VNIVERSITAT DE VALÈNCIA

Speech to be Delivered

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ENGLISH

Dear Prof. Esteban Morcillo, Rector of the University Valencia
Dear Executives of the University of Valencia
Dear Faculty Members,
Dedicated Guests,
Ladies and Gentlemen,

I feel more than honored that I've been invited to speak to you today. It's a very special day for me. Being awarded with the title Doctor Honoris Causa is not just something. For me, it's one of the most significant recognitions in my professional life.

It´s also a pleasure for me to share this event with young people that, in the framework of their Doctoral Thesis, have contributed with new and innovative ideas, and who are distinguished for their work and effort. Congratulations!

I know that nominating somebody as "Doctor Honoris Causa" involves a good deal of work. The nominee's contribution to academia, to the industry and to engineering societies have to be examined in detail. I would like to express my gratitude towards everybody involved in the internal processes at the University of Valencia.

However, at the very beginning of such a nomination stands someone, who comes up with the initial idea and then triggers the relevant processes. **In my case, the initiator is somebody whom I've known personally for more than 25 years. My deepest thanks go to Prof. Enrique Dede!**

I remember very well when back in the early 1990s, we started a common project with an exciting new technology - very fast switching power devices in an application for inductive heating systems that had been developed by Enrique. I learned a lot from his ideas and hopefully Enrique benefited from my knowledge as well. Since then, we have always been in contact and over the years, we even built up a friendship which isn't so common in the business world. **Today, we are both board members of several important organizations such as PCIM, EPE, ECPE and some more. Thank you, Enrique!**

I don't want to bore you with all the details of my professional life. **Let me just briefly spend some words on the four main areas that I was privileged to contribute to throughout my career.**

- **In my carrier in the industry**, I was very soon promoted to take over responsibility for the R&D team in the new power semiconductor technology unit of Siemens. This position enabled me to drive pioneering work in advanced and new semiconductor technologies and to shape the power electronics industry.
- Along with this new technology movement, **I contributed to update the relevant conference landscape**.
- Thanks to the new technology development trends, I had the chance to contribute

actively with presentations to international conferences. I felt a sort of responsibility to **share my knowledge with universities around the world and started supervising MS/PhD students and providing courses in power devices technologies.**

- The economic downturn in the mid-nineties had a huge, negative impact on all engineering disciplines. Together with a small group of people, **I set up the ECPE to promote power electronics in the industry, in academia and in governmental funding organizations.**

I started my professional carrier in the semiconductor industry in 1979. In the semiconductor industry, innovation and pioneering work is key for success in global markets.

Colin Powell "Former US State Secretary"once said: „There are no secrets to success. Don't waste your time looking for them. Success is the result of perfection, hard work, learning from failure, loyalty to those for whom you work and persistence. "

When we transfer that to „innovation", I have a clear stance on that: **Innovation is based on the know-how of experts, on management trust in sometimes risky research, extended team work and openness for new research directions.**

My motivation for driving the development of new technologies was based on a famous sentence from Albert Einstein: "It takes a new way of thinking to solve the problems we created by the old way of thinking ".

Innovative semiconductor solutions address the global requirements for the economic development of any country. Thus, they are also considered as the "raw material" for the future. **To keep relevant R&D in your country is key for any developed economy. Second prerequisite is a highly qualified education in the most important disciplines.**

Today, not only companies compete with each other. **Whole nations fight for technology leadership**. Still today in Germany and in Europe, we have an excellent infrastructure for the industry with many top experts on board. We have outstanding research centers and universities with leading scientist. We have a stable infrastructure that enables us to organize conferences, workshops and support engineering societies.

Over the last three decades, I had the chance to build up a large university network in Germany, Europe and worldwide for research cooperation's, the supervision of PhD students and providing lectures and courses for graduate students.

I'm glad that also at the University of Valencia, the School of Electronic Engineering, **I several times had the chance to give lectures, talk to students and contribute to PhD theses. This allowed me once more to get a deeper insight into the excellent research team at the University of Valencia lead by Prof. Dede that set many key milestones**

in the development of new power converters with leading-edge technologies. Prof. Dede´s trendsetting inventions along with his excellent presentations at international conferences elevated him to a top scientist in his field of expertise. Furthermore, I would like to mention how much he understands to listen, to identify a common voice within expert teams of different disciplines and to assume the role of a moderator in effectively leading to a solution.

I talked a lot now about the past. I'm afraid that's typical when you reach a certain age. Let's look ahead. **What will be the trends in technology and education and what challenges will we face in the next two to three decades?**

Briefly speaking, I see at least four new directions in technology development and „Business-to-Society".

1. We will have to set new technology milestones when it comes to the power electronics component level.
2. We will experience a paradigm shift in the power conversion system development.
3. We need to go completely new ways in factory automation, the so called "SMART Factory".
4. We will have to undergo a revolutionary technology development to meet the requirements of the future mobility concept.

Let me highlight a few examples for the different directions in technology development that I've just mentioned.

New technology milestones in the field of power electronic components

You might remember the Google competition announced two years ago: to develop the world's smallest power converter reducing the size and volume of a state-of-the-art power electronic system by a factor of 10.

