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“The Global Responsibility of Engineers in the 21st Century – Challenges for the Engineering Education”

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Introduction

The modern societies in which we live have high expectations and ambitious plans for the future. All of us would like to live in

a world with an intact natural environment and none of us would want to do without the amenities provided by modern technology. At the same time, our societies face major challenges that can only be addressed jointly



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on a global scale. Examples include the rapid population growth and fast-paced economic expansion across large parts of the globe, as well as the associated consumption of natural resources and the ever-greater strain being placed on the environment in general. The global energy supply plays a key role because if we are unable to generate energy in an environmentally friendly manner in the 21st century, we will also be unable to solve the problem of climate change and the impact it will have on our lives and the environment. There's no doubt that we need to view all current developments and innovations in a global context – and that more than anyone else - engineers are the people who need to overcome the challenges. In other words, it is the members of our profession who have to continually come up with new technical solutions. This issue is particularly important in Germany at the moment, given the government's decision to phase out nuclear power. This situation places even greater responsibility on engineers. After all, while politicians can make decisions, the real solutions can only be developed in scientific laboratories and companies. Everything has taken on a global dimension, whereby electric mobility and resource efficiency immediately come to mind here.

The global responsibilities for engineers

In view of the global nature of the challenges, it is extremely important that engineering education around the world should be comparable and geared towards the challenges of the future. We know that this is only the beginning of what will be a long process. Nevertheless, we live in an age in which the human race is taking on ever-greater ecological responsibility and moving toward a system of sustainable development, which is why engineers must also make a contribution to the common good. This brings to mind a very nice saying: “At every turning point of history there has been an engineer.” So what can engineers actually do if they want to live up to their global responsibilities? First of all, they have to join together in a concerted effort around the world, as this is the only way their voice will be heard. What this means for us is that we all have to work together to increase the influence and importance of the WFEO (World Federation of Engineering Organisations) as a worldwide umbrella association



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and a global player. To this end, we need to reform the WFEO in its capacity as the representative of more than 90 national engineering organizations in a manner that ensures it can present the right answers to the global challenges we face and do so effectively at the global level. In line with such an approach, the WFEO must also more effectively and rapidly adapt and expand the scope of its activities to the global problems of the day in order to be able to provide solutions that can be implemented to the benefit of society in a quick and resource-efficient manner – and without red tape. When we speak of the global level, we are referring primarily to the various possibilities the WFEO has as an associate member of UNESCO to launch worldwide programmes and initiatives that will help us overcome the challenges we will face in the future.

This also involves taking on more responsibility in terms of advising international organizations like the UN and UNESCO, as well as national governments and parliaments. This is necessary in order to implement the still to be developed cross-cutting UNESCO Engineering Initiative, for example, which will bring together engineering capacity from all of the existing organizational units in an innovative, pragmatic and cost-effective manner. To put it another

way, this initiative would serve as an engineers' agenda for the coming decades that encompasses the most important tasks, particularly in terms of engineering education, capacity building and of course, global energy supplies.

We would like to take this opportunity to call upon all of our colleagues in the WFEO to obtain the support of their national UNESCO committees so that we can jointly develop and launch the UNESCO Engineering Initiative in the not too distant future. It is FEANI's firm conviction that the UNESCO Engineering Initiative and the associated global capacity building are indispensable elements for ensuring continual economic growth worldwide, which in turn depends in large part on sustainable development and the use of renewable energy sources. The UNESCO Engineering Initiative as an engineers' agenda for the transition from an industrial society to a knowledge society will once again highlight the leading role engineers will play in shaping that future society. Engineering education is crucial here. Engineering degree programmes should not only focus on future requirements but also be linked to the UNESCO Engineering Initiative. This will allow future engineers to fully assume the leading role we just mentioned and serve as engines of innovation whose developments will benefit people everywhere.

Engineers are therefore called upon to create cutting-edge technological solutions to address the challenges of the present and the future. If we look back on the last few centuries, we see that engineers have always been the driving force behind technological progress. However, they have also always been aware of their responsibility to society. Among other things, engineers have continually improved people's working and living conditions over the past few centuries and by as early as the mid-20th century, they had recognized the necessity of environmentally compatible and sustainable product development and production processes. The current and future generations of engineers need to continually refine this basic principle for achieving the common good. Now more than ever, the integration of sustainable development into engineering processes must form a core element of engineering education – not least due to the challenges posed by global energy supplies for the present and future, which makes the demand for so-called sustainable engineering very plausible indeed.

Consequences for engineering-study-programs

What are the consequences of making such demands? Before we discuss that in more detail, we would like to quote Professor Nico Stehr, the designated director of the European Centre for Sustainability Research:

“Sustainability is not only a problem of the environment and development. Sustainability has become a question of the economic, demographic, political, cultural, technical, ecological and — last but not least — moral development of societies.” Stehr also points out that in the coming years and decades sustainability will belong to the “core components of companies, the capital market, technical innovation and certainly, politics in everyday life.”

