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Metrology impact in Technological Universities, Mexico

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Abstract

The Universidades Tecnológicas (Technological Universities) in Mexico have as a mission to offer a high quality education model which has been in operation for more than 50 years in countries where it has proven to be a success. In 1998, the Centro Nacional de Metrología (CENAM) collaborated with the Technological Universities by means of an in-depth technical training in Metrology. The objective was to disseminate the metrological knowledge among the academic members and stimulate them to establish secondary calibration laboratories in their institutions.

Keywords: Metrology, technological universities.

1. Introduction

The Technological Universities (UTs), born at the end of the last century, have to fulfill the need from industry to have graduates with solid practical knowledge. The academic subjects at the UTs are balanced so that students have 70% practical and 30% theoretical activities. Since 1991, the UTs are preparing professionals who will be working between middle commands and superior commands. [1].

The core objective of the UTs is to make industry to participate in the study programs definition for all the different professional studies. This is made for each region of the Country, so that the program studies are directed to the specific needs of each region in Mexico.

From the analysis process performed with the collaboration of several industrial, research, governmental and academic sectors, three study programs were identified to require metrology knowledge to measure products, process and services in order to be able to make the adequate decisions and hence ensure that the quality and technical written standards are met:

- a) Production Processes.
- b) Industrial Maintenance.
- c) Electronics and Automation.

2. Background

Companies declare the strong need to fulfill the existing regulations in diverse matters such as security, environmental impact, quality as well as the fulfillment of the Federal Law on Metrology and Standardization emitted in July 1992. [2].

The Centro Nacional de Metrología [Mexican National Metrology Institute] CENAM, was formed for the fortification of the national metrology system according to article 29 of the Federal Law on Metrology and Standardization, published in the Official Newspaper of the Federation July 1st of 1992, and its reforms published in the Official Newspaper of the Federation the 20th of May of 1997. Its mission is to support the diverse sectors of the society in the satisfaction of its present and future metrological necessities, establishing national measurement standards, developing reference materials and disseminating its accuracy by means of technological services of the highest quality, to increase the competitiveness of the country, to contribute to the sustainable development and to improve the quality of life of the population.

On the other hand, education is the means which will allow spreading metrology and its importance to society and to the industrial sector. The use of metrology as a basic tool of study and analysis allows assimilating everything what surrounds us, from the simplest to the most complex thing. Metrology facilitates the homogenization of characteristics in products and processes for a new globalized world, the Inter changeability of knowledge and products allow therefore scientific, technological, productive, commercial and economic development.

Due to the previous needs and the resources available the Technological Universities (UTs) search support from the Mexican National Metrology Institute (CENAM). The answer was a technical training program in metrology (TTPinM) with the purpose of spreading the metrological culture among the academic personnel of the System of Technological Universities that will then scatter the knowledge to the student population later. To initial objective was to acquire the concepts of measuring instruments calibration and the uncertainty associated for the quantities of length, mass, temperature, pressure, flow, volume and electricity; besides that, the idea was to help the efforts of the Technological Universities to establish calibration secondary laboratories in its facilities and to make possible its accreditation in the future.

3. Metrology in the UTs

This TTPinM begun October 5th 1998, and finished February 4th 1999. The initial participation was by the Technological Universities of Querétaro, Coahuila, San Luis Potosí, Nezahualcoyotl, Guanajuato and Tula Tepeji. Being the development and the diffusion of the metrological culture in our society one of the fundamental functions of CENAM, the collaboration with the System of Technological Universities for the training of personnel comprised a new generation of metrologists for the Mexican National Metrology System.

After the training, the UTs made a reform of its study programs to include the subject of metrology, as of year 2000. To sensitize the students in the use of the international system of units, that although is almost 50 years old has yet to be

adopted in our country in the everyday activities. The subjects of vocabulary, the nomenclature and how to calculate the measurement uncertainty were also included. [3, 4, 5]

At the end of their program the students know the importance of a measurement; how to interpret and analyze results of measurements and they forget the existing erroneous idea that just by measuring it is enough. They know that instruments require to be calibrated at adequate intervals; it is taught to them to distinguish the concepts of error, accuracy and uncertainty; the basic traceability concepts, written standards, metrology benefits, basic definitions, vocabulary of general terms of metrology, International System of units, accuracy dissemination of the standards, basic units, derived units, Federal Law on Metrology and Standardization, introduction to uncertainties estimation, measurement process, repeatability and reproducibility, metrological quality insurance.

The industrial sector usually incurs in errors due to bad measurements and data processing. These translates in production decreases, waste, bad quality and impact in their finances; it is important to recognize the errors, their causes and having trustworthiness in the measuring instruments that, by nature, will always have uncertainty. Nevertheless, this well-known uncertainty must be obtained by means of calibration with traceability to our national and therefore international standards will allow industry to make the most reasonable and adequate decisions. All this awareness is acquired by the University Superior Technician (graduate from a UT) through the metrology subject studied at the UT; from here they will live it and apply it into the real practice; they will thus contribute to the promotion and interest on the value of measurements science with the purpose of generating an optimal economization, taking into account the functionality of instruments and processes with objective and safe technical criteria.

