in order to include users into the planning process, which would make them embrace the training and the whole management.

5. The last step to take is to review the training scheme according to the feedbacks and then start training users. One issue to always take into account is that, training goals should be specific and these goals should be told to the trainees at the beginning (Kirkpatrick, 1987).

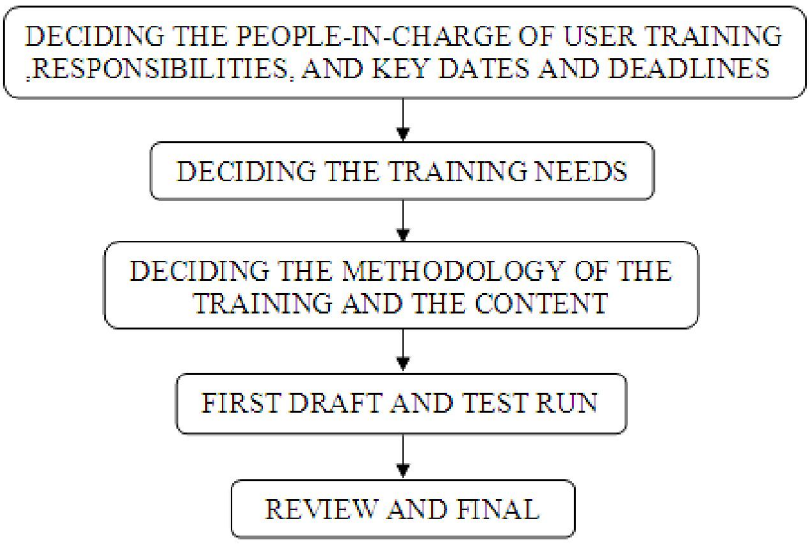


Figure 45: Steps of creating a training program

When it comes to the practical part of the training, an important method to achieve a good training is through repeated trials or practice (Kirkpatrick, 1987). This is where the training transforms from trainer-lead to self-study, but under supervision. For the case, which involves lots of practice (machine, tool use), repetitive practice and informal repetitions on important points are essential methods, that should be used in training. Repetitive practice during training establishes a habit for right (good) practice in the trainees. That’s important because it is harder to teach the good way to someone who learnt the wrong way of doing something first, as habits are hard to change. Another important and tough job about training is creating training materials. Training materials could include handouts, manuals, pre-course assessments, feedback sheets and activity recording sheets. It is rational to distribute the written training materials in a file to the trainees to enable the management of the materials. In addition to the materials that the trainees should keep, preparing a feedback sheet would help the training designers to overview the documents according to the feedbacks from the trainees.

Evaluation of the training is another important phase of the training. The evaluation of training is generally used for the evaluation of the training, but it also evaluates the success of the trainee. At this point, it is important to decide who will be responsible from evaluating the training as it is a tough job. Generally, whoever designs the training also become the responsible from evaluating the training. If evaluation group would be non-training designers, then they should be aware of the objectives of the training, the progress of the training and such. There are several theories on evaluation of training like CIRO (context, input, reaction, outcome), PERT (program evaluation and review technique), Jack Philips’ five level ROI model and the most well known and widely used methods is Kirkpatrick's learning evaluation. Table 12 shows the levels of Kirkpatrick's training evaluation[29].

Table 13: Kirkpatrick's four levels of training evaluation

level	evaluation type (what is measured)	evaluation description and characteristics	examples of evaluation tools and methods	relevance and practicability
1	**reaction**	reaction evaluationis how the delegates felt about the training or learning experience	eg., 'happy sheets', feedback forms also verbal reaction, post-training surveys or questionnaires	quick and very easy to obtain not expensive to gather or to analyse
2	**learning**	learning evaluationis the measurement of the increase in knowledge - before and after	typically assessments or tests before and after the training interview or observation can also be used	relatively simple to set up; clear-cut for quantifiable skills less easy for complex learning
3	**behaviour**	behaviour evaluationis the extent of applied learning back on the job - implementation	observation and interview over time are required to assess change, relevance of change, and sustainability of change	measurement of behaviour change typically requires cooperation and skill of line-managers
4	**results**	results evaluation is the effect on the business or environment by the trainee	measures are already in place via normal management systems and reporting - the challenge is to relate to the trainee	individually not difficult; unlike whole organisation process must attribute clear accountabilities

[29] Tables is acquired from: http://www.businessballs.com/kirkpatricklearningevaluationmodel.htm

With growing opportunities of the internet, intranet, networks and computer technologies, training can also be handled virtually. There are certain benefits of virtual trainings, which are:

- Trainees don't have to wait for the next training session; they can be trained at any time.
- The training sessions can be divided into more sessions, so that if a facility user wants to be trained on bandsaw safely use, he/she can take that training session only.
- Trainees can have the training from their houses and this way, trainers don't have to spend their time for each session.
- Every trainee would have exactly the same training, so there wouldn't be any chance for a trainee to miss anything.

There is a couple of ways to train users online. There are software companies that provides for web-based training software like Pilot Group's PGLearning™ and eLeaP™ learning management system. Other way is to use intranet (if the university has the opportunity) for online trainings. Shepherd (1998) lists the opportunities that come with the use of intranet as:

- 'Information about the course
- A directory containing details of who's on the course
- News – dates, completions, changes, etc.
- Online training modules
- Papers submitted by subject matter experts or trainees for review

- Discussion forums where topics from the course can be debated
- E-mail links to subject matter experts
- Links to related World Wide Web sites
- Book lists
- Feedback surveys
- Assessments'

Training for a model making facility should include two branches: training on how to use machinery and training on health and safety. Training on how to use machinery and tools should also include how to use them safely in addition. It should also emphasize the importance of good practice, possible hazards and applications. Safety training can be defined as a detailed informative process on certain occupation and activities. According to Blake (1963), safety training should transfer to trainees the 'safe method' of all activities within the facilities, possible hazards in the facility, precautions, and in addition, procedures about both the use of the machinery and the facility, and what to use in case of a fire, accident and near-miss. Both trainings should be given by capable people, professionals if possible.

