The 27th Conference of Rectors and Presidents of European Universities of Technology

European and International Cooperation between Universities of Technology

Sept. 25-26, 2008
Kaunas University of Technology

Strengthening the international role for European Universities

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Introduction

The role of European Universities in an international context is determined by two main factors:

- Excel in our teaching and in our research; we want to be able to compete with other leading institutions in the world
- We want to take a leading role in the process of defining the direction our research and our teaching is going to evolve

This will be my two topics: Being competitive and taking the lead

European Universities: Being competitive

Summarize what has been said many times, but what has not been fully achieved yet; hence it is good to keep asking for it.

Competing for what:

- Good researchers and teachers
- Good students
- And as a consequence for international recognition

Let me start with what I consider the most important aspect:
With so many people going to University, we must have the possibility to **differentiate:**

- Research focused,
- more teaching focused,

Some institutions must be particularly strong in infrastructure and in research money, but we should have no institutions that do just research: they should be incorporated in universities or strongly affiliated with them.
What this all amounts to is that if we want to be strong internationally we have to allow for competition within Europe and also within individual countries.
We have to be able to **select our researchers** and teachers in a quality focused manner, i.e. international search by an internationally composed search committee, simple decision mechanism in the hands of the rector or the president. Avoid law of conservation of **mediocrity.**
Attractiveness depends on research environment, equipment, quality of students, and possibilities for spouse and for children. It also depends on the time to be spent on administrative matters: Yet another argument for a strong leadership by the rectorate (touchy argument)

As for the **students**, to be attractive we have to offer clear and future oriented programs, a high **chance for success**, which is possible only if the universities have the right to choose their own students.
There has to be the possibility of giving study **grants**
The students have to be **looked after** during their stay at the university and equally important: during the transition into the labor market and afterwards: alumni
There has to be a climate of **openness** for foreign students
The **programs have to be interesting** and future oriented (though most students do not pay too much attention to this point).
Good **infrastructure** is essential: working space, libraries, and a campus – this is often the most difficult aspect.
To mobilize students in foreign countries it is useful to work in **networks**: but important to avoid over organization of networks: they consume a lot of time and money.
Carefully chose your **partners**: Tell me who your partners are and I tell you who you are.

European Universities: Taking the lead

We are in a phase of change and universities should take a leadership role in this process. I think European Universities are particularly well prepared to do so, but they have to move decisively and convincingly to take up the leadership, making use of the strong European traditions of respecting the diversity of aspects of complicated topics: scientific-engineering, economic, ecological, but also social and moral not to forget the esthetical.

We are in a phase of change and for some time now people have been saying that our future society will be a service society and a knowledge society. I do not want to deny this, but I have come to the conclusion that these two aspects will probably be much less dominating our lives during the next decades than the necessity to cope with the consequences of globalization and to move towards a sustainable world.
These notions have been on the minds of people for quite some time: the Club of Rome published its report “Limits to Growth” almost 40 years ago. But only now does it dawn on us how enormous the changes of our society might be over the next few decades. The threat of the oil reserves being exhausted was not so much frightening, because we were told that there was still an enormous amount of coal at our disposal. The devastating health problems – aids, malaria and more recently again tuberculosis – were mainly a problem of sub-Saharan African countries and so were the malnutrition and the water problem. Only with the threat of a change of the global climate due to CO_2 emission we began to realize, that not only our markets have been globalized but also many of the other major areas, and I mean problem areas, as well. As it turns out climate change is connected in one way or another with most of the other threats, thus involving all of a sudden all of humanity, developed countries as much as developing countries, rich societies as much as poor societies.
It is easy to say that the quest to move our society towards sustainability in the largest sense of the word means

- that we want to make it possible for all humans who live on our planet now and for those who will live on it in times to come
- to live a decent life in dignity, in peace and in freedom, free from fear, free from oppression and from want, free of extreme poverty, hunger, disease
- On a planet that is being preserved in its richness and in its beauty.

