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**Entrepreneurship education in Greece:
Experience and challenges for a Technical University**

L. Papayannakis*, I. Kastelli*, D. Damigos**, G. Mavrotas*

**Laboratory of Industrial and Energy Economics, National Technical University of Athens*

***Laboratory of Mining and Environmental Technology, National Technical University of Athens*

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Abstract

While entrepreneurship has emerged as an important mechanism for the generation of social returns in terms of economic growth and job creation, entrepreneurship education is still something new in Europe and the debate about the need and the way of introduction of specific entrepreneurship courses in higher education is on going. This paper deals with the introduction of entrepreneurship education in engineering curricula and presents the case study of the National Technical University in Greece. The main argument is that entrepreneurship education should be part of a strategic design of University curricula in order to provide engineers with entrepreneurial and management skills that will help modify their profile in accordance with the new requirements of the knowledge-based economy.

Keywords entrepreneurship education, engineering education, Greece.

1. Introduction

Since evidence challenged the conventional wisdom that large firms in oligopolistic industries were at the origins of innovative activity and growth, small firms and new ventures came at the centre of policy concerns as important engines of innovation (Audretch, 2006).

Entrepreneurship has been identified as a mechanism by which private and public investments in knowledge generate social returns in terms of economic growth and job creation (Acs et al., 2004, 2006).

In addition to these remarks, the problems with unemployment, despite high quality of human capital and research capabilities and efforts in most developed countries and especially in Europe, resulted in policies promoting entrepreneurship as one promising solution.

European policy objectives as expressed in the Lisbon strategy (a target for 15 million new jobs creation by 2010) point to the development of entrepreneurial capital and the creation of an entrepreneurial society (European Commission, 2003).

In this direction entrepreneurship education in Europe has been considered as one way of shaping entrepreneurial skills, competencies, attitudes and culture as well as of facilitating entrepreneurial activities through university spin-off firms, tri-lateral initiatives for knowledge-based economic development and strategic alliances among firms, government laboratories and academic research centres (Etzkowitz, Leydesdorff, 2000).

In Greece the discussion about entrepreneurship education is at a very initial stage. Although at the policy level specific actions of the Ministry of Education are promoting the introduction of entrepreneurship education in Higher-Education Institutions, these actions are designed with a top-down approach and still remain in the context of adopting best practices stemming from the experience of other European countries. The most important however is to relate entrepreneurial education with Greek particularities and investigate whether promoting entrepreneurial education in higher education can result to specific positive effects for the research and productive system.

This paper presents the experience from the introduction of entrepreneurship education in engineering curricula of the National Technical University of Athens

(NTUA), one of the oldest higher education institutions in Greece. We argue that contrary to what the Ministry of Education has designed, it is important to integrate entrepreneurship education into a range of courses in economics and management in order to provide engineers with the necessary knowledge and skills to create, develop and manage a business.

2. Why entrepreneurial education is relevant in the Greek case?

There are some specific characteristics of the Greek economy in general but especially the trends and challenges relating to Greek engineers that illustrate the importance of promoting entrepreneurial education in higher education and in engineering faculties in particular.

The deficiencies of the Greek productive system to exploit scientific and research outcomes. Entrepreneurial activities are characterised by their small size, by slow transformations in terms of technological and organisational characteristics and managerial processes, with a specialisation to low-tech activities relying to cheap labour or to protection from strong competitive pressures (Spanos et al., 2001, Giannitsis, 2005). In addition, all indicators of the R&D system show the reluctance of the business sector to improve its competitive position through R&D activities but also its incapacity to exploit foreign technology, as innovative performance is one of the weaker in EU (European Commission, 2005, European Trend Chart on Innovation, 2005, GSRT, 2005) (see table 1 below).

Table 1: National trends in EIS indicators vs. EUaverage=100.

