



Directors Corner

**ADDRESS
AT HONORARY DEGREE CEREMONY
TECHNICAL UNIVERSITY OF LODZ
20 SEPTEMBER 2011**

Your Magnificence, Members of the High Senate, Distinguished Guests, Ladies and Gentlemen.

It is with great humility and happiness that I accept this honor you have kindly bestowed upon me today. It is by far one of the most significant and highest honors I have been conferred upon and I shall forever treasure it. I want to express my deepest sense of gratitude and sincere appreciation to everyone and all the academic bodies involved in the process of conferring this highly prestigious award of Doctor Honoris Causa upon me at this memorable ceremony.

I must clarify at the outset that I take this honor as a collective recognition of the efforts of my numerous mentors throughout my career as well as the hard work put in by my students, research associates and collaborators around the world. I have learned much from my professors and mentors as well as my students. It has indeed been an absolutely delightful journey of well over 33 years of teaching, advising as well as learning from and working with many of my bright, enthusiastic, diligent and conscientious students and associates. My students, research associates and research collaborators have generously provided assistance whenever it was needed. Moreover, for the record, I also want to emphasize the support and encouragement I received from my family members. I am grateful to my mother for her love and everything she has done and continues to do for me. The foundation for lifelong learning was instilled in me early on in my life by my father. He was a humble man who truly believed that, "If you stop learning, you must already be dead." I would also like to thank my wife, Afroza, and our daughters, Joya and Rumki, for their love and support. Quite often the public accomplishments of an individual come at burdens borne by family and friends. I appreciate their understanding for all the things I have not been able to do with them because of my time away at work.

I would also like to take this opportunity to thank two individuals who have provided more than moral support and encouragement. They are Trevor Kletz and Mike O'Connor. First, I really appreciate Trevor's support for our work at the Mary Kay O'Connor Process Safety Center. I also want to thank him for his pioneering leadership in many areas of process safety. Trevor is really a giant in this field, and as Roy Sanders likes to say, "Trevor does cast a long shadow in the field of process safety." I am proud to have Trevor's friendship and his support. I also want to take this opportunity to thank Mike O'Connor. He has converted his personal tragedy into an opportunity to integrate process safety into education, research, and service activities at universities. He has been a true friend and supporter of the mission and goals of the Center.

I have had many professors and mentors throughout my education and career whom I would like to also recognize today. During my formative years during my undergraduate education, Professor Iqbal Mahmud at Bangladesh University of Engineering and Technology left an indelible impression on me and propelled me forward in my life long quest. During my graduate studies in Oklahoma, I learned a lot from Professor Ken Starling and Professor Cheddy Sliepcevic. In fact, I learned much more from them than just pure chemical engineering. And, along this journey, many other collaborators and mentors shaped me into what I am today. I would be remiss if I did not mention my late friend and mentor, Dr. Harry West. I am sure he is watching this event from somewhere in heaven with that interesting smile on his face. Of course, I also want to mention my colleague right here in Lodz, Professor Adam Markowski. He has been a great friend and mentor from whom I have learned much. I am sure I have failed to mention everybody who has helped me with the many facets of my career. To them I apologize and want to assure them the oversight is not intended. To everyone, I owe a big debt of gratitude and I accept this honor on their collective behalf.

With your leave, I would like to take this opportunity to say a few words about general topics of my interest as well as my research and professional activity. I would like to talk about four things, namely the need for research, process safety and sustainable development, the need for a rational and constructive dialogue on risk, and globalization. Of course, you might think that we would need a massive book to cover these topics in detail and the depth they deserve and you would be right. I can also understand some of you cringing at the thought of having to listen to a dry and boring professor for hours. Thankfully for all of you, I have been given a time limit and I intend to honor that limit.

Let me share a few of my thoughts about my favorite subject: teaching and mentoring the next generation in the quest for new knowledge and understanding of the world we live in. R&D organizations whose sole purpose is research and development of new ideas are very much needed and serve their unique purpose. However, one might ask what is the role of research in major universities? Some might argue that that the only role of universities should be teaching. But the question is

what is meant by teaching and does that only involve summarizing the contents of a textbook and helping students learn to solve the problems at the end of each chapter. I would unequivocally state that teaching involves a lot more than that. Every moment of a student's experience in the university should involve some kind of learning. So what should they learn and what should the professors teach. Naturally the professors should teach the material from the various textbooks and help the students complete the various courses required in their degree program. But an important part of teaching at a major university is to mentor/teach the student to seek new knowledge. This is often done by challenging students, both at the undergraduate level and the graduate level, with solving open-ended problems. At the graduate level, working on proposals (whether successful or unsuccessful) teaches students to push the frontiers of knowledge in a coherent and understandable manner. And once the project is funded, being able to give meaning and substance to those ideas are crowning achievements for a student that often shapes future accomplishments and successes. Other things that professors must teach are ethics, teamwork, leadership, diversity of all kinds, and resolution of conflicts. So, it would not be wrong to say that every moment of interaction between a professor and a student is dedicated to teaching, whether it is in the class room, or doing research, or for that matter working on other assignments.

