

## **NDT AND QS INTEGRATED EDUCATIONAL MODULS - A GATEWAY TO AN INTERNATIONAL BACCALAUREATE CREDIT PROGRAM**

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**Abstract:** Regulations are changing.

Organizations must implement appropriate level of educational programs in quality management, to achieve quality of education demanded by the market. Smart leveraging of compliance activities related to educational programs in quality control and quality management, can improve performance of educational system itself. The challenge is to create value through process design and implementation.

Course topics that are arranged by learning modules appropriate for the field of expertise of the learner, could decrease the costs for the institution while increase the quality of educational process itself.

Polytechnic College Velika Gorica will provide the course work on topics: Maintenance of Aircraft and Maintenance of Vehicles, as critical areas of need for Quality Control Methods and assessment. Aircrafts and Vehicles differ with the quaintness and individuality of forms and materials used, which can lead to implementation of complicated methods in NDT as well as other forms of procedure in quality assurance. Survey will be in the year 2003/2004, as the first generation of the polytechnic college, for the analysis of feedback on how the new education is modified to specific areas of expertise, while taken in consideration the students knowledge level and compatibility with other course programs.

Quality control courses of evaluation, integrated in bachalereaus credit program, with special approach on NDT, will be offered as an alternative to time consuming seminars and expensive workshops, after the graduation.

**Introduction:** In this paper is presented example of successful integration of NDT in standard education in polytechnic college. New technical engineers with strong understanding of NDT are educated in shortest practical time and in less time consuming and especially less expensive way. NDT as a profession today, still does not have the broad interception in general technical education, however here we would like to present our example where experience teaches us that it is possible to integrate NDT in regular study program.

Companies in need for new experts in NDT, usually hire experts in specific line of business, like maintenance of motor vehicles or maintenance of aircrafts with college degree (B.Sc.), and then invest time and funding for further education in NDT courses.

The only reason for NDT not to be accepted and included as a standard college subject is due to an expensive and time consuming process of keeping the step with cutting edge technologies. Another reason is that most of the highly qualified NDT experts work in industry –not being able to teach on universities.

Technical college Velika Gorica, starting with new studies has completely devoted to feed the needs of job market, and therefore maintains close collaboration with local and international companies. Technical college builds the program for students that integrate practical work with theory in 50:50 ratio, which enables subjects as practical as NDT to be integrated in standard program.

Result is that in three years new experts are produced, who will be able to do the job as soon as they start working for the company.

Teaching NDT theoretical approach as well as NDT skills, can only follow after quality assurance subject, or as an integral part of QA. That way prospect engineers will have general knowledge sufficient to enable them to realize the need for NDT experts, as well as to have use of NDT results. That way the general view on NDT technology is offered within the regular education and general interest for NDT business is created. Result is that more experts will look for the further specialization in NDT, if they already have the view in the field during their regular education.

Polytechnic college Velika Gorica has four different technical studies that offer their students specialization in NDT, while during the study they get a general overview of NDT techniques as well as Quality management.

Practice will show, how new graduates will be accepted on the market. Perhaps a new paper for the next NDT conference, and perhaps held by one of the prospective graduates.

**Results:** Directive as well as many safety regulations needs to be followed, to preserve life, health and environmental protection in regard to more and more complex products and services on the market. New regulations are set not only on production and service providers, but also on educational institutions that are in charge for our new experts.

The challenge for the International community in overcoming production and the maintenance safety regulations, in field of aircraft as well as other fields where lives are on stake as well as highly valuable material assets, remains an important issue. Education however needs to follow closely every step of this process.

In Europe where university education is known to be more traditional, structured and less flexible, problem of adjusting to new standards can be a harder job, then to start a new organization according to a standard from a scratch.

This is the case in Polytechnic College Velika Gorica (PCVG).  
Founded only recently, in 2003, when it started with a first year of freshmen enrolling the three year B.Sc. level technical programs, PCVG has successfully followed new sets of standards, and is therefore a kind of a pioneer in European education.

