Engineering and technological education in Greece: a missing link in cooperation between academics and professional engineers in the faculty of application-oriented engineering

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ABSTRACT: In this article, the author reviews the current position of the higher education technological sector within the structure of the current dual professional institutional system in Greece. The main institutional roles of the Scientific Society of Technological Education of Engineers (SSTEE) are to promote professionalism and equality in the Greek Engineering Model (GEM), and simultaneously secure various benefits for both students and graduates of Technological Educational Institutions (ATEIs). The analysis is based on a missing link for academics: coordination with professional engineers in application-oriented engineering. The appearance of a lack of a proper coordination strategy among academics and professional engineers may result in an enormous loss of labour-hours, money and intellectual input in Greek society, plus a loss of enrolments for ATEIs, especially during a period of rapid semi-privatisation in higher education. The author argues that, in order to bridge the gap, professionals, academics and government bodies should modernise their old-fashioned views, avoid conflict, promote professionalism and effective engineering practice, and speed up the communal recognition of technological engineering professions.

THE GREEK HIGHER TECHNOLOGICAL EDUCATION SYSTEM

The educational system in Greece offers the opportunity to study engineering at the following types of schools:

- Universities (AEI): public;
- Technical universities (theoretical orientation): public (eg NTUA);
- Technological Educational Institutions (ATEI) (application oriented): public;
- Institute of Occupational Training (IEK) (technical): private and public;
- Hellenic Open University: public (based on fees).

In addition, private educational, training and development institutions currently provide programmes for first, Master's and research degree courses of non-Greek universities (based on the European Directive 36/2005 for the recognition of qualifications).

A very distinctive segmentation of professionals and students is currently taking place within Greek higher and occupational education; this is based on the *branch of science* [1].

Greece has developed engineering courses at technological institutions, technical universities and universities. This segmentation determines the activity of high schools with an emphasis on the national examinations entry system.

After the membership of Greece within the European Union (EU) and especially in the Euro-zone, the development of industry and new technological applications helped to regenerate and promote the foundations of Greek technological institutions, their structure and syllabi, which still exist to this day. This also created a certain vision of a graduate whose basic criteria, as far as the quality of education was concerned, included professionalism and opportunities for further academic development, which was understood as a thorough knowledge of a certain part of a technical field.

Technological Educational Institutions (ATEI) belong to higher education (under the law N. 1404/83 and N. 2916/2001) at the same academic level with universities and technical universities. ATEIs are legal entities under Greek public law and fully self-governed (within the public educational framework). Engineering degrees from ATEIs are academically equivalent to the four-year Bachelor degree in engineering (BEng) in the UK and Fachhochschulen (Diplom Ingeniuere FH) in Germany.

The rapid progress of technology, industrial changes, increased unemployment among young engineers and graduates, the increasing complexity of engineering tasks (which has resulted in a considerable narrowing of engineering specialisations) and professional limitations for engineers of technological education in Greece have forced ATEIs to develop postgraduate programmes in collaboration with universities in Greece (up to 32 recognised Masters degrees) [2]. Collaboration can also extend to be with foreign institutions and universities, and from abroad (eg the UK, USA, Italy, France, etc, with 24 recognised Masters programmes) [2]. Therefore, many graduates follow the postgraduate courses of the Open University (Europe's largest University) in the UK and the Hellenic Open University. The growing demand for specialists, who have both engineering skills and management abilities, has changed the image of an engineer's role in the industrial process, real estate market and technical services (including the public sector).

In this article, the author focuses on a missing link in the level of cooperation between academics and professional engineers in the faculty of application-oriented engineering (public sector).

TECHNOLOGICAL PROFESSIONAL AND SCIENTIFIC INSTITUTION IN GREECE

The Scientific Society of Technological Education Engineers (SSTEE) constitutes the professional and scientific institution of graduate engineers (only), who come from Technological Educational Institutes (ATEIs) and other equivalent engineering schools (eg Fachhochschulen), or other professional engineers, who have graduated from recognised institutions of higher education at the same academic level. Its organisational structure is pan-Hellenic and consists of 47 peripheral departments covering all the prefectures in Greece (see Table 1). The SSTEE's membership exceeds 37,001 engineers with an increasing trend to reach to 40,000.

