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Organization of NDE Centers
The Brazilian Center for Nondestructive Evaluation (CAND)

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Abstract

The assurance of technical safety and quality of materials, parts and components during production and operation, along with monitoring and control of structural health processes and other scenarios, has become essential for modern high-tech industry. As a result, the market demands for NDE equipment and services are growing in respect to specific applications and fit-for-purpose equipment. Furthermore, NDT has become important for national policies directed towards the development of a national engineering infrastructure and to meet government directives.
The development of industries and the use of techniques, which may cause severe damage in case of failure, are also subject to international cooperation and agreements. As a result, within the international framework, each nation has to assume responsibility for safe, secure and controlled technologies.
These aspects prompted the establishment of NDE centers in countries with high-tech industry and installations, such as nuclear power plants. NDE centers have the mission to support authorities and industry, offering education and training to NDE engineers and technicians, developing and certifying specialized solutions for NDE problems, providing technical and scientific information and services and, finally, monitor worldwide NDE activities to consequently spread the culture for safety and quality.
In 2006 we have launched the CAND project in Rio de Janeiro, Brazil. CAND is the Brazilian Center for Nondestructive Evaluation, a non-governmental non-profit organization. CAND has strong links to industry and to universities and focuses on awareness of, and response to, the needs for advanced NDT. Moreover, the CAND advisory board is able to organize international cooperation and is capable of

demonstrating Brazil's ability to take full responsibility for industrial installations and products, which must be safe and reliable.
We present the organization, mission, objectives and current activities of CAND and also illustrate similar projects that have recently been launched in Asia.

Keywords: NDT/NDE Center, Validation, Training, NDT Services

1. Introduction

Technical services are an indispensable element of an efficient industry infrastructure and are necessary for the fulfilment of national responsibilities. Nationalized technical services evolve and expand in accordance with the need and the availability of technologies and knowledge.

Nondestructive testing and examinations are important ingredients of technical services. They are needed to ensure the quality of products and safe operation of technical components, products and plants. Quality and quality costs are performance parameters used to measure the success of sophisticated industry, and technical safety is the prerequisite for the operation of industrial systems in the key areas of a national economy, such as transportation engineering and power engineering.

In traditional industrialized countries the government regulates the use of nondestructive testing and examinations at an early stage [1, 2, 3] by implementing laws and regulations, which lead to a comprehensive body of rules and regulations [4, 5]. The driving force of this development has largely been industry, but it's also heavily influenced by public and/or non-profit organizations.

In the course of the internationalization of markets and technologies, the standardization of technical rules and standards [6] has already started, whereby countries with developing industries are frequently forced to accept existing rules and standards. Although these rules and standards are sufficient to fully comply with technical requirements, inflexible transfer of those rules and regulations to a new culture may obstruct the development and acceptance of accountability and liability, which are important prerequisites to building the obligatory confidence and capability needed to construct and operate industrial plants or complex high-technology systems.

2. Effects of Globalization

Today, production, markets and technical knowledge must be perceived from a global perspective, including the consequences briefly outlined in this paper [7]. Today's production has become highly mobile and constantly looks for optimized conditions for industry locations, which are determined by the local infrastructure. To a large extent, the markets are occupied by globally available products that are only customized for a specific market. The success of a product on this globalized market depends on specifics such as novelty, quality and serviceability and the availability of technical services. The globalization of products and markets likewise leads to the break-up of established public education and research and development structures. Knowledge becomes a

global product and leads to a dramatic acceleration of the innovation cycles in global competition. In this environment, ethical and responsible partnerships between countries are critical for a mutually beneficial cooperation.

The first world conference on NDT was organized and held in 1996. Consequently, the World Federation of NDE Centers (WFNDEC) was established in 1998 and, in the meantime, consists of twenty-one institutes and institutions from 14 countries [8], see Figure 1 below.

