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EPEE's general subject: "Power System Engineering Education for the Network of the Future"

Essay on sustainable and promising engineering education

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SUMMARY

Western scientific and industrial domination in recent centuries was based on the two pillars of tertiary education, the low profile but precious post-secondary professional schools and the new-knowledge and leadership symbols, the universities and the equivalent engineering centers of excellence. With the expansion of university level education, two prevailing structures were established: The one-step continental Europe system, with unified curriculae, leading directly to the highest Master's level and the two-steps Anglo-Saxon one, with a first lower step, the bachelor's level.

During the last forty years, students, academic staff and professional bodies consider that the acquisition of a Master's degree in engineering is the necessary prerequisite for facing the challenges of and adapting to the rapid advances in sciences, technology and all production processes. Consequently the continental european model is already successfully being applied by some of the best Anglo-Saxon engineering schools.

After 1980 we lived the neoliberal restoration of the market's «laisser-faire», and the mutation to the meta-capitalism age, under the global dominance of the speculative funds. Public goods were transformed into commodities, among them the increasing demand for university degrees. Private funds covered this deliberate state absence in Europe and their strong desire for immediate profits has led to the establishment of many «virtual» private universities.

Pressed by the finance ministers and the private investors, european officers imposed the miserable «Bologna Declaration» of 1999. Its main goal was the dramatic cost-reduction of basic university education, through the shortening of curriculae duration and expensive infrastructures. Thirteen years after the implementation of this "declaration", it has been proven that it is not possible to decrease curriculae without downgrading their fundamental university nature, their specialization skills and finally their commercial value. Moreover, this immoral mixture of goals, has trapped the professional future of many thousands young students, 80% of whom are rejected by the actual labour market.

The demystification of students kinesitherapy and collection of pleasant educational credits is also urgent, in order to preserve the quality of the engineering studies and their final output to the labour market. «Bricks and mortar» in disorder are unable to support the formation of a university level degree, the curriculae effectiveness and endurance in the production processes should be based on three structural properties: Building of a wide-oriented, coherent and strong scientific substructure, cultivation of methods and skills for independent access to knowledge, synthesis and human communication-collaboration, development of the personal and social virtues for responsible workers and free citizens.

Consequently, the answer to the EPEE's questions is not only the condemnation of the already discredited Bologna Declaration. The emphasis should be focused on the adoption of a generous state financial support for real engineering education, free fundamental research, massive scholarships for real studies and the rigorous evaluation of all virtual engineering schools.

Given the actual meta-capitalism occupation, I am afraid that the above are not enough. We cannot abandon new generations to the usual leadership of cynical neoliberal economists. We must supply new engineers with the needed culture for a broader social fight, in order to regain the political recognition and change the present miserable situation of the one-dimensional, homo economicus.

KEYPHRASES

1. Sustainable and promising engineering education.
2. Tertiary education complementary components.
3. Evolutional necessity of the continental Europe unified curriculae.
4. Meta-capitalism age and the Bologna Declaration.
5. Failure and consequences of curriculae shortening in time and expensive infrastructures.
6. Demystification of students' kinesitherapy and credits collection.
7. Engineering education essentials: Solid and coherent background, skills for access to knowledge, synthesis, human communication, virtues for responsible managers and free citizens.
8. Genetic deviation of the market's «cost-effective» approach in education and research.
9. Strengthening the human resources with generous scholarships.
10. New engineers' leading social role, for changing the miserable, one-dimensional, homo economicus.

1. Tertiary education: Sources and experiences during recent centuries

Europe, the cradle of the historic notion of "universitas", is the founder of a quality model for the higher tertiary (post-secondary) education, on which the world domination of the western civilization in recent centuries was partially based and fully advertised. Releasing and multiplying the organized production and implementation of new knowledge, all the after-renaissance leading western countries conquered the world through two contradictory processes: By violence, with their powerful armies and peacefully within their «state universities», using them as the intellectual and scientific symbols for internal productivity, social cohesion and international recognition as new knowledge pioneers.