	2000	2001	2002	2003
public RD expenditures/GDP%	0,65*	0,43		0,41
relative to EU-15	34	64		59
business RD expenditures/GDP%		0,21		0,20
relative to EU-15		17		16
SMEs innovating in-house (EU-25=100)	55			
innovative SMEs cooperating with others (EU-25=100)	89			
SMEs using non-technological change (EU-25=100)	120			
early stage venture capital (EU-15=100)	21	26	45	32
employment in high-tech services (EU-15=100)	48	47	49	50
exports of high-tech products (EU-25=100)	36	27	37	42
EPO/m.p (EU-25=100)	5	6	6	
Publications/m.p (EU-15=100)		61	68	82**
Publications/researcher (EU-15=100)			130	

Source: European Trend Chart on Innovation, 2005, EC, "Towards a European Research Area – Science, Technology and Innovation – Key figures", 2003, 2005.

*: year 1999, **: relative to EU-25=100.

The “entrepreneurial deficit” in terms of quantity and quality. In Greece, the number of new firms created annually during the last 15 years remains stable (around 90.000), while the number of firms interrupting operations increases sharply (from 35.000 to 65.000) (Greek Ministry of Finance). The evolution of entrepreneurial activities in Greece appears decreasing when measured in terms of the initial invested capital (ICAP, 2006). At the same time the problematic picture is strengthened by some structural characteristics presented in the Global Entrepreneurship Monitor reports (2003, 2005). The results of the surveys point to the lack of depth in new entrepreneurial activities, the prevalence of necessity entrepreneurship, the low levels of intrapreneurship and the weak exploitation of opportunities even in sectors that don't need high investments in R&D (knowledge creation) but rather use knowledge created in other sectors or locations.

The mismatch between higher education and the labour market in Greece. Two different observations point to the particular situation faced by Greek graduates and particularly engineers. The first relates to the high rates of unemployment in the young graduates, the highest within OECD and EU countries (OECD, 2006). The second observation has to do with the inadequate level of engineers curricula as far as knowledge in economics and management and the development of non-technical skills such as analytical thought, adaptability, decision-making, capability in cooperating, communicating, negotiating etc., are concerned. In the case of engineering schools, it is becoming more commonly understood and accepted that, besides technical skills, engineers need business, social, and interpersonal skills to operate effectively in the organizational environments in which they work (Gokhale, 1995, Korhonen-Yrjänheikki et al., 2007). Nowadays, engineers need to have a strong understanding of the interaction between technology and economy, since they are commonly employed as managers. In Greece 25% of managers have an engineering background (Hellenic Centre for Investment, 2006). In addition, engineers are involved in R&D processes, either as self-employed or as members of research groups. NTUA engineers seem to be dissatisfied from the level of studies in the new fields of knowledge and skills required today, that is ICT skills, basic background in economics and management and development of non-technical skills (decision-making, learning skills etc.) (Liagouras et al., 2003, NTUA, forthcoming). Considering the new roles of the engineers, it becomes evident that entrepreneurship

training is required in order to be a successful technology manager or to commercialize a new technology. Offering this knowledge, polytechnic universities could unleash the hidden energy of their graduates, creating not only innovative technologies but also successful business ventures.

The high level of existing and latent entrepreneurship in engineers reveals a high potential for technological entrepreneurship. Three recent surveys referring to Greek engineers, undertaken in 2000, 2004 and 2005, support this position. In order to better understand these results we should take into account that Greece compared with other European countries¹, has a large percentage of self-employed engineers. In addition Greek statistics include architects in the engineers, contrary to what is happening in most foreign statistics. Finally, the Greek construction sector, which is characterised by the presence of small technical offices and contractors, has an important weight in the economic activities. Keeping in mind the above specificities, the following points present certain interest when assessing the role of entrepreneurship education (NTUA, 2000, TEE & NTUA, 2004, NTUA, forthcoming):

- a) Although decreasing, there is an important percentage of entrepreneurial activities undertaken by young engineers and of latent entrepreneurship during the period 1991-2001².
- b) However, an important percentage of effective entrepreneurs-engineers (30%) are necessity entrepreneurs, which is consistent with the picture we get on the total entrepreneurial activities in Greece.
- c) An interesting finding is also that entrepreneurial venturing is more likely to occur among engineers with graduate degrees than with master's or higher. This justifies the enrichment of engineering curricula with management and entrepreneurship courses at the graduate level.

¹ In France for example less than 5% of the engineers was self-employed (CNSF, 1997) where as in Greece the respective percentage was in 1997 51% (TEE-MRB, 1997).

