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STUDENT'S INTERNSHIP PROGRAM AT POLITECNICO DI TORINO – AUTOMOTIVE ENGINEERING COURSE AS INDISPENSABLE SEGMENT OF TECHNOLOGY TRANSFER IN THE FRAME OF UNIVERSITY EDUCATIONAL PROCESS

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ABSTRACT: *The wider objective of student's internship is the achievement of better interaction between universities and enterprises for timely preparation of the university graduates for labour market. Within the frame of the Automotive Engineering course at Politecnico di Torino, the internship is considered to be an instrument to reduce the distance between the theoretical and methodological knowledge acquired during the academic carrier, and the applicative integrated and systematic knowledge which characterizes the industry. Internship represents an opportunity for the students of their temporary introduction into the industrial community, with the purpose of establishing a first contact with companies, and at the same time, carrying out a training period without the setting of a subordinate work. This paper is presenting the general information about the internship program at the Politecnico di Torino, its understanding, types, philosophy and objectives, benefits and correlation with academic credits, complete organizational structure and collaboration with industrial partner institutions. The applying procedure and activation of an internship, rights and obligations of the parties, and necessary documents relevant to student practice, are also described. Finally, a brief review of internship reports with final evaluation criteria of performed work, and internship evaluation questionnaire is given.*
KEYWORDS: *Automotive Engineering course, host company, internship, trainee*

INTRODUCTION

The Politecnico di Torino is the one of the most prestigious institutions in technical and scientific field in Italy; it is located in Turin, the capital of Piedmont Region. Thanks to its geographical location, the Politecnico is at the centre of the principal industrial European systems and it is very important factor for industrial, technological and social modernization. The year 2009 is marked as the 150th anniversary of Politecnico di Torino foundation and its long-standing tradition has been the basis for the reputation it enjoys today as one of the leading technical universities in Europe and throughout the world. In fact according to the Jiao Tong University's league table, it holds the 7th place in Europe for engineering studies, and is the first in Italy for internationalization and for technical studies according to league tables compiled by Vision and Censis.

In order to organize and manage its didactic activities, the Politecnico has 5 Faculties (3 of Engineering and 2 of Architecture) and the Scuola di Dottorato (PhD School). There are 18 Departments that manage one or more research fields, promote and coordinate research activities and organize research activities for external bodies. There are nearly 30000 students, of which about 4000 are new enrolments. Students are studying mainly in the Torino campuses but there are other 5 small reference campuses, located all over the Piedmont. PhD students are about 700, new PhD students are more than 240 every year.

The Automotive Engineering courses were initiated at Politecnico di Torino in the academic year 1999/2000, on the occasion of the centenary of the founding of Fiat, with the scope to give a properly conceived response to the demand of that specific courses within the engineering education proposal at the Politecnco. At Politecnico di Torino, it had long been active degree courses devoted to aerospace engineering, while only two streams within the mechanical engineering courses were offered for automotive and transportation engineering. Thus it was lacking an educational proposal completely dedicated to this widespread engineering branch: the automotive engineering, that is of the greatest relevance for the Torino area.

The degree course was established and is managed through an agreement between Fiat and Politecnico di Torino and has an important annual contribution of Fiat. The salient features of the agreement are concerning the content of lessons, joint educational activities, a significant number of non-university teachers (so with a sound industry background) and compulsory internships.

This Automotive Engineering degree stems from the belief that for many decades will be necessary to prepare engineers who are able not only to design and build cars, buses, motor vehicles for the transport of goods, special vehicles for agriculture and construction sites, but also to have sensitivity to problems related to the management of production

processes, the mobility of people and things, the green engineering (with particular emphasis on the environmental impact of producing operating and dismissing vehicles), the working place security, the product quality, the business organization, enterprise economics, marketing, the human resources management, relations with the world of automotive components. These high qualified subjects are specifically destined for the competitive development of automotive products, including a marked sensitivity to the technology landscape and the global automotive market. Thus this master degree owner will be prepared to operate in an international context taking into account the deep changes that are taking place in production facilities and in their location all over the world. To meet the competitive needs of the automotive sector, this Master of Science course is divided into three streams that students can freely choose: development of the engine, vehicle and system development, management.

The internship program in Automotive Engineering course seeks to provide students with a worked-based experience that is relevant to their course, together with opportunities to study the various functional areas within real enterprises and to extend the students sense of responsibility and reliability both as an individual and as a member of a team.