In case of Aircraft maintenance – JAR 147 standard for educational institutions in Aircraft maintenance set by JAA (Joint Aviation Authorities)\* was implemented\*\* and not only that the standard was followed but improvements were tested: NDT quality control education is involved through elective subjects, and through Quality management subject in general.

Such improvements, were not by any means meant to break the rules, on contrary, rules were followed through all obligatory courses students need to follow. Having in mind student educational workload—60 ECTS\*, credits represent one year of study with 30 credits are given for six months (a semester), selected course was introduced in order to improve students knowledge in NDT and quality control.

NDT and Quality Assurance –Basic Technical knowledge

PCVG - new founded College, does not have a brand strong enough to be a jump start for it's graduates. Therefore we needed to provide something extra, not just a no name B.Sc. degree, but besides the knowledge that our students will be able to prove – if given a chance – also a

recognized sign for each employer to bite right on – education of NDT in Quality System. Having a B.Sc. degree and NDT knowledge, should add to each curriculum a needed value that would be recognized by every employer.

It is necessary to provide skilled people, which can quickly meet international capacity and needs in the field of Maintenance of Aircraft and Maintenance of Vehicles. NDT as a selective course brings a strong value to this goal. The true understanding of NDT through the very start of engineering education, throws a new light on way students accept and learn each of the basic science subjects (Materials and Heat Treatment, Mechanics, etc.)

Basic knowledge from NDT methods that were included in educational programs are all based on ISO 9712 and EN 473. Specialization in NDT that is normally provided by National NDT associations, are included in program up to the level III. Students who will be involved in specialization in NDT, will be provided a practical work in associated companies, so that some practical knowledge will be granted even before their B.Sc. degree.

Such graduates can easily start their new jobs or progress within their current companies in field of quality management and NDT, granting their companies a valuable work from the first day.

After completing their studies, students will acquire 180 credits according to ECTS (European Credit Transfer System) and the professional title of Engineer (bachelor) of: Pyrotechnical Engineering, Motor Vehicle Maintenance, Aircraft Maintenance, IT Network Maintenance, Humanitarian Demining

Study duration

$$\begin{aligned} & 2 \text{ years of theory - lectures} \\ & \quad + \\ & 1/2 \text{ year practical work (NDT specialization possibility)} \\ & \quad + \\ & 1/2 \text{ year diploma work} \\ & \quad = \\ & \text{B.Sc. in specific field + NDT general knowledge} \end{aligned}$$

Each of professions represented grants better position, if NDT course work is selected – none of those fields can neglect NDT as a necessity of their expertise.

Efficient NDT depends upon four success factors: (1) proper organization, (2) planning, (3) process management at all levels, and (4) technical alertness.

The curriculum offers students the necessary organizational, managerial and technical knowledge and skills to perform all the tasks. The curriculum includes the new methods and technology and implementation of Quality system including QC, QA, QM and TQM. NDT as well as directives and standards, financial management, and operations at productive companies in related field give students the important message that NDT is a part of Quality system.

Specially interesting is the study of Humanitarian Demining, that also known as Mine Action Academy, is the only study program in the world, according to our records, in the field of land mine clearance held by civil and non governmental institution. First non military held institution that finds its sustainable cause in the fact that the problem of land mines clearance and detection is a problem shared by 91 countries in the world. In this moment more then 80 million mines is spread around the globe, waiting for their victims, while humanitarian demining is led by

insufficiently educated civilians. Why? Because all education centers are held by military organizations, for military personnel – for the purpose of military demining.

In any case, all those mines need first to be detected – and the only way to detect land mines is by Non Destructive testing methods

All study programs in general, and each for specific field of technology, need to enhance the ability to estimate: Capability of NDT methods or system used, probability of detection related to sensitivity, reputability and reproducibility as well as many factors influencing the reliability of NDT results.

Finally, there is also information technology (IT), as a must knowledge that each engineer needs. NDT methods and equipment require more IT as technology evolves, so that each NDT research and development centre, requires an IT expert with the basic comprehensive knowledge in NDT.

