Engineering Graduate Studies for Public Security Professionals: the Bachelor Thesis at the End of the Studies

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This work presents the latest results concerning the Bachelor Thesis developed at the end of the fourth course in the Security Engineering Degree. A combined approach has been selected applying technological issues to crime problems, and also attending to legal and social aspects involved.

Keywords: Bachelor Thesis, Security Engineering Degree, Engineering Degree.

1. INTRODUCTION

Traditional studies in Spain for officers of Law Enforcement Agencies focused mainly on social sciences with special attention to legal concerns related to crime prevention and investigation. Nowadays, new technical developments are commonly involved in crimes, and therefore technology is required in crime prevention and investigation. Due to the fast evolution of technology, a solid base in technical knowledge in security is required by the Law Enforcement Agents to allow them to adapt new tools and procedures.

High requirements of technical knowledge for law enforcement agencies have resulted in the change into a new model. The Guardia Civil, military law enforcement Institution under the Home Affairs Ministry decided to increase science and new technologies topics in their curricula for middle rank officer education to obtain a Security Engineering Degree with 240 ECTS (EU credits) in four academic years under the European High Education Area (EHEA). The Security Engineering Degree is the core of the studies for their future officers and has been designed in collaboration between Guardia Civil and the University of Carlos III of Madrid.

One of the crucial parts of the curricula during engineering studies is the Bachelor Thesis developed at the end of the fourth course. This work should be the link between the theoretical and practical learning at the university and the applied professional work in their future professional activities. In the case of the Security Engineering Degree, a new design is required since the project should be oriented to the current work that will be developed by the officer of Guardia Civil. A combined approach including technical and juridical contents has been applied to different cases of crime investigation.

The aim of this paper is to show the scheme followed in the designing of this important part of the new curricula of the officer of Guardia Civil.

2. THE INSTITUTIONS: GUARDIA CIVIL AND THE UNIVERSITY OF CARLOS III

The Guardia Civil is a Spanish national military law enforcement institution under the Home Affairs Ministry, focused on the protection of the free exercise of rights and freedoms, and on ensuring public safety. Since its foundation in 1844, it has been participating in the resolution of the main security issues affecting Spain as a State both nationally and internationally. Currently it is one of the most respected law enforcement agencies in the world owing to strong international projection. The Institution is the final user of advanced technology for security.

The University of Carlos III of Madrid (UC3M) was established by an Act of the Spanish Parliament on 5 May 1989, within the framework of the University Reform Act of 1983 [1]. From

the outset it was intended to be a relatively small, innovative, public university, providing teaching of the highest quality and focused primarily on research. Both Engineering and Social Science studies are offered at this University.

3. THE SECURITY ENGINEERING DEGREE

The collaboration between both institutions involved in the project, started at 2007, allowed the development of a special purpose degree (Security Engineering) combining the experience and know-how in education, research and public security.

The basic engineering courses of the Security Engineering Degree are very similar to those available at any engineering degree, constituting the scientific basis to prepare the students for upper courses oriented to technology and security.

The subjects are described in the following tables [2,3], where the first two years, taught at the Defence University Centre (CUD) (Zaragoza, Spain), are common with the Army.

Table 1. 1st Academic Year (60 ECTS) at the Defence University Centre (CUD).

1st Academic Year (60 ECTS) at Defence University Centre (CUD) – Zaragoza (Spain)			
1st Semester		2nd Semester	
Subject	ECTS	Subject	ECTS
Linear Algebra	6	Calculus I	6
Physics I	6	Physics II	6
Management fundamentals	6	Programming	6
Graphic Expression	6	Statistics	6
Fundamentals of Chemical Engineering	6	English	6

Table 2. 2nd Academic Year (60 ECTS) at the Defence University Centre (CUD).

2nd Academic Year (60 ECTS) at Defence University Centre (CUD) – Zaragoza (Spain)			
1st Semester		**2nd Semester**	
Subject	**ECTS**	**Subject**	**ECTS**
Calculus II	6	Strength of Materials	6
Operations Research	6	Industrial Organization	6
Quality	6	Environmental Technology	6
Fundamentals of Electronic Engineering	6	Fundamentals of Electrical Engineering	6
Mechanics	6	English.	6

These years of the Curriculum are devoted primarily to the basic sciences [4], serving as the foundation for the following two years taught at the Guardia Civil University Centre (CUGC) (Aranjuez, Madrid) by Guardia Civil members and UC3M staff [5]. From 3rd academic course, students start to deepen in technology applied to security. This part of the program is specifically designed for Guardia Civil.

The subjects are described as follows:

Table 3. 3rd Academic Year (60 ECTS) at the Guardia Civil University Centre (CUGC).

3rd Academic Year (60 ECTS) at Guardia Civil University Centre (CUGC) Aranjuez – Madrid (Spain)			
1st Semester		**2nd Semester**	
Subject	**ECTS**	**Subject**	**ECTS**
Techniques of hiding information	6	Vulnerabilities, threats and computer security protocols	6
Fundamentals of fluid mechanics	3	Lightweight protection for mobile systems	6
Dynamic explosion	3	Forensic Science I	6
Sensor Systems	3	Electronic Lab	3
Research Technologies I	3	Research Technologies II	3
Security Legal Framework I	6	Humanities: History of the Civil Guard, professional ethics and prevention of inequality	6
Administrative Law I	3		6
Administrative Law II – Public Safety	3		6

Table 4. 4th Academic Year (60 ECTS) at the Guardia Civil University Centre (CUGC).