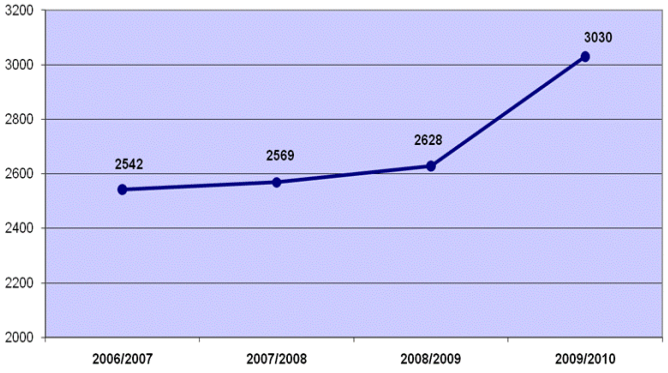

Figure 1. Number of internships performed per academic year

During the internship, students gain a variety of professional skills in employment related to their programme of study, and the ability to apply these to problems in real work situations. Students should be able to relate and apply theoretical and practical experience gained during the studies to their experience during professional training, while giving a full and useful contribution to the activities of the organization that is providing the professional training [1].

According to the analysis of internship projects undertaken at Politecnico di Torino, which scope is to monitor the effectiveness of work experience and perception of the service, the number of internships performed per academic year is increasing constantly (Figure 1). The analyzed data were collected in a database consisted of all training projects started at the beginning of internship. The information is inserted both by Politecnico and companies that are presenting hosting bodies.

UNDERSTANDING THE INTERNSHIP

Due to the Italian university reform, the internship has become an integrating part of the curriculum of engineers who, in this way, can get closer to the business world and obtain an evaluation of the internship activity in university (ECTS) credits. The internship is compulsory for the master degree course. The number of working hours dedicated to the internship is about 500 over about four months that is a quite big effort, and leads to the acquisition of ten academic credits.

According to didactic programme of the Automotive Engineering courses, the internship is introduced during the last semester (term) of Master of Science course. The minimum duration is 4 months, but according to host company needs, it can be prolonged up to 9 months.

The experience gained over years has proved that the value of the internship can be recognized both from the point of view of the student and of the host company [3]:

- *The student can experience the real work, he must face true engineering problems and find a solution, all that in cooperation with other people. It is no more the simple "academic" exercise made only by student itself, but it is a team work in company circumstances.*
- *The host companies consider internships to be both a doorway towards hiring and a moment of integration between academic and operative skills aiming to form professional persons at the end of the academic path. Such experience is important for the company since it allows it to evaluate a possible applicant.*

The academic responsible for internships is the director/manager of the Automotive Engineering University course. Complete practical work is handled by the office particularly established for students of this faculty. It is independent body with respect to Politecnico di Torino Stage&Job office, and it has been established with the scope to provide useful information and contacts only in automotive sector. Currently there are three types of internships, established at Automotive Engineering course:

- *The internship performed in an automotive company*

During this time, the student under the supervision of an engineer who is working in the company and an academic tutor from the Politecnico, has a real work experience. The student will be supported by the engineer in the development of the assigned project,

and also, he will collect all necessary data for the preparation of final thesis. In almost all cases, the internship experience is the preliminary step, which is providing useful information and database for MSc. Thesis.

□ The internship performed at Politecnico di Torino

Besides the internship in a company, students can experience the internship at Politecnico di Torino, usually working in the frame of projects that Automotive Engineering Faculty is offering in the collaboration with industry. In particular, Formula SAE and Shell Eco Marathon Competition Vehicles (extremely low fuel consumption and polluting emissions) are projects which are concerning the design and development of auto-cross racing cars with small formula styles and advanced lightweight materials, that are produced in the collaboration with partner enterprises in Turin and successfully demonstrated in several University student racing competitions in Italy and Europe. The production strategy of these cars consists in a concurrent analytical and experimental development, from the initial conceptual design and coupon testing, through the stages of element and subcomponent engineering, to final component manufacturing. In this way, students can follow the complete chain of product genesis – from design to manufacture. Further they gain a strong experience in team working with a very strict product delivery time.

□ The internship performed abroad

An internship abroad is a great opportunity for student not only to make work experience, but also to develop other types of competences like the improvement of language knowledge, of the culture, and of the lifestyle of the host country. As far as the carrying out abroad of the internship is concerned, the procedure is different with respect to an internship done in Italy, because all the bonds imposed by the host country have to be considered. Mostly all of these internships are performed at foreign European universities, and only small number in foreign companies.

