EJSIT
European Journal of Science, Innovation and Technology
ISSN: 2786-4936
www.ejsit-journal.com
Volume 3 | Number 4 | 2023

Employing Sociotechnical System for Organization Development: Developing a Crime Statistics Database for Nigerian Law Enforcement Organizations

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ABSTRACT

Sociotechnical systems are a method for complex organizational work design that considers how people and technology interact in the workplace. Accordingly, this research is concerned with the development of a crime statistics database system as a socio-technical system which would become instrumental in the efficiency and effectiveness of law enforcement organizations in Nigeria and cornerstone to national security through provision of authentic criminal intelligence information, which can easily be shared among various security organizations. The aim of this study is to therefore develop a central database-driven information system for capturing and reporting crimes. This crime statistics database is intended to become a de facto sharing tool as well as cross-referencing points for different security and intelligence organizations in the country as well as statisticians, social workers, private, public investigators and other stakeholders. The following programming applications were used for developing the system: PHP Hypertext Pre-Processor, Asynchronous JavaScript and Extensible Markup Language (AJAX), Cascading Style Sheet version 3, Bootstrap, Media Querries, Mobile Hypertext Markup Language version 5, JavaScript libraries - JQuery Mobile, JQuery User Interface, JavaScript, PhpMyAdmin and MYSQL database engine. The Object-Oriented System Analysis and Structured Design (OOSASD) methodology was chosen for analysis, design and development of the system. Use case diagram, class diagram, sequence diagrams and an operational flow chart were the chosen sub-sets of Unified Modeling Language (UML) notations and techniques. In addition to the penal code and crime analysis, the study examined existing paper-based crime statistics databases, then acknowledged and addressed their loopholes using a web-based database-driven software that can store history records of criminals, dangerous deviants and terrorists with mobile phones, tablets, computers, PDAs and handheld devices.

Keywords*:* Crime analysis, Crime statistics database, Crime information system, Law enforcement organization, Organization development, Nigeria, Social control, Sociotechnical systems, Sociotechnical theory, Work design

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INTRODUCTION: SOCIOTECHNICAL SYSTEMS, WORK DESIGN AND CRIME INFORMATION SYSTEM

An approach to complicated organizational work design that takes into account how people and technology interact in the workplace is known as sociotechnical systems. The phrase is also used to describe the intricate networks of human relationships, technological devices, and cybernetic operations that make up expansive, sophisticated infrastructures (Stranks, 2007). A development of sociotechnical theory, sociotechnical systems offer a more comprehensive descriptive and conceptual language for describing, analysing, and building organizations. As a result, a sociotechnical system—a networked, systems-based combination of people, technology, and their environment—often refers to an enabling technology, which by definition should not be permitted to be the deciding factor when new work systems are deployed. Therefore, to be categorized as "Sociotechnical," equal emphasis must be placed on creating a superior and fulfilling work environment for an organization's personnel (Mumford, 2001). In the context of a sociotechnical system, utilizing new, disruptive, more advanced technology necessitates assessment from a variety of angles, considering both potential long-term benefits and short-term profits, according to Bednar and Welch (2019).

In accordance with sociotechnical theory, the social and technical systems should be designed in concert to function harmoniously. In contrast to sociotechnical systems, sociotechnical theory suggests a variety of approaches for attaining joint optimization. Instead of the all-too-common scenario where new technology fails to live up to the expectations of both designers and users, they typically focus on designing different kinds of organizations, ones in which the relationships between socio and technical elements lead to the emergence of productivity and wellbeing (Cooper & Foster, 1971).

The socio-technical approach acknowledges that people and technology work together to ensure that work systems are highly efficient and have better qualities, which increases employee job satisfaction and motivates them to improve work quality and go above and beyond expectations (Mumford, 1995; Mumford & Weir, 1979). Therefore, information system development is a business organization issue that is concerned with the process of change rather than necessarily a technical one (Leitch & Warren, 2010).

The sociotechnical systems approach's core components include integrating human and technology components to open new employment opportunities and facilitate technological advancement (Trist, 1981). Although the inclusion of human aspects in negotiations may initially increase burden, it is critical that needs may be identified and considered before deployment since it is essential to the system's success (Mumford, 2006). The sociotechnical systems approach is frequently associated with autonomy, completeness, and job satisfaction due to its mutual causality, as both systems can cooperate to achieve a goal (Winter et al., 2014); and this goes all the way back to the Hawthorne studies (see Ejiofor & Arukwe, 2015).

A crime on the other hand is an action or omission which constitutes an offence and is punishable by law. It is also an action or an instance of negligence that is deemed injurious to the public welfare or morals or to the interests of the state and that is legally prohibited. In practical terms, a crime refers to any behaviour the government considers harmful to the society as defined in Criminal Law, which is a body of statutory rules of a federal government, and prosecutable in criminal court (Jaybhaye, 2022). The following is an inexhaustive list of some acts that are usually contrary to legal code including personal and property crimes: felonies, misdemeanours, accessory, murder, robbery, aggravated assault, aiding and abetting, arson, assault, bribery, child abuse, child pornography, credit card fraud, disorderly conduct, illicit drug cultivation or manufacturing, drug possession, drug trafficking or distribution, drunk driving, embezzlement, extortion, forgery, fraud, harassment, hate crime, identity theft, insurance fraud, kidnapping, prostitution, rape, solicitation, stalking, tax evasion, theft, white collar crimes, personal crimes, homicide, statutory rape, battery, terrorism, threat, cheque

cloning, issuance of bounced cheque, etc. As the number of crimes committed in a country continues to rise, it becomes unavoidably necessary to record a history of criminal activities in an information system. An information system can be a piece of software application that allows users to store and retrieve information.

In the context of this study, we conceptualize crime information as simply a computer information system that provides accurate, timely and accessible information with additional value that can be used by law enforcement organizations to deal with crime. When a suspected terrorist, criminal or any person legally classified as a suspect commits a crime and has been apprehended by law enforcement organizations, the person would usually be required by law to give a formal statement prior to their detention and further investigations. Under normal circumstances, the detainee should not be held in detention any longer than 24 hours from the time of arrest before being charged to court. Although there appears in practice to be discrepancies in routine and ethics of various security organizations in Nigeria (see Arukwe, 2014) especially regarding detention of a suspect among others, crime suspects have been known to be held under arrest while investigations go on and relevant papers filed with the Directorate of Public Prosecution and Relations (DPPR). If it is a case of misdemeanour, the police would handle it, otherwise (say capital offense such as felony, arson, treason, cheque kiting, etc.) the matter would be referred to the court through DPPR. If the court pronounces a suspect as an offender, he or she will be thrown into jail or penitentiary with a serving sentence. From the time of arrest to the time of sentencing, or even release on bail, criminal cases are mostly recorded manually on papers among Nigerian security organizations and piled up in cabinets in disorderly and unprofessional manner, which makes it difficult for someone to easily trace a particular file should the need for retrieval arise. This research therefore adopts an action research approach to develop a digital crime statistics database as a sociotechnical system that will enable law enforcement organizations to input, retrieve and share records of terrorists and criminal activities as well as court cases among themselves using the above web development technologies, methodology and techniques, thereby enriching their jobs as well as their job designs and engendering job satisfaction among others.

Over the years, there has been a rising rate of crimes in all regions of Nigeria. The ill-equipped law enforcement organizations, when they are not implicated in the crimes themselves or employing their Chinese-supplied equipment to suppress legitimate dissent and crack down on and kill hapless citizenry (see for example, Arukwe 2022, pp. 99-104; Arukwe 2023, pp. 82, 85) are inundated with incidence of crimes of varying degrees on daily basis and they cannot easily track criminals and terrorists alike, as well as control illegal racketeering, purchasing and distribution of destructive weapons in the country due to lack of an effective crime statistics database that should be a lifeline to such law enforcement organizations, and a cornerstone to maintaining social order within the country in accordance with international criminal intelligence ethos. It is difficult for the Nigerian law enforcement organizations to perform efficiently and effectively in the absence of an operational crime statistics database that provides an array of services such as database of fingerprints and other biometric information of terrorists and criminals including felonious cases already concluded and those that are still under investigation in all the states of the Federation. It would appear therefore that not much has changed in this regard from the immediate post-independence days to the present period. The absence of a unified and centralized crime statistics database amongst Nigeria's law enforcement organizations would mean among other things that both law enforcement organizations and government social workers, statisticians and other stakeholders in the entire criminal investigation enterprise would find it extremely challenging to track dangerous deviants, terrorists and offenders smartly, and this anomaly hinders their operations. Similarly, fresh criminal cases are not being recorded in a centralized crime statistics database

and there is no readily available federal database that can provide comprehensive information on existing terrorist and criminal activities for intelligence and other administrative purposes.

