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Digitisation and Proactive Management of Coastal and Offshore Infrastructure and Environment

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ABSTRACT

Recent findings of natural gas discoveries in the offshore Eastern Mediterranean Region, i.e., Leviathan in Israel, Aphrodite and Calypso in Cyprus and Zohr in Egypt, as well as future planned exploration by major international offshore operators could contribute significantly to energy security and economic prosperity for the countries in the region. At the same time, renewables are the largest source of energy growth and are set to penetrate the global energy system more quickly than any fuel in human history. In addition to the offshore oil and gas structures and systems that already have been developed and installed, but are still being developed with a growing rate, ocean renewable energy systems (e.g. offshore wind turbines, wave energy converters, combined/hybrid concepts) are currently in the consideration, assessment and design phase. A huge development of coastal and offshore structures is anticipated in near furure; in order to meet efficiently this development safety and environmental protection should be assured.

While the potential benefits of offshore oil and gas as well as the rest of renewable energy technologies exploration are substantial, there are also significant possible negative impacts on the Mediterranean ecosystem which may affect all Blue Growth sectors since infrastructure assets development in coastal and offshore areas are required. Negative impacts may result from accidental or operational hazards, extreme environmental events or other security related risks resulting in loss of life, waste discharge and significant oil spills into the Mediterranean Sea. Such events would have dramatic consequences with main impacts on coastal tourism and fisheries and huge associated financial losses and other catastrophic effects. Effective management schemes for those assets during conception, installation, operation, maintenance and dismantling should be used.

The safe and efficient development of offshore and coastal infrastructures and operational processes as well as the development of the relevant skills to support these industries is of paramount importance. Challenges in connection with condition monitoring, systems integration, materials performance, data, and development of safety codes and standards will be addressed. Those challenges are related with the use of smart technologies for improving the understanding of the physical behavior, ageing and degradation of marine engineered assets and smart proactive management of the whole life cycle from design through to operation, maintenance, life extension and decommissioning.

Towards those needs a National Centre of Excellence has been established for promoting Cyprus as a regional hub for energy, research, innovation, education, and training. East Med Energy Research for Growth and Education Centre of Excellence (EMERGE CoE) has been established within Cyprus University of Technology by faculty members of the Civil Engineering and Geomatics Department.

The creation and installation of in-field monitoring laboratories in cooperation with industry stakeholders has been a key strategic element of the EMERGE CoE's actions, which in turn provides a strong foundation which facilitates many of the above activities. All the aforementioned activities are interconnected and are essential pieces of the puzzle for a successful center. The two initial operational monitoring systems (Figure 1) for measuring the response of marine infrastructures (e.g. accelerations at various coastal jetty and fixed bottom breakwater positions) and environmental factors (wind direction, wind velocity, wave height, temperature, humidity, atmospheric pressure) at two distinct marine locations in Cyprus (the Vasiliko Energy Centre and Ayia Napa Marina) have been augmented by a new monitoring system for water quality parameters installed at the Ayia Napa Marina.

The EMERGE research group is using those significant in-field laboratories as real-time test beds, which will enable many other crucial related activities in line with the center's goals. Over the past few years, the EMERGE research team has worked with two key industry stakeholders, VTTV Vasiliko and Ayia Napa Marina, who provided access to their infrastructure and valuable in-kind support to build up, validate, and operate these systems. In order to facilitate the scopes of the EMERGE CoE's planned study topics, real-time monitored data from the two systems already have been used. It is worth mentioning that three years' worth of data from one of the two systems is currently saved in EMERGE database and is steadily growing. Data analysis already resulted in research publications (Demetriou et al., 2021, 2022) and daily forecasting reports.

Figure 1 Monitoring system in Vasiliko VTTV (left) and Ayia Napa Marina (right), Cyprus

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