² For the total of NTUA engineers the percentage of undertaken entrepreneurial activities was 28% during the period 1991-1995 and 24% during the period 1996-2001, whereas for latent

- d) The reasons for not starting-up a new business are to be found outside the educational system as the key constraints for engineers in undertaking entrepreneurial activities are the absence of initial capital and clients and the lack of professional experience. However, entrepreneurship education developing judgement in decision making and capability in integrating technical and economic information can deliberate more entrepreneurial potential and make engineers better equipped vis-à-vis economic uncertainty.
- e) Latent entrepreneurship is more likely to occur among engineers (especially in the construction activities) that are characterised as quasi-employees³, probably because entrepreneurial activity appears as a way of escaping from the unsatisfactory working conditions.

The message from the above specific facts is the following. Entrepreneurship education can play the role of developing entrepreneurial and managerial skills and understanding, in order for engineers to modify their profile in accordance with the new knowledge and skills required by the emerging knowledge-based economy. Previous studies trying to evaluate the impact of entrepreneurship education in general, have shown that although this impact differs across countries due to different culture with regards to entrepreneurship, it is however positive for undertaking an entrepreneurial venture. In the case of Canada for example, it was found that there was a significant positive relationship between entrepreneurship education and the propensity to start a new venture (Ibrahim and Ellis, 1986, Upton et al., 1995). Especially in the case of engineers it was found that 40% of engineering graduates who had received entrepreneurship training had started their own small business (Menzies and Paradi, 1999). A comparative study of entrepreneurship education in the U.S. and Korea showed that education is very important in building entrepreneurship

entrepreneurship the respective percentage reached 50% in the first period and decreased to 38% in the second period (NTUA, forthcoming).

³ This type of employees works under conditions of self-employment but for one single employer. Most of the time, especially for the young engineers these conditions are quite difficult and professionally unsafe. In the last survey for NTUA engineers, the percentage of quasi-employees was 27% of the total sample.

culture but also that the impact of entrepreneurship education is stronger in countries (like Korea) where entrepreneurship culture is less developed (Lee et al., 2005).

In this context, giving emphasis on the development of skills and competencies that enhance entrepreneur's chance of success, engineers who choose to follow an entrepreneurial path could be better equipped for the challenges of entrepreneurial venturing. These skills and competencies should not refer necessarily to large organisations but to decision-making in the context of a small business and should cover topics not only focusing on the pre-venture creation process (developing the business plan and starting the new venture) but also on the management of an existing small business. This is an appropriate approach of entrepreneurship education for the Greek case, where especially in the small business sector with limited resources, the entrepreneur should have the decision-making and management skills to develop its own business and perform various functions effectively.

3. Fostering entrepreneurship education in Greece: The case of the National Technical University of Athens.

Since 2001 policy initiatives in Greece have been encouraging entrepreneurship education especially in higher-education, using financial support from European Structural Funds. The Ministry of Education has adopted a top-down approach to promote introduction of entrepreneurship courses in all Greek Universities, through the Operational Programme for Educational and Vocational Training "Entrepreneurship Programs in Higher Education". This was a totally new initiative as none of the Academic Institutions, not even Business Schools, had entrepreneurship courses.

In this context the National Technical University of Athens, the oldest educational institution in Greece in the field of technology, launched in 2003 a program entitled "Development and implementation of entrepreneurship courses and supporting activities in the National Technical University of Athens" for promoting entrepreneurial learning among undergraduate students, in order to reinforce their creativity and expand their knowledge in theoretical and practical issues regarding the creation of a new venture and the initial phase of its operations. The main objective of the programme is:

a) To inspire students to see themselves as possessing entrepreneurial capabilities, by developing tacit knowledge, the necessary skills and the capability of understanding and judgement. This can result to the development of self-confidence and self-efficacy in organizing and executing the actions required for undertaking a new venture.

b) To shape a learning context within which students will learn how to take ideas to reality using specific methodology and tools.

c) To assist potential entrepreneurs with specific structures supporting the implementation of their ideas.

