



# NONDESTRUCTIVE TESTING EDUCATION PROGRAM: A PRACTICAL STRATEGY FOR YOUTH EMPLOYMENT IN SAUDI ARABIA

Ahmed Yamani<sup>1</sup>

*1: Associate Professor, Electrical Engineering Department, KFUPM.  
KFUPM, P.O.Box 1811, Dhahran 31261, Saudi Arabia*

*E-mail: [myamani@kfupm.edu.sa](mailto:myamani@kfupm.edu.sa)*

## ABSTRACT

*Nondestructive testing (NDT) profession is the roundabout of many engineering and science disciplines. However, it is also a "black Smith" profession, as NDT skills are not normally taught at traditional engineering schools. Rather, these skills are acquired through hands-on practice coupled with multidisciplinary training. To quantify NDT knowledge, certification schemes based on written practices are used. These schemes categorize it into three groups called Levels.*

*Due to the high demand and requirement of NDT services in the Kingdom, many NDT service providers companies have been created in the last two decades. In the eastern region alone, there are more than 5000 NDT personnel in which Saudi Manpower share is very slim.*

*In this paper, we propose a two years comprehensive NDT program that can be implemented by either KFUPM (in the existing Diploma program) or any Saudi Technical college. The impact of this proposal on Saudization and employment of Saudi youth will be substantial.*

**Keywords:** *Nondestructive testing program, Saudization.*

الملخص

## **1. INTRODUCTION**

Saudi Arabia experienced significant industrialization during the last few decades, especially in oil / petrochemical, power installations, and desalination plants. All these industries require periodic and regular inspections and maintenance. Such requirements become even more essential and frequent in a harsh weather like that in the gulf region. The methodology used to carry out such inspections and monitoring is based on internationally standardized techniques known as nondestructive testing (NDT).

NDT skills are not normally taught at traditional schools or institutions, but rather such skills are acquired through practical experience and a process of multidisciplinary training. Such skills are quantified by universally recognized standard examinations that categorize the skills into three levels: Level I, Level II, and Level III. Upon passing these examinations, certifications are awarded, which need to be renewed after a prescribed period of time.

Due to the high demand and requirement for NDT services by the local industries, there are a number of local companies that provide NDT services to local industry. Many of these companies started their business in the 1990's. Some of them are only a few years old. It is worth mentioning that the Saudi manpower share in these companies is very slim, and thus, an NDT program that can be implemented either by KFUPM or Technical colleges is a must. Saudi Youth can undergo a two year NDT program first, followed by an International Certification carried out by an outside agency. This will enable Saudi youth to find a job after a successful completion of such a course.

## **2. STRATEGIC IMPORTANCE OF NDT TO THE KINGDOM**

### **2.1. Definition**

Nondestructive testing is the examination of an object with technology that does not affect the object's future usefulness. NDT provides an excellent balance between quality control and cost-effectiveness. The term "NDT" includes many methods that can

- detect internal or external imperfections
- determine structure, composition, or material properties
- measure geometric characteristics

NDT is used in all phases of a product's design and manufacture, including materials selection, research and development, assembly, quality control, and maintenance. Many NDT methodologies [Halmshaw, 1998] exist namely:

Ultrasonic testing (UT), Radiographic testing (RT), Magnetic testing (MT), Eddy current testing (ET), Acoustic emission testing (AE), Thermography testing (TT), Liquid penetrant testing (LT), etc...

## **2.2. Market Place**

Numerous types of industries ranging from small construction and maintenance companies to giant petrochemical installations require the NDT services in the Arabian Gulf region. Such industries include:

- Production Facilities (on-shore and off-shore)
- Oil & Gas Pipelines
- Storage Tanks
- Gas Plants
- Refineries
- Power Plants
- Desalination Plants
- Petrochemical Plants
- Transportation (Air and Sea)
- Manufacturing (Metals, Plastics, Glass...)
- Construction (Concrete...)