To respond to this problematique, this research is an exercise in Organization Development that develops a crime statistics database as a sociotechnical system. Specifically, this research would develop a mobile user-friendly data capturing system for crime reporting, develop a central database system for crime data storage, and develop a piece of software for implementing crime statistics database for the law enforcement organizations in Nigeria.

There are many names used for description of computer systems developed to provide and maintain criminal history records by law enforcement organizations and criminal justice systems in different countries. Owing to the diversity in structure and purpose of crime statistics databases, creating a generally acceptable taxonomy to be applied in such a sociotechnical system demands a special attention because what constitutes a crime in one society may not be seen as a crime in another society. For, example, there was a period in European history of pillage and hegemony when it was not a crime to enslave Africans by European and American laws while the same crime attracted severe punishments including death in some African kingdoms (see Arukwe, 2010). The awkward discrepancy in the definition and universal acceptance of crime as a concept in varying societies has a root in the way crimes become categorized by people of different ethnicities and nationalities and socio-cultural inclinations.

LAW, PENAL CODE, SOCIAL CONTROL AND CRIME ANALYSIS: A HISTORICAL PERSPECTIVE

According to the natural law view, morality is based on, or is created by, the nature of the universe or of humans. Thomas Aquinas stated in the thirteenth century that the reason, which is the initial principle of human acts, is the rule and measure of human deeds. He regarded people as by nature rational beings, concluding that it becomes morally appropriate that they should behave in a way that conforms to their rational nature (Aquinas et al., 2002; University of Namibia, 2021). Thus, to be valid, any law must conform to natural law and coercing people to conform to that law is morally acceptable. In the 1760s William Blackstone proposed the thesis that this law of nature is obviously more obligatory than any other because it was established alongside humanity and by God himself. No human law that is antithetical to this is legal anywhere on earth, in any nation, or at any time; those that are valid draw all their authority, either indirectly or directly, from this foundation (Blackstone, 2002). However, John Austin, a pioneer of legal positivism, used utilitarianism to recognize the rational character of people and the existence of an objective morality. He refuted the idea that a norm's morality-conformity determines whether it is lawful legally. Accordingly, in Austinian terms, a moral code can specify what individuals should do in an objective manner, the law can implement whatever norms the legislature decides are necessary to promote societal usefulness, but each person retains the freedom to decide for themselves what they will do (Bix, 2018; Marmor & Sarch, 2019). Similarly, Hart (1961; 1963) saw the law as an aspect of sovereignty, with lawmakers able to adopt any law as a means to a moral end.

Thus, the necessary and sufficient conditions for the truth of a proposition of law simply involved internal logic and consistency, and that the state's agents used state power with responsibility (Himma, 2022). Hart's theory is rejected by Dworkin (2018), who asserts that all people have a fundamental political right to demand the same respect and care from those in positions of authority. He presents a theory of compliance, which is supported by theories of respect (the obligation of citizens to obey the law), and enforcement, which determines the proper objectives of enforcement and punishment. Legislation must adhere to a theory of legitimacy, which outlines the conditions under which a specific person or organization is permitted to enact legislation, and a philosophy of legislative fairness, which outlines the laws they are permitted to or required to enact.

Indeed, despite everything, most natural-law theorists agree that the basic purpose of the law is to uphold acceptable morals. This viewpoint has the drawback of making it impossible to ethically criticize the law because all valid laws must by definition be morally just if conformity with natural law is a requirement for legal legitimacy. According to this line of thinking, a norm's moral justice must follow from its legal legitimacy. By acknowledging some moral relativism and understanding that norms might change through time, one can critique the continuous application of outdated rules in light of the norms of the present. People may find such law acceptable, but the use of state power to coerce citizens to comply with that law lacks moral justification (see Himma, 2022). Recenter versions of the theory define crime as the infringement of personal freedoms. What constitutes a crime also counts as natural, in contrast to laws (considered as man-made), as society views so many rights as natural (thus the name "right") rather than man-made. This idea is best expressed by Adam Smith, who claims that a smuggler would make a great citizen "...had the laws of his country not made that a crime which nature never meant to be so." Therefore, the natural-law theory distinguishes between "illegality" (which has its roots in the interests of people in positions of power) and "criminality" (which comes from human nature). Lawyers will occasionally use the phrases malum in se and malum prohibitum to describe the two ideas (New World Encyclopedia, n.d.). They argue that whereas a "crime malum prohibitum" only counts as a crime because the law has declared it to be one, a "crime malum in se" is criminal by definition. According to this perspective, it is possible to carry out an unlawful conduct without committing a crime, yet an unlawful act may also be entirely legal (see Ofokansi, et al., 2021; Okonta et al., 2013 for examples of such conditions). This viewpoint was held to some extent by many European Enlightenment philosophers, including Adam Smith and the American Founding Fathers, and it continues to have sway among so-called classical liberals and libertarians.

Some religious groups view sin as crime, and others may even emphasize it extremely prominently in legendary or mythical stories of origins—for example, the story of Adam and Eve and the concept of original sin. What one group views as criminal activity may start or intensify war or conflict. Although not necessarily in written form, the earliest known civilizations possessed legal codes that combined civil and criminal laws. According to Oppenheim and Reiner (1964/2009), the Sumerians produced the earliest surviving written codes and Urukagina (reigned c .2380 BC–2360 BC, short chronology) had an early code that has not survived; a later king, Ur-Nammu, left the earliest extant written law-system, the Code of Ur-Nammu (c .2100-2050 BC), which prescribed a formal system of penalties for specific cases in 57 articles. The Sumerians later issued other codes, including the "code of Lipit-Ishtar" (Glosbe, n.d.). This code, from the 20th century BCE, contains some fifty articles, and scholars have reconstructed it by comparing several sources.

According to Kramer (1963) The Sumerian was aware of his own rights and hated any interference with them, whether it came from his King, a peer, or an equal. It would seem in this sense, that the first people to create laws and legal systems were the Sumerians However, archaeological, anthropological, and historical evidence shows that long before there were the Sumerians codes, there were the Kemetians, the "blameless Ethiopians", who gave the world ethics and other moral ethical laws and penal codes. There were therefore these codes that were written down for the purpose of social control in Africa in ancient Kemet. The codes include those written in the Kemetian Book of Coming Forth by Day, The 42 Laws of Ma'at and the 147 negative confessions. Because these codes also come with preternatural sanctions, such other religious moral and ethical codes like the Christian Ten Commandments would be distilled from these codes of the Kemetians. Also, the earliest laws of the Greco-Roman civilization evolved from the Kemetian codes and laws (see Diop, 1989; Jackson, 2015; James, 2019; Williams, 1987). Successive legal codes in Babylon, including the code of Hammurabi (c. 1790 BC), reflected Mesopotamian society's belief that law derived from the will of the

gods (Skaist, 1994). Many states at this time functioned as theocracies, with codes of conduct largely religious in origin or reference. Maine (1861/2012) searched through the old codes that were available in his time but was unable to locate any criminal law in the "modern" sense of the word. The so-called penal law of ancient communities did not deal with "crimes" (Latin: crimina), but rather with "wrongs" (Latin: delicta), whereas modern systems make a distinction between offenses against the "State" or "Community" and offenses against the "Individual". The Hellenic laws, (Garner, 2014) thus considered all types of theft, assault, rape, and murder as private wrongs and left it to the victims or their survivors to take enforcement action. Formal courts don't appear to have existed in the earliest European systems. The Romans standardized the law and implemented it throughout the Roman Empire (see Jaybhaye, 2022). Once more, the basic principles of Roman law treat attacks as a private reparation issue. Dominion was the most important notion in Roman law, according to Daube (1969). All members of the family, even those who were held as slaves, belonged to the pater familias, who also enforced cases concerning interference with property. The Twelve Tables were the subject of Gaius' Commentaries, which were composed between 130 and 180 AD and treated furtum (contemporary slang for "theft") as a tort.

Similarly, a violation of such laws created vinculum juris (an obligation of law) that could only be satisfied by the payment of money compensation (modern "damages"). Assault and violent robbery involved trespass as to the pater's property (so, for example, the rape of an enslaved person could become the subject of compensation to the pater as having trespassed on his "property"). Like today's courts, the combined Teutonic laws of the Germanic tribes comprised a complicated system of monetary compensations for crimes against people that ranged from murder to lesser offenses (Guterman, 1990). Despite the fact that Rome abandoned its Britannic provinces around 400 A.D., the Germanic mercenaries—who had played a significant role in upholding Roman rule in Britannia—acquired land there and continued to follow a hybrid of Roman and Teutonic Law, much of which was codified under the early Anglo-Saxon Kings (Attenborough 1922/2006). But according to Pennington (1993), the modern idea of a crime emerging as both an offense against the "individual" and a wrong against the "State" did not occur until a more centralized English monarchy emerged after the Norman invasion and when the kings of England attempted to assert power over the land and its people.