To realize highly compact systems with such a size reduction, new materials for the magnetic components, new heat management concepts and 3D system integration will be necessary, together with the ongoing technology development of power transistors.

Based on the outcome of the Google competition and many expert workshops, we have specified the technology and research roadmap until 2040.
With our research capabilities in Europe - in the industry and in academia - we are well prepared to compete on the world market.

However, there are some critical points:

- The transformation of basic research results and IP into industrial products takes too long compared to other competitive regions such as China, Korea, or India.

- To pursue the technology roadmap straight forward, we need interdisciplinary, cross-functional cooperation's between companies with different technology competences.

Paradigm shift in the power electronic system development

To meet the requirements for the future development trend in power converter technologies, we have to **evaluate the whole supply chain from material research to the electrical energy we are saving, the maintenance cost, the lifetime and finally the recycling after replacement.**

Besides the energy consumption, which has a direct impact on our environment, we have to strive for digital solutions and high-level communication systems applied to all actuators used in the factory of the future, the „SMART Factory".

To sum up: When it comes to the technical expertise in power electronic systems, the specification of the future requirements for system communication and the internet gateway to the cloud, in Europe and in particular in Germany, we are well prepared to specify basic research topics for the industry and the academic world.

The challenge however to become a front runner in technology is a crucial reorganization and cultural change within the big companies. It's necessary to merge the individual expert teams and add software specialists for handling the power of „Internet to Cloud".

Some words on the „SMART Factory „or Industry 4.0.

"Smart Factory „or „Industry 4.0" as we call it in Germany stands for the 4th industrial revolution. It covers the organization and controlling of the whole value chain of a product life cycle.

In Europe, we have an excellent basis for highly sophisticated production process know-how and hardware oriented solutions, which is an important part of the „SMART Factory". In terms of advanced software solutions however, we are faced with big competitors in the US such as Facebook, Google, and Microsoft as well es in China with companies such as Alibaba or Baidu.

I see one big concern: who is the owner of the "Big Data" collected everywhere from private life, mobility, process control, logistics, etc.?

Big Data is a synonym for political power. All industrial nations fight for a leadership position in this field.

Within the next decade, we will see clearer who has a chance to become the technology leader for the 4th industrial revolution.

Due to the long industrial history in Germany, there is a big danger of not being able to convince the society of the advantage of the digital revolution fast enough.
We have to be aware that the 4th industrial revolution will become the most significant challenge for the industrialized countries and new players will come on top. For this reason, all big, industrialized nations today such as the US, Japan and Europe, in addition to new players such as China and Korea, fight for industrial leadership.

In the **US, they call it "industrial internet"**. The CEO of General Electric Jeff Immelt said: "If you went to bed last night as an industrial company, you're going to wake up this morning as a software and analytics company".

In **China, they call it "Made in China 2025"**. Their strategic goal is: to overtake Germany and Japan by 2035 and become the industrial superpower by 2049.

Basically, Germany set the triggering point for this new direction during the Hannover Fair under the term „Industry 4.0".

To convince society of the benefits of the digital revolution we need to:

- direct and speed up research activities at research centers, universities and in the industry,
- motivate universities to provide the relevant academic education,
- provide full support from the side of politics, academia and the working force to industrial companies during the transition phase from today's production line to SMART Factories.

Let's have a look on the situation at the world market.

The US is without a doubt in a leading position when we talk about internet technologies and software solutions. This is one important requirement for the SMART Factory. However, in the last decades the US transferred many industrial production lines to low-cost countries and lost competences in this field.

Supported by the political system and its long-term strategy, China is developing extremely fast in terms of building up an advanced academic education system, high-tech facilities and a world class infrastructure for transportation systems and energy supply. They just announced the **"Innovation Decade" to enable academia and the industry to move to the top position.**

To prepare China for the future in all these disciplines, engineering sciences are having the highest priority. In contrast to all the western countries, in China, they have a high reputation in the society.

The major blocking point I see today, is that many big companies in China are owned by the government and work very inefficiently when it comes to the development of new technologies. However, we know that China has the highest acquisition rate of high-tech companies worldwide to transfer new technologies into the country.

In Europe, we still enjoy an excellent infrastructure in academic education, research capabilities, an outstanding knowledge in handling complex production processes and high quality products.

The blocking points we are faced with are:

- A low number of engineers in general and a lack of experienced software experts.
- Engineering disciplines are not attractive for young people.
- Standardization platforms for highly flexible production concepts need to be developed and installed.
- The transformation from conventional production processes to the SMART Factory needs advanced training for the work force.

Let me also elaborate shortly on the concept of future mobility.

Today, 80% of the innovation in the car is driven by electronics. With the development of the electric vehicle, the innovation level even will increase to 88%. Within the next one to two decades, we will have a paradigm shift in this industry.

The basic requirement will be to be able to move the passengers from location A to B fast, environmental friendly, without any stress, in a user-friendly and comfortable atmosphere where the user either prepares for work in the office, listens to music or even sleeps.