Given the priorities and particularities of each Faculty⁴, it was decided to develop a common pool of educational resources, as follows:

- Theoretical material (fundamental and in-depth analysis issues)
- Case studies
- Tools (business game, feasibility study, business plan, financial analysis) supported by software.

These resources are hosted on an “e-class” platform, i.e. a server accessible to all students. By means of this approach, each academic member has the ability to form a tailor-made course using only those materials necessary to fulfil Faculty’s needs with respect to entrepreneurship issues.

In parallel with teaching activities, lectures are organised for training the teachers. As the field is quite new for NTUA, it was decided to develop in cooperation with a Business School (The Athens University of Economics and Business) training courses on specific topics concerning entrepreneurial processes, in order to benefit from their experience on management issues.

Besides educational material, entrepreneurship training is further supplemented by the “library of entrepreneurship”, where students and researchers may find specific

⁴ NTUA is divided in nine faculties, namely: civil engineering, architecture, chemical engineering, rural and surveying engineering, mechanical engineering, electrical and computer engineering, mining engineering and metallurgy, naval architecture and marine engineering, applied mathematics and physics.

theoretical and empirical studies or sources for information on entrepreneurship and entrepreneurial activities, investment reports, information on business opportunities, etc. The aim is to generate an understanding of the different fields that offer entrepreneurial opportunities. These opportunities can be met in all sectors and industries, whether starting and managing a business or as employees offering new ideas and approaches.

Apart from the “e-class” server, a portal was developed, offering all necessary information and tools for students that wish either to undertake a new venture or make research in the field of entrepreneurship.

The whole concept is schematically represented in Figure 1.

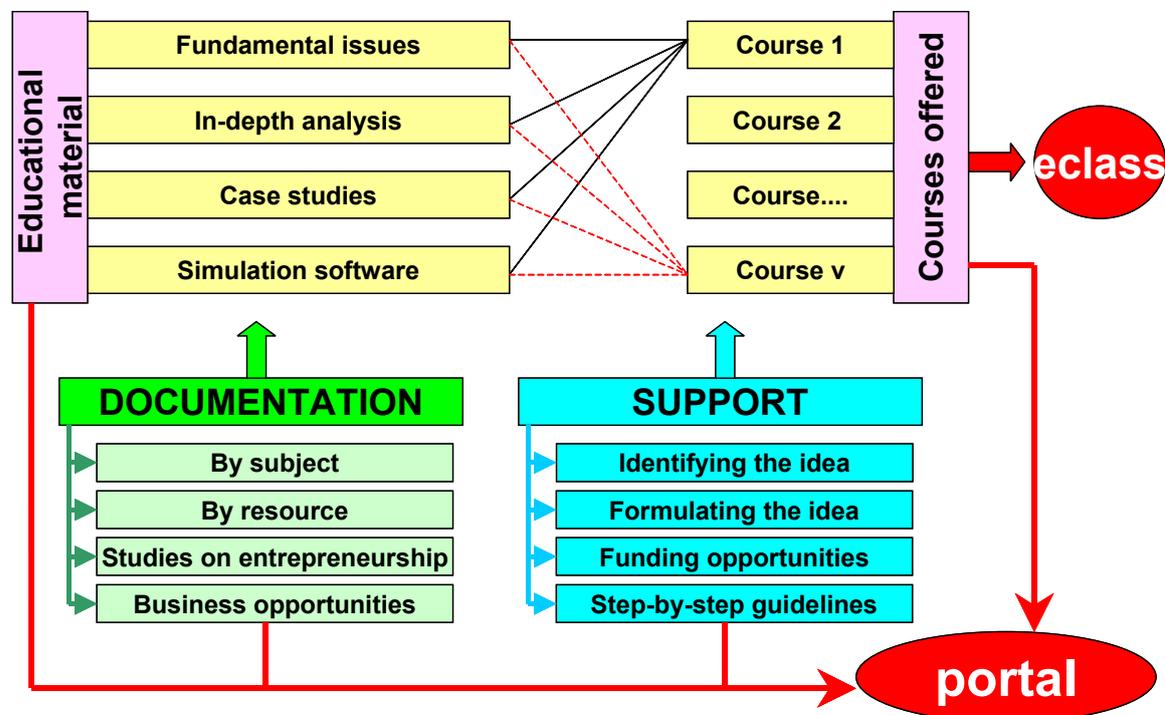


Figure 1. A schematic representation of the current formulated entrepreneurship program