The oldest conception of a crime was based on common law, and it involved significant enough events for the "state" to usurp the normal civil judicial responsibilities and enact a special statute or privilegium against the perpetrator. The civil (delictual) law operated in a highly developed and consistent manner (except from when a King wished to collect money by selling a new type of writ), yet all of the first English criminal trials involved entirely extraordinary and arbitrary courts without any settled law to apply. Only concurrently with or after the establishment of the concept of sovereignty does the notion that the "State" administers justice in a court come into existence.

Roman law continued in continental Europe, but the Christian Church had a bigger effect. Along with the more dispersed political system based on smaller feudal units, other legal traditions with stronger roots in Roman law evolved and were adjusted to fit the political environment. Roman law's influence in Scandinavia did not become apparent until the 17th century, and the courts developed from the assemblies of 32 people. Cases are decided by the public (typically, the largest freeholders predominate). Later, this system evolved into one where a royal judge appointed a group of the parish's most illustrious men to serve as his board, playing the role of "the people" in earlier times (Vinogradoff, 2017). The policy justification for mandating the payment of monetary reparations for wrongs done has been preventing conflict between clans and families since the Hellenic system. The peace would be maintained if compensation could ease the tension between families (Himma, 2022; Jaybhaye, 2022).

However, the introduction of oaths also downplayed the danger of feudal conflict. If he could convince enough of his male relatives to declare him innocent, an accused individual could walk free in both ancient Greece and medieval Scandinavia. (Compare the United Nations Security Council, in which the veto power of the permanent members ensures that the organization does not become involved in crises where it could not enforce its decisions.) These means of restraining private feuds did not always work, and sometimes prevented the fulfilment of justice. But in the earliest times the "state" did not always provide an independent policing force. Thus, criminal law grew out of what 21st-century lawyers would call tort; and, in real terms, many acts and omissions classified as crimes overlap with civil-law concepts.

The development of sociological thought from the 19th century onwards prompted some fresh views on crime and criminality. Friedrich Wilhelm Nietzsche for instance noted a link between crime and creativity – in *The Birth of Tragedy* he asserted: "The best and brightest that man can acquire he must obtain by crime" (Nietzsche, 1872/2011). In the 20th century Michel Foucault in *Discipline and Punish* made a study of criminalization as a coercive method of state control (Foucault, 1977).

According to the United Nations Office on Drugs and Crime, Vienna, the information's application has also advanced. It is now possible to profile past or present crimes or criminal figures using intelligence tools and approaches. Intelligence that can be used strategically and tactically to improve the precision and justification of police decisions is now available. However, to address the question of how the worth of a piece of information kept in a crime statistics database is acknowledged or credited, practitioners have established several typical steps by which this occurs (United Nations Office on Drugs and Crime, Vienna, 2006, pp. 1–25). Figure1 below represents the most common steps in developing intelligence and highlights that once information has been collected or gathered, it will be "evaluated" according to the reliability of its source as well as the relevance and validity of its content before being filed, cross referenced and ordered, "collated" “analysed” and “disseminated”.

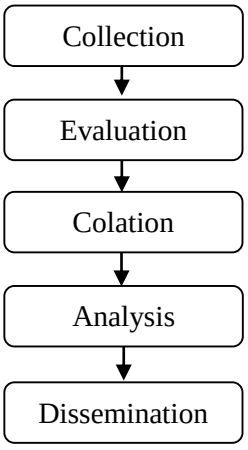

Figure 1. Representation of the Most Common Steps in Developing Intelligence

The actual analysis will then consider the information in context, draw conclusions as to what it means and produce reports, briefings and other documentation representing that meaning. The results or products of this process will then be distributed, or "disseminated" to those who need to know it. The "need to know" principle is fundamental to working with sensitive information and intelligence. It means that unless there is a clear professional reason for sharing information with another person that information should not be shared - even if he or she has the appropriate security clearance level to receive it. The fewer people who know about something, the easier it is to keep it confidential (United Nations Office on Drugs and

Crime, Vienna, 2006, pp. 1–25). This is understandable when dealing with a criminal intelligence database. The opposite is the case in a situation where the goal is to engender organizational efficiency by elevating the level of knowledge of the average worker in the industry or organization to the extent that they would possess the right knowledge to execute the organizational vision and mission efficiently and effectively, and to engender meaningful and progressive Organization Development in a public-facing manner especially in the context of a developing country. This is true for instance of specialized government ministries, parastatals, and bureaucratic formations (see for example Arukwe, 2003; 2004 2014; Arukwe, Akaolisa, et al., 2019; Arukwe, Usman, et al., 2019; Arukwe, Akaolisa, et al., 2020; Arukwe & Ejiofor, 2015; Arukwe & Offor, 2020; 2021; Arukwe, Offor, et al., 2020; 2021; Ejiofor et al., 2016).

Whilst significant differences may be seen in the understanding and acceptance of information and intelligence as a law enforcement tool, the fact remains that, in many countries and international organizations, criminal intelligence has been adopted as the law enforcement strategy of choice to drive law enforcement organizations forward in the next century. Also, national law enforcement secrecy laws may well apply to questions related to information and intelligence so that an assessor may not always receive complete answers to his or her questions. Such a barrier is easy to hide behind where answers to questions would be inconvenient or controversial, for instance, where human rights have been violated, but, on the other hand, there may be no such sinister motive at all.

The availability of statistics related to policing varies greatly. Statistics will also be variable in their reliability and integrity. Where possible, statistics provided by a government agency should be validated against statistics from other sources, such as non-governmental organizations or international bodies (United Nations Office on Drugs and Crime, Vienna, 2006, pp. 1–25). Police information and intelligence can be a sensitive topic and may be protected by special secrecy laws that will preclude answers to some of the assessor's questions.

The history of crime analysis as a profession—in contrast to its history as a concept—lies in the informal method of pattern identification used by patrol officers, detectives, and administrators (A History of Crime Analysis, n.d.). In 1973, the Law Enforcement Assistance Administration observed as much in its *Police Crime Analysis Unit Handbook*:

Informal crime analysis, in its simplest sense, is performed by all officers as they investigate crimes. Crime analysis is the quality of examining one crime occurrence and comparing it with similar past events. In essence, the officer is a walking crime analysis unit as he compares his investigations with his past experiences and with the experiences of others (A History of Crime Analysis, n.d.).

Known as "the father of American policing," August Vollmer (1876–1955) appears to have invented most of the innovations that still shape contemporary police work. The most basic aspects of crime analysis undoubtedly got their start in London in 1829, the same year Sir Robert Peel founded the London Metropolitan Police, which marked the beginning of modern policing. Two "detectives" in each division were employed by the LMP by 1846, and it is possible that these early detectives used some contemporary crime analysis techniques to connect criminal episodes into patterns. Individual crime figures for the city of London were available as early as 1847 (A History of Crime Analysis, n.d.). The idea of modus operandi and the classification of criminals and crimes based on it were first created by the London Metropolitan Police. The modus operandi was largely used in murder cases, although it assisted investigators in more effectively identifying patterns and series. (What is undoubtedly the most well-known murder spree in history took place in London's East End between 1888 and 1889.) It was this idea that would pave the way for the field of crime analysis in America. Crime analysis depends on a careful comparison of current crime to past crime. Through this method, the analyst detects patterns and trends (A History of Crime Analysis, n.d.). A recent house

burglary report might be compared to earlier commercial burglaries, but an analyst will typically pay much more attention to previous residential burglaries. In general, it would be pointless for an analyst to do so. Therefore, the adoption of a deliberate, consistent approach of classification and categorization is the foundation of the process of criminal analysis (A History of Crime Analysis, n.d.). The early 20th century, however, saw a dearth of effective classification techniques. Since statutes varied from one jurisdiction to another (a burglary in California might be defined very differently from a burglary in Maryland), it was impossible to compare crimes across jurisdictions when most police departments classified crimes according to the law they violated. The International Association of Chiefs of Police started talking about a national system for reporting crimes in 1922 after realizing these problems. Chief Vollmer had a crucial role in the procedure and was an IACP member. The program, known as the Uniform Crime Reporting Program, was created by 1930 (A History of Crime Analysis, n.d.).

The UCR program, which is still the most important indication of crime statistics in the US, was subsequently handed over to the Federal Bureau of Investigation for administration. The UCR liberated police departments from statute-based thinking, where "Breaking and Entering into a Dwelling House in the Nighttime with Intent to Commit a Felony while Armed" was its own category, and it assisted them in thinking in terms of broad classifications, such as "Burglary."

