Keynote 01: Forensics - A New Direction for Engineering Education

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ABSTRACT

The number of students wishing to study engineering topics at University is on the decline, thus engineering departments need to consider ways of making engineering more attractive and hence increase student recruitment. While there are many approaches that could be taken, one that we have found has some merit is to include engineering forensics within the curriculum, or even as a complete programme.

Forensic engineering plays a pivotal role in modern society, encompassing a broad range of activities that involve investigating the failure of materials, products, structures, or components. Its importance cannot be overstated, since it provides critical insights that ensure safety, legal accountability, and the advancement of engineering practices.

Firstly, forensic engineering is essential for safety. When buildings collapse, bridges fail, or products malfunction, the consequences can be catastrophic, leading to injuries, loss of life, and significant economic damage. Forensic engineers meticulously analyse these failures to determine their causes. By understanding what went wrong, they can recommend changes to prevent future occurrences. For instance, the investigation into the 1981 Hyatt Regency walkway collapse in the USA, led to significant changes in building codes and design practices to enhance structural safety.

Moreover, forensic engineering is integral to the legal system. Following an incident, questions of liability and responsibility will arise. Forensic engineers provide expert testimony and detailed reports that are used in court to establish the facts. Their analysis helps in attributing fault, whether it lies within design flaws, construction errors, material defects, etc. This expert input is crucial for resolving legal disputes, ensuring that justice is served, and that responsible parties are held accountable.

In addition to legal and safety considerations, forensic engineering contributes to the advancement of engineering knowledge and practices. Each failure analysed offers a learning opportunity. By studying why and how a failure occurred, engineers can improve existing designs and develop new technologies that are more resilient. This iterative process of learning from past mistakes is fundamental to engineering progress. For example, the investigation into the 1876 Abbots Ripton rail disaster determined that in the adverse conditions on the day there was an accumulation of snow and ice on the signal post leading to a systematic signal failure. This led to fundamental changes in British railway signalling practice – often referred to as the start of “fail safe”.

Forensic engineering also has an economic dimension. Failures can be extremely costly, not only due to immediate damages but also because of the long-term impact on public confidence and the financial stability of companies involved. By preventing future failures through thorough investigation and recommendation, forensic engineers help mitigate these economic risks. Their work ensures that investments in infrastructure and technology are more secure, ultimately benefiting society as a whole.

Furthermore, forensic engineering fosters interdisciplinary collaboration, often requiring the integration of knowledge from various fields such as civil engineering, materials science, mechanical engineering, and environmental science. This multidisciplinary approach enriches the investigative process, leading to more comprehensive and accurate conclusions. It also encourages innovation, as engineers from different backgrounds bring unique perspectives and solutions to complex problems.

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Another significant aspect of forensic engineering is its role in educating future engineers. Case studies of engineering failures are a powerful teaching tool in engineering education. They provide real-world examples that illustrate the importance of meticulous design, thorough testing, and adherence to safety standards. By studying these cases, engineering students learn to anticipate potential issues and develop a mindset focused on prevention and safety.

In conclusion, forensic engineering is of paramount importance for numerous reasons. It enhances safety by preventing future failures, supports the legal system by providing expert analysis and testimony, advances engineering practices through lessons learned, mitigates economic risks, fosters interdisciplinary collaboration, and educates future engineers. The meticulous work of forensic engineers ensures that structures and systems are safer and more reliable, ultimately protecting lives, property, and the environment. As our world becomes increasingly complex and technologically advanced, the role of forensic engineering will only continue to grow in significance.

Teaching engineering in a “normal” fashion, does provide students with the appropriate analysis skills. Including forensics within the curriculum extends a graduate’s ability to apply their knowledge and skills in a more appropriate and focused manner. However, having courses that are designed around engineering forensics gives students knowledge and skills in law, analysis (forensic and engineering), court room skills, and so on.

BIOGRAPHY

Dr. Karl O. Jones is a Subject Head in the School of Engineering at Liverpool John Moores University where he has worked for over 35 years. His research interests include Artificial Intelligence, Audio & Video Forensics, Maritime Risk Analysis and Engineering Education, with 12 completed PhDs and 5 current students. He has considerable experience in PhD examination, both as Internal and External Examiner. He was part of an EU funded Europe-wide project to develop curricula for Computing at bachelor, Masters and PhD level. He has spent over 20 years working with Collaborative Partners, mostly in South-East Asia. He has acted as a Link Tutor to SLIIT for a number of years, making many friends in Sri Lanka.

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