

How to maintain and improve competence for active engineers in the electric power sector.

A key factor for success, both within utilities and power equipment manufacturers, is to have personnel with enough and sufficient competence. Young engineers coming directly from education have good theoretical skills but limited practical experience. They must gain experience before being able to perform useful work. Therefore, young engineers very seldom need more theoretical education. They need to face the reality and to make mistakes (be allowed to make mistakes) and then become skilled and experienced engineers.

Older engineers normally have a great amount of experience. They know how things have been done in the past and up till today. The risk with old and stubborn engineers is that progress and new ideas will be kept down. A very dangerous argument is that we do like this because we have always done like this.

Also young engineers become, after a while, old engineers. They gain experience but they do not have a clear picture of the progress of modern technologies. Engineers working within electrical utilities and manufacturers, have to continuously maintain and improve competence within a wide range of areas. How can this be done in an effective and economic way?

This paper will pinpoint some items and ideas to be considered.

What will give most benefit: conventional courses (one way teacher to student communication) or training (hands on and/or problem solving)?

Conventional courses will normally cover a wide area. This is of importance to get an overview of a certain process in different technical areas. There is however a risk that the competence will not be active (soon forgotten). Some problems concerning conventional courses are:

- Short time: The engineer can only be away from the normal work for a limited time (normally no more than three days). During this limited time the engineer shall receive a large amount of facts. There is no time for exercises and practical examples. Most people cannot absorb all the information given.
- “Inactivity”: In conventional courses the information flow direction is often limited to be from the teacher to the student. Active engineers are not used to “just listening”. They cannot keep focus for a long time.
- “The mobile telephone problem”. As many engineers are involved in different projects and other activities that need attention, the engineer will get in contact with the colleagues to solve problems, etc. The modern “mobile telephone society” enables this. The disadvantage is that the engineer will split the attention, and in worst cases the whole group in the course will be disturbed.

Even if we can see some disadvantages with conventional courses they play an important role in updating competence for active engineers. The courses should however be:

- Short or split to several occasions
- Cover limited areas

Learning by training means that the engineer makes actual work under supervision of a more skilled person. Training can include everything between practical “hands on” exercises on equipment to theoretical “problem solving”. Training will in most cases cover a more narrow area compared to conventional courses. The experience is however that the competence gained from training will be active. This means that the engineer can have benefit of the training also some time after the actual training.

As in many other cases a compromise is the best solution. Normal teacher led course lessons should be combined with different kinds of training sessions. First the teacher gives background and theory for a certain area. Then the students apply the theory in practical training. This will probably give best benefit.

How wide competence is required for engineers, working in utilities or manufacturing companies?

The traditional way is that each engineer has one unique responsibility area. The engineer will have very good competence within that special area. There are however some disadvantages:

- The company will be very vulnerable for loss of each engineer. If a specialist disappears some important competence can be lost. This can be an increasing problem, as the companies tend to slim the organizations very much. There will be no personnel back up.
- The development, as a consequence of discussions between different engineers will be limited, if each engineer only acts within one responsibility area.
- To improve the activities, where the engineer is responsible, it is often beneficial to use experiences from other competence areas. This is difficult for a very specialized engineer.

Therefore some competence beyond the normal responsibility is of great importance for development.

Now the question is: How to define the best competence profile for each engineer? As an example we study the relay engineer, working with protection system planning within an electrical utility. We can define the following areas:

- Competence about the protection equipment itself (hardware and software). The engineer must primary know how to handle, configure and set the equipment. It is also of great importance that the engineer knows the limitations and advantages of each piece of the protection equipment.
- Power system competence involving mainly different kinds of analysis techniques. The analysis techniques involve static calculations (load flow, fault calculation, etc.) and time simulations (e.g. EMTDC). It is important that competence within this field does not only mean that the engineer can handle a computer program. The most important skill is to be able to interpret and evaluate the results from calculations.
- Primary equipment competence. Even if a relay engineer shall not have very deep knowledge about, for example a power transformer, he/she must have some base knowledge. How will the properties of the transformer influence the requirements on fault clearance?
- Instrument transformer competence
- Law and regulations influencing the requirements on fault clearance
- Economy: The protection engineer often has to economically justify investments in protection equipment. The economic benefit is compared to the cost.

Similar profiles should be defined for each individual engineer.

Learning by doing.

One of the most efficient ways to get new knowledge is to solve “new” problems. To do this, the engineer needs a good base of knowledge. Also training in solving problems is valuable. In the process of solving problems the engineer often has to study subjects peripheral to his/her previous competence. By facing “new” problems, the competence of the engineer is successively increased.

Co-operation between young and old engineers can be very beneficial. The young engineer can contribute with knowledge of the latest techniques and the old experienced engineer can contribute with experience. A condition for success in this kind of co-operation is that both parts have respect for the competence of the other part.

Job rotation is often encouraged in companies. The idea behind this is that the engineer shall give new and fresh input to “old and stubborn” engineers. The engineers shall also get a broad experience. Many young persons therefore move very often. This gives a risk that the base competence will not be developed enough for advanced problem solving or other “difficult” tasks. To gain deep competence within a certain field, the person has to spend relatively long time to study this field. Normally 3 – 4 years is a far too short time to become a real specialist in an advanced field.

We have to realise that people are different. One can say that some persons are suitable for frequent job rotation (future managers), while others are suitable for deeper analysis work (that requires more experience). It is important that also the engineers, suitable for advanced problem solving, are encouraged in their work (even if they sit on the same job year after year). This includes “alternative” career possibilities. You should not have to become a manager to get high salary and prestige.