

# **Geomatics Engineering Education at NTUA, Greece and ITU, Turkey: A Compare and Contrast**

**Rahmi CELIK (Turkey), Vassilis GIKAS (Greece), Dionysios BALODIMOS (Greece)**

**Key words:** Surveying Education, Curriculum, Greece, NTUA, Turkey, ITU

## **SUMMARY**

As it is the case in other aspects of everyday life, globalization defines and demands standards in professional education. Geomatics Engineering profession, with fundamental but not exclusive specialties being Land & Public Surveying, Geodesy, Photogrammetry, Remote Sensing and Cartography, is the one that serves globalization much more than any other engineering profession. This is due to the nature of the profession itself, as it is the one that defines the spatial structure of the globe and relates spatially all other information within the globe. Moreover, it is the fundamental engineering profession, the products and services of which are essential for almost all other engineering disciplines and professions. Consequently, because of the multilateral character of the profession, Geomatics Engineers should share common terminology and experience, common knowledge and background. In this line, the educational systems and the curricula practiced in various countries play a substantial role.

In this paper, Geomatics Engineering education is examined and compared in two neighbouring European countries, Greece and Turkey – that both share a great potential of a young generation with a continuously increasing interest for the profession. More specifically, the educational system is examined for the corresponding departments of the National Technical University of Athens (NTUA) in Greece and the Istanbul Technical University (ITU) in Turkey. Readers can obtain detailed information, identify the similarities and the differences of the practices exercised in both universities and benefit from the comparison and contrast of their educational systems in the face of potential for future collaboration.

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## **1.0 INTRODUCTION**

Surveying, perhaps more than any other profession, faces the impact of the technological developments of the last twenty years. The impact and the scope of the underlying challenges for the profession are bewildering as one realizes that adaptation is not only necessary in applying new technology to the profession, but that the profession itself is constantly in flux due to changes in the society and the rules imposed by the free market worldwide. However, the challenge for the surveying profession is not merely confined to the effects imposed by the technological developments; it also relates to the broad spectrum of the disciplines and activities belonging and associated with the surveying profession (Psarianos, 2001). Based on these facts, it is realized that in order surveyors to secure and expand their role in today's marketplace and for the years to come, it is imperative that the educational programmes should follow and adapt to the global trends which take place in surveying profession.

Notwithstanding these realizations are broadly accepted by the academic community worldwide, the present status at many universities does not appear to conform to them. With only a limited examination of the educational programmes standing worldwide in surveying today, two points are immediately evident. Firstly, in many countries, the curricula are mainly lecture based and tend to be built on teaching traditional disciplines. Secondly, the educational programmes differ significantly from one country to another in the structure, the content, as well as in the degrees awarded (Virrantaus and Haggri 2002, Rouch 2001]) In the past, substantial work was undertaken towards a classification of the surveying educational curricula. The Allan's report (Allan, 1995), the Mattson's analysis (Mattsson, 2001) and Enemark's three-part-model (Enemark, 2001) are of the most well known. At this point, it is realized that the role of FIG Commission 2 (Professional Education) is vital. It brings around the same table academics and professionals from different countries and variant backgrounds and opens the discussion on educational curricula classification and reforms (Cöltekin, 2002). The outcome of such initiatives (e.g. the FIG Surveying Educational Database) can benefit the surveying community in many ways. Students can obtain information about universities' profile, the content of their educational programmes and their research activities. Similarly, lecturers can get references and obtain virtual courses which are useful for developing their own educational content. Furthermore, it facilitates the mobility of students and researchers and fosters the setup of new collaborations.

In this context, Geomatics Engineering education is examined and contrasted in two neighbouring European countries, Greece and Turkey. More specifically, the educational system is examined for the corresponding faculties of the National Technical University of Athens (NTUA) in Greece and the Istanbul Technical University (ITU) in Turkey. Readers can obtain detailed information, identify the similarities and the differences of the practices

exercised in both universities and benefit from the comparison and contrast of their educational systems in the face of potential for future collaboration.