Our network engineers were quite amassed with lectures in quality management, however by the end of the semester students gained view into the field of expertise that might become their profession, as IT engineers with NDT knowledge. Imagine the possibilities of user friendly interfaces, programs that finally accomplish the level of design, NDT equipment networking with latest IT technology, giving automatically statistical reports compatible with standard tools.

For education in NDT that would mean less expensive seminars, with cheap IT simulation of each method, with on-line interactive tests, bringing students to practical part of education only when their comprehension of each method is already fully acquired. Today it unthinkable to have pilot training without a flight simulator. NDT education will become easier to integrate in general study process, once it becomes less expensive – and IT is the answer for cost reduction.

#### Cadre for Research and Development

The curriculum was designed to provide first-year students with the necessary general and basic technical knowledge. The third semester includes core technical subjects common for all studies, and the fourth semester includes technical subjects that are specific to a student's selected "specialist" studies.

Students spend their fifth semester at a co-operating company or institution, performing practical training and planning the project task of their final thesis, which is completed during the sixth semester. Each student is encouraged by mentor, who follows the progress of a student. Mentor is also engaged to help student find a company for the practical work, if student is not already employed. Companies are encouraged to help students fund their NDT specialization, which is then acknowledged (on basis of ECTS credits) as either one of the electives in second year, or as part of the 6 month practical work. Students get a chance to find employment and already specialize their specific line of business during their B.Sc. program. Companies get a chance to choose most successful candidates, and get new experts in less time and for lesser cost.

During the sixth semester, students have the opportunity to prepare for their final exam through discussions with their mentors. Successful candidates will continue to collaborate with companies where they did their practical work. In that case final thesis is done through collaboration or as continuous project with companies where practical work has been performed. Candidates, who will be granted a funding for NDT specialization, make their final thesis in collaboration with future or actual employers, as project in NDT for the company. That way companies have benefit from PCVG students even before their Diploma.

#### Study of Motor Vehicle Maintenance

The 6-semester curriculum of Motor Vehicle Maintenance provides a professional level of knowledge in the shortest practical time for all who want to be involved in the maintenance of

road and special vehicles. There are two aspects - the academic quality and the customer orientation of the PCVG that are our major objective.

#### Professions employing motor vehicle maintenance engineers

Vehicle Maintenance engineering is the branch of the engineering profession that is concerned not only with repair and damage control, but also research and analysis. Quality control of production and service operations and systems, as well as NDT quality control is introduced as one of the majors in from the very first semester.

There is a need for educated, skilled motor vehicle maintenance engineers in various industries. Contemporary modern technologies in motor vehicle maintenance today require a multi-tasking ability and fast learning ability. Our students will become engineers in motor vehicle maintenance, with knowledge in quality control and NDT. Such education prepares graduates for multitasking and gives them ability to learn easily. New technologies that are yearly introduced in car industry can easily be comprehended by graduates of our 3-year program.

#### NDT specialization

Graduates, who develop a special interest for NDT, can easily follow and specialize in any of NDT's technologies. They can continue their NDT education through PCVG or through any other organization chosen by their employer. Best solution is however, that such individuals are recognized during their course of study, by their current employers or by potential employers, who meet students during their obligatory one semester practical work. Current or potential employers can in that case in collaboration with PCVG, fund their students to concentrate in specific NDT course, which will then be recognized in ECTS credits, and evaluated as one of the majors of their study program in PCVG. That way company will gain new expert for less money and in shorter time.

#### Study of Aircraft Maintenance

The technical study of Aircraft Maintenance covers the requirements for experts in aircraft maintenance. The Aircraft Maintenance program consists of the fundamentals of modern engineering while using intensive lab work, aided by computer programs. Program prepares students to pursue a career in aircraft maintenance, and enables students to take 'C level' JAR certificate, after 2 years of working experience.