In the case, before starting to design the training, the committee decided on the aims, objectives and possible content of the training. Then, the managing committee assigned a training working group to design the training. The group had separate meetings in order to create an outline for the training by considering needs and objectives. Then, the outline of the training was presented to the committee in order to take their opinions. Simultaneously, informative resources are compiled in order to start filling the informative gaps in the training. In the wake of the decisions that are taken by the training working group, the training would be a mixture of theoretical and practical training that will be given in two sessions. The supervisors and the users are decided to be trained separately. A file of manuals and formal information sheets about health and safety and how to use machines is planned to given to supervisors at the beginning of the training session. The file includes a supervisor's check sheet which is also the outline of the training in titles in order to prevent supervisors skip some items. The file also includes additional reading sheets at the back, which are generally online publications of HSE, OSHA and CCOHS (Canadian Center of Occupational Health and Safety). After trainer-lead theoretical (health and safety weighted) and practical (machine use demonstration) training, the trainees are assigned to use the machines to machine raw pieces into pre-designed template objects. Evaluation of the practical phase is done by supervision and evaluation of the theoretical training is done with a test.

4.3.2. Manuals

In order to manage a model making facility, as well as managing any type of facilities used by a wide audience, manuals are essential tools. There can be several types of manuals when a model making facility is considered. Policies and procedures manual (together or separately), training manuals, original machine instruction manuals and any other instruction manuals that are prepared by the management can be included to manuals of a model making facility.

For all the manuals, there are some common points to mark. First of all, in order to transfer information to users of the facility, that information must be as complete as possible and must lack any kind of mistakes. So, before writing any type of manual, a certain amount of work needs to be done to collect the right information and edit them. According to Barros (1985), if steps below are followed, it would be a lot easier to write a good manual:

1. The first thing to do is to list the topics for which the facility needs manuals for. During the establishment phase of a model making facility, every single topic may not be included as some points may be more important than some others, and also some points may be forgotten.
2. Developing a table of content would outline any kind of manual to be written and make things easier for the upcoming writing phases. Topics that are listed would fall into three categories which are management, operational and personnel.
3. The next step is to draft the first manual. The important things to care is that manuals must reflect the managing committee's and the institution's mentality.
4. The first draft should be presented to managing committee and the decision unit making, and then reviewed according to feedbacks.
5. Compiling the reviewed manual as a set of leaflets and introducing it to the model making facility users and supervisors in order to get their feedback is the next step.
6. The last step to take is to reviewing the manual again according to the feedback of users and supervisors.

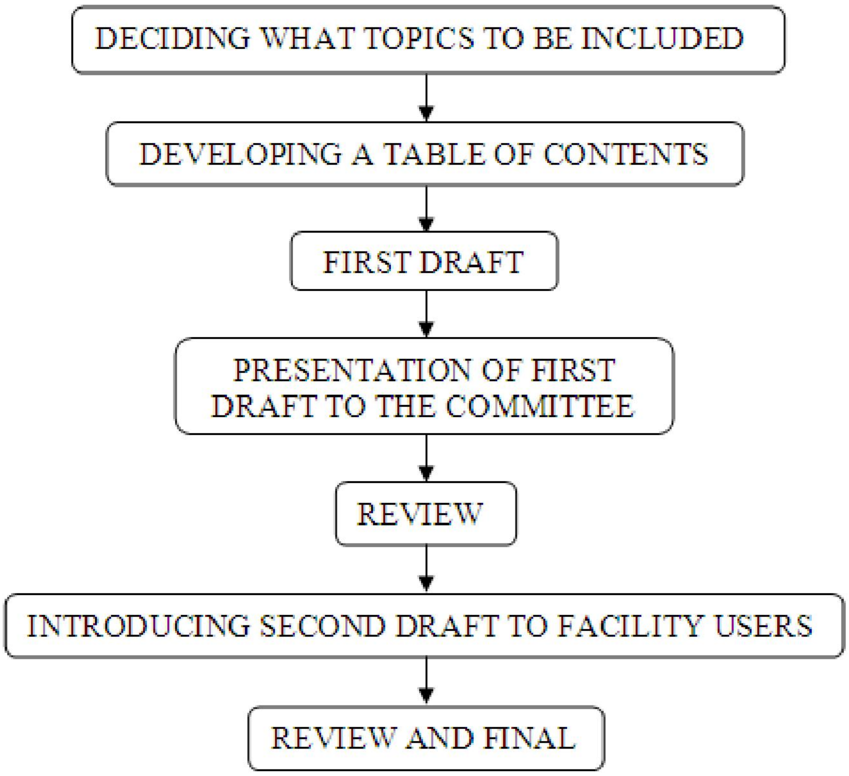


Figure 46: Steps of creating a manual

For the written manuals font, size, character of the writing and such are important details. Bray (2006) suggests using ‘a strong, simple typeface’, 12 point font size, double spaced paragraphs, numbering system for titles, bold, italic or underline for word(s) that is emphasized, black text on white paper and lots of white space on paper. If an instruction manual is used to dispatched, there are a couple of issues to create a good manual. Too much text is not always the best way for teaching as people can be irritated from the manual when they see too much text on a sheet. Lots of empty white space would relieve the reader and enable them to take notes. Visual materials like graphics, illustrations, and charts are also important for transfer of knowledge and skills; they are the aids of written materials especially for training. People are generally tend to remember what they see more than what they hear (Bray, 2006). To achieve success with visual materials, they should be simple, clear and there must be consistency within all the materials including the visuals.

