

SCIENTIFIC REPORT

on the PhD thesis entitled
**Operational Management of Technological Deficiencies and Engineering
Innovation in Mechanical Ventilation and ICU Medical Devices**

written by **Dumitru-Adrian DRĂGHICI**

in order to be accepted for public defence in the field of **Engineering and Management**.

The undersigned, **Professor Angela REPANOVICI, PhD**, as scientific supervisor of the doctoral thesis entitled*“Operational Management of Technological Deficiencies and Engineering Innovation in Mechanical Ventilation and Medical Devices for Intensive Care Units”*, elaborated by the PhD student **Dumitru-Adrian DRĂGHICI**, have carefully analyzed the doctoral thesis and hereby present my assessment regarding the scientific results obtained and the contribution of the candidate, for the purpose of accepting the thesis for public defence and awarding the doctoral degree in the field of **Engineering and Management**.

The doctoral thesis addresses a highly relevant and interdisciplinary research topic situated at the intersection of engineering, technology management, mechatronics, biomedical engineering and intensive care medicine. The research focuses on identifying, analyzing and mitigating technological deficiencies associated with critical medical devices used in Intensive Care Units (ICUs), namely mechanical ventilators, syringe pumps and diahemofiltration systems. The overall objective is to improve patient safety and increase the efficiency and reliability of technological processes involved in critical care.

The thesis demonstrates a strong interdisciplinary approach by integrating engineering design principles, medical technologies, adaptive control systems, technological management concepts and clinical requirements. The research is oriented toward the development of innovative, patient-centered technological solutions based on adaptive feedback mechanisms capable of enhancing the safety and effectiveness of medical interventions performed in intensive care environments.

The doctoral thesis is coherently structured into six chapters covering the state of the art, research methodology, development of conceptual and experimental models, validation studies, original contributions and future research directions. The documentation is extensive and is supported by a comprehensive and up-to-date bibliography drawn from the international scientific literature.

Among the most significant original scientific contributions of the PhD student, the following can be highlighted:

- the conception and experimental validation of an innovative mechatronic system designed to maintain the homogeneity of injectable drugs administered through syringe pumps, using dual mechanical and photonic stabilization mechanisms;

- the development and validation of a hybrid mechanical ventilation system assisted by synchronized electromechanical stimulation of respiratory muscles, aiming to reduce ventilatory pressures and prevent diaphragmatic atrophy;
- the design of an innovative pumping system for diahemofiltration procedures based on vacuum-assisted principles, intended to reduce hemolysis and improve hemocompatibility;
- the integration of adaptive, patient-oriented technological feedback concepts into the management and optimization of medical devices used in intensive care; the execution of complex experimental studies regarding the effects of mechanical ventilation on pulmonary tissue and the mechanical impact of extracorporeal circulation systems on blood components.

The obtained results are supported by rigorous experimental investigations, theoretical modelling and comparative analyses. The thesis demonstrates the candidate's ability to formulate scientific hypotheses, conduct independent research, develop innovative engineering solutions and validate the proposed concepts through appropriate experimental methodologies.

During the doctoral research period, the PhD student disseminated the obtained results through scientific publications and conference presentations. The research activity resulted in **five scientific papers**, including **three articles indexed in Web of Science**, **one article published in an internationally indexed journal**, and **one paper published in the proceedings of an international scientific conference**.

A particularly noteworthy contribution is the article published in the journal **Applied Sciences** (Impact Factor 2.5), entitled *“Mechatronic System for Maintaining the Homogeneity of Injectable Drugs in Syringe Pumps”*, which reflects one of the major research directions developed within the doctoral thesis. The doctoral thesis entitled *“Operational Management of Technological Deficiencies and Engineering Innovation in Mechanical Ventilation and Medical Devices for Intensive Care Units”* represents a valuable scientific contribution from both theoretical and practical perspectives. The research outcomes contribute to the advancement of knowledge in the field of Engineering and Management and provide significant opportunities for future developments in critical care technologies and medical device innovation.

In conclusion, I appreciate that the doctoral thesis entitled *“Operational Management of Technological Deficiencies and Engineering Innovation in Mechanical Ventilation and Medical Devices for Intensive Care Units”*, elaborated by PhD student **Dumitru-Adrian DRĂGHICI**, meets the standards and requirements imposed by the legislation and academic regulations in force, and may be accepted for public defence and for awarding the title of **Doctor of Engineering** in the field of **Engineering and Management**.

Braşov, July 2026

Scientific Supervisor

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