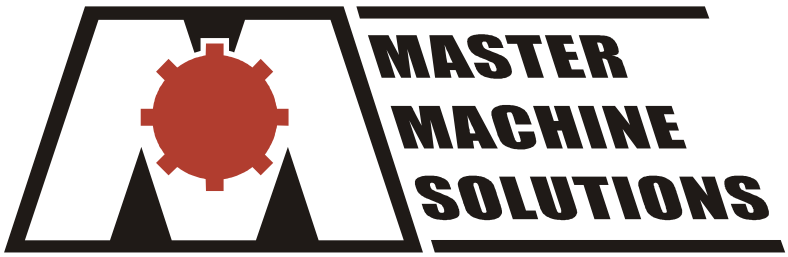

Innovative Solutions for Industry

Engineering Project Checklist

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Master Machine Solutions, Inc. is a family-owned engineering company that specializes in the design of custom industrial machinery. Serving the Fox Valley and the world since 1998, mechanical and electrical engineers are on staff to serve all of your machinery design needs. Whether you want engineering services only or delivery of a complete machine, a single part or complex assembly, control programming or panel layout, Master Machine Solutions, Inc. is your complete engineering resource.

Introduction:

This checklist is designed for electrical and mechanical engineering projects. Although many of the principles would apply to civil, chemical or other engineering projects, they are not the main function of this paper.

There are several types of engineering projects. You may be designing a single part or a product made up of several parts. The project might be a product that you market directly to a consumer or it might be a machine used to produce a product that you market. Whatever the case might be, this list will help you define the project. They might not all apply to your specific project—you be the judge. Some items may be more important than others.

The outline at the end summarizes this procedure. It can be used as a checklist for your engineering project.

I. Who are the decision makers:

For every project there are certain people or groups of people that are responsible for making decisions on the direction of the project. The decision makers could be from various departments in the company, such as sales, marketing, manufacturing, engineering or others. They may or may not have a technical background. They may rely on their own expertise in their given field, or they may use market research as the basis of their decisions. A review team, consisting of people from several different areas in the company, often makes the decisions.

Everyone knows how important customer satisfaction is, and these are customers who must be satisfied. By knowing who these people are and what their expertise is, the engineer can tailor his/her presentations to them. Information must be presented with enough detail and technicality to ensure that all the criteria are met, while realizing that some items may need to be explained in a way that a non-technical person can understand.

II. Budget for Project:

You can't eat lobster on a hamburger budget. Every project has a budget, and budgets must be maintained. Whether we like it or not, the world operates on a monetary system and in the end all projects must be paid for. The budget may be set in various ways.

The assets available for a capital expansion might determine the budget. These would be funds that a company has set aside to improve their manufacturing. They most likely would be determined by a return-on-investment (ROI) calculation. An overrun in the budget would put the ROI at risk.

The budget for a project might be set by what the consumer of the product is willing to pay. Exceeding this budget would reduce market volume for the product. This is simple supply-and-demand economics.

The type of budget must be taken into account by the engineer, because his design for the project has a direct effect on the cost of the project. Although many factors enter into the overall cost of the project; the design, more than anything else, effects the ultimate cost of the project.

III. Define the Product:

There are really two different scenarios for an engineering project. You may design a specific product, like a water glass; or you may be designing the machine to make the water glass. Depending upon which scenario you are using, the definition of the product will be somewhat different.

First, let's assume we are designing the product, the water glass. In this case, we need to know the function of the product, including a list of the features and the importance of these features, and whether they are required or only desired. Is this going to be a single product, or will there be a family of these products, possibly in various sizes. Only include things in this definition that are exactly what is desired. For example, if you want a clear water glass, do not assume that it must be made out of glass. A clear plastic might work just as well. When we are designing the product, we realize that we may not know everything about the product. Many times market research may still be in progress during the design phase, so all of the specifications may not be determined yet, or they may change. At the beginning of a project, having a list of the specifications that still need to be defined might be as important as the list of known specifications.

If we are designing a machine to make the product, we should have a more complete description of the product itself. In this scenario, we will probably know whether the water glass is actually glass or plastic. The machine required to make the water glass will be significantly different depending on the material of the water glass. If our machine is going to produce a family of products, we will need to know how many of each configuration will be required.

IV. Define the Process:

How is the product going to be made? We need to have as complete a description of the manufacturing process as possible. If we are designing the machinery to make the product, we should know more about the process than if we are designing the product. In fact, if we are designing the product, part of the project may be to determine this process.

In defining the process, the important thing to know is what needs to be accomplished, as opposed to how to accomplish it. For example, let's assume we need to apply a label to our water glass. The process should state that we need to apply a label of a certain size with a given amount of pressure. It should not state that we need to apply the label with a pneumatic cylinder. This would dictate how to do it, not what is to be accomplished. There should to be as much flexibility in the process as possible so that the engineer can come up with the most efficient, cost-effective method.