## **2.3. NDT Industry Review**

NDT industry is undergoing rapid change. The core NDT technologies are evolving in important ways, providing new benefits to end-users. The applications in which NDT is used are also changing rapidly. Many of the industries that have traditionally used NDT techniques are stagnant or declining, while other industries that have rarely used NDT techniques are showing increasing interest in employing NDT. In addition, a wave of consolidations and mergers has recently swept over the NDT industry, with many large companies leaving the market.

### **2.3.1 NDT Equipment Market**

The 1997 U.S. NDT equipment market was \$674.9 million [BCC 2000]. This market is projected to grow at an average annual growth rates (AAGR) of 4.5% to reach \$839.7 million by 2002. The NDT techniques expected to experience the fastest growth over the next 5 years include infrared and thermal testing, acoustic emission, and eddy current. The techniques experiencing the slowest growth are expected to be radiographic testing, liquid penetrant and magnetic particle testing. These techniques do not easily lend themselves to automation or computerization, causing many end users to abandon the techniques in favor of others such as ultrasonics or thermography.

The United States dominates the world NDT market, accounting for over 40% of total sales, followed by Europe and Asia. Asian countries are expected to experience the highest AAGR in NDT sales, at 6.3% per year.

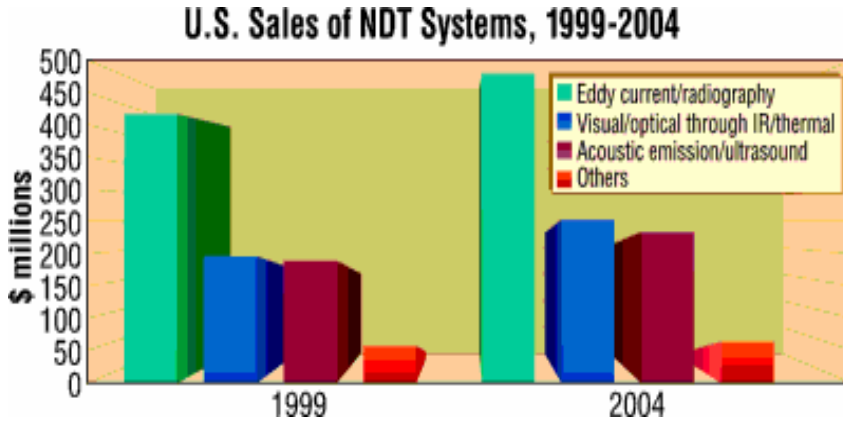


Figure 1: US Sales of NDT Systems, 1999 and 2004.

Of all end-user industries, chemical and petrochemical plants are expected to show the greatest increase in demand for NDT equipment. These plants are using NDT as a key component in maintenance programs designed to reduce plant-operating costs. Electronic manufacturers will also exhibit strong demand increases for nondestructive inspection equipment such as radiography systems that can be integrated into production lines for process control. Demand increases are expected to continue in most areas through 2002.

### 2.3.2 NDT Service Market

The NDT service market is huge. Obtaining a precise and global figure is close to impossible in view of the absence of any analysis in this field as it deals with many sensitive areas such as aerospace, military, petrochemical...etc. However, one can have an idea about the size of the market by considering a known case.

It is known (as a rule of thumb) that the inspection budget represents 15% to 20% of any new pipeline installation cost. Taking the pipeline industry for instance, it can be seen from Table I [Ives 1999] that an average increase of 1,500 miles of pipelines per year (worldwide) yields a net increase of \$450 Millions in inspection cost.

Estimated miles [Ives 1999] of natural gas crude oil and refined products pipelines underway or planned for construction outside the U.S. and Canada total 75,995 miles (122,276 km) [Ives 1999], which incur an average inspection cost between \$17.099 to \$22.799 Billions.

For the Middle East (Table II), this figure ranges between \$3.036 Billions to \$4.049 Billions. Saudi Arabia’s bill of pipeline inspection ranges between \$304.88 Millions to \$406.5 Millions. Bearing in mind that this figure represents inspection cost for newly erected pipeline project only, one can imagine the enormity of inspection budget when other sectors are included.