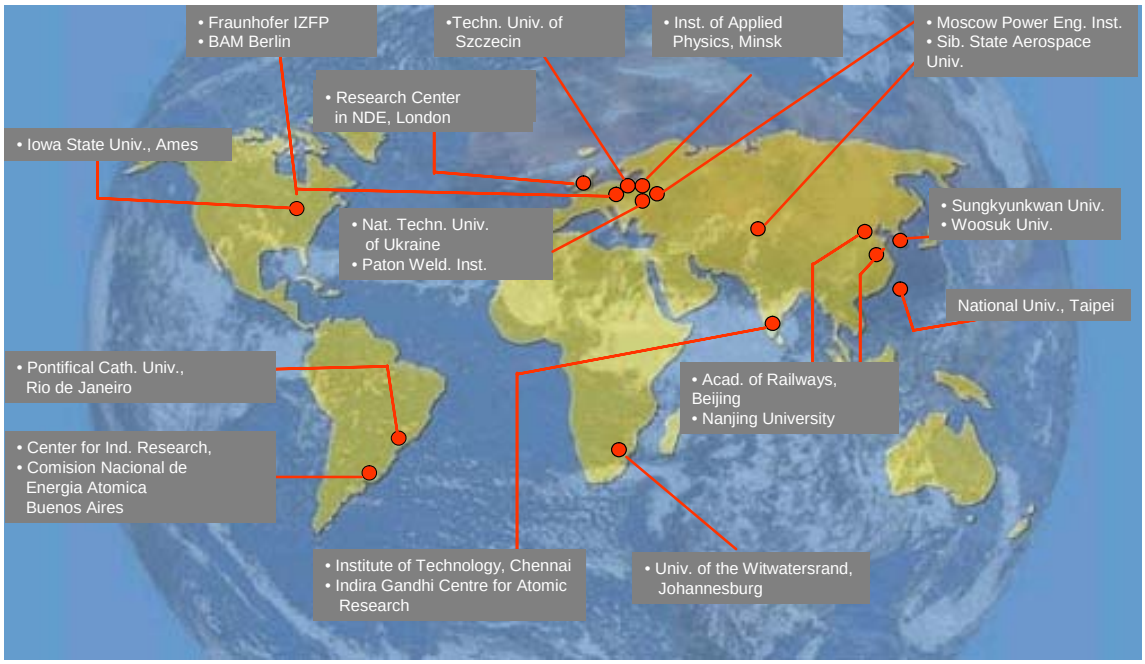

Figure 1. World Federation of NDE Centers

Even if the interaction between all members is not fully developed at present, the program mission objectives (see Figure 2) exhibit important future perspective. To pursue global common interests more effectively, the affiliation of all members will have to be more institutionalized and/or accredited on national and international levels. This would automatically lead to the quest for the development of national or local NDE Centers of international importance.

Figure 2. WFNDEC Mission

3. Establishment of National NDE Centers

The Brazilian NDE Center, CAND (Centro de Avaliação Não Destrutiva), was established in 2006. Comparable initiatives were observed in several other countries at the same time, where in other countries national research and development organizations increasingly assume NDE Center activities.

These initiatives are characterized by the following similarities:

- Centers are based in countries with large growth potential for industrial production
- Establishment of these centers is usually initiated by high-tech industry such as nuclear power technology
- Centers are promoted by industry and national institutions and are organized in partnership with engineering departments of universities and colleges
- Priority goals of these centers include the training of qualified engineers and inspectors and the ability to develop and validate NDE techniques and systems for specific inspection tasks. These services provided on a national level and combined with international cooperation should strengthen individual responsibility and demonstrate the high levels of quality and safety maintained by high-tech industry.

In the People's Republic of China, for example, the portion of power generated by nuclear energy will increase from today's 1.6% to 4% in the near future. To achieve this growth, nondestructive testing must be available on the highest technical level and with sole individual responsibility, which is the primary reason why a national center for validation and certification is currently being established in the PRC.

It is planned to utilize not only European (e.g., ENIQ) and American (e.g., EPRI) practices, but also to combine various Chinese research and development activities to strive to become highly regarded in the global NDE community [(9)].

3.1 CAND – Brazil's Center of NDE

The "Centro de Avaliação Não Destrutiva" (CAND) was established in Rio de Janeiro, Brazil in 2006, driven primarily by the "Electronuclear" company. On behalf of Electronuclear, the "Instituto de Energia" (institute for energy engineering) at the "Pontifícia Universidade Católica" (PUC) in Rio de Janeiro, developed a NDE Center model to fulfill the needs of Brazilian industry.

To begin with, the center's emphasis is on NDE/NDT technologies that are required to assure safe operation of pressurized components and the assessment of their condition. This is primarily for the Brazilian power generation industry, conventional and nuclear power, and the oil and gas industries which utilize pipelines and offshore platforms and plants.

Figure 3 presents an overview of the center's tasks and assignments, published during the foundation ceremony.