The 1990s saw a resurgence in crime analysis, marked by fresh perspectives, fresh money, and hundreds of brand-new crime analysis initiatives. Herman Goldstein, a professor at the University of Wisconsin who, coincidentally, worked as O. W. Wilson's executive assistant at the Chicago Police Department from 1960 to 1964, recommitted the decade to the fundamentals of problem-solving and crime prevention in a book titled Problem-Oriented Policing. A web search for "Problem-Oriented Policing" returns over 1,560 pages; thousands of agencies have adopted POP programs and principles; and it would be very difficult to find anyone in the field of law enforcement who is not familiar with the concept. It is difficult to assess the long-term impact of a book written just ten years ago. Problem-oriented policing describes a set of procedures that seek to make police operations more effective by focusing on the crime problem rather than the crime incident, and by funding ways to eliminate root causes before the problems themselves develop.

As the twenty-first century begins, crime analysts must contend with a number of developments that will influence the growth of the field over the following 10 years. Our current concern is whether or not the "golden age" of the 1990s marked the profession of crime analysis's peak or a new beginning. Is the commitment shown by federal, state, and local authorities still a solid basis upon which to develop in the years to come, or is it already waning? Analysts must adopt professional norms and come to some sort of understanding about what we do to be successful. At the same time, policing organizations need to recognize crime analysis as a core function, rather than a peripheral one. A detective, a canine officer, or an identification technician are all positions that few police agencies would be able to function without; crime analysis systems must be treated in a similar manner. Failure means a decline in police capabilities and a return to the era of irregular, ad hoc crime analysis carried out by patrol personnel. Success can result in thousands of crimes being prevented, significantly increased problem-oriented policing capabilities, efficient resource allocation, and lower crime rates. It will demonstrate how little progress we have made since the beginning of the Anthropocene if humanity continues to vehemently promote the advantages of crime analysis while also noting that most law enforcement organizations still lack proper crime analysis programs.

THEORETICAL FRAMEWORK

This research adopts the sociotechnical theory as the theoretical framework to provide theoretical grounding for the work. The goal of sociotechnical theory is collaborative optimization, with a focus on achieving both technical performance perfection and quality in people's working life. In contrast to sociotechnical systems, sociotechnical theory suggests a variety of approaches for attaining joint optimization. The foundation of these approaches is typically the design of various organizational forms, with the idea being that the functional output of various sociotechnical elements results in system efficiency, productive sustainability, user effectiveness and happiness as well as change management (Stranks, 2007).

In a ground-breaking work published in 1951, Eric Trist and Ken Bamforth built on some of the fundamental ideas of sociotechnical theory. This is a fascinating case study that, like most of the sociotechnical theory research, focuses on a type of "production system" representative of the period and the modern technological systems it featured (Trist & Bamforth, 1951).

Combining human and technical components to enable new job possibilities and open the door for technological transformation is one of the main tenets of the sociotechnical system method. The sociotechnical system approach is frequently associated with autonomy, completeness, and job satisfaction due to its mutual causality, as both systems can cooperate to achieve a goal (Winter et al., 2014).

According to Trist and Bamforth (1951), designing an organization with the traits of small groups but avoiding the "silo-thinking" and "stovepipe" neologisms of contemporary management theory appears to be the key to responsible autonomy. The system has to limit its bad in a way that does not damage its good in order to maintain the loyalties on which the small group depends. This necessitates that groups oversee their own internal control and supervision, with a group leader's explicit primary responsibility being to connect the group to the larger system. Therefore, this theory outlines a method for eliminating more conventional command hierarchies (Rice, 2013).

METHODOLOGY

This segment of the article analyses and designs a crime statistics database by means of the Object-Oriented Systems Analysis and Design Methodology (OOSADM) and the following Unified Modeling Language (UML) techniques together with their associated notation symbols: Use Case diagram, Sequence Diagrams, Class Diagrams and Program Workflow Chart.

Analysis of the Existing System

Based on our extensive observational study, we determined that the manual method that currently operates among Nigerian law enforcement organizations operates as follows: Once a suspect is apprehended and taken to the Police Station, Army Barrack, or any other security or intelligence organization, he or she will be required to make an official statement in writing, which will be filed against him or her before detention. An investigation into a suspect’s case will go on while he or she is under Police custody. Depending on the nature of the crime being committed, the suspect may be moved to Awaiting Trial (ATM). In some cases, a suspect may be kept in ATM for months or even years before being charged to a court for hearing by a magistrate. If the magistrate releases a criminal on bail, sentences him or her to prison, or orders his or her execution in a final verdict, a court clerk records the proceedings in a court register on paper.

If the same criminal or offender was arrested for committing yet another crime and booked in the same police station, then a manual search is conducted on the suspect’s file, otherwise, a new case file would be opened against him or her.

Problems Inherent in the Existing System

We observed that the problems of the existing system are compounded regarding the following:

The police and other law enforcement organizations still write criminal cases on a piece of paper, and since paper materials are not durable, there is a possibility that information written on them would be lost as the materials depreciate over time.

The manual filing cabinets used for storing paper files are prone to being vandalized by someone who may want to protect his or her interest.

It is not easy to access information directly from a remote place since a law enforcement agent will be required to travel to an office where the filing cabinets are physically located.

There are always reports of missing case files due to human negligence and complexities.

Available criminal history records documented on paper would usually not be complete because one or more pages may have been removed to invalidate the entire case file.

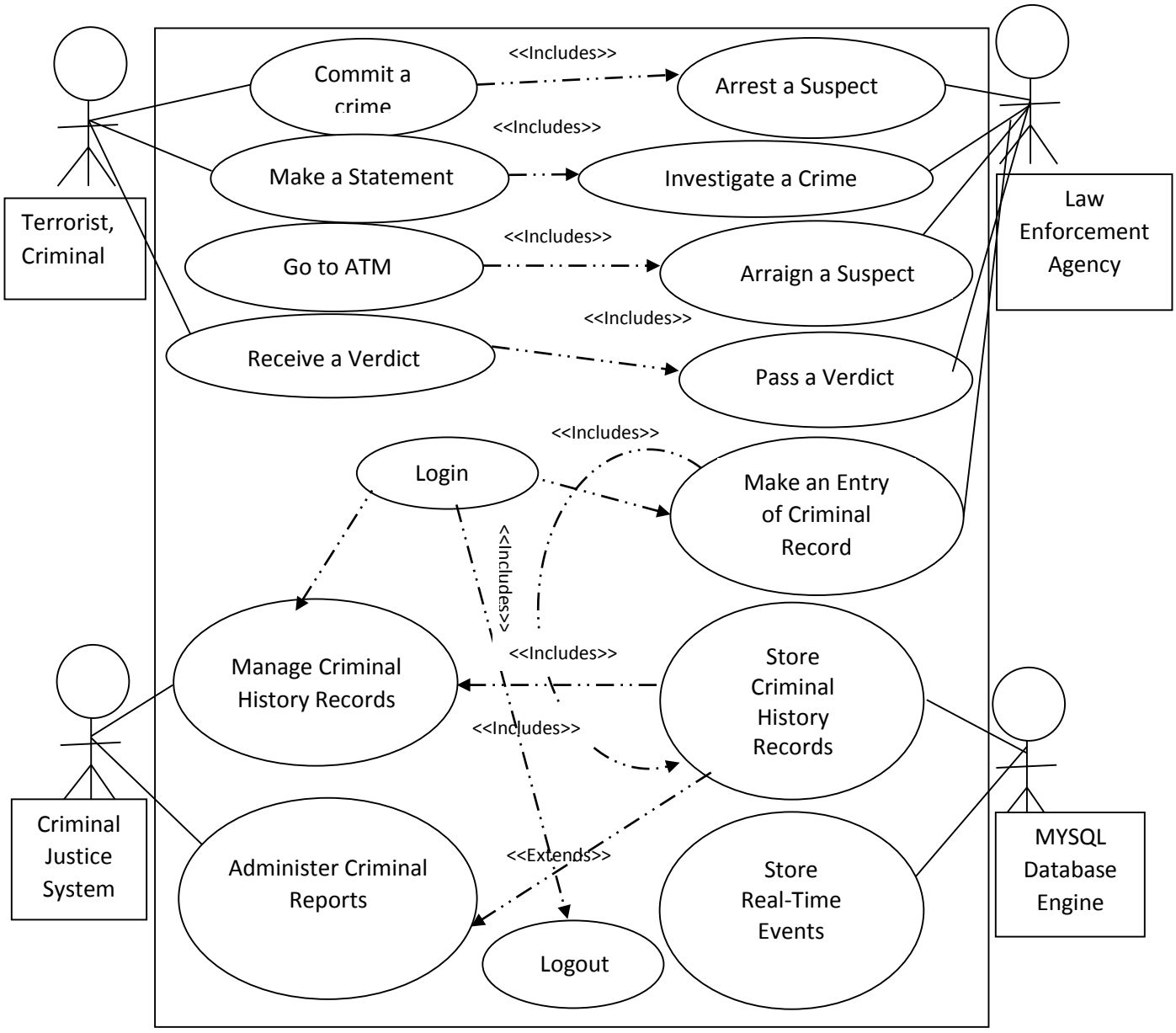

Figure 2. Use Case diagram of a Crime Statistics Database

Figure 2 shows a Unified Modeling Language (UML) Use Case diagram for a crime statistics database consisting of four actors namely – Criminal, Law Enforcement Agency, Criminal Justice System and MYSQL Database Engine.