In order to meet their increasing needs in applied sciences, infrastructures and industries, the governments of western leadership also set up and promoted, through healthy competition, public «engineering institutions» of university level, under various names (colleges, grandes écoles, etc). These centers of excellence, initially created by state development bodies, were educating staff of highest standards, needed for the efficient technical and administrative management in the public and private sectors. The basic needs of the industrial age were on the other hand covered by the rapid development of post-secondary-education professional schools, invaluable in every production process and constituting the first pillar of the tertiary education.

Within this parallel upsurge of universities and equivalent engineering schools, their two prevailing structures were established: The one-step continental european system, with unified curriculae, leading directly to the highest degree or diploma of a Master's level and the two-steps Anglo-Saxon one, with a first separate lower step, the bachelor's level. During the last forty years we are all facing the pressing demands, both from engineering students and academic staff, for an increase of the duration and the facilities of curriculae, due to the exponential growth of knowledge in natural sciences and technology. We are facing every day the inadequacy of most bachelor degrees, as leading diplomas, in the labour market.

Given this continuously increasing need for basic scientific knowledge for engineers before their incorporation into the professional arena, it is also recognized by the relevant professional bodies that, the acquisition of a diploma of Master's level is a necessary prerequisite for facing the challenges of and adapting to the rapid advances in all production processes[1]. This is why the continental European model is already successfully being applied by some of the best Anglo-Saxon engineering schools.

In conclusion, the two components of tertiary education, namely that of universities or equivalent engineering institutions with their two different structures and the post-secondary professional schools, satisfied the rapid development and leadership of western countries during the last four centuries. They both have reached an equilibrium of complementary and harmonic coexistence, until Thatcher's education reform of the eighties and the Bologna declaration in 1999.

[1] In Greece we are also facing the failure of using engineers with short-term studies and weak scientific background. I have an unpleasant personal experience during my services as General Manager of the Public Power Corporation and as deputy minister of Public Works.

2. Meta-capitalism age and the Bologna Declaration

Let us first realize that after 1980, mankind entered in a new meta-capitalist period: By the end of the Keynesian thirty golden years, (1945-1975), in western economic policy we lived the restoration of the market's «laisser-faire», under the costume of neoliberal ideology[2]. This re-domination of classical economics was strengthen by the almighty development of electronics communication and information processes. Using this new superpower and abusing the weaknesses of western political leaders, the international capitals activated the mutation of the known capitalism towards a new, non-productive shape, under the dominance of the purely speculative funds. After the final collapse of the «adversary awe», the Soviet Union, in 1991, this mutation has been politically completed and the winners imposed the meta-capitalism age all over the world.

These international hedge funds pushed also for the abolition of public utilities in order to buy the capital-intensive state investments at humiliating prices. Public goods were transformed into commodities, among them university education. In the eighties, Margaret Thatcher kick starts the commercialization of higher education's diploma, with the virtual and inexpensive upgrading of polytechnics to universities. She was followed by the leaders of continental Europe, through their political refusal to provide sufficient financial support to the exponentially increasing demand for university degrees.

In Europe, private funds covered this deliberate state absence and their strong desire for immediate profits has led to the establishment of many «virtual» private universities. The next step was inevitable: Pressed by the finance ministers and the private investors, the neoliberal oriented officers in Brussels imposed the miserable Bologna Declaration of 1999. Its main goal was the dramatic cost-reduction of basic university education, through two structural measures, the shortening of curriculae duration, (maximum three years) and their emaciation from all expensive infrastructures.

Thirteen years after the implementation of this "declaration", the few who dared then to react[3] are fully justified. Without an adequate scientific foundation and with immature specializations, these shallow three-year studies have been proved insufficient for the production processes. According to last year estimations in Italy, 80% of these graduates are rejected by the actual labour market! The first Bologna cycle is considered by the managers of the private sector as generalized educational seminars or post-secondary vocational schools. The obvious truth was revealed: It is, at least, unreasonable to claim that it is possible to decrease the duration and the substructure of curriculae without downgrading at the same time their fundamental university nature, their specialization skills and finally their commercial value.

In conclusion, the failure of the two main objectives of the Bologna declaration has been proven. The massive creation of a low-cost university level work-force for the satisfaction of the increased european citizens-clients demand for university titles, even of a mutated nature -however useful to the immediate needs of the labour market-, ultimately led to unproductive educational expenses. Moreover, this essentially immoral mixture of goals, has trapped the professional future of many thousands young students, all over continental Europe.