It is easy to say this, because it sounds as if it were just about others, not about us. We might generously do something for the others. And there is no sense of urgency in these statements: eventually we might want to do something, for the moment we can wait.
But now, dear colleagues, I think the phase of talking, the phase of postponing and delaying action over and over again is over. The latest developments and scientific insights into the threat of a climate change that is already under way have made it clear to many of us, that the problems are here and now and that we have to act. And the universities have to take the lead much more decisively than they have done so far. And European universities are challenged to take the lead.
Climate change is the most obvious threat, it seems to be unavoidable. For the first time we experience in reality what it means, that some major change in the conditions under which we live may have been caused by people living far away in space and in time and they affects all of us; ironically those who have contributed the least will be affected more than the others. But it becomes more

and more evident, that climate change should not be dealt with as an isolated problem: the question of CO_2 neutral sources of energy is intimately connected with it and that draws behind it all the rest like droughts, land loss, the imminent hunger crisis, natural disasters, the big global health problems, the loss of biodiversity, the diminution of water supply, increasingly climate induced mass migrations and soon enough also the threats to collective security.

Obviously, if we want to cope with these problems we need engineers and we need new research, we need the support of our industry and a strong will of our governments. But the traditional concepts will not be sufficient anymore. Hence the questions are:

- What should we expect from our engineers, how should we educate them, with which focus and towards which abilities?
- In which direction do we want to direct our research, in which fields should we invest our research funding?
- How should we advise our industrial leaders to focus their developments, and
- How do we want our political leaders to proceed to create the right boundary conditions to cope with the problems?

Let me anticipate what my answer will be: the main guiding star should be our strive for sustainability in the widest sense as the major foundation of our society, but this should not exclude entirely other aims and goals.
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We will first have a closer look at some of the problem areas I have mentioned before:
I will begin with an in depth discussion of the imminent climate change
Then I will say something about desertification
And I will illustrate what could be negative consequences of reducing biodiversity

Then we shall come back to give a somewhat more detailed answer to the questions about education, research, directions for industries and governments.

Climate Change

The Climate Change we are talking about is an increase of the yearly average temperature.
Climate Change is a global development. It is an economic issue and a security issue, which undermines

- The environmental sustainability
- Poverty alleviation and the livelihood of the poor
- Personal and, national and regional security.

But Climate Change is also an equity issue:

- Developing countries and poor people in these countries are the most vulnerable

- The actions of today will affect future generations.

All the measurements clearly show that there has been an increase of up to 0.6 °C over the last 20 – 30 years and the increase is growing.
Scientists have developed several models trying to separate natural effects from effects that are due to CO_2 emissions. All the models confirm that the increase is human made.
Projections of future changes in mean surface temperature predict a global warming until the end of the century of anything between 1 and 4 °C
As a side effect the models show that precipitations will diminish, which will make areas that are dry already now uninhabitable.
The impacts of climate change are already visible and more are to come, inevitably:

- Falling *crop yields*, particularly in developing regions.
- Possibly higher yields in high latitude regions.

But once the temperature is more than 4°C higher than it was in preindustrial times, then the yields will be falling in many developed regions as well.

The ***water*** **supply** will be threatened in many regions. The glaciers recede or disappear completely in many regions and there will be a significant decrease in water availability in many regions including the Mediterranean and Southern Africa. This goes hand in hand with a rapid depletion of the ground water, a lowering of the water level and in many regions a penetration of seawater and thus a salination of the ground water.

Extreme Weather conditions will be more and more frequent with a rising number of storms, forest fires, droughts, flooding and heat waves.

It is important to notice, that the **risk of irreversible impacts** increases strongly as temperature goes up, but there are no precise predictions yet. In a way this is the most dangerous aspect: over time humans have taken the habit to think, that if changes proceed in small steps, wrong developments can be corrected once they are identified. What is new in these whole climate developments is that there are most likely points of no return, which means situations that, once they have been reached, cannot be undone anymore.
Changes may also **occur all of a sudden and quickly**: Studying the ice in Greenland a Danish research group from the University of Copenhagen has found, that in the period of 15 000 until 11 000 years ago the climate has changed dramatically three times, each time in an interval of just 1 -3 years

The model calculations I mentioned earlier also indicate with high confidence that climate change will result in an increase in worldwide malnutrition – now 1 out of 6 billion people are suffering from hunger and malnutrition and it could soon be 2 billion – it will dramatically increase the number of people suffering from death, disease and injuries from extreme weather conditions. The frequency of cardio-

respiratory diseases will increase from changes in air quality an there will be an increase in the range of infectious disease vectors. It is possible that – as a positive side effect – the cold-related deaths will decrease.
It is clear, that the vegetation, the ice extent and the indigenous peoples on the arctic will be affected most.