- A case diagram, represented by a large circumscribing rectangular box as in Figure 2 above, depicts a crime statistics database under development and shows the four actors acting on the system together with the respective use cases, activities, functions, operations, or actions each of them must perform at run time. A use case is an activity, operation, or function that an object must carry out in order to make an information system work properly.
- A criminal or terror suspect can commit a crime, make a statement, go to an Awaiting Trial Moment, or receive a verdict.
- A law enforcement organization arrests a suspect, investigates a crime, arraigns a suspect, proposes a verdict, login, and logout.
- A magistrate, judge, justice, supreme court justice or any person with appropriate legal rights can manage criminal history records and administer criminal reports.
- When a criminal or terror suspect commits a crime, he or she can be arrested by a law enforcement officer.
- When a criminal makes a formal statement while under arrest, a law enforcement officer can investigate his or her case.
- A law enforcement organization can arraign a suspect in Awaiting Trial Moment (ATM) to court and each of these use cases are depicted by an arrow with broken lines.
- The use case at the tail side of an arrow must take place first before a use case to which an arrow points and this kind of direct relationship is marked <<includes>>, otherwise when two actions may occur independently, or put simply, when two use cases have mutually exclusive relationship, they are marked with an <<extends>> symbol.
- The system is designed to allow only law enforcement organizations and criminal justice systems to login to add a criminal record and manage criminal records respectively and then log out of the system. This is shown in the case diagram using two arrows such that a law enforcement agent must log into the system before he or she can log out of it.
- A criminal justice system comprises a variety of legal practitioners that are empowered to manage criminal records and administer criminal reports stored in the relational database server, denoted by an <<extends>> notation because the two use cases are mutually exclusive to each other.
- This proposed crime reporting and capturing information system is designed to disallow unauthorized persons, criminals, crooks, or terrorists from using it.

Program Flow Chart

The diagram below shows the program flow chart of a crime statistics database with considerations for various functions of the software application under analysis, design and development, which seeks to enable a law enforcement officer to register, login, and post criminal records to the database via a user interface tool like an electronic form. The chart also shows different criminal records that can be created in the database according to the category of offences that a criminal may commit to attract punishment from the law of the land. It presents a step-by-step approach for logging into the system in respect of some required login parameters (username and password) as well as actions that a user can perform based on his or her security access level. The system will redirect users to pages or resources based on his or her login security access level.