So, if research is integral to teaching and universities have an important role in this, the question is how the research should be funded. Clearly, from the ancient times, countries and societies that have funded research have prospered. A recent example is the decision by Singapore to fund research at the level of 3% of GDP and a significant majority of this outlay is expected to come from industry and businesses. I am sure the example of a relatively small population and economy is not applicable to all countries, nevertheless it is a powerful endorsement by Singapore on the necessity of research and the value of research.

With regard to who should fund the research, the main problem arises in the type of research, fundamental or applied. There is a saying that universities are interested in the "R" that is the research part of R&D, and industry is primarily interested in the "D" that is the development part of

R&D. My opinion is that both universities and industry should try to move a bit closer to each other. There is a reason that R&D is always lumped together. If there is no progress in research, there is no development. Also, since the time scales of research in universities is typically longer, it results in more incompatibility. So, I believe that there should be an accommodation from both universities and the industry. Close industry-university interaction is essential to foster this new paradigm. Finally, government has also a significant role in boosting support for research, both fundamental and applied. As a bottom line, research must continue to be funded at a very significant level or we as a society will go the way of dinosaurs that is become extinct.

Now I would like to turn to my research area, i.e., process safety and its link to sustainable development. Our engineering education today lacks integration of knowledge needed for modern industry practice, and is inadequate in providing students with an understanding of societal impact and global role of engineering. My vision for engineering education brings together elements of manufacturing, design and sustainable engineering in an integrated form. And interwoven through this new paradigm is the consideration of risk in every aspect. An engineer must function as a member of the global community. This means not only competing in the global marketplace, but also acting as a professional who shares the global responsibilities. These responsibilities entail proper account of the finite world resources, sensitivity to the impact on the environment, ethical conduct, process safety, risk consideration and much more. Today's engineering education largely neglects preparing our graduates to meet these challenges. This "extra", but much needed aspect may be called "the sustainability dimension" to engineering education and practice, and can be summarized as, "The design of materials, processes, products and systems to sustain good and safe conditions for human health and environment."

On December 3, 1984, events in Bhopal, India, forever changed the chemical industry and left a distinct legacy. It was a quiet night in Bhopal, India, until a cascading series of catastrophic circumstances, system failures, and management system deficiencies at the nearby Union Carbide India pesticide plant led to the release into the atmosphere of approximately 40 metric tons of

acutely toxic methyl isocyanate. The dense cloud of deadly vapor spread over the sleeping community, and within a few days more than 3,000 people had died and at least 100,000 were injured. It is widely acknowledged to be the worst industrial accident in history, leaving as many as 50,000 people partially or totally disabled as of 1994, according to the International Medical Commission on Bhopal. The incident also left a miasma of civil and criminal litigation in its wake. The Bhopal incident is not an isolated incident. Over the last 30+ years, other catastrophic incidents have grabbed the attention of the public and the media. It is even more important now to design processes and equipment to precise standards based on a complete understanding of the underlying hazards, process chemistry, and the impact of operating conditions. Recently a lot of attention has been paid to human factors and its impact on chemical plant incidents. Process safety is a relatively young and evolving field whose driving force has been mainly based on tragic events. Unfortunately, it is also a thankless activity, whose importance becomes evident only after negative events occur. Even today, after so many industrial incidents, there is a school of thought that if nothing bad happens, it is because there are no hazards and hence no need to take preventive measures. However, time and again incidents like Flixborough, UK; Seveso, Italy; Mexico City, Mexico; Bhopal, India; Texas City, USA; Buncefield, UK and more recently the Macondo Deep Water Oil Spill in the United States have reinforced the need to develop and implement sound process safety programs. We need a framework where industry, government, academia and other stakeholders can work together to reduce the probability of occurrence and the consequences of such catastrophic incidents. Companies cannot be sustainable without successful safety and risk management programs. And thus by extension, it is impossible for society to reach the goals for "engineering for sustainable development" without successful safety and risk management programs. Our inability to adapt to the demands of a changing world and eco-system has the potential to take us down the same path as "dinosaurs."

