

## **Networking engineering communities in advancing information sharing: open collaboration for Greek engineers**

**Leda G. Boussiakou<sup>†</sup>, Efrossini C. Kalkani<sup>‡</sup> & Iris K. Boussiakou<sup>\*</sup>**

King Saud University, Riyadh, Kingdom of Saudi Arabia<sup>†</sup>  
National Technical University of Athens, Athens, Greece<sup>‡</sup>  
University of Leicester, Leicester, England, United Kingdom<sup>\*</sup>

**ABSTRACT:** This article explores the effectiveness of emerging technologies for engineering communities, in sharing information regarding opportunities and challenges in performing the engineering profession. The article is oriented towards the professional engineering body in Greece, the characteristics of the engineers, the problems of employment and unemployment, the needs in continuing education and life-long learning, the opportunities in entrepreneurship and financing. Along with this information lies the information regarding incentives and restrictions from the governmental laws referring to the economic development of the country, the employment opportunities and social policies, the productivity, employee compensation, employee benefits, and education and training. The creation of networking engineering communities will enable the engineers to explore the opportunities for multi-disciplinary and community based collaboration in searching for opportunities and reacting to challenges of the profession with the goal of enhancing their performance and productivity.

### **INTRODUCTION**

This article explores the creation of networking engineering communities in Greece that will employ emerging technologies for networking, with the goal of obtaining open collaboration by sharing information, and will successfully address opportunities and challenges that confront engineers performing in the engineering profession.

The goal of this article is to formulate the supportive knowledge that needs to be disseminated and taught as continuing engineering education through the networking engineering communities. The collaborative action within the communities will assist engineers to respond effectively to the challenges of the profession in a knowledge market economy and to the changes of the job demands that require life-long professional development.

Networking engineering communities will use the collaboration tools and applications already used by large enterprises. In those enterprises, there is a need to provide access to corporate information to mobile and remote employees, suppliers, partners and customers. The use of networking technology allows the enterprises to disseminate the right information to the right people, at the time and location the information is needed. Sophisticated and easy to use networking tools are offered by AT&T, Cisco, Novell, EE Times-Asia, Siemens, Lynx, Microsoft, Nortel and others.

The creation of networking engineering communities in Greece will facilitate the spread of knowledge on the range of issues of interest to engineers. More specifically, information and advice on legislation passed, labour issues, taxation, new projects, availability of jobs, and issues on continuing education and human resources development can be available to enable real time collaboration. Also, information can be readily available to professional engineers on projects and the stakeholders of projects, and on the decisions of politicians and regulators. Further, continuing education and e-courses can be available on the network in engineering subjects, and in law and economics for engineers.

The outcome of this article is a state-of-the-art report for the existing information that can be available to the body of engineers in Greece and the existing concern in developing open collaborative networking communities for engineers supported by the Greek Government and the Technical Chamber of Greece, which will contribute to an enhancement of the productivity of the engineering profession.

### **NETWORKING FORMULATION**

To formulate the networking of the Greek professional engineers in open collaboration and information sharing, a series of data was collected from the following sources:

- The Technical Chamber of Greece (TEE), regarding the membership of engineers, the activities and concerns of the members, and the measures to survey and assist professional engineers;
- The Organisation for Employment of the Working Force (OAED), the programmes available to assist the work force in Greece on issues regarding employment, benefits and continuing education;
- The National Printing Office of Greece (ET), regarding the latest laws on employment, economic incentives, benefits and education of the working force;
- The TNS/CAP and VENTRIS surveys for professional engineers, with the outline of the needs and the wants of the engineers in performing in their profession, and their suggestions in subjects of continuing education.

An example of a networking engineering community is the Autodesk Civil Engineering Community ([www.autodesk.com](http://www.autodesk.com)), which has the goals of keeping its members current with the industry, growing the professional network of the members, and taking advantage of a host of resources. The benefits of membership include access to CIVIL-3D content sharing, member discussions, blogs (on line diaries) of local events and webcasts, and user-submitted tips and tricks. Also, members have access to featured community news, and the Autodesk University, which is the premier learning and networking activity devoted to Autodesk users. The Autodesk University accepts registration from members who need to learn and practice on the different options of CIVIL-3D. Since the membership is international, country-specific profile views are available, because CIVIL-3D can specify workflow, settings or features based on user preferences. The advantages of the network are network updates (2009 updates of the CIVIL-3D product), upcoming events, articles, consulting guides, consultant's code of conduct, practical services (service packs from the Autodesk Web site).

