SUMMARY

The habilitation thesis summarizes the author teaching, professional and research activity, after obtaining the doctorate entitled "*Research on the Corrosion Behavior of Stainless Steel Subject to Plastic Deformation and Ion Nitriding*" at the Technical University of Cluj-Napoca, granted by the Ministry of Education and Research, no. 3460/ 03.15.1999.

A. Author's main education activities are the following: holder of several courses at the Technical University of Cluj-Napoca, setting and organizing laboratories and activities, involving students and master students in research, mentoring students in drafting bachelor's and master graduation works, publication of teaching materials and laboratory guidance for students.

B. Research and professional achievements are reflected in articles, papers in conferences, books and books chapters and other publications, ISI/ BDI indexed or indexed in other international databases, research projects, contracts with industry partners etc.
After obtaining doctorate, the author followed a period of sixteen years of deepening a multidisciplinary research at the following faculty departments: Heat Treatments and Aggregates, Surface Engineering, Environmental Protection; and at the Department of Environmental Engineering and Sustainable Development Entrepreneurship. Such researches aimed to develop sustainable technologies with reduced environmental impact, for increasing parts resistance to corrosion, wear, fatigue, thermal shock etc., in order to extend the life of steel/ steel substrate products/ structures.

Argument
Since in the coming decades global industrial production will rise much above current level, which is already four times higher than the industrial levels during 50s, it is obvious that pollution control of the "spill" is not an acceptable solution.
The concept of "green industry" involves the restructuring of all industries to reduce emissions and to re-use materials during all stages of the production cycle.
Sustainability means choosing those particular goods and technologies that do not jeopardize the ecosystems integrity and species diversity (*Basic Principles of Sustainable Development, Jonathan M. Harris, Global Development and Environment Institute, June 2000*).
Future technologies are based on the best available techniques (BAT), which primarily means reduced energy and materials consumption, and minimization or no waste. In other words, it's about those technologies that are suitable for recycling, resulting in reduced consumption for new products manufacturing.
This paper presents an interdisciplinary perspective of four thematic actual directions in the field of durability and the sustainability of steel/ steel substrate structures/ products:
1. *Improving lead acid batteries properties.* Energy and environmental issues lead to the development and widespreading of electric vehicles (EV), hybrid electric vehicles (HEV), electric elevators and electric forklifts (LL). Conventional batteries, in particular lead acid batteries, play an essential role in the electricity production and storage. Lead acid batteries presents real cost, recycling, and power efficiency advantages. Lead acid battery performance can be improved by increasing the electrodes performance, by finding new solutions for electrolyte, by replacing liquid solutions with gel, by finding new separators. Lead acid batteries performance improvement by using additives ensures better human health and environment protection and reduces fossil fuel consumption.
2. *Means and methods for studying surfaces* produced by different methods, when exposed to corrosion, wear, fatigue and thermal shock (AFM, SEM, CV, XRD etc.). Electrochemical phenomena, surface properties and chemical composition are studied using methods such as: Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Cyclic Voltammetry (CV), Electrochemical Impedance Spectroscopy (EIS), X-ray Diffraction (XRD). The aim of such measurements are the materials properties research in industry, to

improve their performance in service, extending the life of steel/ steel substrate structures, with reduced environmental impact.
3. *Ensuring sustainability and durability of steel structures by applying corrosion protection* methods with low environmental impact. Extending the life of products / structures in the context of increasingly pressing environmental legislation on the consumption of materials and energy, environment, human health protection and safety, is achieved by applying various protective coatings. Corrosion protection is important in the context of sustainable development as it extend products life, particularly when materials used for corrosion protection are recyclable.
Initial choice of materials and processes for corrosion protection plays an important role in the structures maintenance and repair costs throughout their life. Using the concept of cost over the entire lifespan of a product / structure, it was found that buildings in general, bridges and other steel structures are the most profitable choice, and that the corrosion protection by hot dip galvanizing is the most effective choice.
4. Materials protection of steel/ steel substrate products against aggressive environment, for improved performance and life extension, by applying *surface engineering technologies with reduced environmental impact*, such as: coatings deposition, electrochemical co-deposition with nano-materials inclusions, heat treatment, nitriding/ carbonitriding, laser treatments etc.

The **relevance and originality** of this thesis consists in the interdisciplinary research combining surface engineering with concepts of steel structures sustainability and durability, industrial environment protection, including protection against noise, and human safety and health in industry.

The main development directions
a) *Development of technologies for corrosion preventing, monitoring and for corrosion protection to extend steel structures/ products life duration, by applying technologies with reduced environmental impact*
The main purpose of corrosion control is to maintain the strength and integrity of a structure. If structures involved in road transportation, storage, products processing and transport are resistant to corrosion, the risk of hazards, leakage or explosion is significantly reduced. Corrosion control offers proven methods with low costs, to reduce premature deterioration of materials, thus extending their life duration in use, and protecting both human safety and the environment.
b) *Development of limiting standards for corrosion products emission in the environment*
An important component of this process is the use of qualified human resources equipped with the latest technologies. Another equally important thing is to raise awareness of the fact that corrosion is indeed a threat, and the corrosion prevention and mitigation is a necessity.

C. Among the managerial activities that add to the author's professional and research experience, the following are mentioned:

- 2006-present – member of the technical committee for *Corrosion and corrosion protection of metals* (ASRO/CT 157);
- 2015-present (/2011-2015) – Executive Director (/Director) of ANAZ (Asociația Națională a Zincatorilor din Romania – Romanian National Galvanizing Association), participating in eight national and international conferences about Hot Dip Galvanizing in the actual context of sustainable development and durability, about best available techniques for Hot Dip Galvanizing industry etc.;
- 2006-2012 – Chief Editor of the Corrosion and Corrosion protection Journal, COPERNICUS Indexed, in which he published twenty articles in domain of Corrosion and Environment Protection;
- 2007, 2009-2011 - Member of the Admission Central Committee;
- 2012-present – Deputy Dean for the Faculty of Materials Engineering and Environment.