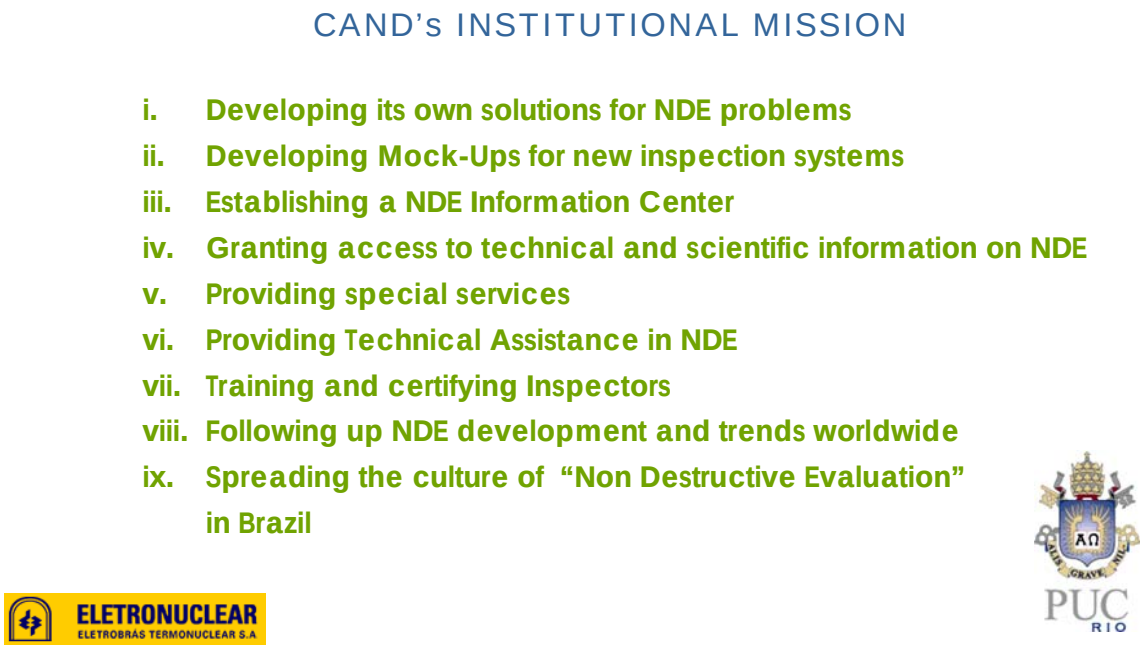

Figure 3. CAND's Institutional Mission

In the first step, CAND will develop four work areas, i.e. the development of inspection and testing systems, supply of the Brazilian industry with relevant information on NDE/NDT, supply of special services and training of professional inspectors and test engineers, and the certification of inspection and testing personnel including the validation and certification of inspection techniques, as illustrated in Figure 4 below.

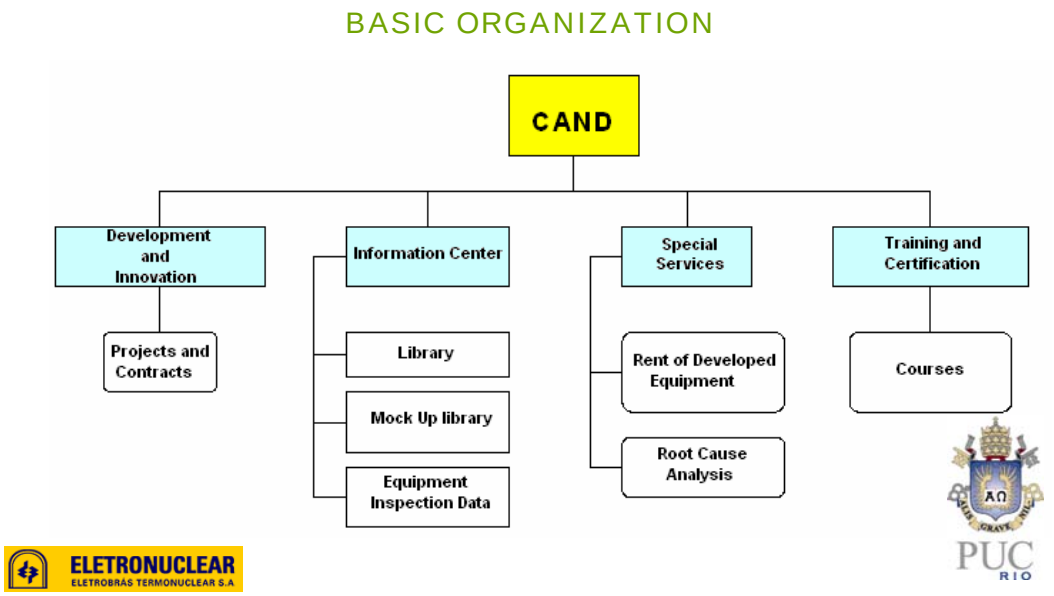

Figure 4. CAND's Basic Organization

3.2 The Structure of CAND

The general organization presented in Figure 4 assures that the objectives specified by CAND can be adjusted going forward to meet future necessities.
During the course of the development of CAND, a strategy is to be developed that considers and accounts for sufficient financing and available technical and personnel resources. Figure 5 shows the different financing sources according to the initially planned activities.