Instead of or in addition to physically written manuals, the managing committee may choose to publish them online or via intranet to only facility users. It is common for universities especially to publish policies and procedures online, but publishing manuals is not that a commonly used way. Like training materials, publishing manuals online has some advantages like (U.S. Santa Cruz Policies and Procedures Team, 1994).

- Accessibility: Users and supervisors can access to any manual either from their homes or from the model making office.
- Less cost: There is not any cost to publishing manuals online when there is an existing website and a committee to write manuals.
- Responsiveness: Any mistakes can be corrected quickly and manuals can be updated without any cost to publishing new materials.
- Accountability: Users can be held accountable about any online published materials.

In the case, the model making committee prepared "model making facility manual for students", which includes information about general health and safety, signage coding and general safety rules; training manual (file) for supervisors, which includes the outline of the training and additional reading documents from HSE, OSHA and CCOHS about health and safety; and quick instruction manuals[30] for each machine, which include short and quick explanations on how to use that machine and

[30] See the Appendix C for a sample " quick instruction manual" that is created by the author.

safety. In order to keep the consistency in all the documents in terms of the use of the same texts and visuals, a lexicon[31] is created by the author.

4.3.3. Safety Equipment

Hazards are unavoidable realities for any kind of workplaces of any kind of industries; they happen in spite of even the best health and safety management and trainings. Accidents or incidents happen, dust and fume is produced but they can be dodged with the smallest damage and that is possible with safety equipment. Safety equipment can be classified under two main categories which are personal protective and workplace safety equipment (figure 47):

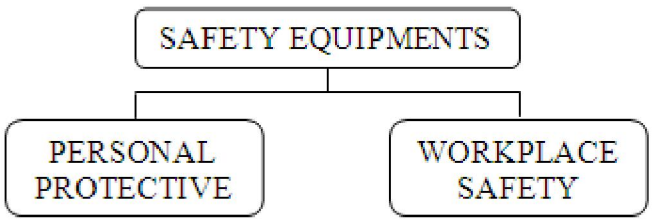


Figure 47: Safety equipment classification

1. Personal protective equipment (PPE) is defined as 'all equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work and which protects him against one or more risks to his health or safety' in Personal Protective Equipment at Work Regulations (1992, Statutory Instrument No.2966, cited in HSE INDG175 (rev1)) of Office of Public Sector Information (OPSI) United Kingdom. PPEs consist of eye and face protective equipment like prescription lenses, safety spectacles, goggles and face shields; head protective equipment like types of hard hats and bump caps, hearing protection

[31] See the Appendix D for the lexicons that is created by the author.

equipment like earplugs and earmuffs; breathing protective equipment like half and full face respirators, air-fed helmets breathing masks (also called as RPE (respiratory protective equipment)); foot and leg protective equipment like leggings, metatarsal guards, toe guards, combination foot shin and guards, safety shoes and special safety shoes; hand and arm protective equipment like gloves, gauntlets, mitts, wrist cuffs and armlets; body protective equipment like conventional and disposable overalls, boiler suits and high-visibility clothing (samples can be seen in figure 48).

Figure 48: Examples of personal protective equipment. (From left to right) 3MTM 2720 spectacle, 8833 breathing mask and 1261/1271 earplugs (pictures are acquired from the 3M official website. Accessed 27 April 2009)

It is important to choose the right PPEs, because each hazard needs the right type of equipment and PPEs are produced in this mentality. Although there can be combination equipment, in general every equipment has its own purpose and capability. There are certain details when choosing the right equipment and the first step is hazard assessment. Various types of hazards may be moving objects, dust exposure or electrical connections. The next step is to find the proper PPE to the hazards. However, as it was mentioned above, a PPE can not be bought randomly. As an example, there are many kinds of breathing masks and all of them are designed for various types of hazards like particles, gas and fume. Even breathing masks for particles have various types for different levels of exposures. The best thing to do about choosing the right PPEs is to ask for professional help. If that is not possible, as OSHA recommends[32], it is best to get the PPE that provides greater protection that that is needed.

Knowing how to use and how to maintain PPEs are the other important issues that should be known about PPEs. Just like choosing the proper PPEs, users must know how to use them in order to achieve the level of protection needed, and maintain them the right way in order to again achieve the level of protection through the lifetime of them and in order to use them for long. It is the responsibility of whoever is in charge of health and safety in the model making facility to train users how to use, when to use and why to use PPEs.

2. Workplace safety equipment can be listed as fire fighting equipment, safety signs, first-aid kits, safety curtains, safety fences and tapes, safety cabinets, special purpose containers, non-slip tapes, anti-fatigue mats, safety switches and testing instruments (some other items can also be included to the list). Like PPEs, workplace safety equipment is essential items for a healthy and safe model making facility environment. When fire is considered, there are two aspects of it. The first one is fire protection systems which alert people about possible start of a fire. Smoke detectors and heat detectors are equipments that are used to detect incidents and alarm the people-in-charge. In addition to these, fire alarm panels, bells and brake-glass alarms can be included to fire protection system. The other aspect of a fire system, is the fire fighting system, which consists of all the infrastructure, tanks, pipes, hoses, sprinkler

[32] OSHA 3151-12R 2003

systems and portable extinguishers. Besides fire fighting equipment, the facility or the institution must have procedures about how to act in case of a fire.