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[2] Chicago school-Milton Friedman, with first western lovers, Margaret Thatcher and Ronald Reagan.

[3] Including the writer, at that time rector of NTUA.

The Bologna Declaration was also implemented in Greece,(2001), through the political endowment of university status to the medium-level Technological Educational Institutions without any evaluation. The obvious failure of this virtual upgrading -an imitation of the model used in the U.K for the Polytechnics-, created a major handicap to the graduates of these greek Polytechnics: The new army of about four thousands sophomoric technologists, is rejected by the majority of the labour markets. These «desperados» graduates are fighting to upgrade their qualifications through a Master's degree, which usually fails in practice to cover the basic structural gaps of their scientific pyramid.

The Greek middle and upper class families rejected this offer of university education with reduced value in the labour market. They chose to pay and register their children in foreign universities, instead of leaving them in the second class local ones and this caused a ridiculous paradox: Greek governments' financial leaders burdened all citizens for the massive creation of low-quality new universities and TEIs during the last 20 years and in the same period the increasing students' migration abroad, aggravated the national commercial balance. The substantial failure of the attempted false expansion of higher education is also proven by its final economic results.

3. Some essentials about suitable and adaptable engineering curriculae

Let us now try to summarize some answers on the two first and the fourth topics of the EPEE Session. The long «trial and error» history of all curriculae in applied sciences, including the engineering ones, has shown that their effectiveness in the production processes and their endurance through time should be based on the three following structural properties:

- Building of a wide-oriented, coherent and strong substructure, on the broader scientific area selected by the student, during the first 30 to 40% of each curriculae, without premature and shallow specialization courses.
- From the very beginning of the curriculae, cultivation of scientific methods for independent access to the continuously sprinkling sources of knowledge and skills for synthesis, human communication and collaboration.
- Development of the broader personal and social virtues for the emergence of integrated personalities, disposing not only a renewable professional, scientific and technological background but also the culture to stand as responsible workers and managers of staff and projects and exist as conscious, free citizens.

We must also be careful to another deviation from the well structured engineering curriculae. In the framework of a useful, up to some extent, students' mobility, the quality and cohesion of the studies final output should be preserved. The "idealizing" of mobility from the E.A. political leadership, reaches the point where students acquire easy educational credits throughout Europe in order to achieve professional recognition in scientific fields, which nevertheless require coherent studies. The unpleasant result is that these students will finally obtain a degree without solid basis, which also means without a clear "identity" for the labour market.

For the above reason and within the necessity to evaluate all components of engineering -and not only- education, we must request the estimation of both general and specific benefits, due to the expensive european programmes of mobility during the last twenty years. E.g., which are the particular ameliorations of the studies level, and of the subsequent professional employment due to these programs? How and in which sectors the development of the research through new technologies, or in the traditional sciences, is obviously strengthened?

My answer to such questions, based on investigations in Greek and French engineering schools is that we urgently need the reorientation of the mobility structures and the prohibition of any inconsiderate transferability of credits. All real universities should take the necessary distances from the markets' oriented virtual universities advertisement to the student-client: "come to us, don't worry, be happy!!". Serious studies mean labour and pain and every scientist knows that the free choice of unrelated multidisciplinary subjects in the beginning of the studies will certainly lead to shallow basic foundations. The collection of «bricks and mortar» is unable to support the formation of a university level degree. Subsequently, engineering professional bodies should declare that all recognized engineering schools are obliged,

- to guarantee for their students a structure of well organized, coherent and continuous studies, leading directly to serious degrees, equivalent to the Anglo-Saxon master level,
- to demystify and shorten the kinesitherapy and the credits collection of students and staff, by evaluating seriously with objective standards, the real benefits and losses from the mobility programmes,
- to strengthen their educational and research human resources with generous scholarships for real studies and long-term programmes for transuniversity collaborations.

This is the way, the western tradition of engineering schools will support the democratic societies, will prevail and expand universally, equipping its graduates during this century for a difficult survival and successful competition with the new emerging powers in China, India, etc, and their numerous scientific staff.