Another example of a networking community is the Joint Consultants Forum (JCF), which organises interesting lectures for its members on asset management, energy cycles, effective supply chain management and accessing potentially useful resources ([www.consultantsjcf.org.uk](http://www.consultantsjcf.org.uk)). The JCF also provides information on the consultant's key (on how to present one's practice), the endorsed code of conduct for consultants (which may be adopted and declared to clients), management keys (explanations of the key points within various management related topics, providing a useful document for reference from time to time), a chat line (free e-mail discussion service for members), consultants' advisory panel and associate network (a Web-based networking group, to establish associate relationships), a quality assurance model (quality assurance for the sole practitioner), a model quality manual is available in a key (this is available for adoption by registrants and is based on ISO9001 requirements), submissions in progress (sharing ideas between members and experts), a discussion forum (expressing ideas and aspects) and events information (participation in event planning, suggestions on events topics, and event places). On line courses (articles, products, courses, papers, virtual labs, webinars, and weblogs) are available on the Web for the members to choose from. The configuration of the Web site includes a design centre, a learning centre, a product centre, the company information centre, a directory, and careers search. From the courses a list of highly rated courses may be produced for members to facilitate their course selection.

One last example is the Tech On-Line communities that include Audio Design Line, Automotive Design Line, Digital TV Design Line, DSP and EDA Design Lines, Electronic Engineering Product Center, Industrial Control Design Line, Mobile Handset Design Line, Planet Analog, Power Management Design Line, Programmable Logic Design Line, RF Design Line, Video/Imaging Design Line, Wireless Net Design Line. Additional Network sites are Deep Chip, Design and Reuse, Electronic Supply and Manufacturing, and Microwave Engineering ([www.techonline.com](http://www.techonline.com)). The News Release for the Internet and Electronic Resources for Engineers is from I-Spark, which is an engineering community that goes on line, and is considered to be a revolutionary online career development and networking opportunity for the UK scientists, engineers and technologists. The idea is to create an online community where members can share their experiences and expertise, develop their careers, make contact with their peers in different companies and countries, expand their knowledge and debate issues of interest.

Based on the above examples of networking communities, the professional engineers in Greece can formulate their own open collaboration network or networks, using the existing networking tools and following the examples of the existing networking communities. Suggestions for the configuration of the network and services to be offered are given in this study.

## APPROACH AND METHODOLOGY

### The Technical Chamber of Greece (TEE)

The members of the Technical Chamber of Greece are professional engineers with degrees from engineering universities in Greece or accredited universities from abroad. The Technical Chamber of Greece ([www.tee.gr](http://www.tee.gr)) grants the Professional License (PE) after offering examinations three times a year. Those who pass the examination become members of TEE. The number of TEE members and their specialties are shown in Table 1.

The Technical Chamber of Greece recently undertook a major survey of its membership. The companies involved in the survey were TNS/CAP (that selected the data), and VENTRIS (that performed the analysis) [1]. The research was based

on telephone interviews of a sample of the members during autumn 2006. The results of earlier surveys of the membership were also used, from the 1997 survey by MRB-Hellas and ORCO, and from the 2003 survey by MRB-Hellas [1][2]. The sample at the TEE survey included 2400 engineers selected ad hoc from the body of engineers who are members of TEE. A smaller sample of about 210 engineers was used from those who belong to the new specialties, i.e. Electronic and Computer Engineers. The sample was separated into five-year groups from 1971, according to when licenses were issued, by specialty, and according to area of residence. The TEE members who participated in the survey had to answer questions regarding demographics, family situation, engineering education, preparation for the profession, employment, competition, unemployment, searching for jobs, earnings and entrepreneurship.

Table 1: Distribution of TEE members into specialties ([www.tee.gr](http://www.tee.gr)).

№	Specialty	Members	№	Specialty	Members
1	Civil Engineers	25969	7	Electronic engineers	2677
2	Architects	16843	8	Mechanical-electrical	2458
3	Electrical engineers	13813	9	Mining and metallurgical	2166
4	Mechanical engineers	12819	10	Naval and mechanical	1482
5	Chemical engineers	8312	11	Ship-building engineers	84
6	Surveying engineers	5989		Total	92612

The Technical Chamber of Greece is very much concerned when engineers are unemployed; particularly those who are TEE members. It considers that the issue is a major political issue that should be discussed, leading to legislation on providing unemployment benefits to professional engineers, along with incentives to develop entrepreneurial activities, to participate in technology transfer, and to develop innovation [3].

The political issue in supporting professional engineers should be designed within the framework of human resources development, with the necessary activities that lead to applications consistent with the structure of the job market, employer and employee rights and obligations, and the quality of the work required and offered. One of the targets of the issue should be government support of the entrepreneurial activities of experienced engineers to develop projects that will give jobs to young university graduates and female engineers. A second target should be the financial support and availability of resources for entrepreneurial activities and the development of innovative ideas. A third target should be the elimination of complicated licensing procedures in connection with the reorganisation of the economic policies of the country.

Thirteen years ago, TEE created a data base for its members [4]. This data base offers several possibilities of use via the Internet; however, these possibilities are limited to the retrieval of information and do not provide scope for social learning. The services offered are legal information, bids on construction, design, supplies, price list analysis for public works, the job market for engineers, registration information for members, issuance of certifications of membership from home or office, software packages for engineers, information on commissioning of design projects, and email for members. Through networking engineering communities the TEE members could have the opportunity to obtain knowledge through collaboration with other members within an active online community or communities.