Waste management is also important for health and safety in a facility. In a model making facility, generally solid-state waste is produced. However, there may sometimes be liquid-state waste that is produced during finishing or manufacturing. These types of waste are called industrial waste and must be managed with care (Erkan, 1989). Liquid-state wastes should not be given to central sewage system without being filtered. When it comes to solid-state waste, there are a couple of ways of managing it. However for a model making facility, probably the best way is to collect solid-state wastes separately and send them to recycling companies. Until they are being sent, they have to be kept under safe conditions in special purpose containers (especially chemical wastes).

The important thing about all the safety equipment is that, the users and the supervisors should be trained about the procedures, how to act in a fire and accident situation and how to use safety equipment. In the case, the model making facility is installed with a central fire sprinkler system, two fire hoses at each end of the corridor that runs between model making facility machines room and 3D studio, and two dry chemical fire extinguishers. The fire system is managed by the university's relevant unit periodically.

4.3.4. Signage

Signage is another essential but sometimes ignored or mistaken aspect of safety in manufacturing facilities. Another responsibility of the model making managing committee is to warn facility users about possible hazards, consequences of misuse of facility equipment or wrong behavior and other important things that the users should pay attention to. This is possible with the help of signage systems which consists of warning signs, special notice labels, directional arrows and tapes that show passageways and machines' work areas.

There are two choices for a model making committee about signage; either using the existing signs or creating a unique coding system. In both ways, there are certain standards that the signs to be used in the facility should be up to which can be seen in figure 49.

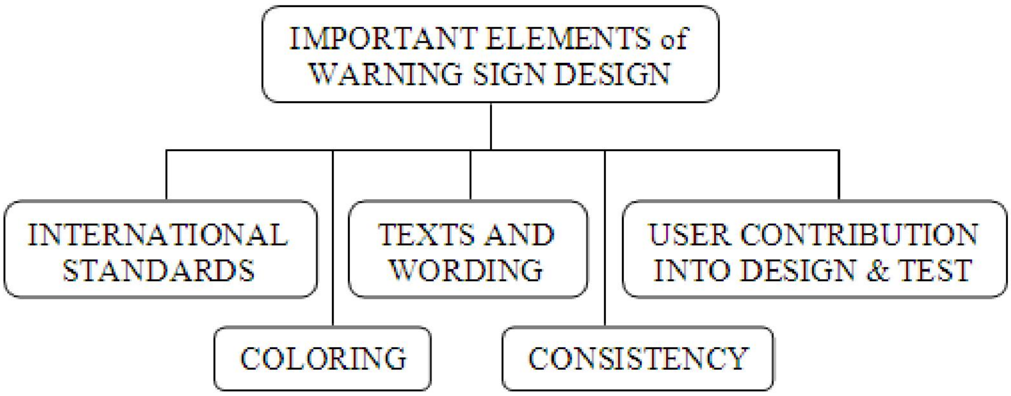


Figure 49: Important elements of warning sign design

- In the United States of America (USA), Europe and the rest of the world, signs, labeling and colorings of signs are bound to certain standards. As an example, according to standards of OSHA and ISO (International Organization of

Standardization), the wording on signs should be readable and in sizes according to reading distance[33] and each color that is used on the signs should comply with the related standard[34].

- Besides the standards that are set by institutions, there are also some logical standards that are acquired from the results of scientific researches. If the managing committee decides to design unique signs, designers should follow some rules. For example, according to Sanders and McCormick (1992), the designed sign should be tested before it is being used and symbolic signs should be preferred instead of verbal ones, as the level of understandability of a symbolic sign is much higher from a verbal sign. Still, a symbolic sign should be simple and clear for high rate of understandability.

- Another right way to follow about designing signs is to have consistency throughout the whole facility management systems. A warning sign and its referent should always be associated to only each other. The symbols, the text and even punctuation should be consistent and chosen carefully.

- OSHA and ANSI (American National Standards Institute) classifies signs in different ways, but the more important detail is that, there are certain words that are associated with a certain level of warning. As the result, the word danger generally indicates very hazardous situations which end up with death or serious injuries; the word warning generally indicates potentially hazardous situations which may end up with death or serious injuries; the word caution generally indicates potentially hazardous situations which may end up with minor or moderate injuries; the word

[33] EZFacts document no:201
[34] EZFacts document no:202

notice generally indicates ‘a statement of company policy’ about safety or protection of the property[35].

- Coloring of the signs is also set by standardization institutions[36], but with minor varieties. According to these standards, red identifies danger, fire and stop signs; yellow identifies caution signs; green identifies general safety and safety equipment, and first-aid; blue is used in mandatory action signs.

Locating warning signs is another job to be planned carefully. A warning sign should be located in places where they can be seen easily but do not distract facility users, they should not be hooked on moving objects like doors or windows and if necessary, they must be equipped with lighting. In addition to warning signs, other aspects of signage is identifying passenger ways and permanent aisles by marking them with tapes; marking direction of rotation of certain machines’ blades or discs, like a bandsaw’s and circular saw’s blades and disc sanders’ discs; marking first-aid locations, exits and entrances, hazardous chemicals and their storage area or containers, hazardous wastes and their storage area or containers, power lines and high voltage and confined spaces[37].

In the case, the model making committee tried to use existing signage systems, but at some points had to design some unique signs, abiding the procedure of testing them in advance. For example, for “No Loose Clothing”, “No Jewelry” and “No Sandals or Open Shoes” warning signs, the warning sign that is shown in figure 50.