Figure 5. Support Funding

The strategy to develop a healthy organization includes the basic premise of achieving a return on the initial investments from the very beginning, i.e. profits according to the projected targets of CAND.

This may initially be achieved through development projects. CAND requires close cooperation with a neighboring scientific institution and/or university, such as the "Pontificia Universidade Catolica" (PUC) in Rio de Janeiro, in order to accomplish the initial phase efficiently and in accordance with the state-of-the-art of science and technology.

In addition, national resources must be obtained, so that they can be used by CAND and to permit efficient accessibility of resulting CAND developments and products to Brazil's industry. To establish more effective resource management and to fulfill above mentioned globalization aspects, international partnership with comparable centers and NDT/NDE institutions must also be created.

The project produces lasting resources that can be invested in NDE/NDT services and

education, training and certification. This means that project engineers, who can manage and execute these tasks later, must be integrated. The Brazilian NDE society, the industry's NDE/NDT labs and mid-size NDE/NDT companies, including service providers and equipment manufacturers, will play a significant role in the development of CAND's service business.

How, and in which form, CAND can serve in a central function to achieve the desired NDE/NDT evolution is currently under evaluation.

It has to be determined to what extent the center becomes operationally effective or if professional NDE/NDT companies have to be involved. Hybrid solutions, such as CAND developed models provided for the industry standard, are also possible. Figure 6 shows a first draft of the structure strategy of CAND.

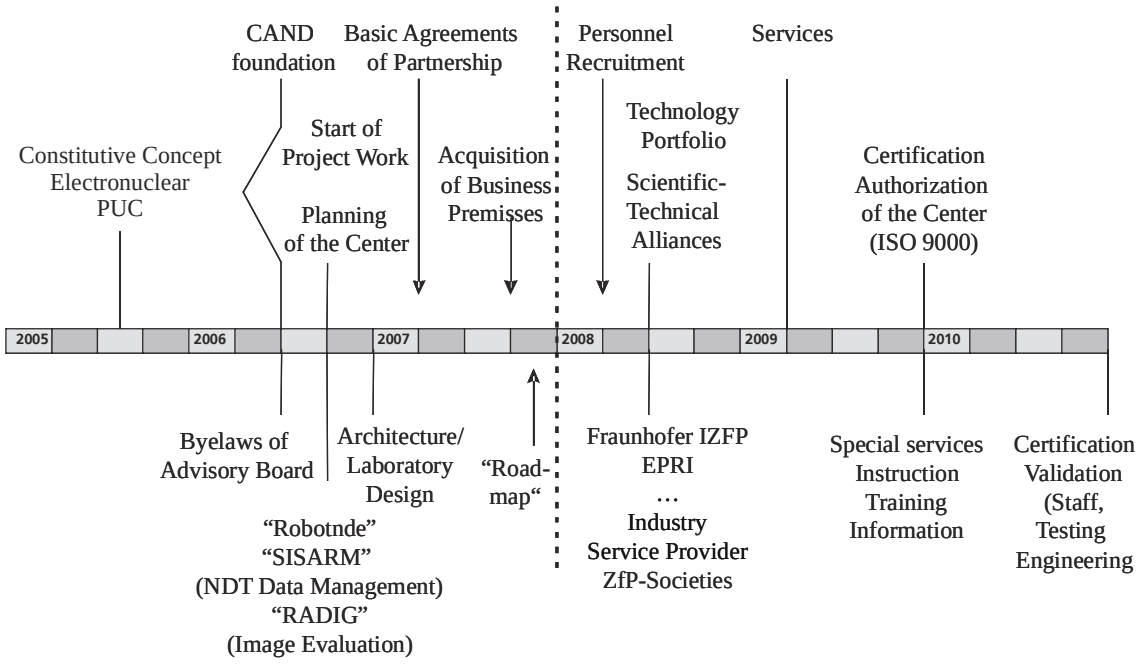

Figure 6. CAND Development Strategy

Figure 7 below shows an initial architectural blueprint of the center. This plan allows for future expansion construction of the center by using a modular, expandable structure design.