The Universities of present Mexico face great challenges, one of fundamental importance is to establish within their training programs Metrology. Conscientious of this, the director of the Technological University of Tula Tepeji (UTTT), Alicia Grande Olguín impels the metrology culture supporting the update and formation of personnel through academic bodies that work in projects of research and application within the field of metrology, still barren in the educative culture of our Country.

Product of the alliance between the UTTT and CENAM has been possible to insert some students in the accomplishment of projects in the laboratories of mass, temperature, dimensional, electrical, force and pressure, flow and volume. Thanks to the follow up of academic advisers and the invaluable support of the metrologists and executives from CENAM, lead by Dr. Hector Nava Jaimes (General Director), that shared their knowledge and research with the students, the academic formation have concluded and the students have been integrated to the work field in a successful form contributing to the dissemination of metrology in the industrial sector; some of them are working in CENAM. Also, students have made training projects related to metrology in companies; and advising the industrial sector about the services that our primary national metrology institute offers, fulfilling the objective of dissemination of the metrological culture in our Country.

4. Discussion

The uncertainty is understood as the doubt that exists in the result of a measurement; this doubt is an interval within which the true value could be found. All measurements, without exception, present this doubt and its knowledge allows making decisions with respect to the obtained results, for example acceptance or rejection of products. In order to have confidence in the measurements the instruments must be calibrated, that is to say, they are due to be compared with other instrument with better accuracy called standard; when compared a statistical analysis of its behavior is carried out as well as of the influence that the main variables have: some causes of variable influence are due to the manufacture of the instrument, others due to the operator or the method, to the environment. This analysis implies to make calculations of the quantity (characteristic to measure) and its behavior, firstly isolating each variable, and finally combining all of them.

Knowing these influence variables and their behavior during a calibration means a greater trustworthiness of the data provided in a calibration certificate or technical reports, to the client. Also this makes possible to give recommendations on the care to have when measuring with the instrument to obtain more accurate results. Mexico must work for the generation of value and wealth in the society. This implies that all organizations and companies, public or private, of the country assume and respond to the exigencies of quality and productivity imposed by the present competition.

These exigencies of quality and productivity, base for the competitiveness, can only be confronted successfully if a metrological culture and the elements to exert it suitably are acquired. The civilized life implies a series of regulations, customs, and laws that allow us to live in community, with an honest behavior with respect towards each other, that facilitate the order, the efficiency and the interrelations, some examples are the language, the official schedules, the symbols, the products, among others.

The set of these regulations can be called standardization. Basically, standardization is communication between producers and consumers or users based on technical terms, definitions, symbols, methods of test and procedures. It is, in addition one discipline that is based on certain results acquired by means of science, technique and experience, fruit of the balance between technical - economic of the moment. The technical standardization was considered, until some years ago, as an effect of industrialization and development. At the present time it is the cause or motor element in which industry and economic development leans. The measurement and the standardization are a fundamental activity in the economic evolution of any country and the Technological University Tula Tepeji, arduously works in the transmission of this metrological culture in benefit of the university community and society in general.

5. Conclusions

Technical standardization was considered an effect of development and industrialization. Now days, it is the stone or motor element in which industry and economical development is supported. Measurement and standardization are

important activities in a Country's economical evolution. The Universidad Tecnológica Tula Tepeji (Tula Tepeji Technical University) works intensively in disseminating the metrological culture in benefit of the university community and society in general.

As from year 2000, the study programs at the UTs were improved to include the subject of metrology in order to make students aware of the SI units, the metrological vocabulary as well as measurements uncertainty evaluation and the need of traceability. The UTs have now people with solid background in metrology.

Table 1
First metrologists generation in the Universidades Tecnológicas (UTs) {Technological Universities}

Name	University
Gustavo Mercado Barrera	Universidad Tecnológica de Coahuila
Laurencio Galindo Vargas	Universidad Tecnológica de Nezahualcoyotl
Ernesto Alonso Partida	Universidad Tecnológica de Querétaro
Felipe Aguilar Pereyra	Universidad Tecnológica de Querétaro
Jorge Gutiérrez Velasco	Universidad Tecnológica de Querétaro
Juan Carlos Pérez Lujan	Universidad Tecnológica de Querétaro
Mario Guerrero Martínez	Universidad Tecnológica de Querétaro
José de los Santos Mauricio	Universidad Tecnológica de San Luis Potosí
Fabiola Laguna Aguilar	Universidad Tecnológica de Tula-Tepeji
Sergio Martínez Sánchez	Universidad Tecnológica de Tula-Tepeji

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