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# Readjusting the current trend in Electrical Power Engineering

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***Abstract :*** *In this paper, the electrical power education curriculum is analysed from the viewpoint of the electrical power industry and from the viewpoint of young people that contemplate their future academic study. From the perspective of young people in industrialized countries contemplating their future and the possibilities of an academic study, the current curriculum in (power) engineering lacks attraction. The number of freshmen still shows a decreasing trend. This paper is aimed to be a contribution towards readjusting this trend.*

***Keywords -*** *Driving force electrical engineering, change driving force young students, attract young students, Industrial and knowledge platforms.*

## I. INTRODUCTION

In this paper, the electrical power education curriculum is analysed from two different -but not entirely Independent- perspectives, from the viewpoint of the electrical power industry and from the viewpoint of young people that contemplate their future academic study. An analysis is presented of the current state of affairs of the electrical power industry and its need for young engineers. It will be shown that the driving forces of this industry have changed through the years. This change is reflected -amongst others- in the required qualities of young engineers. Now we observe a discrepancy between education programs for electrical power engineering and the requirements of industry.

From the perspective of young people in industrialized countries contemplating their future and the possibilities of an academic study, the current curriculum in (power) engineering lacks attraction. The number of freshmen still shows a decreasing trend. This paper is aimed to be a contribution towards readjusting this trend. In the Netherland, we have about 170.000 students distributed over 10 general and 3 technical oriented universities. Of the latter category Delft University of Technology is the largest in the Netherlands, having a total increasing number of 13500 students. The declined interest in Beta technological studies has been observed in the number of students in the discipline of Electrical Engineering, which suffered years of decrease down to 600 indeed. Since two years our new education program consists so-called minors can be chosen, which provide interfacing and switching options with other disciplines. In that way, more adaptation to the skills of the student and the multidisciplinary needs of the society becomes possible. All 30 MSc courses are given in the English language, which is accessed also by 1400 foreign students mainly from Europe, Asia, America and Africa. Selected students go for an additional 4 years postgraduate term. TU Delft is a strongly research oriented university, supported by and co-operating with industrial companies and governmental institutions. Our research feeds the educational system with the most recent developments and as a result, TUD has nowadays a fast increasing number of PhD doctorates, now up to 300 per year. Yet it is unclear if these measures are effective, but the number of BSc/ MSc students in Electrical Engineering has stabilized since two years, having an upward tendency.

## II. DRIVING FORCE POWER ENGINEERING

### 2.1. Engineering as a driving force

In the industrialized countries, the main driving force of the electrical power industry is nowadays the economic factor. With reference to CIGRE publication 224 [1] we have learned from the historical development

in these countries that minus and plus 20 years from now, we discern three dominant driving E-factors, respectively:
Engineering, Economics and Environment. Depending on the local growth scenario, these drivers will rank differently. Some developing countries have high growth rates well over 10%, involved in projects to build new power systems bringing electrical power to the people even for the first time.

### 2.2. Economics as a driving force

On the other hand, the electrical infrastructure has reached a mature level in the industrialized countries. In that case the engineering is not the primary objective, but its economical production/utilization and improved delivery performance. Power trading, upgrading and lifetime extension of the systems are examples of challenges that induce a revolution in managing and operating the aged assets of the system.

### 2.3. Environment as a driving force

Future technology should include more sustainable solutions for power processing, energy storage and social/societal demands. Environmental concerns are expected to impose higher requirements from society as well as from international treaties. Environmental advantages may be found by small/mid-scale decentralized power generation (micro power e.g. fuel cells) growing into the distribution system. Thereby, auxiliary diagnostics need to have more control over power flows and automatic transmission and distribution equipment to improve the self-restoring capability of the system, the future energy internet.

## III. DRIVING FORCE YOUNG STUDENTS

To facilitate the developments and progress in the abovementioned three stages it is of the utmost importance to mobilize young people and convince them to make a choice for electric power engineering studies, and more in general, technical studies. This driving force is related to the specific stage a country is in. In the developing countries where the growth rate is high, the need for a strong extension of the electric power system is clear. In fact, electrification brings about many things that increase the standard of life. Such basic progress stimulates young people to choose for technical studies, as is the case, for instance, in the far-east Asian countries even without any specific advertisement.

In most of the industrialized countries, a mature stage of the power infrastructure has been reached. The standard of living is high and electrical power engineering is seen from a different perspective. Electricity is considered more and more as a commodity and the field of power engineering seems to be regarded more as a necessity than a precursor for further development. Despite the fact that the now introduced techno economic approaches and information technology are quite innovative, this multidisciplinary approach yet does not seem to appeal to young people; still the shade of maturity conceals the challenges in electrical power engineering.