The hosting companies, which are offering positions for internships to Automotive Engineering Faculty, are coming always from automotive sector. In order to propose an internship, the company should contact directly the responsible office. Currently, the Automotive Engineering Faculty is collaborating with about 100 industry partners from Italy and abroad which are offering internships to Automotive Engineering Faculty. The following table contain a list of main of them.

After the initial contact, companies have to provide the internship office of Automotive Engineering Faculty with a list of possible subjects, the related principal engineering areas and the name of possible industrial tutors which will guide trainee during the internship. Since the students of the second year of Master of Science course are subdivided by different specialization streams (power train, body & chassis, vehicle electronics, etc.), it is very useful that company covers at least more than one of the automotive sectors. The example of internship titles and areas proposed by Fiat Automobiles and Fiat Research Centre are shown in the following tables.

Table 1. Industrial partner institutions

FIAT Automobiles	FIAT Power Train	MAGNETI MARELLI	CRF (FIAT Research Center)
CNH (Case New Holland)	IVECO	TEKSID	PININFARINA
BENTELER	BMW	AUDI	ITALDESIGN
MICHELIN	SKF SPA	ROBERT BOSCH	SIEMENS
VOLVO	TOYOTA	General Motors Europe	DUCATI
PIAGGIO	HONDA	AZIMUTH YACHTS	BERTONE SPA
COMAU	FEDERAL MOGUL	TNO - MADYMO	JOHNSON CONTROLS

Table 2. Proposed internship projects of Fiat Group Automobiles

FIAT GROUP AUTOMOBILES – proposed internships	
AREA	TITLE
R&D - Chassis	New solutions of traction control for braking ESC modulators
Interiors	Methodologies and innovative technologies to improve the perceived quality of the instrument panel
Electrical electronics	Diagnostics of LIN: development services and protocol requirements
R&D - Body	The design of the full plastic front-end for high-speed collisions
Product quality	Development of the accelerated cycle: reliability test vehicle in customer view

ACTIVATION PROCEDURE OF AN INTERNSHIP

After the meeting between the company tutor and student, after having decided together the content of the internship, the modality of carrying it out, the timetable and the location, there are some compulsory documents which have to be handled in between Politecnico di Torino and the hosting company/public body before the start of the internship: Convention for the internship and Training project.

With the Convention for the internship, the parties declare their availability of enabling internships, undertaking to respect the rules in force (with specific reference to the aims and the maximum extension of the internship, insurance coverage, final evaluation). Without this agreement, no internship can be started. However once the Convention for the internship is signed, it is absolutely not compulsory for

the enterprise to accept a student for trainee. It is therefore fundamental for the activation of an internship to verify the existence and the validity of a Convention of the internship between student and Politecnico. Then, on the occasion, this should be confirmed and personalised with the specific Training Project.

Therefore, if the Convention for the internship is the agreement generally stipulated between Politecnico di Torino and the hosting body, the Training project is a document which directly involves the student or the graduate and which contains:

- *The names of the trainee, the Academic Tutor of Politecnico di Torino and the Company Tutor;*
- *The objectives, the modalities of carrying out and the duration of the internship;*
- *The details of the insurance policies stipulated by Politecnico di Torino against the accidents at work and the civil responsibility towards third parties;*
- *Company sector where the internship will be carried out.*

For starting of the internship and filling out of the Training project it is necessary that the student and the company agree on certain points like:

- *The location where the internship will be carried out;*
- *Duration and starting date;*
- *Educational objectives, a short description of which is necessary;*
- *The chosen company tutor (telephone number, fax number, e-mail address, information regarding the position in the company);*
- *Schedule: trainees cannot carry out a number of weekly hours greater than the one assigned by contract to the employees of the same organizational structure. That schedule is also relevant for the insurance coverage that will be given by the Politecnico.*
- *Reimbursement of expenses or benefits.*

The trainee will insert this information in the Training project and will have it checked and signed by the company tutor. The document will be also signed by the trainee and the academic tutor and will have to be handled in to the internship office of Automotive Engineering course at least 7 days before the starting date. The communication of the start of the internship will be done through a letter, sent by the internship office to the company tutor by fax. It will be the company's responsibility to inform the internship by fax in case of any type of variation (temporary transfer, schedule variations, interruptions or temporary suspensions) through the special form which can be downloaded from the Politecnico di Torino web site ("Modify or Interrupt an internship").