## **2. SCHOOL OF RURAL AND SURVEYING ENGINEERING, NTUA**

### **2.1 Historical Overview**

The National Technical University of Athens (NTUA) is the oldest and undoubtedly, one of the most prestigious educational institutions in Greece in the field of technology. Since its foundation (1836), it has been closely linked up to the social and political reforms in Greece and therefore, from this standpoint it has contributed unceasingly to the country's scientific, technical and economic development. In its present form, NTUA is comprised in nine Schools which are further divided into Departments covering specific scientific areas ([www.ntua.gr](http://www.ntua.gr)).

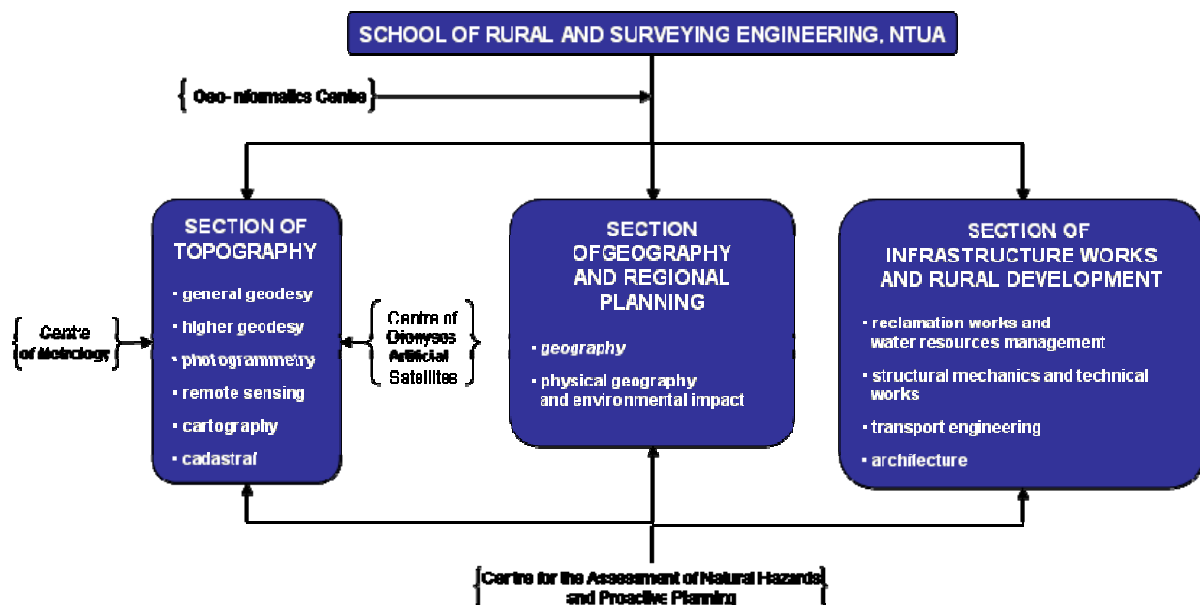
The School of Rural and Surveying Engineering (SRSE) was founded in 1917 as "*Higher School of Surveying Engineering*". Initially, three years of studies were required for graduation. However, soon after (1930), in order the faculty to respond to the pressing needs for highly qualified graduates, the studies were extended to four years. At this time, the expansion of the country's rural population resulted in excessive demands for the construction of infrastructure works and regional planning activities. In order to accommodate the new developments, the plan and the curriculum setting of the School were reformed and consequently, its name was changed to "*Higher School of Rural and Surveying Engineering*". Since 1974 the School's curriculum was further extended to five years studies ([www.survey.ntua.gr](http://www.survey.ntua.gr)).