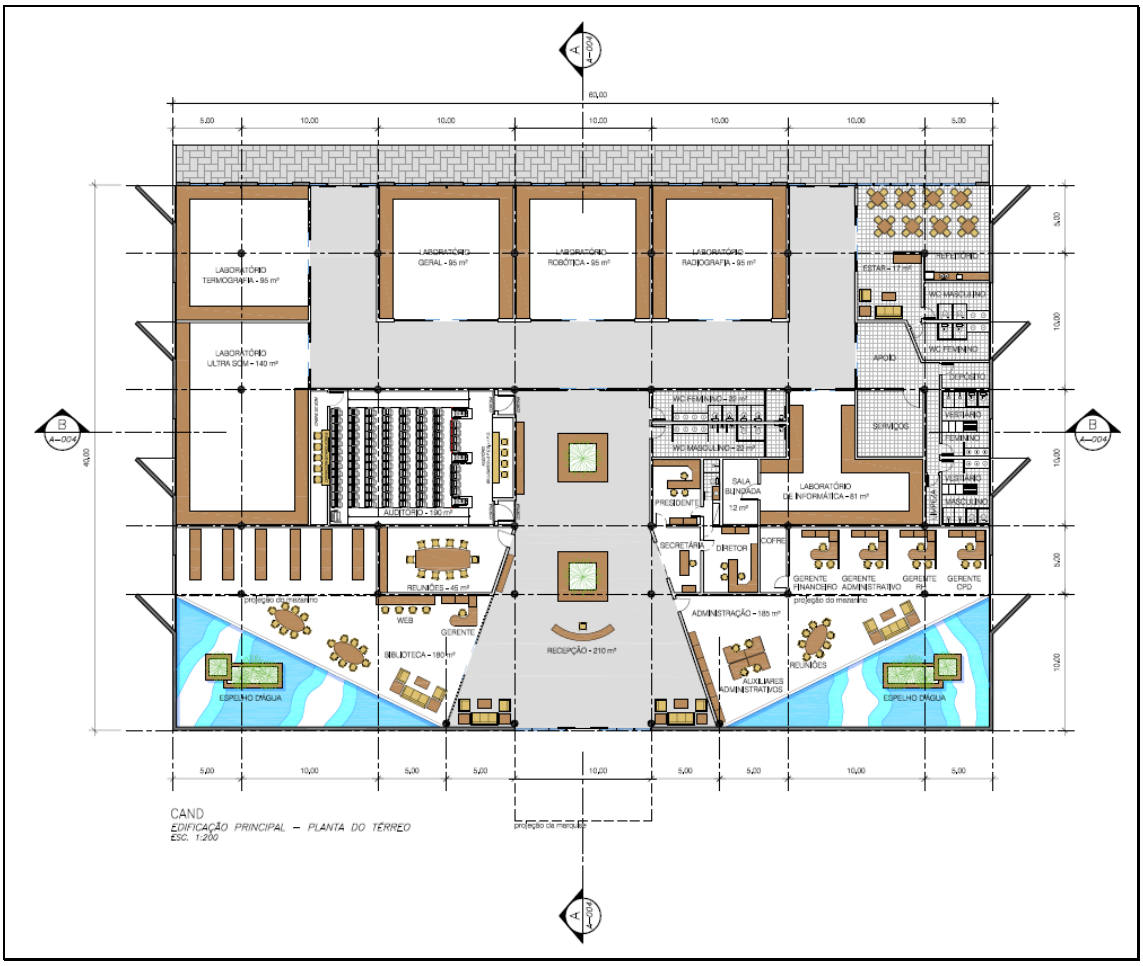

Figure 7. CAND Center Blueprint

3.3 CAND Projects

High-performance NDE/NDT requires the application of handling and manipulation techniques, signal processing and post-processing capability of acquired test data. Today, many modern manipulation systems (robotic systems) are available for automated manufacturing. This technology can also be usefully applied to NDE/NDT systems.

The “RobotNDE” project, largely handled by PUC, will produce a NDE/NDT design for automated testing on the basis of electromechanical robotics modules.

As a result of the research project it is expected that the utilization of standard robotics components, available on the market, will permit the construction of specialized high-performance automated test systems in an economical and expeditious fashion. Figure 8 illustrates the integration of robotic modules into a nondestructive testing system;