Students are encouraged to learn through the experience of others, through their experience and through the integration of examples (case studies) into the lectures. Analysis of written case studies and guest entrepreneurs making presentations of their experience, enable students to learn directly from those involved in the innovation and venture creation process. Finally, getting young engineers familiar with the recent transformations occurred in activities that are of interest to them, in relation with competence building, might open some new possibilities for driving new ideas into

successful exploitation of opportunities. Students learn how to write business plans, how to seek financial support, how to work individually or as members of a group. The idea is to offer students the possibility to experience themselves in different virtual projects and interact in small teams and with the teacher.

In addition there is an effort to provide support to students that wish to undertake an entrepreneurial venture, through specific structures, internal to the University. Most of these structures are developed in the context of parallel policy initiatives promoting entrepreneurship. At this stage, consultation and technical support for business plan are provided by a specialized service within the NTUA Career Office. This service evaluates the ideas presented in order to identify the most promising ones. Further, it provides step-by-step guidelines, as well as assistance in formulating and funding these new ideas.

The technology incubator in the Lavrion Technology Park is another parallel action that provides an important resource network and physical infrastructure for those graduates who are willing to take the risk of putting into practice their ideas.

4. The challenges and constraints

The program, as adopted at its first phase, presents more-or-less the same characteristics of entrepreneurship education in other European universities, as mentioned by Twaalfhoven and Wilson (2004) and Wilson (2004).

There are however, some weaknesses and limitations in introducing entrepreneurship education due either to the initial policy design or to internal rigidities of the engineering schools.

The programme of the Ministry of Education promotes the introduction of a specific course in entrepreneurship, independently of the specific needs of each University and its syllabus. However, we should not consider the needs of an engineering faculty being the same with those of a business school. The same problem persists even among engineering faculties as their syllabi differentiate in terms of economic and management courses offered. The international experience showed that there are different types of programmes differentiating according to the academic area of each faculty and to their specific needs (Volkman, 2004). Thus entrepreneurship courses offered in non-business faculties have a different profile than that in Business Schools

and courses offered in e.g. a faculty of Informatics are different than those in faculties of Engineering Sciences (ibid).

In the same horizontal logic the programme imposes specific tasks to be implemented and funded, leaving little space for initiatives responding to each University's needs and specificities.

The specific categories of expenditure to be funded are rigidly determined and teaching teams have few to no degrees of freedom. Experience from implementation of entrepreneurship education in other engineering faculties (Standish-Kuon, Rice, 1998) but also in NTUA, showed that it is important to develop a critical mass of people working on the topic of entrepreneurship (teaching and research), who recognise the opportunity that technological entrepreneurship represents. These people are not necessarily professors but also senior or young researchers that will create a community in the entrepreneurship field. Then support and resources are needed for all the team in order to be sufficiently trained and to develop networking of educators across Europe.

Regarding the introduction of entrepreneurship education in NTUA, we observe some more specific problems:

1. There are difficulties to integrate the programme to the more general strategic design of the University, because of structural rigidities and also a conservatism regarding the profile of the engineer. The nature and relevance of entrepreneurship education are not well recognised by academics and students as appropriate curriculum content in engineering faculties. In fact, the syllabus of NTUA faculties is little or not at all oriented towards integrating courses in economics and management. Even those departments, who are modifying their curricula to that direction, are still at an initial phase. The courses are offered mainly on a stand-alone basis, although a systematic effort is being carried out towards a coherent framework. Additionally, only a few faculty members have been engaged up to now. This means that one course cannot be suitable for all faculties. Taking into consideration the changes in the engineer profile internationally, the introduction of entrepreneurship education in engineering schools should be part of a more general strategic design of the University towards studies in the new

areas of economic, managerial and entrepreneurial skills. This design should also take into consideration that engineering curricula are already overcrowded with content.

There is also need for institutional acceptance in the curriculum arena, in the structure of the programme and in financing as the public support is provided only for the introduction stage of entrepreneurship courses.