The variables in the process should be defined. Using the example of applying a label to the glass, are there different sizes or materials that we need to contend with? Maybe some get labels and some don't. You also need to be aware of environmental conditions that may affect the materials used in the process. For example, will the materials react the same in hot humid month of August as they do in the cool dry month of January? The engineer must anticipate these kinds of effects so that he or she can make plans to accommodate them.

V. Production Rate:

The production rate can be defined in many different ways; for example, how many need to be produced in a given amount of time, or how fast the machine needs to run. These things are based on the anticipated

volume of product desired. As much as possible, we try to define the amount of product needed rather than how fast the machine needs to run.

If we are designing the production machine, there are other variables that we will want to know. How much time will the machine run: one, two, or three shifts? Will the machine run five days a week or seven; or will it only run occasionally, maybe a few days a month? We want to have an idea of the expected percentage of running time. How often will the machine require maintenance? Since it is not reasonable to expect the machine to run 100%, if we can increase the speed of the machine we can allow for some down time and still maintain production.

We may also need to take into account the amount of time needed for setup or changeover from one variation of product to the next. We also need to plan for the skill level or the tools available to the person who will make these changes. All of these factors are part of the overall production of the machine.

VI. Ideas and History:

Taking a look at what has been done in the past and spending some time looking at existing equipment can be valuable. Examine similar projects and see what has worked before and what did not. There is no sense in reinventing the wheel. Let's look at history and learn from it.

Talk to people and get as many ideas as possible. You never know where a truly great idea is going to come from. The idea may come directly from someone else or they may help you look at the subject in a way that you did not think of. In the beginning, all ideas are open to discussion.

The engineer needs to know the manufacturing capabilities that are available. Your design must be able to be manufactured with the tools that are available to you or that can be acquired without exceeding budget requirements. If the design can't be manufactured, it is not of much value.

VII. Power Available:

Examine all the power that may be available for you to use: electric, air, hydraulic, steam, heat, water, or other types. Find out what is available, how much is available and what are the restrictions. Electricity is usually the most efficient, and most machines require it. Keep in mind that things like air logic circuits do exist, and for some specific applications they work very well.

VIII. Preferred Vendors:

Are there specific suppliers that are required for any components? Many times companies have specific component manufacturers that they like to use for electrical, hydraulic, pneumatic or power transmission parts. Finding out who these vendors are up front will save a lot of time later.

IX. Space Limitations:

Determine any space limitations or restrictions that might affect the design. If you are designing a specific product, the physical size might be part of the specification. You may also need to look at how this product will be shipped. How many pieces of the product are in a box? How many boxes in a case? How well do the cases fill a 4' x 4' x 4' pallet cube? There may be size limitations that come into play here as well; make sure you look at everything.

If you are designing a specialized machine, you will want to look at where it will be installed. Look at the size of the doorways that it must go through, or the capacity of the equipment required to move it through the shop. Determine the availability of the tools to assemble this machine in the factory. If these restrictions are known up front, the designer can plan a method to accommodate them.

X. Timeline and responsibility of each item:

The timeline for the project is an integral part of the project. You will need to look at, and may need to allow time for: Engineering, Manufacturing, Proto-typing, Installation, Debugging, or Training. In addition, allow time in the schedule for design reviews. The number of design reviews will depend on the complexity of the project. All of these items need to be adjusted for the number of people available to work on the project. There are a variety of different project planning software packages available.

It is also important to know who is responsible for each of these steps. Different departments will quite often handle proto-typing, manufacturing or installations. The availability of resources in other departments can affect the timeline.

Summary:

Almost any obstacle can be overcome with the right amount of planning. The key to good planning is to try to foresee the obstacles before they occur and plan for them. The old adage is true "an ounce of prevention is worth a pound of cure." The key is to anticipate, plan, anticipate, plan, and so on. This is why we have provided this checklist; to help you think of things that might occur, plan for them, and complete a successful project.

Engineering Project Checklist Outline:

Project Name:

I. **Who are the decisions makers:**

II. **Budget for project:**

III. **Define the product:**
   A. Complete description of the product
   B. Determine variations of the product
   C. Percentage usage of each variation

IV. **Define the Process:**
   A. Description of what needs to be accomplished
   B. Define the variables in process.

V. **Production Rate:**
   A. Production rate of each product
   B. Speed of feed requirements
   C. Percentage of run time to be achieved
   D. Time available for setup or changeover
   E. Skill level of person doing setup or changeover

VI. **Ideas and History:**
   A. What has been tried before?
   B. What worked and what did not?
   C. What ideas would you like to see?

VII. **Power available:**
   A. Electrical voltage/phase/watts
   B. Air or Hydraulic, Pressure and volume
   C. Steam, Heat, Water, other

VIII. **Preferred vendors for:**
   A. Electrical
   B. Mechanical
   C. Construction

IX. **Space Limitations:**
   A. Physical size of equipment
   B. Size limit of doors or other restrictions
   C. Product shipping requirements

X. **Timeline and responsibility of each item:**
   A. Engineering
   B. Manufacturing
   C. Installation
   D. Proto-type
   E. Debug
   F. Training