#### The Organization for Employment of Working Force (OAED)

Human resources development for the different categories of work forces is the responsibility of OAED ([www.oaed.gr](http://www.oaed.gr)) in Greece, an organisation for the unemployment of the work force, where unemployed workers can be registered and be given the privilege of getting unemployment benefits, and participating in programmes of education and training. Engineers and other professionals who have professional education from a university are not included in the categories of workers registered with OAED and, hence, they have to provide resources for unemployment, continuing education and training themselves.

The different programmes of OAED that are presently running are presented in Table 2. These programmes refer to benefits for workers, education and training programmes, assistance in searching for jobs, financial support and sponsoring of activities, and mobility programmes for workers.

#### The National Printing Office of Greece (ET)

A search for recent major legislation (within the last four years) on employment, economic development and incentives, unemployment and benefits, social security and education of the working force was undertaken ([www.et.gr](http://www.et.gr)). Many laws affect engineers either directly or indirectly, and on many occasions they present opportunities or challenges for the engineering profession. The information collected was sorted out and presented in Tables 3, 4, 5 and 6.

Table 2: Programmes for OAED regarding benefits, education, job searching and financial support.

<p><i>Benefits for workers</i></p> <ul style="list-style-type: none"> <li>• Benefits for medical-pharmaceutical support of unemployed;</li> <li>• Benefits for people between 20-29 years old;</li> <li>• Benefits of additional leave of absence for workers being students;</li> <li>• Unemployment benefits;</li> <li>• Special benefits;</li> <li>• Registration with elective social security (Law 2874/00, article 10);</li> <li>• Programme of giving incentives for the geographic mobility of the working force.</li> </ul> <p><i>Education</i></p> <ul style="list-style-type: none"> <li>• Education at the OAED Schools of A' and B' cycles;</li> <li>• Education of unemployed at the OAED Centres for Continuing Professional Education;</li> <li>• Professional and educational information;</li> <li>• Programme of vocational education;</li> <li>• Sponsoring businesses for on-the-job-training of students of the Technological Educational Institutions.</li> </ul>	<p><i>Searching for jobs</i></p> <ul style="list-style-type: none"> <li>• Protection of the rights of the employee in case of firing;</li> <li>• Searching for jobs in the private sector;</li> <li>• Searching for jobs within the European Union;</li> <li>• Professional orientation.</li> </ul> <p><i>Financial support and sponsoring of activities</i></p> <ul style="list-style-type: none"> <li>• Financial support of industrial, home business, mining, cattle raising, hotel and maritime businesses, of certain prefectures of the Law N1262/82;</li> <li>• Sponsoring new businesses from OAED for unemployed close to retirement;</li> <li>• Sponsoring new employment positions and new entrepreneurs for unemployed from sensitive social groups;</li> <li>• Sponsoring of hotels to keep employment positions;</li> <li>• Sponsoring of industrial and home businesses of frontier areas, for employing university graduates;</li> <li>• Sponsorship programme of OAED;</li> <li>• Programme of financial support of new entrepreneurs.</li> </ul>
--	---

Table 3: Tabulation of laws on economic development.

<ul style="list-style-type: none"> <li>• Law N3219/FEK A 13/27.01.2004, <i>Amendment of Law N.2601/1998 FEK 81A, In regard to Strengthening Private Investments for the Economic and Regional Development of the State.</i></li> <li>• Law N3220/FEK A 15/28.01.2004, <i>In regard to Measures of Developmental and Social Policy towards the objective of Internal Revenue Control.</i></li> <li>• Law N3299/FEK A 261/23.12.2004, <i>In regard to Incentives of Private Investments for the Economic Development and Regional Convergence.</i></li> <li>• Law N3550/FEK A 72/26.03.2007, <i>Ratification of the Decisions of including Investment Plans to Article 9 of Law N3299/2004 In regard to Incentives of Private Investments for the Economic Development and Regional Convergence, and other Regulations.</i></li> <li>• Law N3585/FEK A 148/05.07.2007, <i>Protection of Environment, Agricultural Insurance, and other Regulations.</i></li> <li>• Law N3614/FEK A 267/03.12.2007, <i>Management, Control, and Application of Development Activities for the Programme Period 2007-2013.</i></li> <li>• Law N3752/FEK A 40/04.03.2009, <i>Revisions of Investment Laws and other Regulations.</i></li> <li>• Law N3756/FEK A 53/31.03.2009, <i>Regulations for the Capital Market, Taxation Issues, and other Regulations.</i></li> <li>• Law N3775/FEK A 122/21.07.2009, <i>Guidelines for the Proof of Same Time Exchanges, Regulations of Underinvestment of Companies, Procedure of Fast Licensing and other Regulations.</i></li> </ul>
--

Table 4: Tabulation of laws on employee benefits.