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[35] ANSI Z535.2-2002
[36] OSHA standards from document no: 29 CFR 1910.144; ANSI standards from document no: Z535.1-1998.
[37] EZFacts document no.202

Figure 50: Examples of unique warning signs designed and used by the model making committee in IUE FFAD (designs and illustration by Alex Velasco, 2008). From left to right: “No Loose Clothing”, “No Jewelry” and “No Sandals or Open Shoes”

The model making committee set a color and shape coding for levels of usability of machinery. According to this coding, the machines that can be used freely after facility users pass the training session are called the “green square machines”, the machines that can be used under supervision after the training session are called the “yellow triangle machines” and the machines that can only be used by supervisors with advanced training are called the “red circle machines”, and are labeled with the signs in figure 51.

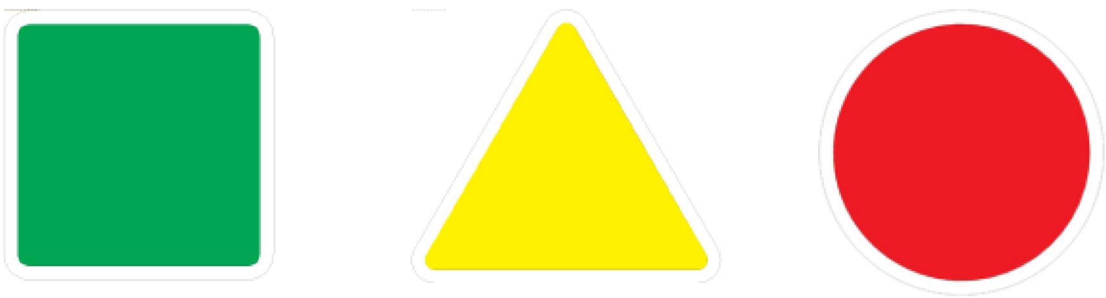

Figure 51: Color and shape coding of (machine) usability in the case (designs and illustration by Alex Velasco and the author, 2008)

4.3.5. First-Aid

A model making facility managing committee's first aim about safety should be to set the conditions in order to prevent accidents and bad practice in the facility, and protecting the users and the facility (Blake, 1963). However, despite any kind of precautions, coordinate maintenance, a perfect safety and training program, accidents may happen. There is not a way of completely eliminating injuries. Hence a committee should be well-prepared for such occasions, and that is possible with first-aid knowledge in the first place. In manufacturing plants, health professionals and facilities are provided, but for a model making facility this may not be feasible or possible. In stead, a group of full-time first-aiders could be created from supervisors. Training has to be done by professionals, and at the end of training, each successful trainee should be given a certificate (and license) for first-aiders (otherwise, it would be illegal to first-aid an injured person although right practice is applied). The licensed first-aid can then promote safety and first-aid, and provide first-aid training to any volunteers, either supervisors or students in order to grow the first-aid group like in Oxford University and McGill University[38]. In addition to first-aiders, every university has health care centers or units for post-first-aid health care.

In order to handle first-aid, the facility must at least have a first-aid kit, and it should be maintained carefully and regularly. Every user should also be trained and aware of the procedures about how to react to an accident situation; emergency telephone numbers must be located centrally with a telephone nearby. The responsibility of a model making facility managing committee about the issue is to create a first-aid

[38] The information about both Oxford University First-Aid Unit and McGill First-Aid Service is acquired from their official websites http://www.oufau.org/ and http://www.mcsgillfirstaidservice.org/.

team (committee members should also be trained), provide volunteers and users with first-aid training and promote health, safety and good practice in order to avoid accidents.

In the case, the model making committee started with creating a group from committee members, faculty department heads and instructors to be trained. The training would be provided by Turkish Red Crescent, and successful trainees would become licensed first-aiders. However, the training did not take place as this study was being done. Besides, the university provides health care professionals of a doctor and a nurse.

CHAPTER 5

CONCLUSION

In today's world of education, especially where practice is an important part of the education and production is also considered as another part of the education like industrial design education, model making facilities play an important role for education institutions. Not only with the actualization of a design idea but with developing the students' design capability and knowledge, are these facilities also directly related. This study has defined and analyzed important topics that need to be managed in order to be able to reach the aim of establishing a model making facility and manage it.

Emphasizing the importance of physical model making in the education of design was an important practicable aim of this study in the first place. In addition to the emphasis on model making, an extra emphasis needed to be given on the importance of traditional methods of model making as with new 3D modelling and production technologies (CAID: computer aided industrial design) and facilities (especially rapid prototyping technology) evolve and become available and affordable rapidly. The study has shown that even new computer aided design and production technologies ease designers' and students' work in some terms like time and physical effort, traditional hands-on model making has still important benefits for designers and especially students that can not be ignored. However, a more detailed comparative study that uses statistical and analytical methods to measure the effectiveness and efficiency of both traditional and computer aided model making methods could be a benefit for the area of design research. A comparative study on the issue could not have been included in this study, as the main focus has been on the establishment and management of model making facilities, not those facilities' advantages and disadvantages to each other.

The study needed to choose and include not every kind of materials and model making methods as these subjects could also be the main topics of individual studies with their amount of content. Instead the most commonly used materials and production methods have been chosen to be included in this study. Another reason of this choice is that, in an establishment process of a model making facility (which is also the situation of the application of the study in Izmir Economy University Faculty of Fine Arts and Design) it would not be logical and practicable to have all the facilities from the most traditional method to the most technological method at the same time. Therefore, a collection of the facilities that a model making facility may need at the start-up phase are included in this study. A more detailed study that includes, analyzes the entire possible model making methods and their facilities, their superiorities and weaknesses could also be beneficial for model making facility institutions and their managers that want to develop their existing facilities to an upper level with observation and interviews with professional model makers.