Finally, there is a traditional mistrust within the University that restrains initiatives for commercialisation of discoveries or promotion of entrepreneurship as being ethically dubious just because the University is publicly funded.

2. The scope of entrepreneurship education is much wider than training on how to start a new business. It is important to offer a complete course or set of courses that analyse the whole entrepreneurial process – from the venture idea to the newly formed business's strategic success (Ihrig et al., 2006). At the NTUA, this first educational phase focuses mainly on the start-up phase of a new business. This problem has been also pointed out in the recent survey conducted in 2004 jointly by the European Foundation for Entrepreneurship Research and the European Foundation for Management Development, as being one of the limitations of the introduction of entrepreneurship education in European Universities.
3. Entrepreneurs and managers have been invited in the classrooms, in order to share their experience and to motivate the students, but still as guest lecturers. However, there is need to increase University-industry relationships by involving more the firms in the educational process. Mentoring or coaching from people with business experience can prove to be very beneficiary for students, who should get more involved in enterprise projects. Interactive methods are required for the transfer of tacit knowledge from people experienced in business activities.
4. Educators are not specialised in the field of entrepreneurship, firstly because there is a general weakness in the supply of entrepreneurship educators related to the lack of master or doctoral programmes in this field and secondly because the people involved in the NTUA come from other disciplines, either engineering science or business and management.

5. A proposition for future directions

Regardless of any obstacles mentioned, the first results are quite promising. The NTUA students show a significant interest, which is reflected not only to their participation but also on the evaluation of the courses offered. In addition, the results of the program have stimulated the interest of external organizations. For example, the Technical Chamber of Greece, which is the official association of Greek engineers, wishes for participating in this effort funding business plan competitions, giving scholarships for diploma theses, organizing seminars for graduated engineers, etc. In any case we should not assess the impact of entrepreneurship education in terms of start-up rates upon graduation. It has been shown that students rarely claim to start a business immediately after their graduation and that the potential benefit of entrepreneurship education in higher education should be found in a more long-term evaluation (Carter, 1998, Galloway and Brown, 2002).

After two years of implementation, the programme “Development and implementation of entrepreneurship courses and supporting activities in the National Technical University of Athens” entered a second phase of consolidation of this effort. The next steps are the following:

- (1) To better integrate entrepreneurship education into the curricula of each Faculty, taking into consideration the specific needs of the latter.
- (2) To promote collaborations with more NTUA academics, other higher education institutes, entrepreneurs, and economic and technological organizations.
- (3) To extend the content of the entrepreneurship course beyond the start-up phase of the entrepreneurial process.
- (4) To more actively involve students in specific projects.
- (5) To turn academic interest also to research in entrepreneurship, undertaking empirical research, in order to advance our knowledge on the entrepreneurial process.
- (6) To promote training of educators in order to develop a small group of teachers and researchers that will implement the linking of engineering science with entrepreneurship courses.

6. Conclusion

In Greece, there is evidence for serious weaknesses as far as entrepreneurial venturing is concerned. Although these weaknesses are not to be related to the educational system per se, one could argue that providing students and especially engineers with entrepreneurial and management skills can deliberate an innovative potential and improve the success rate of business venturing.

The general trend towards a weightless economy (an economy where the product tends to be lighter in physical terms) challenges the profile of the future engineer, with an emphasis to new skills required (Liagouras, 2006a,b). Technological entrepreneurship and intrapreneurship need a different design in the University curricula that should take into account that an engineer doesn't need only the "classic" engineering skills but economic and management competencies in order to create, design and manage complex techno-economic systems. The issue is not to change the role of the University but to recognise the new challenges in the context of a knowledge-based society and the opportunities that entrepreneurship may constitute for new engineers.

The National Technical University of Athens is implementing a programme to that direction. However, these initiatives are still at an initial stage and many improvements need to be done, especially in terms of the strategic design of the University and the integration of entrepreneurship education in the University's curricula.

An appropriate path of evolution could be the development of a curriculum that is offered in all faculties as a distinctive module, which would focus on the specific context of the engineering students, with regard to the new requirements for economic understanding and managerial and entrepreneurial skills.

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