Table 1: Distribution of the local branches of the SSTEE.

Headquarters: Athens (capital)	Greek Islands: Agios Nikolaos Rhodes, Mitilini, Chania, Chios, Heraklio, Rethymno, Kerkira, Argostoli, Zakynthos, Samos & Lefkada	Evros: Xanthi, Drama, Komotini & Alexandroupoli
Thessalia: Agrinio, Volos, Larisa, Karditsa & Trikala	Peloponissos Patra, Argolida, Loutraki, Sparti, Kalamata, Pyrgos & Tripoli	Sterea Hellada (incl. Evritania): Halkida, Lamia, Leivadia & Amfissa
Hepiros: Preveza, Arta, Ioannina & Hegoumenitsa	Macedonia (incl. Grevana): Kavala, Serres, Kilkis Kastoria, Florina, Kozani, Keterini, Giannitsa & Veria	Thessaloniki/ Chalkidiki: Thessaloniki

The SSTEE's registered members include graduates from schools of technological applications (engineering) at the departments of 12 ATEIs listed in Table 2.

The SSTEE's registered as professional members include graduates from engineering schools of technological applications in the fields shown in Table 3.

It is widely recognised that the national examinations of the Greek Entry System (GES) into higher education suffers from the underperformance of thousands of candidates. New entry limitations are resulting in losses of entries for many departments at universities and ATEIs (especially those that are located in the regions of Arta, Chania, Heraklion, Hegoumenitsa, Larisa, Kalamata, Kozani, Messologgi, Rethymnon, Serres, etc. There is also the threat of closure of various departments in conjunction with the increased entry rates for those passing to the ATEIs in Piraeus and Athens (after the reduction of places).

The objectives of the SSTEE, among others, are as follows:

- The protection and progression of the common goals and interests of its professional members using various legal means;
- The advocacy and elevation of the scientific and technological standards of its members, especially as far as the areas of applied science and techniques are concerned;

Table 2: Technological application specialities.

Electrical Engineering	Geotechnology & Environmental Engineering	Music Technology & Acoustics
Applied Informatics & Multimedia	Industrial Design	Petroleum Technology & Natural Gas
Automation	Industrial Informatics	Pollution Control
Building Renovation & Restoration	Informatics & Communication	Shipbuilding Engineering
Civil Engineering & Structural Work Engineering	Informatics & Computer Technology	Surveying/ Geomatics & Surveying
Computer Sciences and Telecommunications	Informatics Technology & Telecommunications	Technology of Aircraft
Computer Systems	Mechanical Engineering	Technology of Natural Resources and Environment
Electronic Engineering	Medical Instruments	Telecommunications & Computer Networks
Energy & Environmental Technology	Medical Systems Technology	Textile Engineering
Energy Technology Engineering	Mining Engineering	Vehicle Engineering

Table 3: Engineering professions.

Aircraft Engineer TE	Energy Technology Engineer TE	Mining Engineer TE
Architect Engineer TE	Environmental Engineer TE	Petroleum Engineer TE
Automation Engineer TE	Geotechnology & Environmental Engineer TE	Building Restoration & Renovation Engineer TE
Civil Engineer TE & Structural Work Engineer TE	Industrial Planning Engineer TE	Surveyor Engineer TE
Computer Systems Engineer TE	Informatics Engineer TE	Textile Engineer TE
Electrical Engineer TE	Mechanical Engineer TE	Vehicle Engineer TE
Electronic Engineer TE	Medical Instruments Engineer TE	Aircraft Engineer TE

- The contribution in the promotion of know-how and technology transfer generally and in cooperation with other organisations (bodies) for the self-dependent financial, social and cultural development of Greece.

