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Correlation of Forensic Science and Bioengineering; Forensic Engineering

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Abstract
The aim of this paper is to analyse the relationship between forensic science and bioengineering. Forensic engineering can be confidential as a technical discipline or more precisely as one of applied technical sciences where the main focus is on investigating the causes, the course and costs of negative technical phenomena in various fields. These phenomena are quantitatively analysed, interpreted and clarified for the proceeding's purposes before the state authorities, most often in criminal and civil proceedings. In terms of current development, the interdisciplinarity is becoming progressively important. Basically, here combine seemingly disparate scientific fields that have good hypothetical basis. The main task of the forensic engineering scientific development now is mainly the building of new specific disciplines while maintaining the quality the theoretical foundations of the original disciplines.

Keywords: *Bioengineering, Forensic engineering, relationship between forensic science and engineering.*

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I. INTRODUCTION

Forensic engineering, defined as the application of engineering principles and procedures toward the purposes of the law, is a rapidly developing forensics specialty. Forensic engineering and its potential from the outlook of solving risk situations. Possibilities of applying forensic engineering in practice, especially in the context of forensic expertise. The field of forensic engineering is amazingly broad, since by definition it encompasses all of the engineering disciplines applied in a legal context. This paper points out the importance of Bioengineering and risk analysis in the form of forensic expertise.

1. ***What Is Forensic Science***?

In the ancient Roman Empire, the Senate used to conduct its meetings in a public place called the forum. Anyone who wanted to could listen to the great debates of the day and watch the government in action. The key here is that the forum was a place where everyone could come and observe. The term "forum" is Latin for "public" and "forensic" is derived from that term. "Forensic science" implies, then, something about science and the public. In the broadest sense, forensic science can be defined as the methods of science applied to public matters. By this definition, forensic science doesn't necessarily have to do with crime, but the term has evolved in modern times to refer to the application of science to court or criminal matters. Most forensic scientists work in the criminal area of the justice system, although civil cases are an important component of forensic science.

1.1 HISTORY AND DEVELOPMENT OF FORENSIC SCIENCE

The Chinese were the first to discover the value of forensic science in identification. They were the first to use fingerprints to identify the owners of objects such as pottery, but had no formal classification process. In later centuries, a number of scientists, such as Marcello Malphighi, noted the presence of fingerprints and that they had thought-provoking characteristics, but didn't make any connection to personal identification. The first person to identify that fingerprint could be classified into types (nine major kinds) was Jan Purkinje, a professor of anatomy. In 1880, a Scottish physician named Henry Faulds published an article in the journal Nature that suggested that the uniqueness of fingerprints could be used to identify someone. This was quickly followed in the 1890s by Frances Galton, who published the first book on fingerprints; Juan Vucetich, who developed a fingerprint cataloguing system that is still used today in South America; and Sir Edward Henry, who developed the fingerprint classification system that has been adopted in the United States and Europe. The development of a forensic science structure including crime labs is much more recent and quite interesting. For example, the first detective force was developed in France, The Sûreté of Paris by Eugene Vidocq in 1810. In 1905, President Teddy Roosevelt established the FBI, but the FBI lab was not established until 1932. The first crime laboratory was established in France in 1910 by Edmund Locard, a professor of forensic medicine. He later espoused his famous Locard Exchange Principle, which will be discussed in the next chapter. In the United

States, the first crime laboratory was established by August Vollmer, chief of police in Los Angeles. The first journal devoted to forensic science was begun by Calvin Goddard and his staff in 1930 at the newly formed Scientific Crime Detection Laboratory on the 14 Forensic Science: The Basics, Second Edition campus of Northwestern University. Initially called the American Journal of Police Science, the name was later changed to the Journal of Criminal Law, Criminology, and Police Science. In 1937, Paul Kirk established the first university-based forensic science program at the University of California at Berkeley. It was called Technical Criminology. Dr. Kirk is generally considered the father of modern forensic science in the United States. In 1950, the American Academy of Forensic Science (AAFS) was founded in Chicago. The AAFS is the largest forensic science society in the world and has members from many different countries. The Academy began publication of the Journal of Forensic Sciences, the professional journal of forensic science, shortly after AAFS was founded. The realization that blood and bodily fluids had the potential for being important evidence in criminal investigation is an old idea. Bloody palm prints were used as evidence more than a thousand years ago in Rome. In 1853, Ludwig Teichmann developed the first of a number of crystalline tests still used today in the characterization of blood. His test detected the presence of hemoglobin. The German scientist Schönbein developed the first presumptive test for blood. It takes advantage of the ability of hydrogen peroxide to react with hemoglobin. This was in 1863. In 1900, Karl Landsteiner made major breakthroughs in the analysis of blood when he determined that there are actually four types of human blood. This became the basis for the ABO blood typing system and set the stage for all further work in serology. Landsteiner won the Nobel Prize for his work in 1930. Max Richter took Landsteiner's results and adapted them to blood stains, such as those found in crime scenes. Fifteen years later, Leone Lattes, a professor in Italy, developed a test to determine blood type in the ABO system and wrote a book about how to type dried stains. There were a number of advances over the next thirty years, culminating in the work of Sir Alec Jeffreys of the University of Leicester. In 1984, Jeffreys used a technique called DNA fingerprinting to solve a double murder case in England, the first case solved by DNA analysis. The year before, Kary Mullis developed the polymerase chain reaction (PCR), which is the basis for all DNA typing in forensic cases today. He also won the Nobel Prize for his work.