At the beginning of the internship the student will be given the internship book which contains:

- *the appointment calendar, in which the student will register the most important contacts which took place between the student, academic tutor and company tutor during the internship;*
- *attendance sheets, which will have to be filled out by following the instructions contained within the internship book itself.*

The internship book has to be returned to the internship office within 10 days after the end of the internship and is considered to be the only official document which accompanies the student during the internship and which certifies its correct carrying out.

INTERNSHIP REPORTS AND EVALUATION CRITERIA

At the end of the internship, students should write the detailed report about activities performed in the company or public body. This report has to be signed both by academic and company tutors for approval. In order to acquire 10 ECTS academic credits, the final evaluation of the internship report and achieved results is performed according to the statement: Satisfied or Not satisfied.

Furthermore, in order to improve and map out a course of internship activities at Automotive Engineering faculty, it is introduced the monitoring of the effectiveness of placements and the perception of the service. The analyzed data are collected in a database containing an evaluation questionnaire, submitted at the end of internship, where students can express their first impressions about the internship just finished.

THE EXAMPLE OF THE INTERNSHIP PERFORMED AT AUTOMOTIVE ENGINEERING COURSE

In this chapter, it is presented the summary of the internship performed at AUDI AG, by an MSc. student of Automotive Engineering course. The student spent 8 months in Ingolstadt, Germany, working on industrial R&D project. The title of the internship report is the influence of packaging hybrid components in the development of new concepts.

The project work deployed has been developed in the Concept Development Department at AUDI AG and under the supervision of the "Institut für Kraftfahrzeuge der RWTH Aachen".

Starting from the understanding of the evolution of the market of Electrical Vehicle in the upcoming future, the analysis focuses on the necessity of developing new power train technologies to reduce CO_2 emissions of vehicles. The new EU regulation introduces CO_2 emission targets that need to be met by OEM car fleets in the new future. Therefore, all OEM are developing Hybrid Vehicle (HEV) as the next step toward a mature electrical mobility.

The analysis then focuses on the development of Plug-In Hybrid, adopting an "Initial EV" strategy, allowing the vehicle to drive in pure electrical mode from start for the driving range set. Such strategy allows the vehicle to obtain 0 g/km of CO2 in the NEDC homologation cycle, helping to reduce the emissions of the fleet.

Once strategy is defined, the electrical components of a HEV have been analyzed in order to evaluate their size and volume to package. Battery, of course, represents the most important component in the definition of a concept of HEV: the size of the battery pack is variable according to the driving strategy chosen.

Once the Hybrid components have analyzed in terms of volume, a CATIA model has been created in order to understand the influence of packaging them on the car body design at early stages of development. The analysis has been conducted on a mid-size compact sedan.

The main settings of vehicle, such as H-point, ergonomics and dimensions, vary when Hybrid components are installed on board. Using the CATIA model, possible layout of components has been analyzed. The layout mainly depends on the position of the battery pack that must fulfill requirements for dynamics, production and crash performances. The two possible layouts have been defined: one with batteries packaged in the tunnel, the other with batteries packaged in trunk.

Packaging batteries in the tunnel influences the position of the dummy on both the first and second rows. Due to ergonomics reason, the driver results seated in higher position and in a sport position, affecting the comfort and the feeling of the vehicle. Moreover, passengers on the second row have less head room and leg room.

All results have been collected in order to understand strength and weakness of each configuration: on one hand packaging battery in the trunk does not affect the ergonomics of the vehicle, but has important influences on the dynamics, assembly; on the other having batteries in the tunnel allows a better dynamics of the vehicle and offers the opportunity to assemble the electrical components together with the drive train, even if there are limits on the dimensions of the battery. Though the second configuration affects the ergonomics of the vehicle, it offers better chances of improvement. The analysis conducted focuses on influences on the ergonomics: the next step would be the study of influence of Hybrid components on crash performances.

CONCLUSIONS

The internship in Automotive Engineering course has wider objective on achievement of interaction between university and enterprises for timely preparation of the university graduates for labor market. From this final scope, there are two specific objectives stated in the frame of constant internship improvement process.

The first one is oriented on improvement of students internship models in relevant study programs in order to enable students to experience the typical engineer working environment, to gain base professional experience, to develop skills, to explore career fields, and to contribute to the missions and goals of professional organizations, all while earning academic credit.

The second particular objective is to enhance the communication channels through which transfer of know-how from university to enterprises in the particular fields is achieved in order to contribute on improvement of relations and cooperation between Politecnico and enterprises as one of the major pre-request for development of knowledge based economy.

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