One other aim of this study was to include every possible topic that need to be considered in order to have a smoothly running and coordinated model making facility. This meant a huge amount of content from safety, scheduling, management of users, information, and costs to many other more topics. These issues are also considerations of establishing and managing a production plant, and the author has believes that in order to have a model making facility that runs smoothly, the same pattern of the management of production plants needed to be followed, but with simplifying most of the methods and adapt them to the needs and requirements of a model making facility. For further studies, it would be logical to focus on specific topics from all the content. This way, a topic or some topics that are interrelated may be approached in more details, which can be considered as one of the deficiencies of this study. When all the topics that should be taken care of in order to establish and manage a model making facility are included in a research, none of those topics can be analyzed in full details. But, this should be mentioned that the aim to be reached by this study on the issues that are related to management is to point out every possible issue that would be encountered by the managers during establishment of a model making facility, in order to create awareness for them. Going into too many details about each issue has not been the aim of this study as each item could have been individual studies.

The study showed that there are a couple of important points for the application of the findings of the study. Good planning and distribution of the responsibility are the two key factors for a successful establishment, development and management process. This is mainly because of the huge amount of work and probable impossibility of accomplishing this amount of work by a small number of contributors to the process. To create the awareness of all others that are not directly in the process, communicating with them is another key factor. This is essential in order to have the responsibilities of a model making facility distributed and make everyone embrace the process and the facility. This way, the number of the contributors can rise and the process can pace more smoothly. Not only adding members to the process may be enough to speed the process up. Getting ready to use examples from other model making facilities for methods could be also essential. In order to collect more comprehensive information about how other model making facilities are managed and developed, more observation on other universities' facilities and interview with people-in-charge about their methods on managing the facilities would be valuable in that sense. Model making facilities in the region should be observed first and those facilities' managers should be interviewed. In addition to make connections with design school model making facilities managers in the region, the managers of design schools all around the country and the world could be connected via email or telephone. Gathering valuable data from these connections could hasten the process of establishing a model making facility or they could also orient managers to find better solutions for certain issues.

Keeping statistics about issues and also direct feedbacks from facility users by the help of questionnaires or forms could also help to improve certain details or adapt the facility to the user profile. As an example, it is especially essential to get feedbacks from the users if a non-existing warning sign is designed and used in the facility, and getting users opinions always gives the feeling to the users that they are a part of the process and so they embrace the outcomes of the whole work that is done. In this sense, a quantitative study could be valuable in order to understand the needs of a model making facility in industrial education.

As a summary, the issues studied under the study can be listed as:

1. Importance of traditional (hands-on) model making in industrial design education.

2. Types of materials and model making facilities that are generally used and essential in industrial design education.

3. Managerial issues regarding the management of a model making facility in industrial design education.

4. Important details that came out during the application of the study like distribution of the responsibility, finding the right people and good planning.

Suggestions for further studies can be listed as:

1. Detailed and comparative analysis of model making materials and techniques, their advantages and disadvantages to one another.

2. Individual or interrelated topics about the management of an industrial design education model making facilities.

3. Research on other model making facilities of design schools in order to understand their management systems and create of good management system for industrial design model making facilities.

4. A quantitative research about the needs of such facilities such as the number of tools needed for a specific number of students or number of area for a specific faculty.

5. A study that correlates the nature of industrial design education, the curriculum of design educations and model making facilities of design schools from the point of education and educators' view.

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APPENDIX A

PROCEDURE SAMPLE

A. Purpose/Background:

This procedure informs the people-in-charge (full-time and part-time instructors, security personnel) what students/users have to do in order to be able to work in CZ101 and CZ102, the Faculty of Fine Arts and Design, Model Making Facilities out of office hours.

B. Definitions:

The Faculty of Fine Arts and Design, Model Making Facilities – C Block Ground Floor
CZ101 – Model Making Hand Tools Room
CZ102 – Model Making Machines Room

C. Procedure:

1. Students/users must complete Authorization Form.
2. Authorization form to be signed FIRST by the course instructor. Authorization form to be signed SECOND by facility technician.
3. Authorization form to be copied twice. Original copy should be given to the university security department. One copy should be given to the facility technician. One copy is for the student/user.

D. Responsibilities:

1. Course instructors:

- Check authorization form; make sure the students/users names are legitimate.

2. Faculty technician:

- Check authorization form, and check it is signed by course instructor.
- Give original authorization to security personnel.
- Establish whether the students/users are trained and qualified for using facilities.

3. Students/users:

- Fill the authorization form without any missing parts.

E. Forms:

Authorization form

APPENDIX B

USER DESCRIPTION FORM SAMPLE

MODEL MAKING LABORATORIES		USER DESCRIPTIO
STUDENT NO.		PHOTOGRAPH
NAME-SURNAME		
DEPARTMENT- YEAR ENROLLED		
ADDRESS		
PHONE NO.1		
CELL PHONE NO.1		
CELL PHONE NO.2		
EMAIL ADDRESS 1		
EMAIL ADDRESS 2		
EMERGENCY PHONE NO		
EMERGENCY NAME		

TRAINING SESSION 1

I have attended to the training section 1 which is introduction, orientation, health and safety, and using manual handtools and I agree to abide by the rules and guidelines in the "Faculty of Fine Arts and Design - Model Making Workshop Manual for Students". My signature below certifies that I have full responsibility on every incident or accident if I fail to comply with the rules and regulations.

Student	Supervisor	Instructor
	Argun Tanrıverdi	

TRAINING - SESSION 2

I have attended to the training session 2 which is power hand tools, green square and yellow triangle machines, and I have been trained about safety and how to use the machines that are marked below. My signature below certifies that I have full responsibility on every incident or accident if I fail to comply with the rules and regulations.