2. *What is Bioengineering?*

Biological Engineering or bioengineering (including biological systems engineering) is the application of concepts and means of biology (and secondarily of physics, chemistry, mathematics, and computer science) to solve real-world problems related to the life sciences or the application thereof, using engineering's own analytical and synthetic methodologies and also its traditional sensitivity to the cost and practicality of the solution(s) arrived at. In this context, while traditional engineering applies physical and mathematical sciences to analyse, design and assembly inanimate tools, structures and processes, biological engineering uses primarily the rapidly developing body of knowledge known as molecular biology to study and advance applications of living organisms. An especially important application is the analysis and cost-effective solution of problems related to human health, but the field is much more general than that. For example, biomimetics is a branch of biological engineering which strives to find ways in which the structures and functions of living organisms can be used as models for the design and engineering of resources and machines. Systems biology, on the other hand, seeks to utilize the engineer's familiarity with complex artificial systems, and perhaps the concepts used in "reverse engineering", to enable the difficult process of recognition of the structure, function, and precise method of operation of complex biological systems.

Bioengineering as a defined field is relatively new, although attempts to solve biological problems have continued throughout history. Recently, the practice of bioengineering has expanded beyond large-scale efforts like prosthetics and hospital equipment to include engineering at the molecular and cellular level – with applications in energy and the environment as well as health care. A very broad area of study, bioengineering can include elements of electrical and mechanical engineering, computer science, materials, chemistry and biology. This breadth allows students and faculty to specialize in their areas of interest and collaborate widely with researchers in allied fields. Biological engineering is a science-based discipline founded upon the biological sciences in the same way that chemical engineering, electrical engineering, and mechanical engineering can be based upon chemistry, electricity and magnetism, and classical mechanics, respectively. Biological engineering can be distinguished from its roots of pure biology or other engineering fields. Biological studies often follow a reductionist approach in inspecting a system on its smallest possible scale which naturally leads toward tools such as functional genomics. Engineering approaches, using classical design perspectives, are constructionist, building new devices, approaches, and technologies from component concepts. Biological engineering utilizes both kinds of methods in concert, relying on reductionist approaches to identify, understand, and organize the fundamental units which are then integrated to generate something new. In addition, because it is an engineering discipline, biological engineering is fundamentally concerned with not just the basic science, but its practical application of the scientific knowledge is to solve real-world problems in a cost-effective way. Although engineered biological systems have been used to manipulate information, construct materials, process chemicals, produce energy, provide food, and help maintain or enhance human health and our environment, our ability to quickly and reliably engineer biological systems that behave as expected is at present less well developed than our mastery over mechanical and electrical systems. The word bioengineering was coined by British scientist and broadcaster Heinz Wolff in 1954. The term bioengineering is also used to describe the use of vegetation in civil engineering construction. The term bioengineering may also be applied to environmental modifications such as surface soil protection, slope stabilisation, watercourse and shoreline protection, windbreaks, vegetation barriers including noise barriers and visual screens, and the ecological enhancement of an area.

2.1 **Forensic Engineering**

Forensic engineers can be valued in cases where something has gone wrong with a mechanical or structural entity or in cases of automobile crashes. A few years ago, a balcony collapsed in the lobby of a Hyatt hotel in Kansas City. Many people were on the balcony at the time inspecting a rock concert going on in the lobby several stories below. Questions arose about why the balcony collapsed. Forensic engineers were called in to examine the structural remains of the balcony and the concrete that fell. They concluded that the construction of the balcony was faulty and contributed to its failure. Failure analysis is one of the major contributions that forensic engineers make to the justice system. Figure 1.1 shows the damage to the Hyatt hotel in Kansas City after the walkway collapse. The majority of the work of forensic engineers is in the investigation of traffic smashes. Accident reconstruction is used to regulate speed of travel, direction of impact, and who was driving the vehicle at the time of the crash. Insurance companies and police departments use forensic engineers extensively in traffic incident investigation.

Figure 1.1 Wreckage of the collapsed Hyatt Regency Hotel in Kansas City.