<ul style="list-style-type: none"> <li>• Law N3232/FEK A 48/12.02.2004, <i>In regard to Issues of Social Security, and other Regulations.</i></li> <li>• Law N3302/FEK A 267/28.12.2004, <i>In regard to the Regulation of the Annual Leave of Absence of Employees, and other Regulations.</i></li> <li>• Law N3329/FEK A 81/04.04.2005, <i>In regard to the National Health System and Social Welfare.</i></li> <li>• Law N3454/ FEK A 75/07.04.2006, <i>In regard to the Support of the Family, and other Regulations.</i></li> <li>• Law N3457/ FEK A 93/08.05.2006, <i>In regard to the Reform of the System of Pharmaceutical Care.</i></li> <li>• Law N3667/FEK A 114/18.06.2008, <i>Issues on Special Subsidizing of Unemployment and other Regulations.</i></li> <li>• Law N3719/FEK A 241/26.11.08, <i>Reforms for the Family, the child, the Society and other Regulations.</i></li> <li>• Law N3769/FEK A 105/01.07.2009, <i>Application of the Principle of Equal Facing of Men and Women regarding the Access to Goods and Services and the Provision of the Same and other Regulations.</i></li> </ul>
---

Table 5: Tabulation of laws on employment opportunities and policies.

<ul style="list-style-type: none"> <li>• Law N3226/FEK A 24/04.02.2004, <i>In regard to the Availability of Legal Aid to Citizens in Receipt of Low Income.</i></li> <li>• Law N3227/FEK A 31/09.02.2004, <i>In regard to Measures to address Unemployment, and other Regulations.</i></li> <li>• Law N3230/ FEK A 44/11.02.2004, <i>In regard to the Establishment of an Administrative System towards the Measurement of Productivity.</i></li> <li>• Law N3250/FEK A 124/07.07.2004, <i>In regard to Part Time Employment in the Public Sector, Organizations of Local Governments, and Utilities.</i></li> <li>• Law N3260/FEK A 151/06.08.2004, <i>In regard to the System of Regulation for the Appointment of Employees and of Internal Affairs of the Public Administration.</i></li> <li>• Law N3325/FEK A 68/11.03.2005, <i>In regard to the Establishment and Function of Industrial and Handicraft Businesses in the Framework of Sustainable Development, and other Regulations.</i></li> <li>• Law N3385/FEK A 210/19.08.2005, <i>In regard to the Regulations for the Promotion and Support of Occupational Employment, and the Strengthening of Social Cohesion, and other Regulations.</i></li> <li>• Law N3386/ FEK A 212/23.08.2005, <i>In regard to the Entrance, Residence, and Social Integration of Citizens from Developing Countries in the Greek State.</i></li> <li>• Law N3488/FEK A 191/11.09.2006, <i>In regard to the Application of the Principle of Equal Treatment for Men and Women regarding Access and Terms of Employment, Vocational Education and Development, and Work Conditions.</i></li> <li>• Law N3552/FEK A 77/04.04.2007, <i>Creation of Fund for Social Solidarity and other Regulations.</i></li> <li>• Law N3631/FEK A 6/29.01.2008, <i>Creation of National Fund for Social Solidarity and other Regulations.</i></li> <li>• Law N3655/FEK A 58/03.04.2008, <i>Administrative and Organizational Reform of the System of Social Security and other Regulations.</i></li> <li>• Law N3707/FEK A 209/08.10.2008, <i>Regulation of Issues of Private Enterprises of Social Security and Offices of Private Investigations.</i></li> </ul>
--

Table 6: Tabulation of laws on education.

<ul style="list-style-type: none"> <li>• Law N3255/FEK A 138/22.07.2004, <i>In regard to Regulation of all Levels of Education.</i></li> <li>• Law N3369/FEK A 171/06.07.2005, <i>In regard to the Codification of Life-long Learning.</i></li> <li>• Law N3374/FEK A 189/02.08.2005, <i>In regard to Quality Assurance of Higher Education, System of Transfer and Accumulation of Credit Units, Addendum of Degree.</i></li> <li>• Law N3376/FEK A 191/02.08.2005, <i>In regard to Establishment of School of European Culture.</i></li> <li>• Law N3384/FEK A 209/19.08.2005, <i>In regard to the Ratification of the Agreement regarding the Goals and the Management of the Initiative for the European Schools Network.</i></li> <li>• Law N3391/FEK A 240/04.10.2005, <i>International University of Greece.</i></li> <li>• Law N3404/FEK A 260/17.10.2005, <i>In regard to the Regulation of Issues of the University and Technological Sectors of the Higher Education.</i></li> <li>• Law N3475/FEK A 146/13.07.2006, <i>In regard to the Organization and Operation of the Secondary Level Vocational Education.</i></li> <li>• Law N3549/FEK A 69/20.03.2007, <i>In regard to the Reform of the Legal Framework for the Structure and Operation of the Higher Educational Institutions.</i></li> <li>• Law N3577/FEK A 130/08.06.2007, <i>In regard to the Establishment of a Body for the Administration of the Lifelong Learning Program and the Regulation of Issues of Private Education, and Auditing Bodies of the Ministry of Education and Religious Affairs.</i></li> <li>• Law N3653/FEK A 49/21.03.2008, <i>Legal Framework of Research and Technology and other Regulations.</i></li> <li>• Law N3685/FEK A 148/16.07.2008, <i>Legal Framework for the Graduate Studies.</i></li> <li>• Law N3696/FEK A 177/25.08.2008, <i>Establishment and Operation of Colleges and other Regulations.</i></li> <li>• Law N3699/FEK A 199/02.10.2008, <i>Special Training and Education of Persons with Handicap or Special Educational Needs.</i></li> <li>• Law N3748/FEK A 29/19.02.2009, <i>Access to the Higher Education of the Graduates of Vocational Lyceum and other Regulations.</i></li> </ul>
---