In the (near) future, environmental issues will become more and more important and they will trigger many new developments. These may look attractive for young people but these innovative developments are weakly subsidized in a period of economic optimization. The innovative breakthroughs are in time often far away from the daily practice, so that the relevance is hardly noticed by the public. In fact, this is reflected by the limited coverage in newspapers and especially Internet and television, which are the main sources of information in the industrialized countries

## IV. HOW TO ATTRACT YOUNG STUDENTS

We need to make a distinction between high school students who are on the brink of making a choice for further education and freshmen university students that contemplate on the field in which they want to specialize.

### 4.1. High school students

In [II], the phrase which is often heard “the student is our customer" is discussed. Whether we agree with this statement or not, it is a fact that young people shop around when it comes to choosing a study. So it is very important that the young potential engineers are addressed directly and timely. The first contact with the young generation goes mainly through the Internet.

Here lies a good possibility for national as well as international organizations like CIGRE, IEC and IEEE. The latter organization has a dedicated website for students, which have already chosen for a technical study. At the educational CIGRE panel in Paris 2004 suggestions were made to arrange websites for young people, where they can find information on the newest findings and revolutionary developments coming up in the electrical power industry in all its multidisciplinary aspects. This website should look very professional and kept well maintained and up-to-date, so that educational institutes will recommend its use to the students. It was proposed that each study committee should submit to the editor of this website their revolutionary developments. Important is that this website has a high quality in accessibility and modern presentations like games and movies,

downloadable pictures and so on. Also chat boxes on interesting subjects like the discussion on EMF, energy storage, fuel cells, greenhouse effect or new inventions/ideas for sustainable solutions should be treated using the worldwide connections of the organizations involved. The upgraded website should be designed such that it can be reached “accidentally" by surfing young kids even years before they even think of studying at all.

### 4.2. Freshmen

In many publications, describing ways to increase student interest and comprehension in power engineering the use of computers and multimedia is promoted. It is our experience that students appreciate also to practically implement what they have learned. Learning from experience is of fundamental benefit for students, analytic and synthetic skills are then more easily accepted.

For instance several years ago, a new freshmen course was set up by the power engineering department of Delft University of Technology that stimulated the students to apply their newly obtained knowledge on Electricity and Magnetism as well as energy systems.

In less than 4 days, groups of 10 students designed, built and tested a complete working energy supply system making use of renewable sources like wind and sun, Figure 2. This approach has worked very well and more students are now informed on the challenges in power engineering. These are, however, methods of teaching, but what is taught should be most important. And in fact just here lie great opportunities when we listen to the needs of society in the industrialized countries. For the near and intermediate future, a number of challenges can be designed and a range of “hot topics" can be identified [7], [1] among which are:

4.2.1 Distributed power generation (the power Internet)
4.2.2 Energy storage (a condition for large scale implementation of wind energy)
4.2.3 Superconducting transmission (high energy density connections and very long distance transmission lines)
4.2.4 Clean technologies (electricity/hydrogen, distributed renewable power systems, fuel cells)
4.2.5 Power electronics (FACTS)Asset management, IT support systems and power trade
4.2.6 Asset management, IT support systems and power trade

Many of these topics are the subject of pioneering research work and they should be advertised as such using the right PR in order to attract more young engineers to electrical power engineering. The fact that for many of these topics a multidisciplinary approach is needed should add to the attractiveness of the field.

## V. IMPLICATIONS OF CHANGING DRIVING FORCES FOR EDUCATION

We may expect an increasing demand for young academics with a wider scope of electro technology. The deregulated, competitive utility industry needs engineers with broader educational backgrounds[8]. Basic knowledge in economics and management together with communication skills are required inaddition to engineering knowledge. Signs of this have already been observed, for instance engineers with additional master of business degrees become popular. So the question for universities is how should the curriculam be changed in order to meet the society's needs of the near future? An extensive inventory of how the curricula could/should be changed to address both the needs of society and the decline in interest in enrolment in power engineering is given in [4]. The engineer of the future has to be made aware that he or she will enter other working environments more than ever before. So in addition to basic engineering skills education should include economical and environmental aspects, which are of concern to society. Engineering won't be the dominating factor anymore, but it is the basis upon which the students have to learn how more complicated but even more challenging solutions for technology applications have to be founded. For universities this implies that the curriculum has to take into account the top layer drivers of Fig.1, if they want to prepare students well on their near future.