2.2 Biomechanics of Injury

Biomechanical injuries typically occur without the direct impact of an outside object on the skull or brain, but rather in the background of acceleration–deceleration injuries. High-speed situations such as motor vehicle accidents and sports provide mediums for these inertia-based injuries. The structure of the skull includes sinuses and bony protective regions. Underlying brain tissue is held in suspension underneath the skull not only by the meninges, but also by a cushion of cerebral spinal fluid. Different inertial forces such as linear acceleration, rotation of the head, or massive vibration or air pressure changes in the environment can result in a wide range of possible damage to these underlying substances. Biomechanics, which simply means the application of Newtonian mechanics to biology, is a subfield of bioengineering, which can be defined as the application of engineering principles and methodology to biological systems.. The field of biomechanics is likewise vast, with applications beyond the vehicular considerations. For example, to name a few, biome-chanukiahs are involved in the design of artificial organs, prostheses, bioinstrumentation, medical devices, safety devices such as protective sports equipment, automobile design and restraint system design to minimize injuries in locations to the body region, type of anatomic structure, specific anatomic structure, and level of injury within a specific region and anatomic structure.

2.3. Forensic engineering, its significance from the historical point of view and in the interdisciplinary context

From the historical point of view the need for expert evidence has only arisen with the development of such areas of human activity to which this evidence be associated with. Only when some of them reached levels that were no longer comprehensible by the judge, did the need to invite an description of an expert arose. The concept of “an expert “starts to appear at the break of 19th century, with the development of science and technology. However, the view that expert is an assistant to court is still widely accepted. On the contrary, the situation nowadays is such that state authorities, most regularly courts, take forensic expertise as a clear indication on the basis of which they decide the dispute with the parties involved trying to challenge the forensic expertise. As a consequence, one case can generate several expert calculations. Forensic engineering can be classified as a technical discipline or more precisely as one of applied technical sciences where the main focus is on investigating the causes, the course and consequences of negative technical phenomena in various fields. These phenomena are objectively analysed, interpreted and clarified for the proceeding's purposes before the state authorities, most often in criminal and civil proceedings. In terms of current development, the interdisciplinarity is becoming increasingly important. Basically, here combine seemingly disparate scientific fields that have good theoretical basis. The main task of the forensic engineering scientific development now is mainly the construction of new specific disciplines while maintaining the quality the theoretical foundations of the original disciplines.

II. RESULTS AND DISSCUSSIONS.

The legal system widely recognizes the role of forensic evidence in the trial of criminal offenders. This is because when scientific techniques and methods are used, there is not much scope for bias or injustice. That is why DNA profiling and a host of other forensics evidence are widely accepted in courts across the world. Interestingly, the first forensic technique ever used to involve finger and palm print identification dates backs to Chinese. Forensic evidence is extensively used worldwide to both convict and exonerate defendants. Importance of biomedical engineering in the field of forensics is increasing day by day. The evidence collected from a crime scene should scientifically analysed and should make a conclusion regarding the evidence. For that the field of instrumentation in forensic should make a devastating change. Forensic engineers provide services in a setting that is foreign to most engi- neers. Most engineers communicate with their colleagues using the shared language of calculations, moduli, stresses, and strains. Forensic engineers speak to a broader audience composed of lawyers and lay people with little knowledge of engineering. The typical engineer tries to understand the causes of failure in order to design remedial measures or to avoid future failures. In contrast, in a legal proceeding, the forensic engineer's opinion may be relied on by others to assign blame. Because the engineer's testimony or work product may be presented in a legal proceeding, the forensic engineer should be generally familiar with legal proceedings and with what is expected of an expert witness.

III. CONCLUSION

In the past, forensic engineering has been associated almost exclusively with connotations of litigation activity (i.e., the expert witness in the court- room). While forensic engineers continue to play an important role in litigation, they are becoming increasingly involved in a wide variety of activities that may have little to do with litigation. In civil engineering, for example, the skills and knowledge of the forensic engineer are useful in assessing the per- affirmance of the deteriorating infrastructure, and in making recommendations for repair procedures. The civil engineering forensic consultant, with a knowledge of construction practices, materials, and design standards used in past eras, is often called on to assist in the adaptive reuse and historic conservation of significant architectural structures. Forensic engineers have also expanded their role in contributing to the dissemination of information resulting from failure investigation, so that practices and products may be improved. The practice of forensic engineering is a challenging and rewarding profession. Forensic engineering requires technical expertise to find the facts, communication skills to explain those facts, and professional diplomacy to assist in the resolution of related disputes.

The successful forensic engineer serves society by contributively to an understanding of the causes of failures and accidents. The efforts of the forensic engineer advance the art and science of engineering as the result of learning from failures.

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