#### The TNS/CAP and VENTRIS Surveys for Professional Engineers

The TNS/CAP and VENTRIS surveys were performed on behalf of TEE, and included questions on employment sectors, employment within specialties, competition, labour contracts and second jobs, pension fund contributions, unemployment rates and trends, unemployment by specialty, gender and job location, searching for jobs, entrepreneurial activities, annual earnings, family concern and continuing education preferences. The findings of the surveys are presented below.

## *Employment*

- Employment sectors: The majority of engineers work in the tertiary (services) economic sector, i.e. in building construction and public works (49.4%), education and research (7.4%) and in the public sector services (6.9%). From the total of engineers, only 8.3% work in the secondary economic sector of production (de-industrialisation of the country), while 2% work in the primary economic sector.
- Employment within specialty: The majority of engineers (69%) are employed within their specialty, while the rest work in combined specialties (19%), in economics and management (5%) and in other specialties (3%).
- Professional competition: The main competitors of professional engineers in the work place are the graduates of the Technological Educational Institutions (39%), other specialties of engineers (25%), engineers from within the European Union (11%), university graduates with non-engineering degrees (11%), business graduates (10%) and graduates of economic schools (4%).
- Labour contracts and second job: One half of the professional engineers have their own practice, while from those employed, one quarter at the public and one quarter at the private sector, are covered by a labour contract. From those employed some have a second job (17%), which is in engineering (77%) or in non-engineering jobs (23%).
- Pension Fund contributions: From the total of the engineers the majority (61%) make their own contributions to TSMEDE (Pension Fund of Engineers and Contractors of Public Works), while one third (33%) have their dues paid by their employer. For those engineers employed in a second job, there are no contributions to a pension fund from that job.

## *Unemployment*

- Unemployment rates, trends: The unemployment rate is low (4.5%) for the total of professional engineers, while almost half of that rate (2.8%) is the voluntarily unemployed. The rate of unemployment for new specialties is high (9.1%) for the total of the group, while the rate for the voluntarily unemployed is smaller (6.2%). The unemployment rate has increased as a whole over the last few years.
- Unemployment by specialty, gender and location: The unemployment rates by specialty are high for metallurgical engineers (11.3%) and chemical engineers (10.2%). The unemployment rate for women (7%) is greater when compared to the rate for men (4%), and engineers residing in Thessalonica have a higher unemployment rate (7%) than those residing in Athens (5%).
- Searching for jobs: A large number of unemployed engineers (20.3%) look for a job for a period of longer than 13 months and from those some (8.3%) for a period longer than 25 months. From those unemployed, three out of ten declare that they have worked for less than 6 months before being fired, while two out of ten worked for a period of 7 to 12 months. Personal contacts and recommendations are very important for finding the first job (56.5%), while the same level of importance (54.4%) is attached to former professional experience.
- Entrepreneurial activities: A high percentage of professional engineers, who do not have their own practice (69%) declare that they do not intend to start their own business, while of those who intend to start a business the building construction and public works is the preferable sector (56.3%), with lower rates for other practices: engineering consulting (10.1%), informatics (9.3%) and engineering economics (0.8%). By specialty, the engineers are more likely to start new businesses if they are architects (31%) or are civil and mechanical engineers (34%). Regarding gender, more interest is shown by men in starting jobs (30%) compared to women, and regarding new graduates, almost half of the total (45%) show interest in starting new businesses.
- Annual earnings: The annual earnings (before taxes and health insurance) are over €25,000 for only 39% of professional engineers. More than half of the electromechanical engineers and naval engineers have an annual income higher than €25,000, while more than half of the electronic and metallurgical engineers, architects and civil engineers have an annual income of less than €25,000.
- Family concern: The family provides financial assistance to professional engineers (67%). The rate is higher for younger engineers (70%) than older engineers (33%), who live with the family regardless the earnings (low or high income).