### **2.2 Structure and Organization**

For a number of reasons that relate to the historical evolution of Surveying Engineering in Greece, the SRSE differs from most allied departments established in other countries, both from an educational and a professional point of view. Along with the conventional subjects that usually come under the field of geomatics (i.e. geodesy, engineering surveying, photogrammetry, cartography, remote sensing and GIS), the SRSE also encompasses two other major disciplines – geography and regional planning as well as rural engineering. This uncommon educational profile, that in the first sight appears to be of a peculiar character, accentuates an interesting synthesis that springs from the enclosure of the disciplines of geography and regional planning under an engineering faculty. Graduates with an engineering degree interested in geography and regional planning, expand and enjoy better employment opportunities compared with graduates of other academic institutions. Having said that, it is stressed out that the focal point of the educational activities of SRSE is in the collection, the analysis and usage of the various types of geoinformation. In this perspective, the synergy of the skills acquired in the field of geomatics pieced together with qualifications in geography, regional planning and rural engineering, render SRSE graduates competent to act and succeed in today's marketplace – in particular, in specialties and projects that a strong background in geoinformatics and a multidisciplinary approach is necessary. Nevertheless,

just like other Schools of NTUA, the degree awarded shows no specialization. Although, the students are impelled by the academic curricula to decide on and go deep into a discipline area by the appropriate selection of relevant courses.

As prescribed by law, the SRSE is administered by the General Assembly constituted by the academic personnel and representative members of the assistants and research associates, the administrative and the technical personnel as well as the students. The SRSE is divided into Sections covering different scientific areas. Sections are also administered by General Assemblies formulated in a similar manner to the School's General Assembly. Finally, there exist further subdivisions in the shape of Laboratories which deal with specific scientific areas.



**Figure 1:** School of Surveying and Rural Engineering, NTUA – structure chart.

As depicted in Figure 1, the SRSE comprises three Sections – namely, the *Section of Topography*, the *Section of Geography and Regional Planning* and the *Section of Infrastructure Works and Rural Development*. Furthermore, Figure 1 shows a more detailed classification of the specific scientific areas covered by each one of the three Sections. In order to enhance the interdisciplinary cooperation among the staff members who belong in different Sections and Laboratories, the School has established Inter-Laboratory Centers of cooperation which deal with scientific areas of common interest for the participating Laboratories. These are the *Inter-Laboratory Center of Metrology*, the *Inter-Laboratory Center for the Assessment of Natural Hazards and Proactive Planning* and the *Center of Dionysos Artificial Satellites*. The focal point on information technology in the SRSE is the *Geo-Informatics Center*. Its main activity is to provide the necessary infrastructure (hardware / software and personnel) to support the educational and research activities at under-graduate and post-graduate level. Also, *GEOTOPOS*, a repository of Geosciences-based digital resources is currently under development in SRSE. It is anticipated that the system would

essentially evolve into a digital library that will eventually support and enhance the traditional learning process and address the multiple learning styles and needs of SRSE (Delikaraoglou, 2005).

## **2.3 The Educational Programme**

### **2.3.1 Undergraduate Studies (Dipl. Ing.)**

The Academic Calendar of SRSE formally comprises five years of studies. Each academic year is further divided into two semesters – the fall and the spring semesters. The wide range of subjects covered by the educational programme of SRSE leads to the necessity for the provision of a large number of courses. In order to assist the students to decide on and delve into a discipline, specialized educational areas have been recognized. For this purpose, the courses offered are divided in two categories – mandatory and elective ones. Mandatory courses are those that lead the student into mastering the prerequisites in all disciplines covered in the SRSE and prepare him for specialization in a certain field. By analogy, the elective courses deal with specialized subject areas and topics in a field chosen by the student. These courses provide the required knowledge for further studies and scientific research. Also, in order to ensure that the educational programme reflects the changes in the activities belonging to or associated with the surveying profession, new courses (such as, methods and applications of interlinked digital systems) have been recently brought in the curriculum (SRSE 2005, [www.survey.ntua.gr](http://www.survey.ntua.gr)).