The main activities of the SSTEE are as follows:

- Provision of advice to requests on any matter (related to professional, educational, engineering, etc) that is within its competence;

- Identification of representatives to the Committees of Physical Planning, Housing and Environment – eg ΣΧΟΠ (law nr. 69- Government Gazette 60/A'/9.3.2000);
- Member of the Executive Board of the TSMEDE and participation in the committee of the Constructor Experience Register (MEK) of the Ministry of Housing, Public Works and Environment;
- Member of the National Board of Education (ΕΣΥΠ) and the Board of the Technological Sector of Higher Technological Education (ΣΑΤΕ);
- Participation in a board for the recognition of professional qualifications (European Directive 89/48) and in a committee to define the professional rights for recently-established departments of the engineering specialisations of ATEIs (law nr. 165/2000 Government Gazette 149A'/28-6-2000);
- Participation in the Governmental committees for the processing of legislative plans concerning construction projects;
- Provision of certifications *which can prove the fact that our members haven't committed any disciplinary misdemeanor during the practice of their profession, in order to be able to take part in auctions of the Greek State*;
- Provision of certifications that are requested from both public and private sector;
- Publication of the scientific and technical journal *Techniko Vima*;
- The SSTEE also cooperates with Governmental and national organisations, as well as technological education institutes;
- Subscriptions and membership data;
- The Professional Contact Committee provides certificates to members so that they are able to submit tenders.

THE STATE OF ACADEMICS – TECHNOLOGICAL EDUCATED ENGINEERS COOPERATION

The development of a common syllabus applied by ATEIs are part of a comprehensive strategy for research and development (R&D), and the recognition of professional rights for graduates and professional engineers working in the Greek construction industry under the umbrella of the SSTEE [3]. They are necessary in order to generate and transfer knowledge to industry, create wealth, use CPD programmes, minimise socioeconomic deviations of graduates and promote more sustainable development.

It is agreed that educators need to prepare engineering students to confront real-life issues, especially in the topics of engineering, the environment, construction management and information technology applications. Educators also need to teach engineering students to consciously strive for sustainable engineering practice [4].

Despite the long-term efforts made by the academic community of ATEIs and the Scientific Society of Technological Education Engineers, the Greek higher technological educational system is still lagging behind the EU's announcements/decisions for the European Sector of Higher Education (eg Berlin 2005). Thus, Greek technological education engineers are not able to benefit from internationalisation, research, innovation and development when compared with other European graduates (eg Germans, Britons, etc), as well graduates from universities and technical universities.

In addition, many technological educated engineers with postgraduate or research degrees could not promote, contribute or participate into research projects of ATEIs or other organisations in both the public and private sectors. Moreover, it is very difficult to fund their initiatives.

Molson stated the following:

> *The Greek Engineering Model (GEM) of technological education should not be static, but it should comply with the requirements of international collaboration in engineering and technology education* [5].

This includes the recognition of qualifications and accreditation systems for engineering and technology courses; the transformation of information on engineering and technological applications; the international mobility of academic staff, researchers, graduates and students; and international collaborative programmes and systems. This should also comply with the European Union's Directives and Decisions for the European Sector of Higher Education. Furthermore, it should also promote academia/industry linkages. Molson has further stated:

> *Globalisation has knocked on the doors of the Greek educational system, and under the umbrella of the Scientific Society of Technological Education Engineers, graduates* [especially in the private sector] *can promote their academic objectives and benefit from academia/industry partnership. Further professional recognition delays and conflicts create a negative environment and establish* discrimination *against technologically-educated engineers, which is generated by the current Greek Engineering Model (GEM)* [5].

In order to achieve this common goal, the SSTEE has to establish and implement an agreed plan of action, understand international engineering education development issues and simultaneously overcome possible internal disputes.

Survey Methodology and Analysis

According to a semi-structured interview survey based on tele-survey methodologies, a survey was conducted on 30 of 47 peripheral departments and their Headquarters, asking 30 local presidents for their expert opinions (as individuals) on the major theme of coordination between academics and professionals in the faculty of application-oriented engineers.

The selection of dual-frame mixed-mode surveys combined with telephone conference interviews and face-to-face interviewing (semi-structured interview survey) resulted in the minimisation of the bias of telephone surveys. The relative low cost of telephone interviewing (using mobile phones) and the sample of the special population (representatives of 47 branches) were the key points for the survey's methodology.