4. The genetic deviation of the market's «cost-effective» approach in education and research

Regarding the third and the last topic's questions about the role of research in education and whether they both should be «cost-effective», the answers must be seen within their evaluation goals. The continuous and rigorous evaluation of research and education for their scientific quality and social usefulness is not only an implicit right of any taxpayer but also a major obligation of all state universities to the society. This means a systematic and objective critical analysis, of all university components and the transparent public presentation, of the evaluation conclusions and proposals on the positive features and especially on the weaknesses of research, educational programs and subsequent operations of their institutions.

Given the genetic connection between research and education, for each teacher and student of engineering-and not only-institutions, the research is both a right and an obligation and should be exercised in conditions of academic freedom. The generous

public and private funding of research for technology purposes is motivated by the economic exploitation of their results and led to the explosion of discoveries in all targeted commercial applications. The industrial suppliers of equipment and services are financed by private and state banks for the creation of all possible temptations- sometimes useful, often damaging and toxic- for the daily life of the homo-consumer. Consequently, the free and pure scientific research in areas without visible economic value is without financial support by the applied research market, because we are evaluating quantitatively and considered that our money will not to be rewarded as soon as possible.

However, all regenerating experiences during the long mankind history demonstrate that the research contribution to all societies can't be quantified and restricted simply by profit. The innovating research contribution is in principle not only commercial but multidimensional, just like the human brain's values. Moreover, a credible and integral evaluation is impossible to be completed during the limited timeline and epistemic horizon of a judge, no matter how good he is. The preservation of each pure, spontaneous, restless, exploratory spirit, the survival of the invaluable long-term scientific and broader social benefits from the creative dedication of researchers, struggling outside the market, are therefore the alter-ego of our holistic development and remain essential to avoid teratogenesis.

In conclusion, given that the research and education sizes are primarily qualitative entities, their real evaluation is complex and in no way can be replaced by an immediate or even short-term economic efficiency, i.e. the sale indicators of usual goods in the current market and the students' community. By offering absolute power to some specific indexes of university knowledge based on the demand from the students and the "market", we finance a malformed genetic deviation to the interdependent development of education and research: We push to a massive retreat the fundamental basis of sciences, because they do not "sell" and we disregard the new ideas, because they are not objectively measurable. Finally, we condemn the investments of qualified teachers and students to the future and the evolutionary perspectives of our societies.

5. Epilogue

The main question raised by the EPEE Session in Paris 2012, is how the engineering education will manage to maintain and/or regain its status of high and solid scientific quality and sustainable value in the labour market. The trend of the post-capitalism policies is to transform the majority of engineering schools into providers of superficial skills with the exception of some excellence centers for wealthy students. Judging from its consequences to social welfare and the economic growth, is this market choice right or wrong?

The indisputable democratic right of any willing and intellectually qualified citizen in education is completed by the state's offer of access to real university -and engineering- studies. This principle imposes the rejection of the myopic meta-capitalism markets' goal, i.e. the dramatic reduction of investments for state university education.

History during the last four centuries proves that, in the long run, investments to state universities of high standards are also beneficial from the market's point of view,

obviously more productive than short-term satisfaction of economic indicators and interests.

Consequently, the appropriate answer to the above question of EPEE is not only the immediate condemnation of the already discredited Bologna Declaration, namely the creation of a short first cycle with shallow scientific basis and immature specialization skills. The emphasis should be focused on the adoption of a generous financial support for real education and free fundamental research, for the state reinvesting in high level universities and engineering schools. Respecting the european tradition of universitas, state or private, we are foremost obliged to equip our engineering -and not only- graduates with the weapons needed for the difficult task of survival within the actual global labour market.

The promising policy imposes at the same time the contribution of all professional bodies, included CIGRÉ, to the rigorous evaluation of curriculae and technical substructures of all virtual engineering schools instead of caressing the ears of their managers with muddy generalities. Their students have also the right, granted by the rapid development of science and technology, to achieve the real university level.

Given the actual meta-capitalism occupation, I am afraid that the above are not enough. We cannot abandon the future of new generations to the usual leadership of cynical neoliberal economists. We must supply new engineers with the needed culture for a broader social fight, in order to regain the political recognition and change the present miserable situation of the one-dimensional, homo economicus.

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