The summer courses form an important part of the studies in the SRSE. These are offered in the fields of geodesy, photogrammetry and remote sensing. Such courses are collective training projects which are undertaken either within the premises of the University campus or in distant areas throughout Greece. In the latter case, these courses are usually set up in cooperation with and for the benefit of local authorities and take place in the period between the end of the spring semester and the beginning of the fall semester.

Students, in addition to lectures and practical courses prescribed by the curriculum, are required to submit a diploma thesis. It is a major work of analytic, synthetic, experimental or applied character that has to be related to one of the courses of the faculty. Diploma theses last at least a full academic semester and are usually combined with research and engineering projects in cooperation with local authorities and public institutions.

### **2.3.2 Postgraduate Studies**

As it is the case in many other five-year engineering programmes in Europe, the degree offered by NTUA is not a B.E. (Bachelor of Engineering) but a degree in Engineering which is considered to be equivalent to M. Eng. (Master of Engineering) and a Dipl. Ing. Based on this fact, postgraduate studies at NTUA are organized in the form of interdisciplinary programmes, which have been designed to address graduates from SRSE, from other engineering Schools as well as graduates in applied or earth sciences.

The SRSE participates in six *Interdisciplinary Programmes of Postgraduate Studies* of NTUA, leading to “*Post-Graduate Specialization Diploma*”. In two such programmes, the SRSE is the coordinating School. These are the “*Geo-Informatics*” and the “*Environment & Development*” programmes. The interdisciplinary character of the programmes is fully justified, as they have been primarily designed to emphasize more on principles, research methodology, problem solving, technical writing and presenting as well as defending ideas about projects (Balodimos et al 2000). The minimum duration of studies is one academic year and not exceeding two years. Graduates from the postgraduate programmes can enroll for doctorate studies. Although the procedure is different, graduates of the five-year programme are also able to enroll for doctorate studies.

### **3. DEPARTMENT OF GEODESY AND PHOTOGRAMMETRY ENGINEERING, ITU**

#### **3.1 Historical Overview**

Istanbul Technical University (ITU) is the first oldest technical university and the second oldest university of Turkey. It was founded in 1773. Since then it has taken very important role for developing process of the country in all ways, scientific, social, political, economical etc. It has currently thirteen technical faculties on different technical and scientific subjects, five technical institutes and additional five other units like high school or educational centre on foreign languages, arts and sports ([www.itu.edu.tr](http://www.itu.edu.tr)). There are forty one different engineering, social and art departments under thirteen faculties and Department of Geodesy and Photogrammetry (DoGFE) is one of them.

The Department of Geodesy and Photogrammetry Engineering was founded in 1969 under the Faculty of Civil Engineering for four years engineering education. At the initial step two basic science subdivisions were established as Geodesy and Cartography and then it was turned to Geodesy and Cartography as one subdivision and Photogrammetry as another one. There after those two basic science subdivisions’ names were changed to Geodesy and Photogrammetry in 1979. In 1989 main science subdivisions were reinitiated as five different basic science subdivisions as follows Geodesy, Photogrammetry, Cartography, Surveying Techniques and Remote Sensing ([www.ins.itu.edu.tr/jeodezi](http://www.ins.itu.edu.tr/jeodezi)). However it should be mentioned here that the first civilian Land Surveying education was begun in 1949 at Yıldız Technical University formerly named as Yıldız Technique School in Turkey.