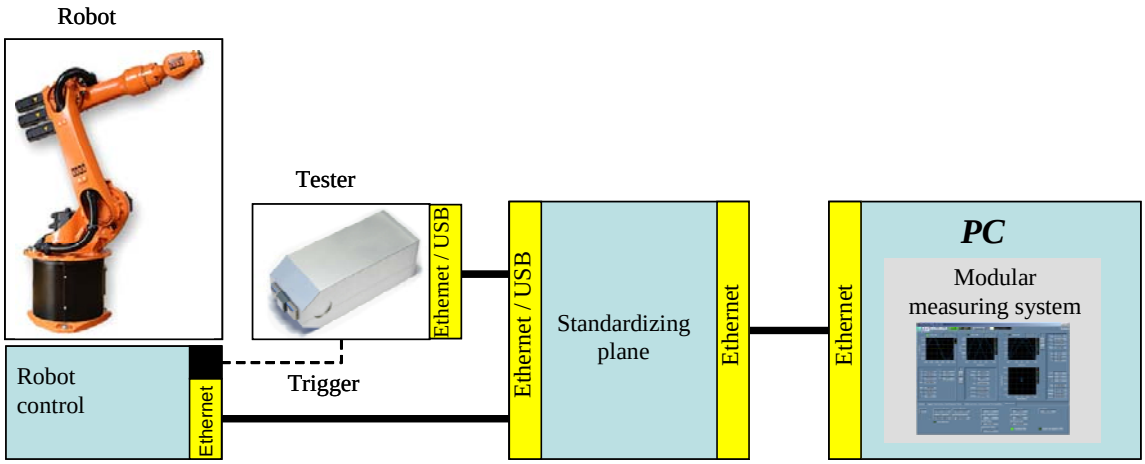

Figure 8. Modular Robotic Platform w/ Standardized Control Module

Figure 9 shows an example of a practical application [10].

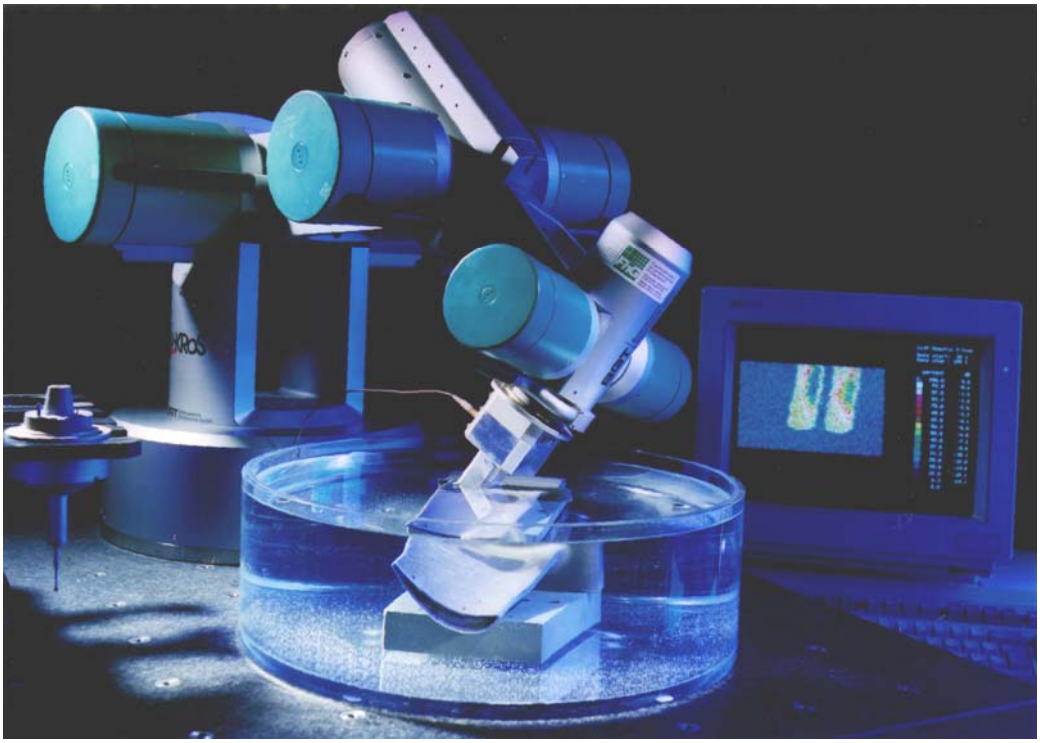

Figure 9. Ultrasonic Inspection of Freeform Surface Objects

The "SISARM" project was established to provide a fundamental basis for efficiently supplying NDE/NDT data for superordinated information management of production, maintenance, service or even for life-time management. This will improve the inspection planning and, in addition, the deployment of NDE/NDT to decrease quality related costs and/or maintenance expenditures [11].

Figure 10 shows the information flow in an operational information management system.