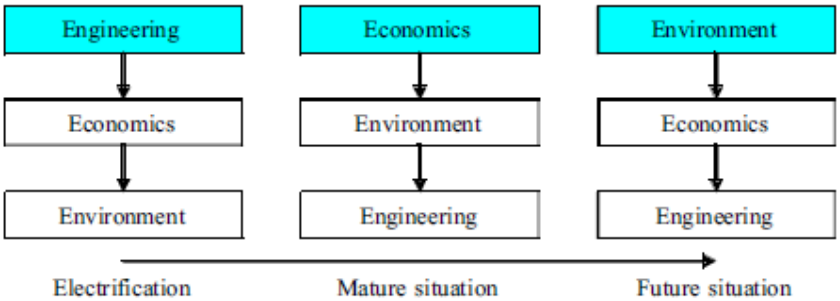


Figure 1. EEE drivers of the electrical power industry over a period of about two decades

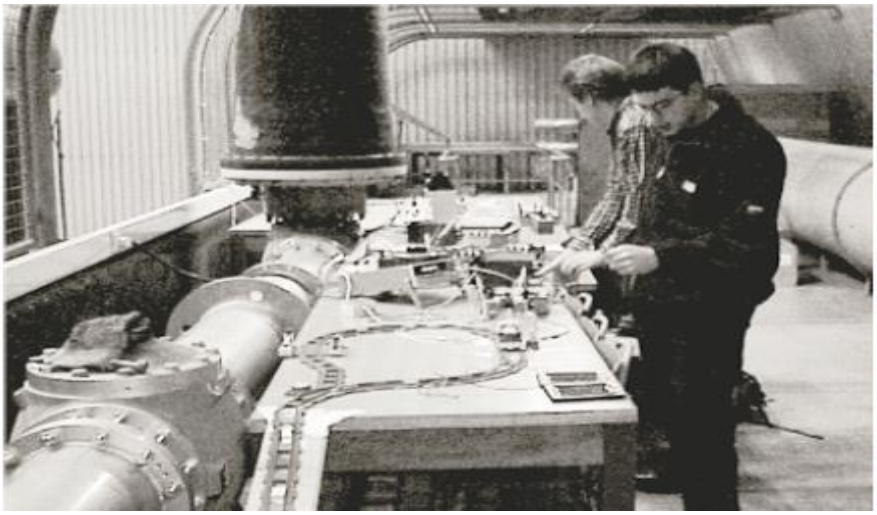

Figure 2. Freshmen testing their design of a durable railroad connection in the high voltage lab.

## VI. POTENTIAL ROLE FOR INDUSTRY AND KNOWLEDGE PLATFORM

For industry, it is of importance to ensure a continuous influx of well-trained and educated engineers that are fully prepared for today's society. Active public relations using the media and in particular the Internet is asked for to change the image of electric power engineering and to show the challenges in the field. Further, traineeships, presentations at universities and cooperation between industry and university need to close the gap between young students and the field of power engineering.

Here, knowledge platforms may have an important task. Knowledge platforms consisting of consortia of research institutions and industry can arrange lectures, workshops and training based upon trends in the electric power industry and current research themes. Due to business pressures, asset managers and network managers are less likely to implement applied research and often they will base their decisions on less relevant data. A knowledge platform like KSANDR [9] combines scientific research with practical experience for both utilities and large industrial companies.

## VII. CONCLUSIONS

In this paper, an analysis is presented of the current state of affairs of the electrical power industry and its need for young engineers. It is shown that the driving forces of this industry have changed through the years and are dependent on the stage of industrialization. The driving forces are, in order of appearance Engineering, Economics and Environment. The change from one driver to another is reflected in the required qualities of young engineers. Now we observe a discrepancy between education programs for electrical power engineering and the requirements of industry.

From the perspective of young people contemplating their future and the possibilities of an academic study, the current curriculum in (power) engineering lacks attraction. Yet we have not been able to use the great challenges in the field of electric power engineering to attract more students and to redirect the declining trend in applications for power engineering studies.

In order to adjust the trend both the curriculum and the way we approach young people should be changed. In setting up a PR scheme and a curriculum for electrical power engineering, we must realize that today's youth are the product of a society, which promotes a “zap” culture, where almost everything can be found on the Internet and where it has become important to know where to find what. Therefore learning methods should be used that take into account the student's perception of learning. In the renewed curriculum, more emphasis should be put multidisciplinary skills. Guest lectures by people from industry and company scholarships should be stimulated in order to strengthen the contact with industry. National and International organizations like CIGRE, IEC, IEEE and others can play an important role in advertising the challenges in the field of power engineering. It is suggested that they develop

Websites dedicated to young people that are easily accessible, well up to date, and fed by experts from those organizations regarding the most important developments and challenges in the field of power engineering.

Knowledge platforms in which industry and research institutes operate together may help in bridging the gap between students and industry at the university level.

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