



**NATIONAL TECHNICAL UNIVERSITY OF ATHENS**  
PROFESSIONAL INTERDISCIPLINARY POSTGRADUATE PROGRAMME OF SPECIALIZED STUDIES  
«Infrastructure and Construction Project Management»

**Postgraduate Diploma Thesis**

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***Deformation and Structural Health Monitoring of Infrastructure Projects:  
Geodetic Methods, New Technologies and Management Aspects***

Student Name: ***Angeliki Lakrinti***

Supervisor: ***George Pantazis, Professor, NTUA***

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**Abstract**

The present thesis focuses on instrumented monitoring systems, emphasizing geodetic monitoring methods, emerging technologies and managerial aspects of such systems. The aim of the study is (i) to examine existing principles, methods and frameworks of structural monitoring, (ii) to investigate the integration of new technologies into the monitoring process, (iii) to assess the current situation in Greece and (iv) to accentuate the role of monitoring as a project management tool, contributing to more rational and objective, data-driven decisions.

A comprehensive literature review was conducted, with Scopus and Google Scholar being principal sources. To explore the potential of emerging technologies, publications from the 5th Joint International Symposium on Deformation Monitoring were analyzed. Moreover, to demonstrate the managerial role of monitoring as decision making tool, research papers from focus group “Data-informed Decisions for Structures and Infrastructures” were examined.

The analysis led to the following key findings: the main factors limiting widespread adoption of monitoring systems in practice are their cost and the reluctance of project owners to invest in them. A solution to this issue can be found through the Value of Information (VoI) framework, which quantifies and translates the benefits of monitoring into monetary terms, thereby providing a rational basis for investment decisions. Beyond economic barriers, technical and computational challenges were also identified. These can be addressed through emerging technologies, which enable monitoring in inaccessible or hazardous areas, automated result generation using advanced algorithms, more efficient data management, and improved communication among stakeholders.

In the case of Greece, no binding or standardized framework was identified. Monitoring practices among large-scale infrastructure projects appear heterogeneous, which is partially justified by the diversity of structural types and conditions. Nevertheless, the case studies confirmed the theoretical advantages of monitoring, demonstrating its value in identifying deviations from design assumptions, correlating deformations with probable causes, providing timely information during emergencies, and informing maintenance and rehabilitation actions.



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Finally, the future of monitoring is population-based monitoring systems, which exploit the capabilities of machine learning and require fewer training data. However, the implementation of such systems requires both the integration of advanced technologies into the monitoring process and the establishment of clear, detailed standards to ensure the quality and reliability of the collected data.

In conclusion, this study presents instrumented structural monitoring not merely as a technological tool but as a holistic methodology that integrates measurement, data analysis, and management. By doing so, it underscores monitoring as an essential instrument for more efficient, informed, and sustainable infrastructure management.