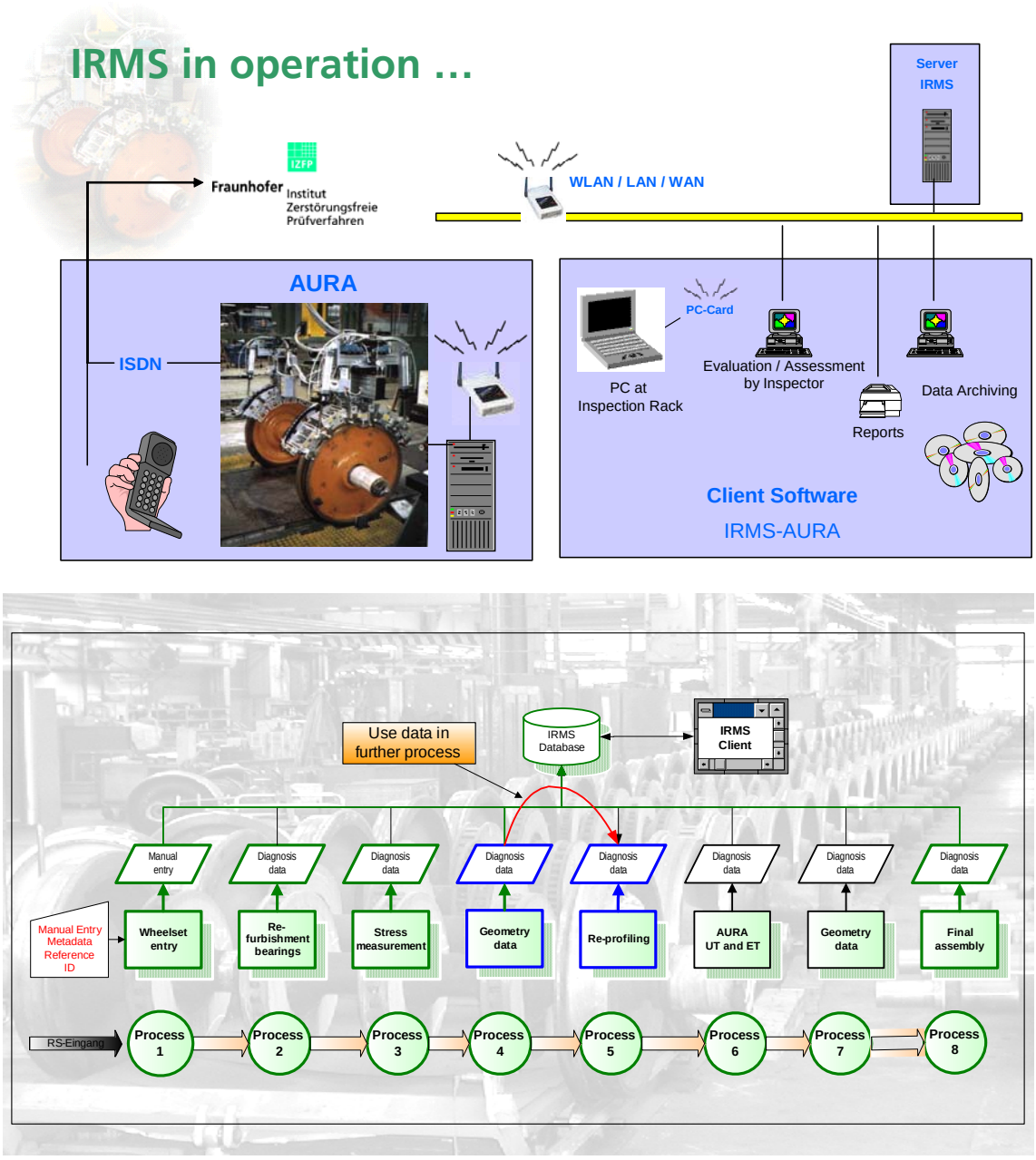

Figure 10. NDE/NDT Information Management System

Today, high-speed nondestructive testing techniques are usually based on various imaging technologies. To produce theses images, test data have to be generated and evaluated during the testing process. The “RADIG” project describes the basic principles for image generation and processing, commencing with typical image processing techniques used to produce radiographic images. Figure 11 depicts typical image enhancement processing results, to achieve better flaw detection capabilities, on an example of a radiographic image.

