Organization of Engineering Departments

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Organization of Engineering Departments

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Preliminary Considerations

The overall organization of an Engineering Department encounters many challenges that are not always formally recognized. In many instances (such as the cases of the medium and large companies) the Engineering Department is well established when a new Engineering Manager enters the stage. He/she is presented with a team of employees with known experience and skills, and is asked to solve various problems (projects) in a specific time frame and within certain cost constraints. In other cases (such as the small companies, start-ups, growing companies, etc.) the Engineering Manager may have the opportunity to build the department from scratch, but at the same time he/she also needs to meet the Company's short term needs. In this case the projects need to be successfully handled "here and now" and little attention is usually given to the long term needs of the department. A successful Engineering Manager satisfies the Department's and Company's short term needs and at the same time prepares the department to tackle the future demands.

Today's work environment is fast, dynamic and highly competitive. Successful companies understand this and organize themselves in such ways that allow them to answer the market's demands with ease. This is valid for each of the Company's departments, including the Engineering Department. In the light of those principles, an efficient organization of the Engineering Department allows it to be:

Agile – able to tap easily into the available resources

Responsive – capable of react quickly to the Company's needs

Flexible – able to easily re-organize to respond to new demands

A well organized Engineering Department allows the Engineering Manager to effortlessly restructure the work relationships between the team members in order to better respond to the various particularities and challenges of the incoming projects. The ability to quickly adapt to the requirements of new projects (and hence to respond well to the market demands) contributes to the Engineering Department's success.

Terminology

This course will use the following terminology:

The "team" represents the collection of the individuals that form the Engineering Department.

The "Engineering Manager" refers to the assigned leader of the Engineering Department. The formal title can sound different (Lead Engineer, Senior Engineer, Principal Engineer, etc.), but the responsibilities include managing the engineering team.

The "project" is the sequence of tasks performed by the department in order to develop a product (machine, process, etc.). It is often generated by a Sales Order or by an AFE (Approval for Expenditure).

The "process' refers to what the products developed by the Engineering Department are meant to do: metal cutting, earth moving, fluidics processing, pressure containment by pressure vessels, chemical process, etc. This is not the machine itself, but the work performed by that machine.

The term "discipline" represents the type of engineering knowledge required to develop a product: mechanical engineering, civil engineering, electrical engineering, hydraulics/pneumatics engineering, software engineering, etc.

Factors that affect the organization of Engineering Departments

Several factors need to be taken into consideration when organizing the Engineering Department. Those will be discussed in the following.

General Considerations

Typically the Engineering Departments perform two types of activities: Sustaining Engineering or Research & Development (R&D). Sustaining Engineering is defined as "continuing engineering and technical support that follows release of requirements, specifications, and drawings for fabrication, assembly, testing, and delivery of an end-product"[i]. R&D activities are defined as "systematic activities combining both basic and applied research, and aimed at discovering solutions to problems or creating new goods and knowledge"[ii]. Furthermore, the R&D activities can be divided into:

Research – during which basic research is employed to solve engineering problems or develop new processes, products, or technologies

Development - it takes existing engineering knowledge – processes, technologies, techniques, etc. - and applies to new developing products

Some Engineering Departments developing new products are doing development, sometimes in conjunction with a small amount of research. The processes and skills required for each of those types of activities are not always the same.

A typical company project workflow is described in Figure 1, where a project (sometimes called a "job") is taken from Pre-Sales stage up to the Client Support phase:

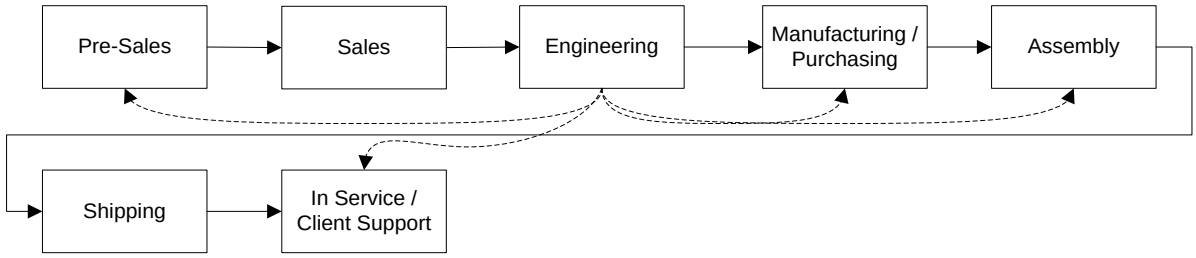

Figure 1: Typical Project workflow and the involvement of the Engineering Department

This workflow may be different from company to company, depending on the nature of the product developed. For instance, a Testing phase may be necessary for products that rely on many parameters that cannot be anticipated at the design stage. In this case a continuous feedback is needed between the engineering activities and testing activities.