Mobile telephones were used to reach the participants. The present levels of mobile telephone coverage imply that *mobile* telephone surveys can, in general, only be used for specific populations [6]. An e-mail survey was not utilised due to limited information about participants' e-mail and Web coverage. A computer self-administrated questionnaire was preferable in use but required a high coverage rate for e-mail

and Web surveys. A previous academic work in the field of patents and industry-academia cooperation was used as a reference for the questionnaire design [7].

The feedback data was gathered and analysed from 25 (30) correspondents regarding their expert opinions on the missing link in the cooperation between academics and professional engineers. The data are summarised in Table 4.

Table 4: Survey of experts' opinions.

	Professional Representatives	Conducted Departments	Responded Departments
No.	47	30	25
%	100%	63.80%	53.19%

The response rate was 53.19% due to the regional distribution of departments and the fact that few representatives were not available or else had limited time to correspond. The professionals' expert opinions can be used for the structure of a proper industrial survey in the future. This can be conducted on both graduates and students of ATEIs. This survey could be extended with the incorporation of professionals from the public sector.

It has been recognised by all participants that there is a gap between academic staff's objectives and their culture, and of real-life professional issues of graduates and professional engineers. This gap is often a misunderstanding of the role of higher education versus the requirement for real professional rights in practice beyond university life.

It was agreed by 51.06% of the representatives that the extraordinary growth of the construction and real estate markets in the period 2000-2006 and the opportunities for business in the construction, tourist, industrial and other sectors have created a substantial deviation among theoretical and technically-oriented engineers. This deviation could result in enormous losses of labour-hours in education and losses in places for ATEIs through the pan-Hellenic Entry Examinations System.

It was recognised by many representatives (42.55%) that competition is hard among consulting and construction/ engineering firms in Greece, and that the integration of educational programmes with industrial practice (*placements in an industrial or business environment*) produce very competent technical application-oriented engineers. All participants agreed that their professional rights were limited versus their academic achievements (accredited courses).

It was reported by participants that many engineers of technological education have shown a greater level of maturity, higher project task completion rates, greater commitment to their responsibilities and better understanding of engineering practice, which are significant for their career development. However, barriers that faced graduates in real-life issues minimised their expectations readily (in private businesses).

It was widely recognised by 53.19% of representatives that an accredited engineering programme should lead to professional institutional membership with real benefits to graduates.

Many practitioners' concerns (53.19%) referred to the fact that members of academic community have already gained membership with professional institutions, such as the Technical Chamber of Greece, and avoided cooperating on professional topics beyond the completion of the study stage.

Many participants (53.19%) agreed that the academic community has not made enough progress in the field of academic-professional engineer cooperation in the faculty of application-oriented engineers, especially after their graduation. From the perspective of professional engineers, in order to bridge the cooperation gap, the professionals, academics and government bodies involved should modernise their old-fashioned views about ATEIs, avoid conflict, promote professionalism and effective engineering practice, and speed up the communal recognition of technological engineering professions. The appearance of a lack of a proper coordination strategy among academics and professional engineers may result in an enormous loss of labour-hours, money and intellectual input in Greek society, especially as many students move abroad for studies. This may also lead to a loss of enrolments for ATEIs.

Many participants (48.93%) disagreed that engineering students sustain habits that are inappropriate for their future career (such as a lack of confidence, insecurity, trustiness, culture shock, etc) and that graduates have remarkable rates in employment (especially in the construction sector).

CONCLUSIONS

A missing link in cooperation between academic community of ATEIs and professional technological educated engineers in the faculty of application-oriented engineers is based on real-life issues and from assessments made by both partners (academics and professionals) with different objectives, namely to secure academic positions and external funding versus graduates' professional career expectations for equality and further recognition (professional rights). Further investigation is needed (based on a proper research project carried out by ATEIs) in order to clarify the patents of cooperation and to accelerate the communal recognition of technological engineering professions.

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