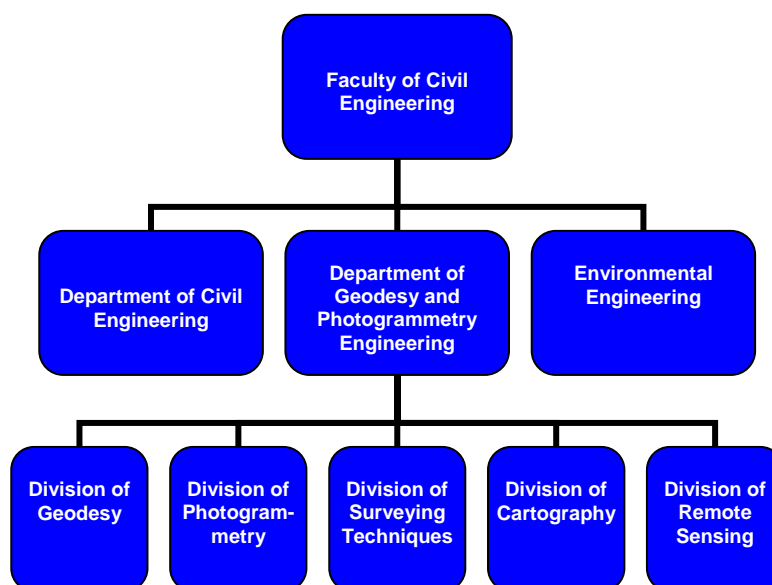
#### **3.2 Structure and Organization**

Geodesy and Photogrammetry Engineering profession is an essential profession for a country that would like to develop. Since this is the one that provide spatial infrastructure of the country. Therefore all other information collected is much valuable and beneficial when integrated with spatial information for planning, developing, building and modernising the country. This is the way of having and running powerful and effective execution in the country. That’s why all developed countries gave privilege and provide full of public support to land surveying profession at first step. For instance when first order geodetic network

progress of Turkey is investigated that was carried out in between the beginning and mid of 1900s, (Serbetci, 1999) road of development progress of the country can easily be seen.

Department of Geodesy and Photogrammetry Engineering of Istanbul Technical University is the most popular and distinguished one out of other 21 similar departments in the country (Gökhan, 2003). It is also the one that its educational and organisational structures are taken as the model for other departments. Moreover it is the only one in the country that is accredited by Accreditation Board for Engineering and Technology (ABET). Therefore any student of the department can apply to continue his/her engineering education without any interruptions in other ABET accredited Geodesy and Photogrammetry Engineering or Geomatics Engineering or any equivalent departments in the world. Hence these students can carry out their education without any discontinuity. Learning of English is essential in the education system of the university. Therefore graduates of the department have the ability of understanding, speaking and writing of at least a foreign language, especially English.

The organisational structure of the department is given in Figure 2. As is seen from Figure 2, Department of Geodesy and Photogrammetry Engineering is one of the departments under Civil Engineering Faculty. The other two departments are Department of Civil Engineering and Department of Environmental Engineering. This is also a good advantages for all departments since they find chance to run multidisciplinary projects and corporation in first step within the faculty.



**Figure 2:** Organisational Structure of DoGFE

Department of Geodesy and Photogrammetry Engineering is divided into five basic science subdivisions: Geodesy, Photogrammetry, Cartography, Surveying Techniques and Remote Sensing. Public Surveying is also another basic science subdivision in Turkey. However it is not spread as subdivision in ITU, it is embedded into Surveying Technique subdivision (Köktürk et al, 2005). Following laboratories of the department are in the service for high

quality practical education and research. IGS ISTA Satellite Observation and Data Processing Laboratory. Geodesy Laboratory, Photogrammetry Laboratory, Cartography Laboratory, Remote Sensing Laboratory, Geodetic and Surveying Instrument Laboratory, Geographical Information System Laboratory. Moreover the department has also a museum for old instruments.