The program is built according to JAR 147 standard and therefore provides knowledge in techniques, procedures and documentation standards necessary to perform maintenance on aircraft. That would include: disassembly, inspection, repair, re-assembly and testing of the aircraft and its systems. All aspects of aircraft maintenance are covered in this study, including the airframe, power plant, aircraft electrical and electronic equipment, aircraft systems and the regulatory requirements in aviation.

#### NDT specialization

Polytechnic College Velika Gorica (PCVG), introduces also elective subjects, beyond JAR 147 requirements. Students do not need to take this subject, as it is not required by JAA for their C level, however course is strongly recommended by PCVG mentors.

PCVG students have mentor who helps them choose and find best line of specialization, who helps with collaborations with companies, that each student finds a company for contemporary practical work. It is during this contemporary period that students are introduced with NDT mostly, for PCVG has a strong collaborations with Croatia airlines quality control in maintenance. Students

can choose to continue in NDT specialization after they take elective 'NDT in aircraft maintenance course.

Through close collaborations with mentor and associated companies funding can be found for students who want to specialize in NDT. Such students will:

- 1) save time, and finish NDT course during their B.Sc. program – course will be granted ECTS credits, as an elective in the second year.
- 2) Companies funding prospect experts, save time and investment in new employees who need to reach professional level of expertise. PCVG graduates can start being a productive part of the company instantly after their graduation.

PCVG introducing educational moduls of NDT and Quality assurance:

1<sup>st</sup> year - basic engineering courses + elective NDT course

2<sup>nd</sup> year – specific aircraft maintenance courses according to JAR147 + NDT specialization (if elected by student and funded by company)

3<sup>rd</sup> year - 6 month of practical work, NDT specialized courses are accepted as practical work/ or as second year elective

Professions employing aircraft maintenance engineers

The need to employ aircraft maintenance experts is highly growing due to a fact that new JAR standards are being introduced in whole Europe for maintenance of aircraft.

Graduates of this program may also find employment with any of the local, regional, national or international air carriers, maintenance organizations or aircraft manufacturers in Croatia or abroad. Introduction of NDT specialization possibility brings an extra value to PCVG graduates and hopefully higher chance for employment.

\*JAA is an associated body of the European Civil Aviation Conference (ECAC)

\*\* the actual certification for JAR 147 has it's own speed, since Croatia has only recently became a full member of JAA

\*ECTS: European Credit Transfer System, another new standard also implemented on PCVG

**Conclusions:** Looking to the future possibilities of NDT – there is no progress in NDT research and development without critical number of new experts in the field.

With all due respect to accomplishments made in NDT today, and all the individual efforts involved – more general systematic approach by involving NDT in general education, through the gateway of quality management subject, could be a great contribution to popularization of this technology.

Specialist education presented today, and very well organized through EFNDT and ICNDT will in further remain the leading support to each educational centre in NDT, however general knowledge of NDT, needs to become more present in basic higher education, on most of the technical studies.

Involving R&D in NDT field in general education, will contribute to sustainable development of NDT, opening views to students who will choose to become NDT experts.

As in every field of business NDT needs to become larger and more acknowledged brand, more known to experts of any field of technology.

NDT needs to follow up with new standards – and influence on new regulations not only on standards referring to production and R&D, but also in the field of education. Education not only in the field of NDT, but in every technical field.

Maintenance of aircraft for example – regulations of education are set by JAR 147, and NDT is implemented for the first time by Polytechnic College Velika Gorica, as an elective subject.

Not undermining the necessity of the knowledge covered by the standard – our view is that each engineer needs to have the basic knowledge in NDT, however Maintenance without NDT today is unthinkable.

**References:**

1. Krstelj, V.; Krstelj, T.: Feasibility study of Polytechnic College Velika Gorica, Center of Technology Transfer, Zagreb 2003.,
2. Civil Aviation Authority, JAR – 66 Aircraft Maintenance Licence, Documents 03, V16
3. Civil Aviation Authority , JAR – 147
4. ISO 2000 Standards