If this is to actually happen, we will, however, need to reform engineering education programmes so that the greater use of renewable energy sources, resource efficiency,

recycling, and the economic, ecological, social and sociological aspects of business activity become integral parts of engineering education. Engineers must be made aware that everything in our world today is linked in one way or another and that every change made to the natural environment will have consequences.

This new view that engineers will have of themselves will require new knowledge and skills. As we all know, we have been taking major steps towards the establishment of a knowledge society for several decades now. But knowledge alone is not enough. It has to be presented and communicated in a way that conforms to its practical application if the necessary expertise is to be developed. Such expertise must contribute to an expansion of the innovative ability of companies and the conservation of our natural resources.

As said, this will require changes to be made to engineering-study-programmes, as these are the primary resource for attaining new knowl-



Mr Dirk BOCHAR and Mrs Doris LEUTHARD, President of the Confederation of Switzerland 2010 and Federal Councillor of the Switzerland taken during the WEC Conference on 5 September 2011



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edge and expertise. We can no longer limit ourselves to addressing technical issues as we did in the industrial age. Instead, we need to take a holistic view of the economic, ecological and social impacts of our actions — and always do so from a global perspective. Our objective here must be to ensure that every engineer adopts an international point of view so as to enable him or her to contribute to the improvement of the quality of life for everyone on the planet. Such “holistic expertise” will enable engineers to think and learn in an interdisciplinary manner and develop products that address the social and global challenges we face.

A future engineering program

The worldwide debate on global warming, the finite nature of fossil resources, the excessive disruption of plant and animal life and the extinction of entire species are all compelling us to change the way we think. Many engineering associations have long understood that certain requirements must be fulfilled if we are to establish a state-of-the-art engineering education that will enable engineers to address the challenges of the future in line with UNESCO's Millennium Development Goals. It is now time for the universities to gradually reform their engineering curricula in a manner that will enable future engineers to tackle the challenges of the 21st century.

Clearly, a future engineering programme will include a broad spectrum of fundamental knowledge of mathematics, the natural sciences and technology, as well as the necessary interdisciplinary skills. These central subjects form the basis of each engineer's qualifications. The most important educational goal for any engineer must be to use the knowledge he/she gained to develop the expertise they will need for their future tasks. In other words, engineering education programmes must open themselves up to new content on the one hand, and take the needs of industry and society more into account on the other. This is important because there's hardly a branch of industry left in which the ecological and social impact of product development and production aren't taken into consideration.

This brief description of future engineering education requirements makes it clear that there is still plenty of room for innovation with regard to the development of new engineering education concepts for the future. It is also crucial here that university instructors become aware of the changes that have to be made in the curricula and that they effectively play the role of developers and communicators of new knowledge.

Using the future requirements for engineering education as a basis, we could define the engineer of the future as follows:

The engineer of the 21st century must be able to keep pace with rapid technological advances in an increasingly interlinked global economy, solve complex multidisciplinary problems and use natural and human resources in the most efficient manner possible. The engineer of the future must also be able to act as an innovation manager and entrepreneur who can run a company, draw up business plans and generate economic growth.

In our opinion, if you accept this definition of a modern engineer, you have to conclude that the engineering education system as we know it is in urgent need of reform. The responsible individuals around the world, and particularly in Europe, have recognised this need and have launched initial steps to adjust curricula.

We are firmly convinced that the European unification process and the European Higher Education Area – the Bologna Process – propagated by the European Union (EU) will help ensure that principles of ecology and sustainability will sooner or later become an established part of engineering education worldwide. Still, national education systems continue to express the cultural identity of their respective countries. Despite their many commonalities, the national education systems often display substantial structural differences and these need to be reduced by making the content of the engineering programmes comparable.

Conclusion

To conclude, we would like to mention three key demands that must be met in order to promote the reform of engineering education systems on a global level:

First, despite the fact that universities remain firmly anchored to their respective national educational systems, they nevertheless take the challenges of globalisation very seriously. Indeed, many of these institutions of higher education are on their way to becoming globalised organisations that can anticipate future challenges. The future engineers who will study at these institutions need to participate in programmes that more extensively integrate sustainability principles and concepts than has previously been the case. This will soon make it possible to increase the number of instruments that can be used to address future challenges and adapt these instruments to new requirements as needed. The integration of sustainability principles into engineering curricula around the world will create added value for engineering graduates and solidify and expand the role engineers play as trailblazers for overcoming future challenges.

Secondly, to ensure that future engineers can overcome challenges effectively and on a global scale, our goal should be to enable a comparison of engineering programmes from around the world. The idea here is not to make all the programmes the same; it goes without saying that they can conform to national traditions. However, it will have to be possible to compare their outcomes, so to speak.

Third, the programmes must reflect and take into account the international context of an increasingly interconnected global economy in a multicultural world.

We believe that the World Engineers Convention has offered an ideal platform for positioning our profession as a bearer of global responsibility. We ask society and politicians to help us put this responsibility of the world's engineers into action and ensure it is reflected in the engineering education systems of the future.