Student	Supervisor	Instructor
	Argun Tanrıverdi	

MACHINE	SIGNATURE	MACHINE	SIGNATURE
Mızrak MZK 500K		Güngör GM13	
Netmak PL400		Universal PLS 120D	
Metabo BAS 316G			
Smart DP 51025F1			
Tamiş TZ11/2K			
Çelik M.S.ORS			

BORROWED ITEM			
ITEM	DATE OF RECEIPT	DATE OF TURN	SIGNATURE

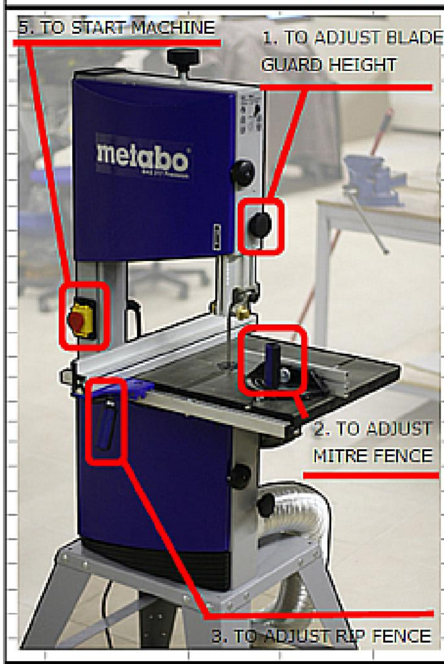
INCIDENTS - NEAR MISSES	
DATE	DETAILS

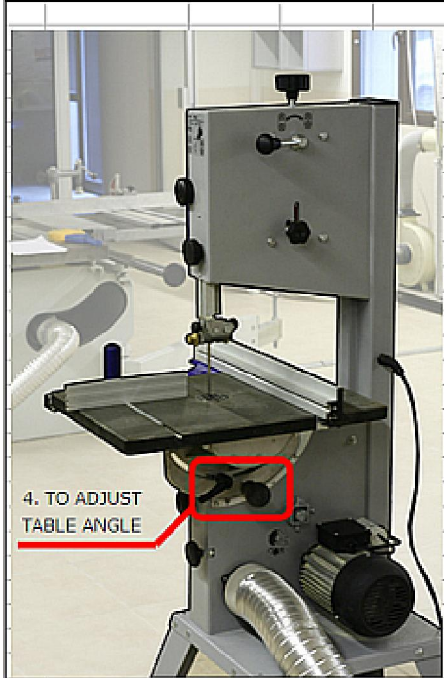
NOTES	
DATE	DETAILS

APPENDIX C

QUICK INSTRUCTION MANUAL SAMPLE

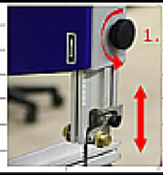
QUICK INSTRUCTION	BANDSAW	METABO BAS 316
YOU MUST BE TRAINED TO USE THIS MACHINE		
ONLY WORK UNDER SUPERVISION		





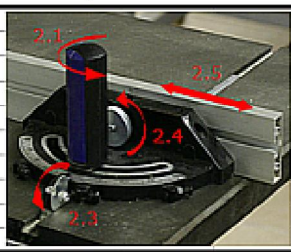
1. TO ADJUST BLADE GUARD HEIGHT

1,1	Turn (knob) to adjust blade guard height.



2. TO ADJUST MITRE FENCE

2,1	Loosen handle by twisting CCW.
2,2	Adjust fence angle.
2,3	Find preset angles with or without stopper.
2,4	Loosen knob.
2,5	Adjust fence position.

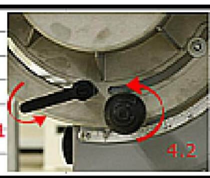


3. TO ADJUST RIP FENCE

3,1	Pull (lever) up to unlock fence.
3,2	Adjust fence position.
3,3	Push (lever) down to lock fence.

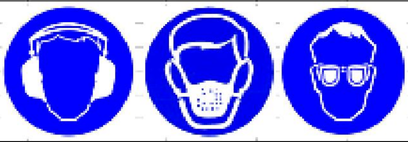
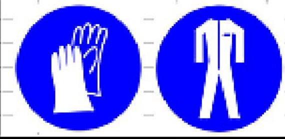
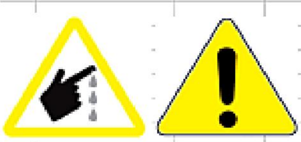
4. TO ADJUST TABLE ANGLE

4,1	Loosen lever
4,2	Turn (ballhead) to adjust table angle.



5. TO START MACHINE

5,1	Lift red cover up, open yellow cap. Push green button.

SAFETY INSTRUCTIONS	
	Read instruction manual before using the machine.
	Wear goggles, breathing mask and ear plugs while using the machine.
	Wear proper clothing, wear gloves if necessary.
	Long hair must be tied back. Loose clothing must be tucked in or folded back. Do not wear jewellery. Do not wear sandals, thongs, slippers, open toe shoes.
	This machine is potentially dangerous. Injuries can occur. Be alert when using the machines. Keep your eyes on your work.
CLEAN UP BEFORE YOU LEAVE AND PUT EVERYTHING BACK IN THEIR PLACES	

