

Engineering Forensics

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Abstract

This research paper looks at Engineering Forensics, which is one of many fields in Forensics Science. This paper describes how accidents are investigated, to locate the cause or causes of failure with a view to improve further performance and safety. It will cover the legal and law aspects of the subject and investigations of intellectual property claims or patents. It also covers the analysis which is how the accidents are examined for evidence, examples of real life cases where this area of science is used and applications of it. The paper also gives a view at the field of forensics and how a forensics investigator works.

Keywords: Type your keywords here, separated by semicolons ;

1. Introduction

Forensics engineering is the investigation and determination of the causes and failures of structural disasters. Forensics engineers also instigate failures of products, components and materials. These consequences of failure are then dealt by the law of product liability.

It uses reverse engineering to inspect the cause why a component, material or product failed to perform as intended. Later, those findings can be used as evidence in court if that failure caused any physical damage to a person or damage to a property. The findings are also used to determine if the failure was related to some other criminal case.

This subject is mostly applied in civil law cases, although the findings and evidence may be used in criminal law cases. The purpose of a forensic engineering investigation is to locate cause or causes of failure. However, these findings are also used to help and improve the performance of life or a component and assist a court in determining the facts of an accident (Polymer Solutions 2015).

1.1. History

The forensics engineering came from an organization which was formed on the November 19, 1980 at the Crow Canyon Country Club in San Ramon, California, by the unanimous vote of the people that was present. The organization was named Society of Forensic Engineers and Scientists. The

purpose of the society was to spread and share forensic technical and business information, and upgrade the standards of the profession (Forensics Society 2017).

‘The purpose of this Society was to share forensic technical and business information, and to actively assist in upgrading the standards of the profession’ (Forensics Society 2017). The Society was very exclusive and only accessible to professionals.

2. Identification

Forensics identification is the application of forensics science and technology to identify different elements from the trace evidence they leave. This is mostly applied at crime scenes or the scene of an accident. The direct definition of the word forensics is “for the courts”.

Forensics engineering is primarily combination of engineering and law, whether it is in a criminal or civil case.

The objective of an investigation will usually be to discover and locate the cause of failure in particular material, structure, product or component, and resolve the question whether this failure was intentional or accidental.

Accidents and failures can be also results of natural causes, such as corrosion or fatigue. Engineering disasters, such as a failure of engine in an airplane would be classified as a subject to an engineering investigation.

2.1. Investigation types

Forensic Engineering Investigation is a collection of many methods and experiments used by engineers and scientific investigators. They are used to figure out the typical and commonplace types of failures and hazards. Its main task is to determine how an object or structure was damaged and what legal consequences it will meet.

Scientific method of investigation is where experiments are made on the subject where the variable being studied is not obscured or complicated by other effects acting on it. The variable which would be the factor of the accident or failure would be singled out to be free from other influences, this means that when large number of diverse experiments are carried out to determine what evaluates when the variable is changed. Numerous tests are taken with the variable changed to determine and provide a statistical basis for figuring out how the variable works, and forecast what will occur under other circumstances. In this way, theoretically, any accident, failure, crime or catastrophic event could be experimentally duplicated or reconstructed' (Noon 2000, p 1.6).

Although there are problems with this approach, as a result of many events and failures being singular events. From consideration of cost and safety, the experiments cannot be constantly repeated in variety of ways. Only crucial and necessary experiments can be taken.

3. Collection

At first a forensics engineer collects data and all possible evidence. This includes interviews, inspection of scene, scientific studies, collection of opinions of experts in the same field and field agent reports.

Once all analyzed and identified evidence has been studied and recorded by a forensics engineer, appropriate techniques are used to collect the evidence. Evidence are usually recorded in forms of photographs, drawing sketches, notes and sketch plans. In collection of other evidence systematic collection techniques are used to prevent damage or contamination of samples.

During data collection and testing phase of an investigation, the forensics may cooperate with other investigators representing different areas of forensics. This results in more effecting investigating and

reduces the cost and time associated with an investigation (Carper 2000, p9).

The most important aspect of data collection is the protection of evidence. The crucial part of collecting evidence is careful and appropriate the collection of physical evidence. Physical evidence must be preserved in an appropriate way to avoid any damage done to it. When the evidence is collected investigators representing other areas of forensics can cooperate with each other during collection and testing phase of an investigation. In case of a damage done to evidence, or even minor alteration, it can totally change the outcome of an investigation and the results may become biased.

Another critical aspect of collecting data is the timing. The forensics engineer is often required to move quickly to an accident site. In some cases, there is a possibility that the evidence could be damaged or destroyed by industrial accident, fire or collapse of a structure during the rescue and cleanup operations.