### **3.3 The Educational Programme**

#### **3.3.1 Undergraduate Studies**

The Academic Calendar of the Department of Geodesy and Photogrammetry formally comprises four years of undergraduate study. At least thirty percent of BSc. education in ITU is in English language that means thirty percent of courses are given in English. Students graduate with the title of engineer and Bachelor of Science (BSc.) from their undergraduate education. Each calendar year there are three terms as fall, spring and summer terms. Summer term is mainly preferred by students to compensate their unsuccessful courses; however thanks to summer school a student can also complete his/her undergraduate studies shorter than four years. The wide range of subjects covered by the educational programme of DoGFE leads to the necessity for the provision of a large number of courses. These courses are classified generally on basic sciences that mainly covers mathematics, analytical geometry, physics, chemistry and their practices in labs; on humanity and social sciences that mainly covers general and engineering ethics, professional and property laws, language both Turkish and English; on fundamental engineering that mainly covers basic computer knowledge, computer programming, parameter estimation, digital image processing and introduction to professional topics like geodesy, photogrammetry, cartography, surveying techniques, and remote sensing; on professional and engineering design that mainly covers advanced knowledge on professional topics and design such as geodesy, photogrammetry, cartography, surveying techniques, public surveying, cadastre, remote sensing, satellite geodesy and surveying, engineering surveying, spatial, geospatial and geographical information systems, and etc. These courses are in two categories as mandatory and elective ones. Mandatory courses are the ones all students must have all these courses to achieve diploma of engineering degree. Elective courses depend on the students' professional interest during his/her education. A student who would like to achieve diploma must complete certain number of credit from elective courses. Moreover students have to take intensive practical field work courses in summer of first, second and third years of his/her studies. These intensive practical field work courses are also accounted as their internship. However in order to complete internship progress, a student has to work as a trainee in a professional surveying company under the supervision of a surveying engineer. Additionally students should prepare a professional design project under the supervision of a senior lecturer as a final thesis. And then he/she must submit it to present and defend his/her project to a jury that is formed with senior lecturers of the department.



### 2.3.2 Postgraduate Studies

Post graduate studies are carried out by Science and Technology Institute of the university. All departments are represented as basic sciences under the institution. Department of Geodesy and Photogrammetry Engineering is represented as Geodesy and Photogrammetry Engineering Basic Science in the institution. It has a post graduate program called as Geomatics Engineering Program. This program provides both Master of Science (MSc.) and Doctor of Philosophy (PhD.) degree. Therefore the one who has already a BSc. diploma of engineering and meeting other required criteria might apply to achieve MSc. degree. If the one has already got MSc. degree and meeting other required criteria might apply to achieve PhD. degree. However the one who is a successful student and has high graduation average grade from his/her BSc. studies and meeting other required criteria might directly apply to achieve PhD. degree.

In order to achieve MSc. diploma a student must have courses including advanced mathematic and professional courses in at least two academic terms. Moreover he/she needs to prepare a master thesis on a specific professional topic under supervision of a professor. Thereafter the student has to submit this thesis to the institute for scientific review by the jury elected by the institute. Finally the student is taken an oral examination to defend his/her thesis by the jury. The student agreed as successful in the oral examination by the jury is awarded with MSc. degree by the institute executive board and then to gain right to get his/her MSc. diploma on Geomatics Engineering. Similar procedure is carried out for PhD. studies. PhD students also have to have advanced professional courses in at least two academic terms. Thereafter they have to prepare a PhD. thesis under the supervision of a professor. After submission of his/her thesis for scientific review, he/she needs to take his/her viva for being successful to achieve his/her PhD. degree and diploma on Geomatics Engineering.

## **4. DISCUSSION AND CONCLUSIONS**

In this paper, the structure and organisation as well as the educational programmes of SRSE, NTUA and DoGFE, ITU were discussed in detail. Generally, both departments provide an equivalent standard of education. However, several differences as well as similarities can be identified. SRSE has been established first (1917) followed by DoGFE (1969) in well structured, highly distinguished very old universities dating back in the 18<sup>th</sup> century. It is realized that the focal point of the educational/research activities of SRSE and DoGFE is in the collection, the analysis and the usage of the various types of geoinformation with the peculiarities discussed for SRSE in Section 2.2. However, noteworthy, it is stressed out that the name of both departments does not include the term “Geomatics” – a term, that is widely accepted in many universities in the world with a similar educational profile. Nevertheless, it is pointed out that discussion has commenced in both departments for modifying their names, so that they are adjusted to the future needs of the profession and the society.