## *Continuing Education*

- Continuing education courses: The courses that are of interest to the professional engineers show higher rates in computers and new technologies (55%) or business and marketing (47%), while lower rates are in other courses, i.e. renewable energies (34%), the environment (32%), quality control (25%), health and safety (21%), energy savings (19%), refurbishment (15%) waste and pollution (9%), biotechnology (7%) and electronics (6%).

## DISCUSSION OF THE IMPORTANCE OF THE RESULTS

University education is publicly supported in Greece, but since the year 2008 new legislation has allowed education in private universities. Greece's engineering universities and TEE organise continuing education courses for professional engineers [5][6]. Some private companies also organise continuing education courses in certain subjects. The universities develop and upgrade their courses to keep up with technological developments and the needs of the professional engineers, but only in the engineering areas. In other areas, such as economics and law (business administration, management, human resources, marketing, labour laws, employment issues, rights and responsibilities

of employees, laws in starting and operating a company, finances and risks, taxation laws, and other issues), engineers do not have the necessary education and they need to take courses offered by business schools or take continuing education courses before starting their own businesses [6].

Engineering courses should be updated periodically, not only to upgrade the contents to keep pace with rapid technological developments and applications, but also to apply current educational theories [7-9]. Continuing education courses should also be regularly assessed, and continuously restructured and upgraded. The assessment methodologies that have been used repeatedly in the evaluation of engineering courses, curricula and educational research, suggested the need of sound and rigorous assessment in engineering education [10].

Collaboration in the work place or effective teamwork studied in the classroom implies the production of high quality engineering products [11]. Similarly good results are reported for a teachers' online-community-collaboration, which contributes to a transition from an information retrieval situation to a social learning situation, aiming to the encouragement of the users' cognitive and social presence, and knowledge constructed through collaboration and critical reflection within an active online community [12]. These aspects of collaboration were not studied in the TEE surveys. Teamwork skills need to be practiced professionally in engineering classrooms [13]. University students with work experience in engineering companies expressed their opinions about the necessity of incorporating business classes to the curricula that would facilitate their positioning in the work place and the understanding of their responsibilities [14].

Education in collaboration and networking can definitely use the new technologies as a means of continuing education. The worldwide Web and the new computer technologies can deliver not only the educational content, but also facilitate the exchange of ideas and opinions and assist collaboration and networking with accuracy and speed, the same way as they are applied successfully in engineering education [15].

In developing networking engineering communities, as well as in university education, there are no gender differences in teaching and course work, or the degrees issued [16]. In the TEE survey, gender differences are present in certain areas, mainly unemployment, which is higher for women. Also, in networking engineering communities the development of a positive and supportive environment to the members is necessary. The emotional intelligence of TEE members was not considered in the survey, while emotional intelligence studies for students show extreme cases of positive or negative behaviour [17]. Survey responses regarding satisfaction from the profession and interest in starting a new business are connected to the emotional intelligence of the individuals. Also, collaboration and networking is connected to the emotional intelligence of people, and both are difficult to apply in extreme cases of positive and negative attitudes of people, unless people are educated in the development of their emotional intelligence.

Retention in networking engineering communities is an important issue; unemployment, low earnings, having a second job, and the competition within the profession make some engineers consider changing profession. The belief that an engineering degree enhances career security at a respectable salary was the main predictor of short and long term persistence in engineering [18]; however, in the work place the conditions may not favour retention for long periods.

Regarding technical courses, the continuing education survey indicated interest of engineers in continuing education courses such as computers and new technologies, business and marketing, renewable energies, environment, quality control, health and safety, energy saving, refurbishment, wastes and pollution, biotechnology and electronics [1]. These courses cover the needs of professional engineers in continuing education courses in different proportions.

Regarding business and law courses, the employment and competition survey showed that almost half of engineers are employed in the building construction industry and a large percentage faces competition from other professionals, which indicates the need of courses on Labour Law, and Rights and Responsibilities of Employees. The unemployment survey with 10% unemployment rate and higher rates for young engineers, women, and in certain engineering specialties indicated the need of courses on job interviewing and negotiating. It can be added that courses on collaboration or team work, networking and working the room might give additional skills. The entrepreneurship survey with interests of civil engineers, architects and mechanical engineers, as well as younger engineers, indicated the needs in labour-management relations, labour law, employee benefits, business administration, finance and accounting [6].

The efforts in the deliberate creation of a community of practice of researchers in computer science education (CSEd) (reported elsewhere) was characterised by mutual engagement in a joint enterprise that gave rise to a shared source of knowledge, artefacts and practices. It concluded with four open questions for the project and other projects like it: Where is the locus of the community of practice? Who are the core members? Do capacity-building models transfer to other disciplines? Can our theoretically motivated measures of success apply to other projects of the same nature [19]? Even if these four questions do not address directly the project, the locus and core members will emerge from the needs of the application of the project, and there will be similar goals in the capacity building and the measures of success defined in the CSEd community of practice.