APPENDIX D

TERMS AND WARNING SIGNS LEXICON SAMPLE

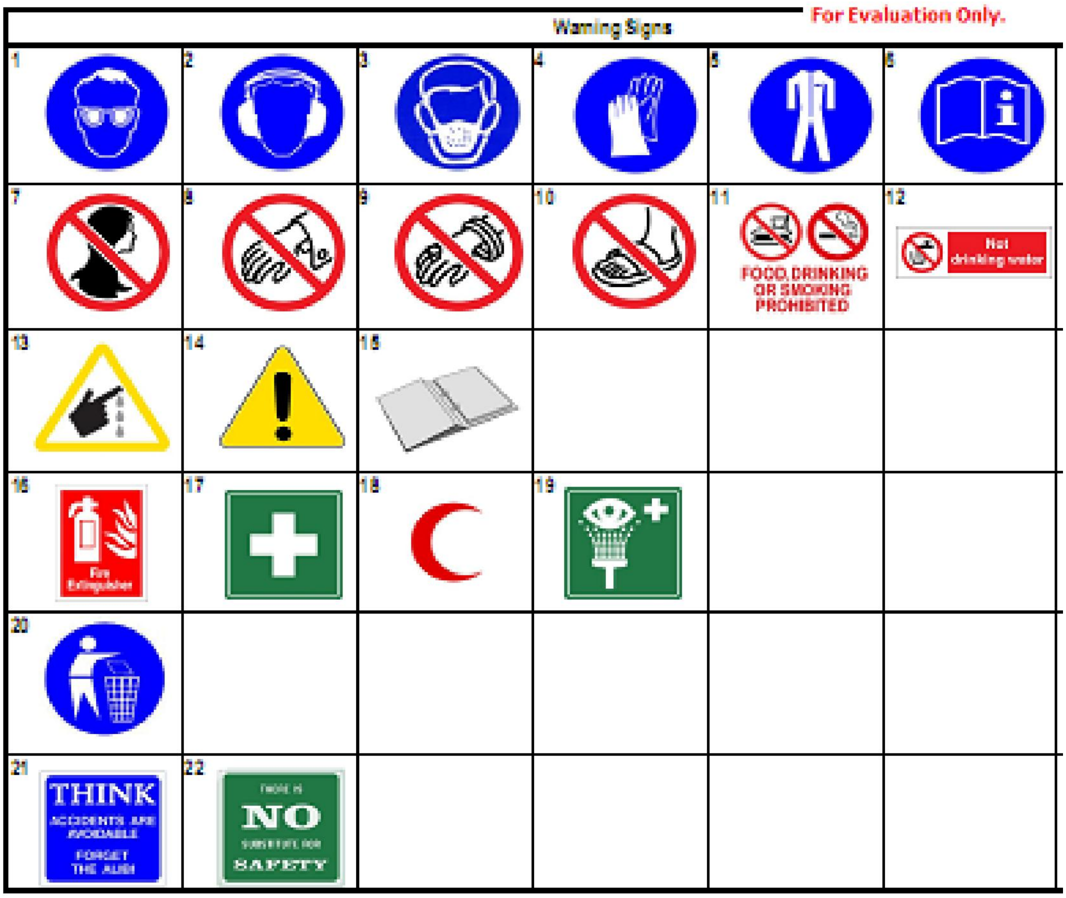
Lexicon for Workshop Facilities' Manuals

Machine Use Related

Adjust belt angle	:		Loosen lever.	
			Adjust sand paper belt angle and tighten lever.	
Adjust blade guard height	:		Turn (knob) to adjust blade guard height.	
Adjust blade height	:		Turn wheel to adjust blade height.	
Adjust blade angle	:	(for GT 10)	Turn lever CCW to unlock blade.	
			Move control arm to adjust blade angle.	
			Turn lever CW to lock blade.	
		(for YDT 40)	Turn wheel to adjust blade angle.	
Adjust drill depth	:	(for Güngör GM 13)	Twist knob and watch scale for adjustment.	Check drill depth with the power off.
		(for Smart DP51025)	Loosen lever.	
			Turn collar.	
			Tighten (lever).	

Adjust fence position	:	Loosen lever.	**Adjust face angle**	:	Loosen lever.
		Turn wheel to move the fence			Move handle to adjust angle.
		Tighten lever.			Tighten lever.

Adjust head height	:		Loosen lever.
			Turn ring to adjust head height.
Adjust head stock	:		Pull set pin.
			Loosen quick release lever.
			Turn headstock 90° or 180°.
			Release set pin.
			Engage quick release lever.


Warning Signs
1
2
3
4
5
6
7
8
9
10
11
FOOD, DRINKING OR SMOKING PROHIBITED
12
Not drinking water
13
14
15
16
Fire Extinguisher
17
18
19
20
21
THINK
ACCIDENTS ARE AVOIDABLE
22
THERE IS
NO
SUBSTITUTE FOR
SAFETY

APPENDIX E

MODEL MAKING FACILITIES EQUIPMENT LIST SAMPLE

(BASED ON THE LIST BY ALEX VELASCO, 2006)

Name	Table (Circular) Saw	
Sample Model	Jet JTAS-12XL50/5-1	
	Keywords: Woodworking Plastics working	

Name	Panel (Circular) Saw - Horizontal	
Sample Model	Powermatic HPS67	
	Keywords: Woodworking	

Name	Micro Table Saw	
Sample Model	Proxxon FKS/E	
	Keywords: Woodworking Small scale Plastics and Foam working	

Name	Micro Bandsaw	
Sample Model	Proxxon MBS 240/E	
	Keywords: Woodworking Small scale Plastics and Foam working	

Name	Saws – Universal	
Sample Model	Stanley 20-526	
	Keywords: Hand Tools Manual Woodworking General use	

Name	Saws – Backsaw	
Sample Model	Stanley 17-202	
	Keywords: Hand Tools Manual Woodworking General use	

Name	Clay Tools - Hogger	
Sample Model		
	Keywords: Hand Tools Manual Clay Model Making	

Name	Clay Tools - Wooden Modeling Tool Set	
Sample Model	Axner	
	Keywords: Hand Tools Manual Clay Model Making	

Name	Clay Tools - Wires	
Sample Model		
	Keywords: Hand Tools Manual Clay Model Making	