4th Academic Year (60 ECTS) at Guardia Civil University Centre (CUGC) Aranjuez – Madrid (Spain)			
1st Semester		**2nd Semester**	
Subject	**ECTS**	**Subject**	**ECTS**
Administration and management of information security	6	Public Security Management	6
Communication systems and networks for security and emergency	6	Infrastructure security against impact and intrusion	6
Forensic Science II	6	Data processing	3
Security Legal Framework II	3	Research Technologies III - GIS	3
Fundamentals of Economics	3	Forensic Computer	3
Management and Leadership	6	Bachelor thesis	12

There are other important Military and Law enforcement aspects which must be simultaneously present in this education process, due to the dual status condition of Guardia Civil (Military status performing police missions). These subjects are covered by experts of Guardia Civil.

The resulting graduates need to change from the theoretical to the practical point [6]. Here, it is worth to note the importance of the Bachelor Thesis in the degree: at the end of the 4th course the link between theoretical and practical topics and the future professional activities constitutes. The objectives and characteristics of the Bachelor Thesis are described in the next section.

4. THE BACHELOR THESIS

The Bachelor Thesis has been traditionally developed by students in the context of engineering studies as the final part of their studies. For decades it has been a good opportunity to have the first contact with professional projects. The figure of the Advisor of the Bachelor Thesis is crucial for a student, and therefore, an advisor is usually involved in a few theses, developed in a small group of students.

Special characteristics of students and the Degree in Security Engineering should be taken into account when designing the structure and contents of the Bachelor Thesis [7].

Notice the character of students, being future officers of a law enforcement agency. Their professional life will involve a variety of activities related not only to technology but also to social and juridical issues. This fact requires a combined approach of the Bachelor Thesis involving technological direction and also assessment in social and law dimension.

This problem has been solved through the statement of a combined direction of the Bachelor Thesis. Technical aspects are carried out by a professor from University involved in some particular topics of the Degree, meanwhile professional aspects related to application to the activity of Guardia Civil involving legal and social requirements are responsibility of one member of the Institution. Both advisors collaborate for the topic definition, student assessment and final presentation of the Bachelor Thesis. The Guardia Civil advisor is in permanent communication with the most advanced activities of the different Operative Units of the institution, covering diverse fields. The most important of these fields are Road safety, Administrative control for weapons, and explosives devices, Security in port, airports, border and territorial sea, Environmental police and Tax police.

Final defences of Bachelor Theses undergo the preparation of a technical memory and oral presentation for a jury composed of external professionals, professors and researchers from the University and members of Guardia Civil [8]. The approved final reports will become in open access for the Guardia Civil members and future students, if confidentiality norms permit, in order to create a first technological database adapted to Security problems of reference.

5. RESULTS AND CONCLUSIONS

Following the structure previously described, up to 45 projects have been prepared and defended.

The activities covered by the Bachelor Thesis include the following topics:

- Personal protections and armoured infrastructures
- Forensic sciences
- Cyber-security
- Sensors for security

Figures 1 and 2 are the representative examples of the first topic, related with the use of numerical simulation tools, typical in solid mechanics problems, but adapted to be used in security applications related with impact problems. Figure 1 shows an example of one of the projects focusing on personal armours. A helmet for ballistic threads has been tested using a numerical code modelling the impact of several types of ammunition.

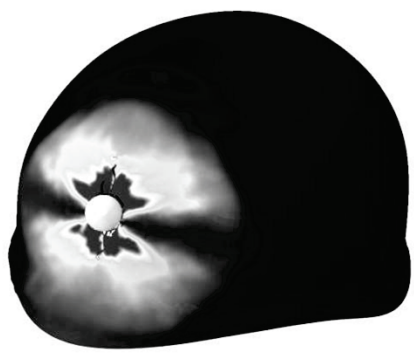

Fig. 1. Simulation of a sphere impact against a helmet developed as part of one of the Bachelor Theses.

The second example, Figure 2, is related to the design of armoured infrastructures, where numerical simulations are used to optimize thickness and materials in vehicle protection.

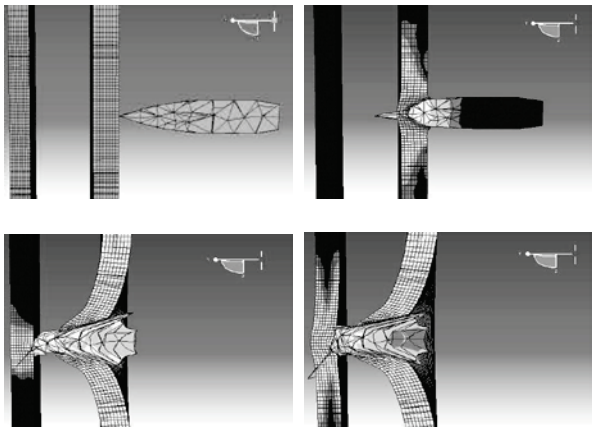

Fig. 2. Numerical simulation of a ballistic impact against an armoured plate.

The experience of development of Bachelor Thesis structure, evaluation and topics has constituted a challenge for both institutions Guardia Civil and the University of Carlos III of Madrid.

The perception of students and advisors has been highly positive. Students have the opportunity to develop real applications of the knowledge and abilities acquired during their degree. The contact with operative units of Guardia Civil seems crucial to achieve this objective, proposing to impulse some specific topics to be rapidly adapted in their units.

On the other hand, advisors from the University have collaborated with experts from Guardia Civil and the experience allowed a better understanding of the global project. New topics for future academics courses are under project and also research projects are under development between groups from both institutions.

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