Most of the users even will not have their own car; they direct the car by an app to the location specified. To meet all these requirements, we will have new development directions for:

- Purely electric driven cars,
- An autonomous driving style and
- New business models for car companies and users.

The autonomously driven car contributes significantly to relax the user, the traffic system and reduce the rate of traffic accidents.

The car industry, the user behavior, the public traffic system and the business model will undergo a revolutionary development.

The **driving force** and the speed for the development of this new technology as well as the cultural change is dominated and directed by **"new economies"** such as China, Korea and India and new players might dominate the car business of the future.

An old economy such as Germany is facing many barriers that need to be broken down.

The big and well known car companies of today with their comprehensive know-how in motor management systems have to reduce their number of top experts and build up a completely new technology line with expertise in power electronics. This will need a cultural change throughout all management levels.

The speed of this revolutionary change depends on the decision making mentality in the companies, the investment in new technologies and hiring of relevant experts supported by political decision and governmental benefits.

In this case, the automotive industry is faced with a multidimensional change:

- From combustion engine to e-Drive,
- from conventional driving style to autonomous driving,
- and from segmented lean factory to a highly flexible SMART Factory.

With lining out these four new technology development trends, I wanted to give you some ideas of the main research directions in the future, the challenges and the competition we are faced with by moving ahead.

However, the major challenge will be to realize a save and reliable communications network between the users, the machines in the factories and the transportation systems without interfering in our social life to much.

As already mentioned, in the upcoming 4th industrial revolution, we will have new players with high numbers of population for consumption and excellent educated engineers developing business to the future society.

The "New Economy" will be organized in a very different way:

- Industry 4.0 with the implementation of the "digital world" will ask for new qualification skills.
- Our mobility system will undergo a deep going revolution.
- Our education system will be adjusted to the global demand.

In particular, big competitors such as China initiated the so called "Innovation Decade". **The generation of patents in important future technologies for engineering disciplines on university level, research centers, and companies is a new measurable for funding programs and bonus systems**. Within this frame program, most of the investment is going to the educational system. Engineering education has the highest priority and in the meantime also the highest reputation in the society.

This is in contrast to most western countries where engineering disciplines are not at all attractive for young people.

From my point of view, there are three main factors:

- The education prior to university in many cases is not sufficient to prepare young people for a successful engineering career.
- The reputation in our society is not in favor of an engineering profession.
- The relevant industries in the developed countries are obviously not demonstrating the importance for the economic development of a country in an attractive way.

The latest university evaluation and rating for engineering sciences on a worldwide basis is showing an interesting fact: **Among the top 10 players, there are five Chinese universities**; Tsinghua is number 1 just before the MIT in the US. In Europe, we have ETH Zürich on position 12 and the TU Munich being number 16. This is a big challenge.

The main reasons for these developments are:

- The number of highly qualified young people with an excellent pre-education prepared for an engineering study is huge.
- The investment from the government for building up competence centers in the various engineering disciplines is excellent.
- Many top experts from foreign countries have been attracted with excellent conditions for basic research.
- The high reputation of the engineering disciplines.

I'm sure that the future in Europe depends very strongly on competitive products we can offer to the world market. To achieve this goal, we need leading-edge technologies along the value chain from basic material science to SMART components up to final complex systems including highly sophisticated hardware and software solutions produced in SMART Factories.

The key requirements for these are:

- The education of highly qualified young engineers on all levels: BS, MS and PhD.
- Cross-functional education for various engineering and science disciplines, maybe even within university clusters by using future media systems such as e-learning.
- For post graduates a close cooperation with the industry to direct research along the technology roadmap.
- Attract more young people to technical disciplines at a very early age and develop their talents.

For advanced trainings and continuous education of engineers working in Europe, ECPE is an excellent organization. Today, we are faced with a new situation in education. E-learning is becoming an important part of the education process in the regular education as well as in life-long education. On top, open online courses where groups of learners

from all over the world participate are very popular today. For the training activities in ECPE, professors from universities and selected experts from the industry need to work hand in hand to prepare the engineers for the future challenges.

According to analysts, **in the large economies worldwide until 2040 - after the digital revolution - more than 50% of the big players we are having now will no longer exist in the form we see today.**

However, I trust that with our pioneering work for basic research, our innovation potential for new technologies and capability to handle complex business situations, we will find our way to play an important role in the future economy.

Ladies and gentlemen, more than 40 years ago, I started my career in the industry and extended my activities on to university engagement, engineering societies and finally to set up an European based engineering association to facilitate power electronics research, workshops and governmental consulting programs.

As I mentioned in the very beginning, **innovation has always been the effort and cooperation of many smart people**. In my entire career, I have always been in the privileged position to be surrounded by so many smart people that supported my visionary ideas and big projects.

I thank you so much for supporting my active contribution to the changes in technology and to honor my achievements with a Dr. Honoris Causa during this outstanding event.

Last but not least, I would like to thank my family - my wife and daughter - for the great support in my everyday life. Without their understanding, it would not have been possible to work and travel so much.

Thank you! Muchas gracias! Moltes gracies!

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