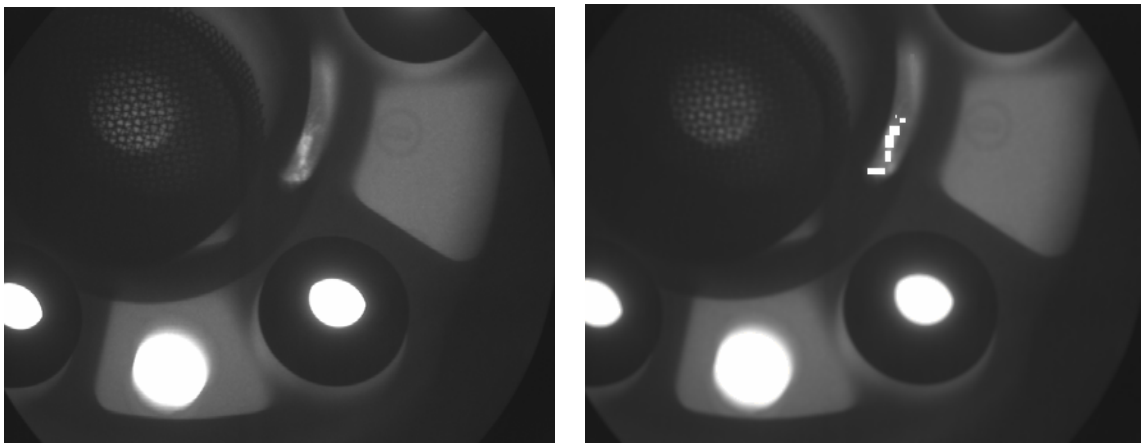

Figure 11. Contrast Improvement of Radiographic Images

4. International Cooperation

CAND has already reached mutual agreements with some NDE/NDT research institutions, NDE/NDT Centers and NDE/NDT companies and will continue to seek additional affiliation opportunities. These opportunities will provide a solid basis for strategic alliances that will be able to cover the needs of NDE/NDT technologies and services in a flexible and highly competent manner.

A first cooperation agreement with the Fraunhofer-Institute Nondestructive Testing, IZFP in Saarbrücken has been established and includes plans for joint research and development projects, need-oriented technology transfer and the exchange of scientists and students. Priorities of this cooperation are: the joint project for high-speed ultrasonic imaging related to quantitative flaw assessment [(12)]; the examination of acoustically anisotropic materials, such as dissimilar metal welds in the primary loop of nuclear power plants [(13)]; the characterization of material properties [(14)]. Regular information exchange will be required, particularly related to technology potentials that can be used for the advancement of NDE/NDT procedures and information on testing problems that evolve from the development of new materials and technical systems [(15)].

In addition to the scientific and technological value gained from this cooperation agreement, CAND can benefit from this agreement by being connected with the European NDE/NDT community.

Similar alliances with industrial regions, such as North-America and Asia, are in preparation.

5. Forecast

CAND, the Brazilian NDE center, is just at the beginning of its assignment. Their self-imposed tasks (its mission) will be successful in the same way it succeeds in building partnerships with industry and NDE/NDT institutions.

These partnerships achieve value and importance through the presentability of the

benefits provided by the Center.

These benefits are obvious as demonstrated by a multitude of similar institutions.

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References

1. 'Gewerbeordnung in der Fassung der Bekanntmachung vom 22. Februar 1999 (BGBl. I S. 202), zuletzt geändert durch Artikel 1 des Gesetzes vom 19. Dezember 2006 (BGBl. I S. 3232)'.
2. 'Atomgesetz in der Fassung der Bekanntmachung vom 15. Juli 1985 (BGBl. IS.1565), zuletzt geändert durch Artikel 161 der Verordnung vom 31. Oktober 2006 (BGBl. I S. 2407)'.
3. http://www.nucleartourist.com/operation/nrc1.htm.
4. 'Regelwerke der ZfP', Berlin, Deutsche Gesellschaft für zerstörungsfreie Prüfung (DGZfP), 2000.
5. http://www.kta-gs.de/common/regel_prog.htm.
6. http://isotc.iso.org.
7. A D Bardhan, D M Jaffee and C A Kroll, 'Globalization and a High-tech Economy: California, the United States and Beyond', Kluwer Academic Publishers, p 80, 2003.
8. http://www.wfndec.org.
9. J Liu, Private Mitteilung, 2007.
10. W Arnold et al., 'Robotergeführte Hochfrequenz-Ultraschallprüfung an Bauteilen und Komponenten mit Freiformflächen in Fortschrittliche ZfP - ein Instrument für Ökonomie und Ökologie', No 1, pp 125-130, 1995.
11. B Rockstroh et al., 'Automatisierte Ultraschallprüfung an Radsätzen (IRMS-Konzept)', Der Eisenbahningenieur, Vol 7, 2001.
12. A Bulavinov et al., 'Real-Time Quantitative Ultrasonic Inspection', IV Pan-American Conference for NDT, Buenos Aires, Argentina, 2007.
13. A Bulavinov et al., 'Ultrasonic Inspection of Austenitic and Dissimilar Welds', IV Pan-American Conference for NDT, Buenos Aires, Argentina, 2007.
14. I Altpeter, M Kröning and J Ribeiro, 'Nondestructive Evaluation of Ageing Steel Stuctures', IV Pan-American Conference for NDT, Buenos Aires, Argentina, 2007.
15. M Kröning, J Ribeiro and A Vidal, 'Progress in NDT System Engineering Through Sensor Physics and Integrated Efficient Computing', IV Pan-American Conference for NDT, Buenos Aires, Argentina, 2007.