**Table I:** Pipeline erection and inspection Cost.

	Length (miles)	Installation Cost in billion\$	Inspection Cost billion\$
1997	20,400	29.784	4.468 - 5.957
1998	22,300	32.558	4.884 - 6.51
1999	23,377	34.130	5.12 - 6.826

**Table II:** Miles of pipelines underway/planned/proposed for the Middle East [Ives 1999].

Country	Gas		Crude		Products		Totals		
	Current	Future	Current	Future	Current	Future	Current	Future	Totals
AbD	62	407					62	407	469
Iran	95	2,907		809			95	3,716	3,811
Iraq		805		347				1,152	1,152
Jordan	20	390		201		99	20	690	710
Oman	140	570					140	570	710
Qatar		409						409	409
KSA	101	652		417		185	101	1,254	1,355
Syria		103						103	103
Turkey	420	2,373		538			420	2,911	3,331
UAE	40	310		236			40	546	586
Yemen		207						207	207
Totals	878	9,786		2,548		284	878	12,618	13,496



Figure 2: Qatari Gas transportation to UAE, Omani and Pakistan Market

## 2.2. NDT Service Provider in Saudi Arabia

There are a number of local companies that provide NDT services to the industry. Many of these companies started their business in the 1990's. Some of them are only a few years old. In addition to NDT, these companies provide other services such as NDT equipment procurement, and training of NDT personnel. The list shown below illustrates some of these NDT service providers.

- AMSYCO
- NDT& CORROSION CONTROL SERVICES
- VETCO
- INDUSTRIAL SUPPORT SERVICES (ISS)
- FAHSS/TUV
- H.A. AL HUSSEINI INSPECTION Co.
- AL HOTY-TRANGER Ltd.
- SGS INSPECTION SERVICES
- GISCO
- AL-OTHMAN TRAINING & CONTRACTING CO.
- GTC (Geotechnical Testing Center)

These companies operate jointly with Western NDT SP companies under a joint-venture (JV) or a memorandum of understanding (MOU) agreement.

### 3. PROPOSED NDT PROGRAM

To my knowledge, there is no dedicated NDT school in the world. In the last few years, few community colleges in the USA started introducing NDT programs in their curricula. However, many schools throughout the world have close-training courses for NDT technicians at level I, level II, and Level III. The duration of these training courses does not exceed three weeks.

Our proposed NDT curriculum span over four semesters. Each semester is as illustrated below.

**Table III:** Semester I.

Course	Credit hour
English	3
Math	3
Physics	3
Metallurgy	3
Instrumentation	3 (2 +Lab)

**Table IV:** Semester II

Course	Credit hour
Electricity & Magnetism	4
Mechanics	4
Material Science	3
Welding Technology	3

**Table V:** Semester III

Course	Credit hour
Ultrasonic	3 (2 +lab.)
Radiography	3 (2 +lab.)
Magnetic particles	2 (1+ Lab.)
Eddy current	3 (2 +lab.)
Liquid penetrant	2 (1+ Lab.)
Acoustic emission	3 (2 +lab.)
Thermography	2 (1+ Lab.)

**Table VI:** Semester IV

<b>6 months training at NDT SP company</b>
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At the end of this program, students would have satisfied the requirements of any written practice. Certification can be done at the student (or his sponsor) cost, and can be arranged by the University or the Technical College responsible for the NDT program. Usually, one week training by a certifying agency would grant successful students to NDT level II in one or more NDT techniques.

### **3.CONCLUSION**

Realizing the importance of this elegant scheme for the Kingdom, it is, therefore, highly desirable to have a public institution adopting such a program. KFUPM is best placed, with its diploma program and its two community colleges, to pioneer this novel idea. A pilot scheme can be first implemented in the diploma program, and can then be extended to KFUPM community colleges at later stage.

The NDT program when implemented will enhance the employability of the Saudi youth, which will contribute significantly to the implementation of H.R.H. Prince Mohamed Bin Fahd's Program for Saudization.

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Useful links:

1. <http://www.krautkramer.com/training/patrainning.htm>
2. <http://www.conaminsp.com/offering1.htm>
3. <http://www.clt.astate.edu/RadSci/PschND.htm>
4. <http://www.ndt-ed.org/EducationResources/CommunityCollege/Radiography/Introduction>