Migration
As mentioned before, climate change possibly coupled with other stresses will lead to massive migrations and ultimately to local and regional conflict. Tens of millions of people will be displaced from low lying deltaic areas, from regions where there is increasing food and water shortage, where natural resources have been depleted, where there are increased incidences of diseases and where there are more and more frequent severe weather events.
In principle the UN Convention on Climate Change requires (Article 2)
"…stabilization of greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interferences with the climate system."
And
"…allow ecosystems to adapt naturally, ensure food production, and allow sustainable economic development."
According to the model calculations there is a fair chance, that we can limit the increase in temperature to 2°C above pre industrial levels if we succeed in stabilizing the greenhouse gases at 450 ppm, but we will more likely end up with an increase of 4°C if the greenhouse gas emission goes beyond 550 ppm.

Mitigation
There are two modes of reacting to this threatening situation: Mitigation and Adaptation of which the first one is by far the more interesting but also the more difficult one. But then one has to see, that mitigation is more cost effective than inaction.
If we do little to nothing to turn around the trends, if we allow the greenhouse gas emission all the way up to 650ppm then estimates predict a cost equivalent to a 20% loss in global GDP. Setting the limits at 550ppm would give us a 50% chance of a temperature increase of less than 3°C at an estimated cost for the mitigation measures of 1% of global GDP in 2050.
But the real problem is how to reduce the emissions. To give you an idea of what it takes to hold the global emissions flat. As an example
If we do little or nothing, the OECD countries will increase there emissions by 60%, by 2050, to stabilize emission globally, they should reduce them by 60%, so as to allow the developing countries an overall increase of 60%, which would be substantially less than the predicted +140% if we do nothing.
I don't want to inundate you with numbers, but what has just been said points to one of the most difficult aspects of mitigation: who should contribute how much? There is a proposal due to the Indian Prime Minister Manmohan Singh, which says that by 2100 the goal should be a globally equal per capita emission. Today the ratios are USA 40, Europe 20, China 10 and India 5. This would allow for

some further (industrial) development for the non-OECD countries, while obviously putting a great burden on the developed countries, which on the other hand should find it much easier to develop new technological options.
There is potential for mitigation for all regions and for all sectors like energy, transport, buildings, industry, agriculture, and forestry, to name the most important ones.
What it takes is a long term (2030 -2050) global regulatory framework, involving all major emitters. The key challenge at this moment is to engage the USA, China and India. Next year there will be a meeting in Copenhagen with the goal to produce a stringent agreement. One of the crucial questions is whether the new US government will be ready so quickly after taking office and whether China and India as much as anybody else are prepared to make major concessions. What should be the goal? I think to be realistic, as for 2050 one should try to limit the temperature increase to 2°C, but be prepared to live with an increase of +4°C.

Adaptation
As I have said before, where mitigation fails, adaptation will be called for. Much is possible, but unfortunately the developing countries are more vulnerable than the others, not only because the impacts are worse there, but also because they have a much lower capacity to adapt. On one hand they have a much smaller margin of tolerance in all the respects we have discussed before: water scarcity, costal vulnerability, poor nutrition and health infrastructure etc. On the other hand they don't have all the modern technology nor industrial and financial capacity and maybe most importantly, they are lagging behind in know-how accumulation and education.

Examples: Desertification
As an example let me just mention a big project, which the sahelo-saharan nations have launched in Africa to prevent the spread of desertification. The project, called the Great Green Wall, is a continental effort coordinated by Senegal and its president Wade in collaboration with the Commission of the African Union. The project consists in planting trees over a distance of 7000 km from Dakar to Djibouti to constitute a 5 km wide strip across the desert to stop any further progress of the desertification process. Part of the project is the regeneration of biodiversity and to make this a new green lung for the planet and to contribute thus to the fight against climatic changes….
It should be mentioned in this context, that China, too, is planning a Green Great Wall.