Figure 1 is showing that the Engineering Department is not only involved in the serial sequence of the project workflow but also supports other activities in that workflow (illustrated by the dashed lines). As such, the Engineering Department is helping the Sales with generating quotes and clarifying specifications, is supporting the Manufacturing, Purchasing and Assembly with engineering expertise and is also supporting the clients (by means of the Service Department) with know-how after the project was released for service. Those activities could be viewed as "disturbances", because they are not planned and need to be resolved without affecting the current projects. However, they are critical for the function of the company and the Engineering Manager needs to be ready to deal with those tasks when creating project plans, organizing teams and forecasting.

Inside the Engineering Department, the projects usually include activities like Design, Analysis, Modeling, Verification, Drafting, as well as the creation of written documents (like manuals and specifications). Those activities can be done sequentially or, in most cases, are parts of an iterative process. They may also require collaboration with experts from inside the company and from outside the company (suppliers).

The Engineering Departments often handle multiple projects at a time. Ideally, the team members are working on one project at a time, but in many cases the reality can be different. During a typical workday, the team members work on more than one project, each of those projects in various stages of completion. Smooth and successful transitions between projects happen when the team members are willing to collaborate, are familiar with the types of projects involved and with other team members' work habits and professional routines.

Departmental strategy

To successfully organize the Engineering Department, the Engineering Manager needs to have a very clear strategic view of the Department and of the Company. He/she will have to:

understand where the Department currently is in its lifecycle:

a. is the department just established?
b. what skills does the team already have and what type of projects can it tackle now?

have the vision of where the Department needs to be in the short term:

c. what are the skills needed in the short term?
d. what type of projects does the company need to tackle in the short run?

have the vision of where the Department needs to be in the long term

e. what are the skills needed in the long term?
f. what type of projects does the company need to tackle in the long run?

Having clear answers to the above points helps the Engineering Manager to successfully organize his/her department.

Departmental processes and required skills

Besides the overall strategy, the departmental processes and the required skills affect the organization of the Engineering Department. Related to this, several factors need to be considered before the organization of the Engineering Department is implemented. Some of the questions that need to be answered are:

Does the Department perform R&D or Sustaining Engineering?

What processes do typical projects go thru?

Does the product development require input from more than one engineering discipline, or just one discipline is sufficient?

What skills do the people in the Department already have?

Does the Department have multi-skilled professionals? Do the team members need to have horizontal skills (several engineering disciplines – mechanical, electrical, etc.), vertical skills (manufacturing, purchasing, etc.) or both?

How much experience do the people already have in their discipline?

Are they at the beginning of their career? Are they towards the end of their career?

Different types of processes require different professional and personal skills. In a successful Engineering Department, the Engineering Manager can effectively match the team members' skills to the projects' requirements.

Types of tasks: creative vs. routine

Creative tasks involve large amounts of unknowns and require tests and experiments to study the machine's (or process') behavior and to prove the machine's performance. There is always the possibility that the project cannot finally be delivered as per specifications. This is the case of research work and design engineering work. The tasks associated with this type of work can be successfully accomplished by employees with lots of practical experience, who are highly educated, determined and who show practical imagination. Those people are thriving when given a certain amount of freedom that allows them to perform at their full capacity; at the same time, they can feel dragged down by bureaucracy and strict schedules.

Routine tasks are well determined and predictive. Those tasks are typically assigned to people that do not like to change their ways. They enjoy a set routine rather than stepping out of their comfort zone. Examples of routine tasks are drafting, technical writing (manuals, procedures, etc.), and interactions with other departments in the company (Purchasing, Manufacturing, Sales). These tasks can be monitored closer and their outcome is usually very predictive.

The Engineering Department needs both types of personnel. The Engineering Manager needs to understand each person's qualities and abilities and to utilize them to the fullest. When this happens, everyone is wining: the employee is professionally satisfied and the project is successfully delivered; this results in a successful Engineering Department.

People and their competencies

The people in the Engin partment's success. Ideally, the Engineering

- a variety of competen ects
- redundant competenci ber becomes unavailable
- a variety of motivations ojects

The Engineering teams sho notivations. In the light of the above pointers, t e following lines:

- experienced vs. novice;
- with desire to learn and a
- experienced in multiple d