A distinct difference between the two departments is in the duration of the undergraduate studies. The educational programme of SRSE is organised in five academic years and

therefore, degree offered is considered to be equivalent to M. Eng./Dipl. Ing. On the other hand, ITU DoGFE is based on a four year educational programme offering an engineering title at a BSc. Diploma level. Also, graduates willing to continue their studies can enrol for a MSc. degree which is a spread study under spread technical and scientific institutional body in ITU DoGFE. Postgraduate studies offered at SRSE of the NTUA are in the form of interdisciplinary postgraduate studies leading to “Postgraduate Specialization Diploma”.

From the discussion it is evident that both departments share a great potential for students who wish to continue their carrier on geodesy and geospatial sciences which are essential for a sustainable world. Moreover, the potential for scientific and educational collaboration between SRSE and DoGFE is considerably high. This is due to their geographical location, the cultural and social closeness, and the acceptance of the respective institutes by the society in both countries.

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- [www.ins.itu.edu.tr/jeodezi](http://www.ins.itu.edu.tr/jeodezi), web page of Department of Geodesy and Photogrammetry Engineering at ITU

## BIOGRAPHICAL NOTES

**Dr. Vassilis Gikas** joined as a lecturer the National Technical University of Athens in 2004. His previous appointments include a research position in the Department of Geomatics at the University of Newcastle upon Tyne, UK. In the past he served the offshore industry in the UK and the USA as a navigation and positioning specialist and more recently, he served the private sector in a series of surveying and transportation engineering projects under the same capacity. His principal areas of research include navigation, high precise GPS and surveying engineering applications.

### **Professor Dionysios Balodimos**

1963 Diploma in Rural and Surveying Engineering, NTUA

1972 Postgraduate studies at Oxford University

1972 D. Phil in Physical Sciences, Geodesy, Oxford University, UK

Since 1979 Professor of General Geodesy at the NTUA and Director of the Laboratory of General Geodesy

Since 1997 Director of the "Geo-Informatics" Interdisciplinary Programme of Postgraduate Studies of NTUA

He has been authored more than 70 scientific papers and coordinator of more than 30 research programmes. His principal areas of interest include technical and industrial geodesy, large scale geodetic surveying, metrology, underground and underwater surveying, monitoring deformations of structures and the earth's crust as well as methods for geodetic astronomy and geoid determination.

**Assoc. Prof. Dr. Rahmi Çelik** was taken his BSc. in the [Department of Geodesy and Photogrammetry](#) in [Istanbul Technical University](#) – ITU. In 1987 he began to work as a research associate in the Department of Geodesy and Photogrammetry. Thereafter he has achieved his MSc. degree in 1989 in the Institute of Science and Technology of ITU. In 1992 he was awarded with a national scholarship for PhD education. He has taken his PhD degree in the [University of Newcastle/England](#) in 1996. He is currently working as a Associated Professor in the Division of Geodesy in the Department of Geodesy and Photogrammetry, and he is the Vice Dean of Science and Technology Institute of ITU. He is mainly lecturing on GPS Techniques, Geodetic Network Design, Advanced Electrometry, Geodetic Infrastructure of GIS, Industrial Measurements, C Programming and etc.

He is active member of <http://www.hkmo.org.tr>. There times he was taken the position in the executive board of the Chamber in Istanbul. In between 2000 and 2002 he was in the position of president of the executive board of the Chamber. He actively remains supporting chambers activities and taken position as a string head or a member in the technical commissions, like Earthquakes and Natural Hazards Commission, Geographic Information System Commission, Education Commission and, National Regulation Preparation Commission for Large Scale Map and Map Information Production, etc. He is also the representative of the Chamber in European Group of Surveyors.

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