Examples: Biodiversity
The 1992 UN Conference on Environment and development, commonly referred to as the Earth summit, brought consensus to have three major environmental

agreements focusing on climate change, desertification and on biodiversity. The importance of biodiversity is often underestimated but as a mater of fact, the Convention on Biological Diversity is quite critical, as it focuses on conservation of Earth's biological resources, their conservation and more importantly on how benefits arising from such use can be equitably shared amongst countries that have sovereign rights over these resources.

According to global estimates there is no one country in this world that is self-sufficient in its biological resources needed for sustaining livelihood. There are plans to develop an International Regime on Access and Benefit Sharing under the Convention on Biological Diversity.

To give you an example of how research and development is being stalled in the absence of an internationally agreed ABS regime as well as national implementations of such a regime.

The mealy bug epidemic (Wikipedia)

In the mid seventies, the tiny arthropod *Phenacoccus manihoti* <*http://en.wikipedia.org/w/index.php?title=Phenacoccus_manihoti&action=edit&redlink=1*> , or the mealy bug <http://en.wikipedia.org/wiki/Mealybug> , had been accidentally introduced to central Africa from its native South America. Lacking natural predators, the species caused an immediate crisis by attacking the cassava <http://en.wikipedia.org/wiki/Cassava> – a hardy plant grown by subsistence farmers across Africa and providing up to 50 percent of a day's caloric nutrition to 200 million people – and ruining as much as four-fifths of the crop in some areas. To head off an impending crisis, governments had begun widespread pesticide spraying programs.

A young biologist, Dr. Herren, proposed that, instead of using expensive chemicals that could harm African ecosystems and contaminate its food supplies, governments and farmers could find a natural predator to the mealy bug. Similar projects had succeeded elsewhere for over a century, but nobody had tried on the scale Dr. Herren was proposing, a swath reaching from Senegal <http://en.wikipedia.org/wiki/Senegal> to Angola <http://en.wikipedia.org/wiki/Angola> in the west and across the continent to Madagascar <http://en.wikipedia.org/wiki/Madagascar> . It would require enormous amounts of time, money, and effort; Dr. Herren was the sole member of the biological control <http://en.wikipedia.org/wiki/Biological_control> program at IITA <http://en.wikipedia.org/w/index.php?title=IITA&action=edit&redlink=1> .

Biological control

From 1980 to 1984, Dr. Herren researched his proposal. He identified a Paraguayan wasp, Epidinocarsis lopezi <http://en.wikipedia.org/wiki/Epidinocarsis_lopezi> , that kills the mealy bug <http://en.wikipedia.org/wiki/Mealybug> but does not threaten other organisms. Having ensured the wasp's long-term suitability to African ecosystems, he outlined a plan to spread E. lopezi populations through ground releases coordinated with drops from airplanes.

To support the project, he organized $20 million over 12 years from international institutions and governments. By 1986, Dr. Herren through IITA <http://en.wikipedia.org/w/index.php?title=IITA&action=edit&redlink=1> was

releasing almost 2000 wasps per second across areas affected by the mealy bug.
Results followed quickly: within five months of the project's initiation, one wasp population had spread over 120 miles. By 1993, mealy bug numbers had stabilized to controllable levels in 30 countries, and its relationship with wasp from Paraguay (*E. lopezi)* had reached ecological equilibrium as well. Africa's cassava reserves – the only hope for feeding the continent's people in famine situations – were saved.
In the process, Dr. Herren built the biological control <http://en.wikipedia.org/wiki/Biological_control> program at IITA <http://en.wikipedia.org/w/index.php?title=IITA&action=edit&redlink=1> into a major IITA-research station staffed by over 20 scientists, who in turn assist hundreds of researchers, educators, technicians, and farmers in biological control programs worldwide. Dr. Herren himself trained over 850 experts from 30 countries in biological and integrated control techniques.

The Mango fruit Fly
That was in the early nineties. In 2006 scientists working at the International Centre for Insect Physiology and Ecology in Kenya embarked on a very similar project: to find natural control agents for a devastating pest, this time attacking soft fruit such as mango in Africa. The damage caused by this insect, the mango fruit fly, is already threatening local livelihoods of millions of Africans. Again the scientists found a natural enemy, a parasitoid, occurring in Sri Lanka, which would be able to control the mango fruit fly. But this time they are refused such use and the possibility to develop a control mechanism for this pest by Sri Lanka, because of absence of national as well as international regime on Access and Benefit Sharing. This is causing millions of dollars of loss to Africans besides threatening the whole mango crop in many other parts of Africa.
The situation now is alarming and needs global attention. But while Sri Lanka is correct in denying access due to legal recognition of sovereign rights over their genetic resources, global diplomacy seems to fail to ensure speedy conclusion of an international agreement that can deal with such precarious conditions.