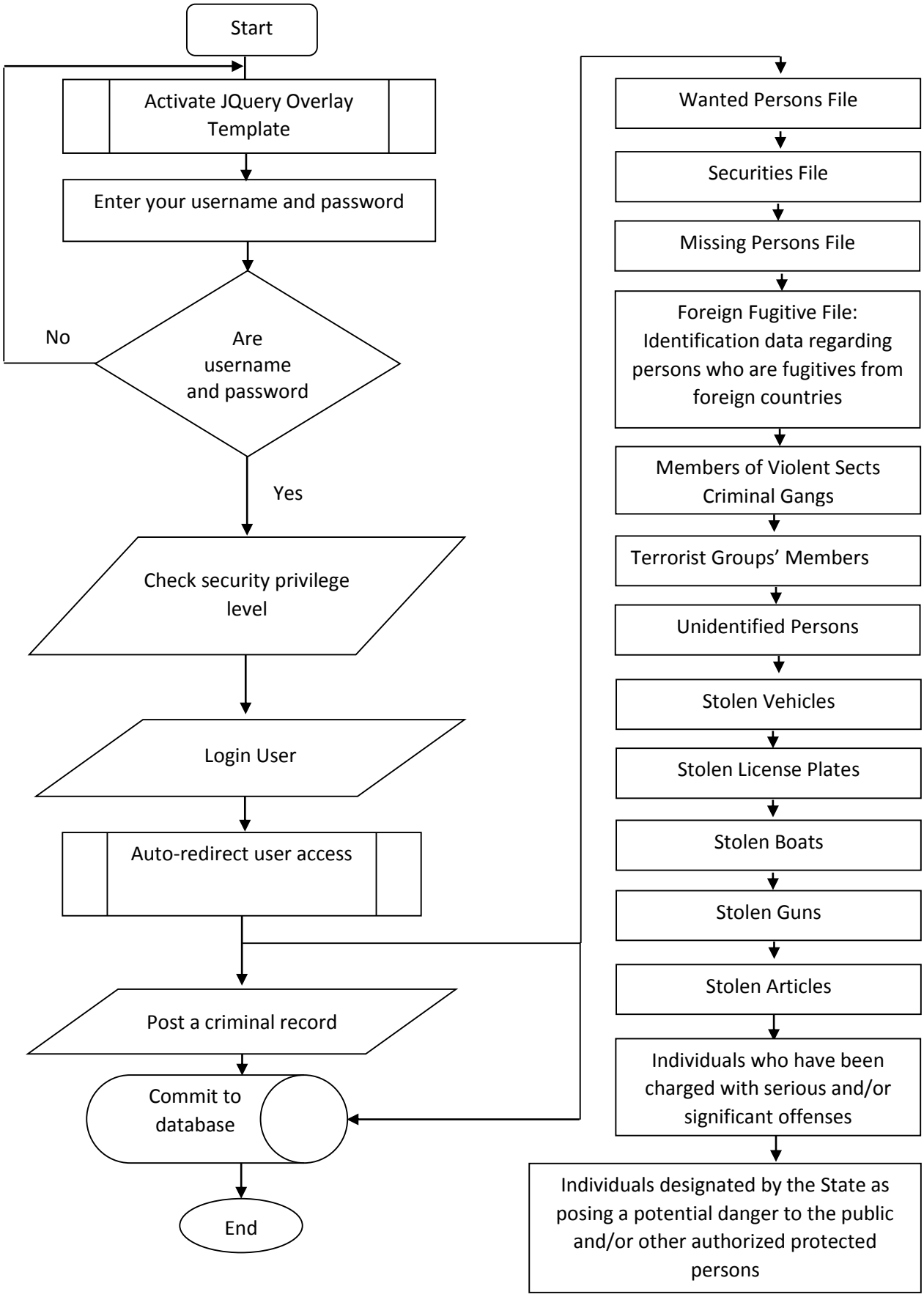

Figure 3. Program Flow Chart of a Crime Statistics Database

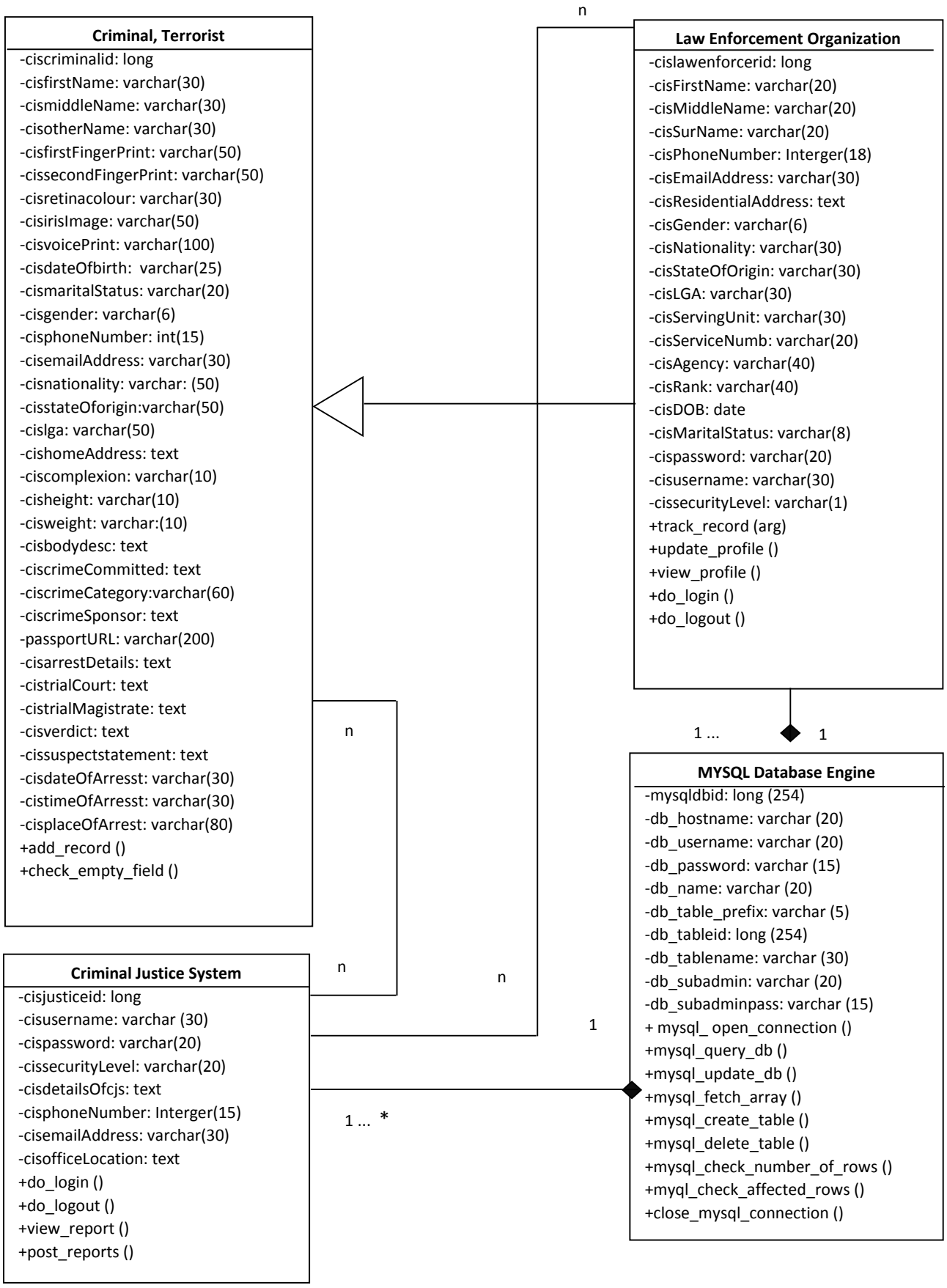

Figure 4. Detailed Class Diagram of a Crime Statistics Database

Figure 4 shows the class diagram of a crime statistics database with the following details:

- The class diagram consists of four classes namely – criminal, law enforcement agency, criminal justice system and MYSQL relational database engine.
- Each class consists of three (3) sections divided in rows. The first row represents the name of the class; the second row represents the attributes or characteristics that describe more details of a class, and the third row represents the operations that a class must accomplish;
- An object in the criminal class is related with another object in the law criminal justice system class by means of UML object association notation symbol because the later manages criminal records and administers criminal reports on the former;
- Both the criminal justice system and law enforcement organization classes are related to MYSQL database engine class by mean of UML object composition association notation symbol in "Whole – Part", or "Parent – Child" relationship. One or more members of a law enforcement organization, and similarly, one or more member of a criminal justice system can gain access to MYSQL database server simultaneously using mobile phones, tablets or computers from remote locations.

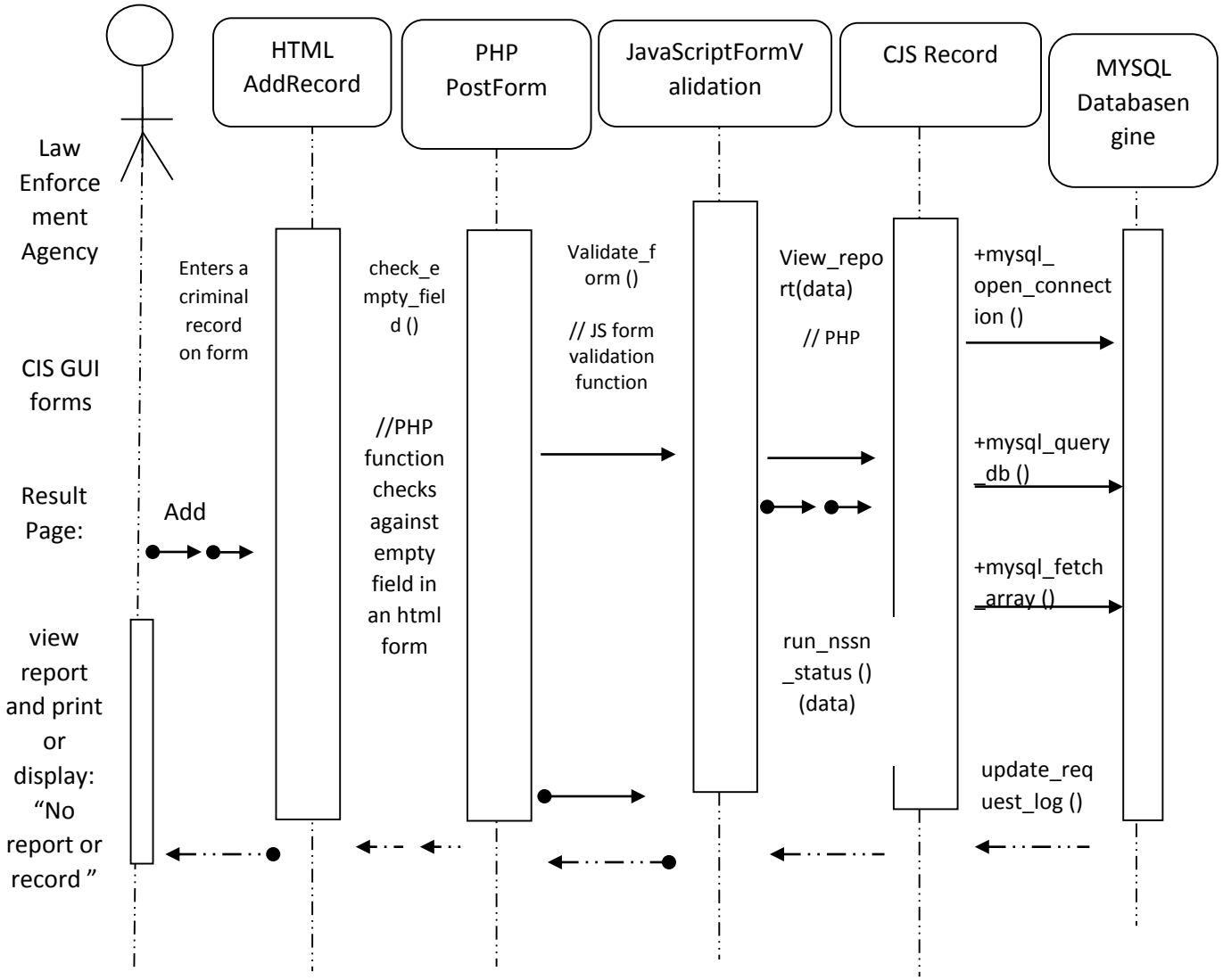

Figure 5. Sequence Diagram for Entering a Criminal Record by Law Enforcement Organization in a Crime Reporting and Information Capturing System

Figure 5 is a sequence diagram showing the step-by-step process through which members of a law enforcement organization make success entries of criminal records and reports. The process is simple. A law enforcement officer completes an HTML form document at the graphical user interface of the software application and clicks on a send link. A PHP function checks whether a field in the form has not been filled out before submission. If there is an empty field not yet filled out, PHP check_empty_field () function disallows the form to be submitted. A JavaScript code runs to validate an HTML form to ensure that data entered in the fields conforms to its data type with respect to HTML form elements or attributes.