The driving forces for change and sustainable development in a society are growing population, rising standard of living, perception of risk, and society's choices based on these driving forces. As the population is growing there is also at the same

time a rise in standard of living. These changes are imminent not only in the United States, but particularly when you travel abroad to countries like China and India. And when the standard of living increases, the perception of risk or how willing you are to tolerate risk also changes. When you don't have a square meal to eat, risk means something quite different. But when you have three good meals, a nice house to live in, and a car to drive, your perception of risk is completely different. And then there comes the issue of society's choices, and as people's perspectives change, the choices made also change. And that's where a constructive and rational public dialogue on risk is essential.

China currently has an annual growth rate of 11% while the Indian economy is growing at about 8%. On a per capita basis, the United States uses 25 times more energy than China and on a similar comparative bases, the United States uses 62 times more energy per capita than India. In addition, when one takes into account the population of the two countries combined (about 2 and a half billion), the math is very simple but scary. So, if the growth rates of the world economies keep on increasing at the rate they are, the question is where the resources are going to come to feed the growth.

Given the back drop of the facts above, we do have to think about what our options are on a day-to-day basis. Clearly, "not in my back yard," is not an approach that will give us sustainable options. There are numerous examples of recent events that puts this dialogue on risk "front and center." In one recent incident, a facility engaged in the production of pesticide, had an accident in 2008, it was inspected by OSHA after that, and citations were issued. It was also inspected and investigated by the EPA and a host of other agencies, including the Chemical Safety and Hazard Investigation Board (CSB). The facility used methyl isocyanate in the production of the pesticide, but the 2008 incident did not involve methyl isocyanate, neither was any part of the plant handling methyl isocyanate involved in the incident. Following the incident, however; the plant went through extensive redesign that included reduction of inventory of methyl isocyanate and major reconfiguration. However, prior to startup of the redesigned plant, a lawsuit was filed in federal court claiming that the plant posed an "unreasonable risk" to the neighbors. The ultimate outcome of the chain of events that followed gives us some interesting and

thought provoking issues to think about.

Globalization of the economy has intensified over the recent years and, together with the development of the new information and telecommunications technology, it is bringing about radical changes in society, comparable to those produced during the industrial revolution. Occupational process safety cannot ignore those changes. And, in this context, the greatest challenge for the countries is the transformation of the difficulties involved in adapting to the new situation into opportunities for the future development of process safety. One of the most important impacts that economic integration and the liberalization of international trade have had on occupational safety and health is undoubtedly that of the harmonization of standards. In talking about process safety standards, we are in fact referring to two distinct types of standards. First, there are the standards concerning labor. They define the general conditions of occupational safety in the workplace. The objective in harmonizing this type of standard is to prevent the comparative advantages that are derived from lower production costs at the expense of inferior working conditions in the enterprise. Second are the standards concerning product safety. As tariffs are eliminated or reduced, as is currently occurring with the regional economic integration agreements and with the signing of multilateral trade agreements in the framework of the World Trade Organization (WTO), non-tariff technical barriers acquire more significance in international trade. Technical standards, particularly those related to product safety, could block international trade as effectively as high tariffs did in the past, and for that reason harmonization of product safety standards has become a prerequisite for economic integration. With the elimination of tariff barriers, less state intervention in economic matters and the globalization of the economy, markets are becoming more and more transparent and an enterprise that wants to stay in the market is forced to continuously improve its competitiveness. Three factors can be seen as determining the competitiveness of an enterprise: its capacity for innovation, the quality of its products, and its productivity. It is, therefore, not surprising that these three factors have become a true obsession for the modern enterprise that wants to remain competitive and thus, survive in the global economy.

That brings me to my long-standing and extremely fruitful and enlightening collaboration with Professor Adam Markowski and his associates. He has been a great friend and a continuous source of inspiration. I only wish I were as young and energetic as him. I must state with gratitude that a number of contributions I was able to make to the field of process safety benefited from outstanding support from Professor Markowski and his associates. I will also look positively forward to further collaboration with the Technical University of Lodz in the area of process safety for mutual benefits.

Poland is blessed with a large number of very highly reputable universities, some hundreds of years old and some relatively young like Technical University of Lodz. Despite the relatively short history, your university can be extremely proud of the global impact of your contributions to science and society. I am also happy to note that in the area of process safety, your university is one of the global leaders.

In closing, I want to again humbly state my gratitude for this exceptional honor your university has bestowed upon me today. I shall continue to strive hard to remain worthy of this award.

Thank you.

M. Sam Mannan

Fall, 2011