Assuming that indeed the most urgent problems of the next decade will be determined by the threat of a major climate change, a decline in energy, etc, as I have sketched it, what would then be the logical answers to my 4 principle questions?

1. *What should we expect from our engineers, how should we educate them, with which focus and towards which abilities?*

First of all, they should still be given a thorough education in one discipline, as we will still need people who understand their trade. We need electrical engineers; we need computer and communication specialists, etc. We want them to be creative and unconventional in their approach to novel problems. We want them to be able to communicate and to explain what they are doing. All this is not

new, as we know.
Even to say, that they should recognize and see aspects of a problem that go beyond pure engineering, maybe aspects that have to be handled by other specialists; even that is not new: Carlo Cattaneo, a famous Italian liberal politician of the Risorgimento, pointed in this direction more than 150 years ago.

We want them to be fully aware of the burning problems of global sustainability, in particular of all the problems discussed earlier.
But besides all that we should in our education give a strong emphasis to **systems** thinking as something that goes far beyond interdisciplinary approaches;

- we should make sure that **modeling** is given enough weight and finally,
- How to systematically approach the problem of **risks**, how to determine them and how to handle them: risk awareness and risk management.
- They should become aware of the **global aspects** of the problems and they should learn how to work in a globalized environment
- They have to be able to communicate and to collaborate with experts from the medical and from the social sciences.

2. In which direction do we want to direct our research, in which fields should we invest our research funding?

If we want to contribute to the solution of the climate and sustainability problems, then we must direct our research in these directions too. Most important is everything that has to do with clean energy, with additional energy, with the reduction of energy consumption. This takes us very far, as it includes such fields as nano technology, surface physics, material sciences, but also geology and atmospheric physics, etc.
The health research that concerns some highly specialized fields like brain research must go on, but a major effort has to be made in the direction of infectious diseases, epidemics, etc.
Agricultural research, all kinds of water research, …the list is long.

Having said all this I want to stress the fact that in my view basic science and non-directed research has not lost its enormous relevance. This has always been and will also be in the future an invaluable source of innovative thinking, of completely new and unpredictable discoveries. All branches of science and of engineering live in one way or another on the inspiration coming from there.

3. How should we advise our industrial leaders to focus their developments?
It is clear that enterprises care for the environment if it is to their advantage in one way or another. They should focus their long-term strategies on things that are in line with global sustainability in the largest sense: there is an enormous potential there. Of course they should themselves respect the requirements of a

sustainable world, but asking for voluntary restraints goes too far, in most cases. It is of course highly desirable that companies develop their own responsibility, but much more reliable is a scheme whereby the basic rules are set by the political side – after consultation with the corporate side, of course. But what counts is that the rules are globally the same and to achieve that is a political task

4. *How do we want our political leaders to proceed to create the right boundary conditions to cope with the problems?*
While the corporate and the scientific worlds are globalised to a highest degree the political side is lagging behind. As we have seen in the mango fly case the necessary international agreements are not there, yet and this is the case in many fields. This might have to do that the political side has surrendered too much of its power to private organization. It will find it more and more difficult to fulfill the tasks it is supposed to do according to the basic ideas of a well balanced democracy: balanced between the polity, the corporate world and the cultural/scientific world. Of course I am delighted to see, that more and more private foundations support scientific research. But in the end this leads us back into the times before the enlightenment when some princes accumulated most of the wealth and then had the power to steer scientific development and other things as well. I think experts that have been entrusted with this in a normal democratic context should determine the global strategy for science.

To conclude I would like to point out that what I have been saying sounds more materialistic than my ideas really are. I think even given the enormous importance of coping with climate change etc. we should never forget that humans also have non-materialistic desires, hopes and quests and that they are just as important for the well being of the human race.
European Universities are well prepared for taking up the leadership role.