

The Urgent Need to Integrate EMC and Product Safety into Engineering Curriculum of Technical Universities

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There is an evolution in the study of electromagnetic field effects on electrical and electronic products and systems. It is progressing from engineering art to an engineering science. The complexity and sophistication of newer technology products has added to an increased need for more consideration of EMC and Product Safety issues. These factors have increased the requirement for technical universities to implement studies of electromagnetic fields and Product Safety into their engineering programs. EMC and Product Safety factors are essential elements in product designs and their required regulatory certification requirements.

INTRODUCTION

The lack of adequate EMC and Product Safety design and development education at the university level is contributing to an erosion of the United States (US) technical and export capabilities. At the present time this field of study is not a standard requirement in the engineering programs of universities. A comprehensive knowledge in the disciplines of electrical, mechanical, chemical, and computer science are required as a prerequisite base for performing design and certification tasks related to EMC and Product Safety.

The study requirements for EMC and Product Safety engineering programs have a very good fit with existing electrical engineering programs since the required curriculum prerequisite courses already exist within the engineering programs. Engineers whose responsibilities include the design and development of electrical and electronic products and systems must meet the product's functional, interoperability, self-compatibility, and their regulatory certification requirements. They must have the educational and experience background to effectively perform these tasks.

EDUCATIONAL RESOURCES PRESENTLY AVAILABLE

At the present in the US there are a limited number of resources available to engineering personnel for obtaining education in the areas of EMC and Product Safety studies. There is a varied amount of university level involvement in EMC and Product Safety training being conducted currently in the US. Among those that have provided or are providing such training in related studies are listed below.

- Clemson University (Vehicle Electronics Laboratory –CVEL) – The Clemson University automotive engineering program awards degrees for a curriculum that includes EMC studies. These studies include courses in the development of EMC computer program modeling. The university has been involved in EMC research projects for over 20 years.
- University of Missouri of Science

and Technology at Rolla – The university has recently opened a new EMC research center in partnership with a major corporation involving an aviation research project.

- University of Michigan – The university is working in conjunction with The Society of Automotive Engineers of Eastern Michigan, a Chapter of the IEEE's EMC Society. The university is involved in cosponsoring seminars that are related to EMC considerations in automotive systems.

- University of Wisconsin at Milwaukee College of Engineering – Has been sponsoring seminars related to EMC topics.

- George Washington University Center for Professional Development – The university has presented educational seminars on EMC related subjects.

- The University of California at Los Angeles (UCLA) – Has a program that awards certificates in EMC studies.

- Oklahoma State University – Presents short courses covering EMC topics and testing considerations.

Universities with engineering programs should consider taking advantage of the IEEE EMC Society's University Grant Program. This program provides funding to those universities to aid them in introducing EMC training into their engineering curriculum. Universities can apply for these grants through the society's grant program and a number of universities have already done so.

Other venues for EMC and Product Safety education are available through various seminars and training programs presented by different related corporate services and consulting organizations.

There are universities throughout the U.S. which have EMC related activities as part of their educational and research programs. There is a considerable amount of activity occurring in the realm of university research projects that is sponsored by the U.S. government agencies. Among these research projects is one that involves a research study to develop counter measures against improvised explosive devices (IED's) that are used against our military. Other projects in this category that are being worked on are electromagnetic weapons that include electromagnetic pulse and microwave weapon systems. Also, there are university research projects that aimed at assessing the effects of electromagnetic fields on the safety of humans and animals. In another category there are university EMC related research efforts being conducted for industry via university industry partnerships. The study requirements for EMC Engineering programs has a very good fit with existing electrical engineering programs since the required curriculum prerequisite courses already exist in that engineering program.

WHERE A FORMAL EDUCATION IS REQUIRED

There are many EMC and Product Safety challenges facing engineers responsible for the design and development of modern day electrical and electronic products and systems. Meeting regulatory certification regulatory compli-

ance is one of them. As an example regulatory compliance requirements are becoming ever more demanding and difficult to meet. The European Union (EU) CE Mark EMC testing requirements are a good example of this fact. The following EMC conformity requirements are applicable for regulatory certification of various electrical and electronic products and systems.

- Electrostatic Discharge (ESD)
- Power Quality Effects factors (PQF)
- Electrical Fast Transient Effects (EFT)
- Radiated Emissions Limits (RE)
- Conducted Emissions Limits (CE)
- Radiated Immunity Limits (RI)
- Conducted Immunity Limits (CI)
- Magnetic Field Effects (H-Field)

The design engineer must be proficient in applying the required mitigating techniques required allowing his product or system to be compatible with these requirements. Some of the Electromagnetic Emissions (EMI) mitigating methods that can be used are, the application of shielding, filtering, optimizing of the grounding design, and applying the correct set of EMC design guideline rules.

Small and medium companies, for the most part, do not have the engineering personnel available who have the knowledge base to perform the required EMC tasks due to their lack of education and experience needed to perform these tasks. The use of consultants is most often the chosen course of action. The added costs related to use of consulting services limits the ability of these companies to be cost competitive in their efforts to export their products globally.

GLOBAL ECONOMIC FACTORS

While the US is currently in a slow growth economic period other countries such as The People's Republic of China, India, Brazil and Russia have economies that are growing at a much faster rate (between 5 and 9 %). This leads to the fact that US manufacturers must look increasingly to exporting their products in order to maintain their profitability. Impeding their ability to be competitive in the international market place is the lack of an adequate pool of educated and experienced EMC and Product Safety Engineers.

More often than not EMC and Product Safety design issues are dealt with in the later stages of the product's design cycle when they are more difficult to fix and are accompanied by greater costs and schedule delays. As companies off shore more and more of their product design, development, and certification activities the result is a diminishing of US's economic capabilities.

EMC and Product Safety requirements are also important considerations for products sold in the US's domestic market. This is true since the Federal Communications Commission (FCC) enforces radiated emissions limit requirements on most electrical and electronic products. They also have strict EMC certification requirements on telecommunication equipment. The Federal Drug

Admiration (FDA) applies several International Electro-technical Commission (IEC) standards requirements on US medical products. As for Products safety certifications there is always the issue of product legal liability considerations to be deal with and the loss of product reputation.

CONCLUSIONS

While there are various sources of EMC and Product Safety educational programs available to engineers, the requirement for a comprehensive formal educational program at the university level is urgently needed. In the years to come, EMC engineering will continue to evolve from an engineering art to an engineering science. Therefore, the need for the understanding of the theoretical and the practical application of EMC principles becomes more essential. It needs to become an integral part of the electrical engineering curriculum.

In the future as device frequencies exceed the 40 GHz level it will present a greater challenge to EMC engineers. Therefore, the need for formally trained and experienced EMC engineers will become more of necessity then an option. At the present time the prevailing view is that EMC engineering entails working with a very complex and intuitively drive science and that only through years of experience can it be mastered in an effective manner. The fast pace of technological advancements and the rapid development of a complex global economy does not allow the luxury of gaining the required years of EMC experience. A formal education must be provided to engineering students to provide them with the required knowledge foundation to work effectively in the engineering field of EMC.

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