3.1. Reporting the Results of an Investigation

As expected there are many ways and formats used to report the results of a forensic engineering investigation. The easiest is a simple narrative, which is describing all investigative endeavors in chronological order (Noon 2000, p1.10). It is when the investigator begins with receiving a call from the client, and proceeds until the last item in the investigation is complete. The report can be then composed daily or piecewise when something important occurs as the investigation progresses, like a diary or journal. Chronological journals are kept by detectives, fire investigators and Insurance adjusters in their case files (Noon 2000, p1.10).

4. Analysis

A large part of an investigation associates with the analysis and interpretation of the data that was earlier collected. During an analysis, the investigators job is to separate real factors from irrelevant and unrelated items or factors. Data in most of the cases will be incomplete or redundant. Redundant evidence is always helpful as it allows the forensic engineer to cross-check conclusions (Carper 2000, p6).

Analysis in forensics engineering is performed by constantly testing, examining and analyzing the failure. After the information about the component is collected like its application and history. Tests are

taken like: magnetic particle test, low magnification, dye penetration test and other non-destructive testing. There are also tests and examinations that destroy the evidence such as hardness testing, mechanical testing chemical analysis.

5. Presentation

Apart from technical competency, a forensic engineer must possess a working knowledge of legal procedures and related vocabulary (Carper 2000, p1.2.2). Presentation of the evidence happens in a court of law. Therefore, it is essential it is done correctly and that the evidence is acceptable for court. The evidence must obey the laws to be acceptable in court.

6. Case Study

Shortcuts in engineering design can save a lot of money and time. Although they can lead to engineering disaster. In order to accommodate society's demands, the creation and discovery of newer technology and infrastructure must be met efficiently and cost effectively.

On February 1, 2003, the space shuttle Columbia disintegrated unexpectedly resulting in death of seven astronauts on board. This disaster caused NASA to suspend space shuttle flights for more than two years, as the investigation of the disaster continued (Howell 2013). An investigator determined the catastrophe was caused by a damaged done to the thermal shielding tiles from the impact which broke off from the propellant tank and damaged the edge of the shuttle's left wing. The Columbia disaster was the second major tragedy in the history of the space shuttle program (History 2017).

The engineering failure that caused the disaster was the insulation that broke off and hit the wing. That caused the wing not to resist the high temperature of 1,540 degrees Celsius when the space shuttle was re-entering the Earth's atmosphere. Pieces of melted aluminum were found on the thermal tiles and the edges of the left wing, that confirmed that the destruction of Columbia was due to hot gases that penetrated the damaged spot on the wing (NASA 2017).

7. Comparison with Forensic Pathology

Both forensics pathology and forensics engineers reconstruct crimes or accidents to determine what

happened and who is responsible. However, they differ in the areas of specialization they work in. A forensics pathologist examines the cause of death by examining corpses, while a forensics engineer investigates products, materials, structures or components that fail or cause damage to people or property.

As for the task of a forensic pathologist is to assist in investigation as a medical expert, the task of a forensics engineer is to provide the engineer side of a disaster (Ranson 2017). In the identification of corpses, a forensics pathologist identifies bodies by CT scanning, blood sampling, drug tests and serology testing. As for a forensics engineer creates tests and identifies the objects for any defects, rust or other factors that could have caused the disaster.

Collection of data in pathology is all about the results of tests, scanning's and samples. Samples of blood, organs and other parts of the bodies can be stored for investigation and proof. In the collection of data in forensics engineering it differs in that there are usually no physical evidence stored, instead sketches, photographs and calculations are stored about a case.

Analysis in forensics pathology involves the study and identification of blood tests, blood samples, CT scans of the head and other tests. They are used for finding out the cause of death, whether it was from a murder, accident or disease. In forensics engineering the analysis is more about separating contributing factors from irrelevant items. Some factors could be suspicious to the investigation and it could be suggested that they were the cause, although the engineer investigator has to provide evidence to the theory he is passing in the court.

The presentation of evidence in both of areas must obey the laws to be acceptable in court. Although that procedure appeals to all the scientists of forensics.

8. Conclusion

In conclusion, the job of a forensics engineer is very versatile. He plays a role in many parts of an investigation, however his main task is to investigate the engineering side of a disaster, accident, or failure of some object. Even though he is a forensics investigator and it would be assumed that his investigation would only include lethal and fatal accidents, in most cases his job is about investigating object, materials or structures that failed which not always include civil harm and death of people. Most of a forensics engineer would be inspection of physical evidence and performing experiments and calculation on specific materials, designs and objects to determine the cause of failure, whether it was accidental, caused by physical damage, erosion or other natural agents.

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