## IMPLICATIONS OF THE RESULTS

The results of this study imply activities in satisfying the needs of professional engineers in information sharing through open collaboration within networking engineering communities. The creation of one engineering community for all the professional engineers in Greece could be followed later by the creation of several engineering communities that would correspond to the different specialties or groups of specialties. The functions of the engineering communities, within the goal of information sharing, will be continuing education for engineers, incentives and restriction in the performance of the profession according to Greek legislation, creation and operation of the networking engineering communities and application of the emerging technologies tools towards a successful operation of the engineering communities. More specifically, the main tasks implied by the results of this study are presented below.

### Needs in Continuing Education

#### *Characteristics of Engineers*

The TNS/CAP and VENTRIS surveys, performed on behalf of TEE, indicated the main engineering sectors in which professional engineers are employed. These are the existing competition in the profession, the labour contracts for each engineer and the contributions to the pension fund. Also, issues on type of employment, searching for jobs and entrepreneurship were surveyed.

#### *Problems of Employment and Unemployment*

The majority of Greek engineers work in the building construction and public works sector. They experienced professional competition from a range of sources; most were covered by labour contracts and made their own contributions to their pension fund. The unemployment rate for engineers is less than 5%. Unemployment programmes and unemployment benefits are provided by OAED, which however do not apply to the professional engineers.

#### *Needs in Continuing Education and Life-long Learning*

The expressed needs in continuing education refer primarily to computers and new technologies, business and marketing, renewable energy, environment, quality control, health and safety, energy saving, refurbishment, wastes and pollution, biotechnology and electronics. Further, more courses are needed on labour law, rights and responsibilities of employees, job interviewing and negotiating, collaboration or team work, networking, working the room, labour-management relations, labour law, employee benefits, business administration, finance and accounting.

#### *Knowledge in Entrepreneurship and Financing*

More than 30% of the engineers, especially civil, mechanical and architects are more likely to start new businesses. These engineers will need information and courses in management, company law, labour law and taxation.

### Incentives and Restrictions of Government Laws

#### *Economic Development*

Recent laws on economic development refer to strengthening private investments, measures for the development and social policy for internal revenue control, and incentives of private investments for the economic development and regional convergence.

#### *Employment Opportunities*

The laws on employment opportunities refer to measures to address unemployment, part time employment in the public sector, local governments and utilities, establishing businesses in the framework of sustainable development, promotion and support of occupational employment, and strengthening of social cohesion.

#### *Social Policies*

The laws on social policies refer to the entrance, residence, and social integration of citizens from developing countries, equal treatment for men and women in terms of employment, and vocational education and work conditions.

#### *Productivity*

The laws refer to the establishment of an administrative system aimed at the measurement of productivity.

### *Employee Compensation and Benefits*

The laws refer to issues of social security, regulations on annual leave, the national health system and social welfare, family support, health care and a special fund for social welfare.

### *Education and Training*

Laws on the codification of life-long learning, higher education quality assurance, the system of transfer and accumulation of credit units, organisation and operation of secondary level vocational education, the legal framework of the operation of the higher education and private education and auditing bodies.

### *Creation of Networking Engineering Communities*

#### *Multidisciplinary Collaboration*

The configuration of the Web site will include a series of centres, such as a design centre, a learning centre, a product centre, an information centre, a directory centre, and a career centre. The networking engineering community can benefit from the available multi-disciplinary collaboration.

#### *Community Collaboration, Searching Opportunities and Reacting to Challenges*

The creation of an online community would allow the members to share their experiences and expertise, develop their careers, make contact with their peers of different professional expertise, expand their knowledge and promote debate on issues of interest. The community members will be searching opportunities such as jobs and new projects, and being well-informed they would react to challenges of the profession on time and with success.

#### *Enhancing Performance and Productivity*

The online engineering community will make available to members information on technical, legal and economic issues that are of interest to the engineers and offer on line courses on these issues, with the goal of enhancing their productivity and performance.

#### *Tools to be Used from Emerging Technologies*

#### *Collaboration Tools*

In meeting professional requirements, engineers need engineering guidelines on how to present practice, an endorsed code of conduct on information disclosure to clients, management guidelines, chat lines, advisory panels. Also, a discussion forum can be available, events information and online courses.

#### *Services Offered*

The services offered will help members to share information and knowledge on activities, experiences and expertise, develop careers, make contacts, expand knowledge and enter into debate on issues of interest. In addition, the engineering community will identify the educational needs for engineers in the urban, industrial and agricultural areas, and encourage and sponsor the participation of engineers in the life-long learning programmes.

#### *Training of Members on How to Use and Benefit from the Network*

The engineers, who are acquainted with and are practicing the use of computers and the Internet, will be easily trained in the use of the networking engineering community. The benefits to the members are member discussions, blogs of local events and webcasts, access to community news, registration to courses, upcoming events and consulting guides.