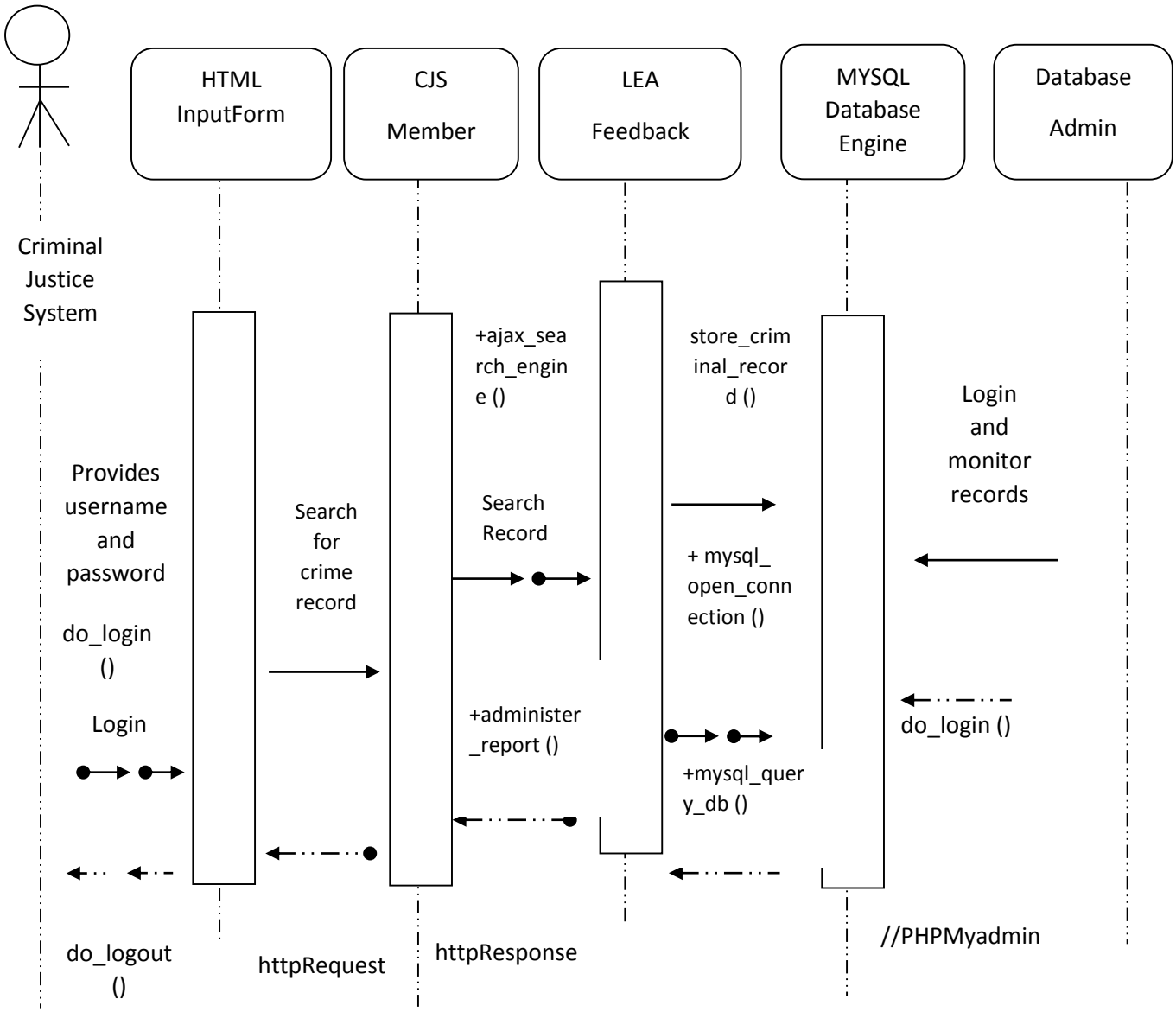

Figure 6. Sequence Diagram Showing a Process to Search for Criminal Records by Criminal Justice System

Figure 6 shows a sequence diagram for managing criminal records by criminal justice system and law enforcement agency after logging into the system with username and password. A member of the criminal justice system or law enforcement organization can log into the proposed crime statistics database with his or her username and password to be automatically redirected to an HTML Input Form thanks to background PHP code running on a conditional loop where he or she will type the particulars (names, phone numbers, email address, etc.) of a

target criminal to capture a record. Well-written lines of PHP code are responsible for communicating with MYSQL relational database and digging out a criminal record based on the search keyword entered by a member of the criminal justice system. The diagram also shows some PHP functions do_login () (responsible for authenticating and logging a user into the system), mysql_open_connection () (responsible for establishing connection with MYSQL relational database server, store_criminal_record () (responsible for storing records of criminal activities as they are uploaded to the crime statistics database by members of a law enforcement organization, mysql_query_db () (responsible for conducting proper search of targeted criminal records); ajax_search_engine () (a generic name given to a block of multiple lines of AJAX code responsible for searching a log of criminal history records and then, making suggestions search results by displaying them for a user to click on a link).

DESIGN OF THE PROPECTIVE SYSTEM

The proposed crime statistics database will function with the aid of a database design, system architecture, input design, output design and algorithm design:

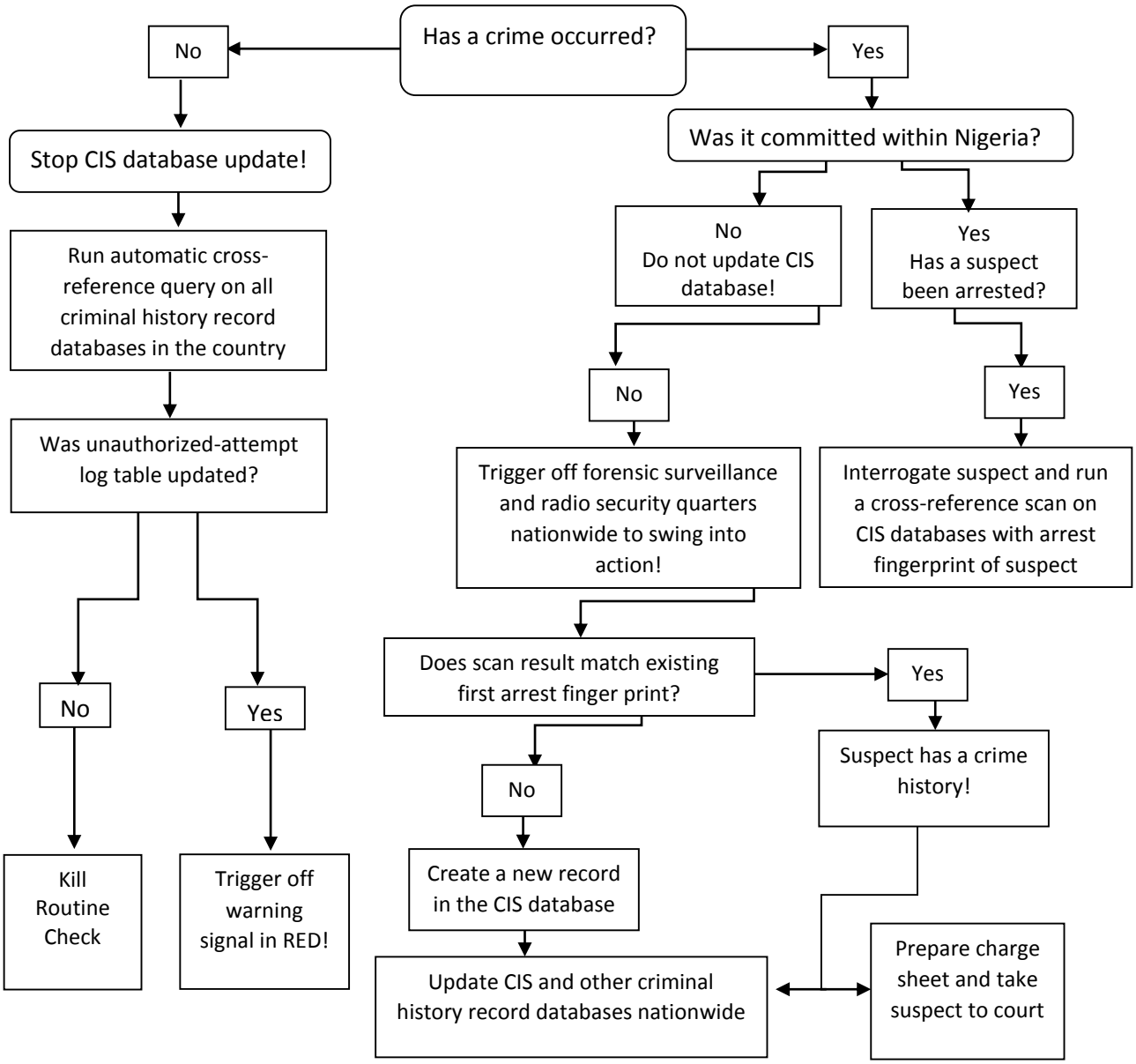

Figure 7. A Crime Information History Record Management Functional Flowchart

Database Design of the New System

The following is a short description of a few sample tables containing criminal history records for the proposed crime statistics database with MYSQL relational database seated as backend:

#	Name	Type	Collation	Null	Default	Action
1	Criminal_ID	int(11)		No	None	Pkey
2	sname	varchar(255)	utf8_general_ci	No		
3	mname	varchar(255)	utf8_general_ci	No		
4	oname	Varchar(255)	utf8_general_ci	No	0	
5	pid	int(15)		No	0	
6	email	varchar(25)	utf8_general_ci	No		
7	phone	int(25)	utf8_general_ci	No		
8	Priority	tinyint(3)		No	0	
9	fa_fingerprint	varchar(255)	utf8_general_ci	No	None	
10	Sa_fingerprint	varchar(255)	utf8_general_ci	No	0	
11	nationality	varchar(40)	utf8_general_ci	No	0	
12	state	varchar(40)	utf8_general_ci	No	0	
13	LGA	varchar(40)	utf8_general_ci	No	0	
14	iris_image	varchar(255)	utf8_general_ci	No		
15	voice_print	varchar(32)	utf8_general_ci	No		
16	retina_colour	varchar(255)	utf8_general_ci	No	0	
17	birthdate	varchar(255)	utf8_general_ci	No	None	
18	birthcertificate	varchar(255)	utf8_general_ci	No	0	
19	marital_status	varchar(8)	utf8_general_ci	No	0	
20	gender	varchar(6)	utf8_general_ci	No		
21	drivers_license	varchar(255)	utf8_general_ci	No	None	
22	national_ID	varchar(255)	utf8_general_ci	No	0	
23	voters_card	varchar(255)	utf8_general_ci	No	0	
24	intl_passport	varchar(255)	utf8_general_ci	No	0	
25	banker	varchar(30)	utf8_general_ci	No	0	
26	account_name	varchar(30)	utf8_general_ci	No	0	
27	account_number	int(10)	utf8_general_ci	No	0	
28	offense	text	utf8_general_ci	No	0	
29	facial_image	varchar(255)	utf8_general_ci	No	0	
30	mug_shot	varchar(255)	utf8_general_ci	No	0	
31	investigator	varchar(255)	utf8_general_ci	No	0	
32	prosecutor	varchar(255)	utf8_general_ci	No	0	

#	Name	Type	Collation	Null	Default	Action
1	Agency_ID	int(11)		No	None	Pkey
2	sname	varchar(255)	utf8_general_ci	No		
3	mname	varchar(255)	utf8_general_ci	No		
4	oname	Varchar(255)	utf8_general_ci	No	0	
5	pid	int(15)		No	0	
6	email	varchar(25)	utf8_general_ci	No		
7	phone	int(25)	utf8_general_ci	No		

8	Priority	tinyint(3)		No	0	
9	username	varchar(25)	utf8_general_ci	No	None	
10	password	varchar(15)	utf8_general_ci	No	0	
11	security_code	varchar(40)	utf8_general_ci	No	0	
12	state	varchar(40)	utf8_general_ci	No	0	
13	LGA	varchar(40)	utf8_general_ci	No	0	
14	login_time	varchar(255)	utf8_general_ci	No		
15	duration	varchar(32)	utf8_general_ci	No		
16	logout_time	varchar(255)	utf8_general_ci	No	0	
17	birthdate	varchar(255)	utf8_general_ci	No	None	
18	birthcertificate	varchar(255)	utf8_general_ci	No	0	
19	marital_status	varchar(8)	utf8_general_ci	No	0	
20	gender	varchar(6)	utf8_general_ci	No		
21	passport	varchar(255)	utf8_general_ci	No	None	
22	agency_name	varchar(255)	utf8_general_ci	No	0	
23	unique_identifier	varchar(255)	utf8_general_ci	No	0	
24	intl_passport	varchar(255)	utf8_general_ci	No	0	
25	rank	varchar(30)	utf8_general_ci	No	0	
26	serving_division	varchar(30)	utf8_general_ci	No	0	

Figure 8. A Sample Table Created in the Database of a Crime Statistics Database Showing Some Records and their Appropriate Data Types

System Architecture

The architecture of this proposed crime statistics database is a 3-tier structural design: the presentation tier, business logic tier and data access tier. What follows is a description of each tier or level of the architecture starting with the presentation tier. All the active links that will direct a user to various sections of the application are neatly arranged on the graphical user interface, which can also be described as the presentation tier. These are some hyperlinks defined with HTML tags in the GUI of the software application namely: Login, Make New Entry, Search, Cross-Reference, Capture Data, Retrieve Password and Logout. The Login link provides a user interface for law enforcement agents or authorized people in the criminal justice system to login and search for criminal history records using a number of criteria such as name or phone number as unique identifiers. The presentation tier or graphical user interface is designed using CSS3 and HTML5 specifications tags. The business logic tier is the stronghold of the crime statistics database in the sense that is where all the essential constraints and business rules in terms of well-structured functions and declared classes are fully implemented within the application using PHP5. The business logic tier sits between the presentation tier and the data access layer, and it is expressed in terms of JavaScript security rules. The database lies in the data access tier of the research project. It includes the database schema (i.e., database internal structural make up or intension). It uses tables to store criminal records as a requirement of MYSQL relational database engine.

Following is a diagram of three-tier architecture of a crime statistics database:

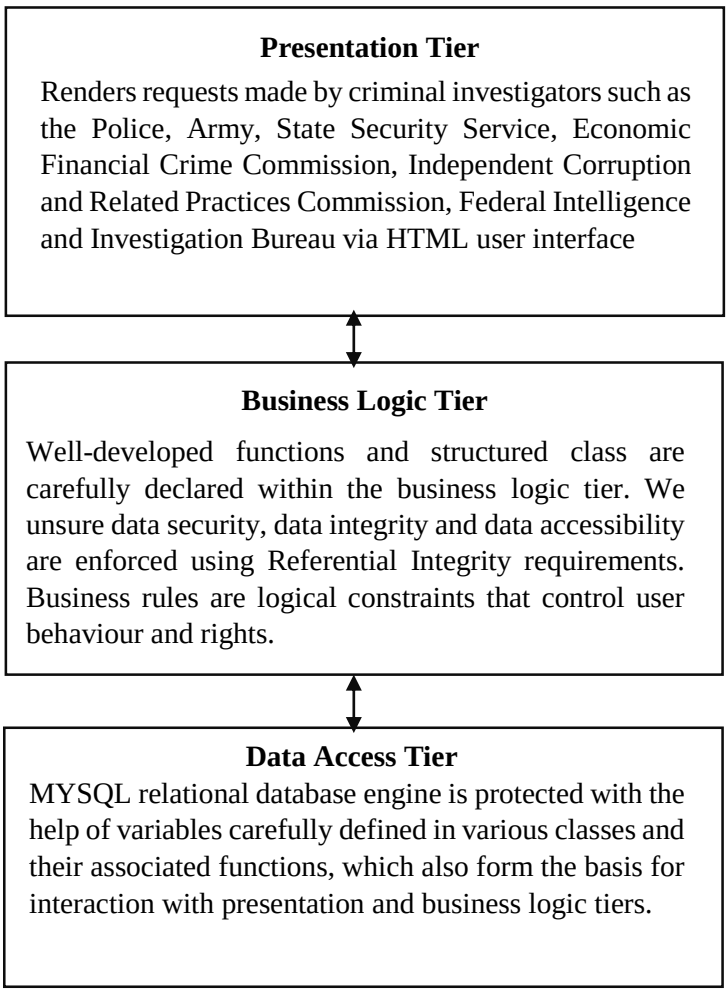

Figure 9. A 3-Tier Architecture of a Crime Statistics Database

Implementation of Database

This crime-statistics database implemented a well-planned database whose schema has been shown in the Entity Relationship, ER-diagram, which was also used for description of the information needs and the data type stored in the database during the requirements analysis phase. An entity stands for a discrete object and can be considered as a noun like Criminal, Officer, Search Output, etc. A relationship captures how two or more entities are associated with each other and can be considered as verbs like Commit, Charge, Enforce, etc. Entity sets are drawn as rectangles, relationship sets as diamonds. If an entity set participates in a relationship set, they are connected with a line. Entities and relationships have attributes which are drawn as ovals.

CONCLUSION

Through the employment of specific programming applications and the sociotechnical theory as the conceptual framework, this research has successfully developed a crime statistics database system as a socio-technical system that is hoped to become instrumental in the efficiency and effectiveness of law enforcement organizations and a cornerstone to national security. This, it is hoped, would engender the regime of accurate criminal intelligence data that can be easily shared among Nigeria's various security organizations. The study assessed current paper-based crime statistics databases among Nigerian law enforcement organizations and identified and corrected their flaws using a web-based database-driven software

application. It is therefore expected that different security and intelligence organizations in the country as well as statisticians, social workers, private and public investigators as well as several other stakeholders would benefit from adopting this sociotechnical system.

ACKNOWLEDGMENTS

The authors would like to thank Nigeria's TETFund for providing part of the funding that made the research from which this paper ensues possible. The authors would also like to thank all the members of the Organization, Industry, Environment & Society Research Group, University of Nigeria, Nsukka (including graduate and undergraduate student members), who contributed to making this research possible through their volunteering activities.

FUNDING

This research received some support from Nigeria's Tertiary Education Trust Fund, TETFund, under the Institution-Based Research fund (IBRF) scheme.

CONFLICT OF INTEREST

The authors report no conflicting interest concerning the research, authorship, and/or publication of this article.

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