## CONCLUSIONS

The effectiveness of the new technologies have been discussed in this study, with the goal of justifying the creation of engineering communities in Greece, for the benefit of professional engineers in searching opportunities and facing the challenges of the profession. The professional engineering body in Greece has been described with respect to membership and specialties, the situation of employment and unemployment, the preferences of engineers in continuing education and life-long learning, the attitudes towards entrepreneurship, and the finances of engineers. The engineering profession is a subject, directly or indirectly, to the laws issued by the Greek Government. The laws refer to the economic development of the country, the employment opportunities and social policies, the productivity, the employee compensation, the employee benefits, the education and training.

The creation of networking engineering communities within the organisation of the Technical Chamber of Greece will enable engineers to undertake research and use multi-disciplinary and community based collaboration in locating opportunities and threats for the profession with the goal of enhancing their performance, productivity and professional development. The creation of an engineering community as a whole of the body of professional engineers or smaller engineering communities for each specialty or groups of specialties can use the existing tools for collaboration. The engineers will be trained to use the collaborative spaces available, understand the usefulness of the network and benefit in their profession from the information sharing.

## REFERENCES

1. TEE. The Greek engineers today. Enimerotiko Deltio, Technical Chamber of Greece, 2007, **2435**, 8-16 (2007) (in Greek).
2. TEE. ICAP Report. Enimerotiko Deltio, Technical Chamber of Greece, 2007, **2423**, 3-7 (2007) (in Greek).
3. TEE. Human resources and lifespan learning. Enimerotiko Deltio, Technical Chamber of Greece, 2007, **2448**, 14 (2007) (in Greek).
4. TEE. Ten years of the TEE data base: New possibilities of making the Internet useful to the engineers. Enimerotiko Deltio, Technical Chamber of Greece, 2006, **2409**, 10-13 (2006) (in Greek).
5. Boussiakou, L.G. and Kalkani, E.C., Aspects of the changes to continuing education courses for engineers. *Proc. 11<sup>th</sup> Baltic Region Seminar on Engineering Education*, Tallinn, Estonia, 18-20 June 2007, 137-144 (2007).
6. Boussiakou, L.G. and Kalkani, E.C., The needs in continuing education courses for professional engineers. *World Transactions on Engng. and Technology Educ.*, 6, **2**, 215-222 (2007).
7. Kalkani, E.C., Boussiakou, I.K. and Boussiakou, L.G., Application of educational theories in restructuring an introductory course in renewable energy engineering. *European J. of Engng. Educ.*, 29, **3**, 401-413 (2004).
8. Kalkani, E.C., Boussiakou, I.K. and Boussiakou, L.G., On course for success. *Int. Water Power and Dam Construction*, 57, **2**, 32-36 (2005).
9. Kalkani, E.C., Boussiakou, L.G. and Boussiakou, I.K., Restructuring a hydropower engineering course to address international professional needs. *World Transactions on Engng and Technology Educ.*, 5, **1**, 27-34 (2006).
10. Olds, B.M., Moskal, B.M. and Miller, R.L., Assessment of engineering education, evolution, approaches and future collaborations. *J. of Engng. Educ.*, 94, **1**, 13-25 (2005).
11. Tonso, K.L., Teams that work: campus culture, engineer identity and social interactions. *J. of Engng. Educ.*, 95, **1**, 25-37 (2006).
12. Vivitsou, M., Lambropoulos, N., Konetas, D., Paraskevas, M. and Grigoropoulos, E., The Project Method e-course: the use of tools towards the evolution of the Greek teachers' online community. *Inter. J. Cont. Engng. Educ. and Lifelong Learning*, 18, **1**, 26-39 (2008).
13. Kalkani, E.C., Boussiakou, I.K. and Boussiakou, L.G., The paper beam: hands-on design for team work experience of freshmen in engineering. *European J. of Engng. Educ.*, 30, **3**, 393-402 (2005).
14. Kalkani, E.C. and Boussiakou, L.G., What business courses do civil engineering students need to get prepared for the profession? *Global J. of Engng. Educ.*, 11, **1**, 75-88 (2007).
15. Bourne, J., Harris, D. and Mayadas, F., Online engineering education: learning anywhere, anytime. *J. of Engng. Educ.*, 94, **1**, 131-146 (2005).
16. Kalkanis, K.G., Boussiakou, L.G., Kalkani, E.C. and Boussiakou, I.K., Student gender differences in the final examination of an introductory engineering course. *World Transactions on Engng. and Technology Educ.*, 5, **3**, 433-439 (2006).
17. Boussiakou, L.G., Boussiakou, I.K. and Kalkani, E.C., Student development using emotional intelligence. *World Transactions on Engng. and Technology Educ.*, 5, **1**, 53-58 (2006).
18. Burtner, J., The use of discriminant analysis to investigate the influence of non-cognitive factors on engineering school persistence. *J. of Engng. Educ.*, 94, **3**, 335-338 (2005).
19. Fincher, S. and Tenenberg, J., Using theory to inform capacity-building: bootstrapping communities of practice in computer science education research. *J. of Engng. Educ.*, 95, **4**, 265-277 (2006).