ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 12| Issue: 8| August 2026|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2026: 8.753|| ISI Value: 1.188

BEYOND THE PRINTS: EXPLORING THE LIVED EXPERIENCES OF FINGERPRINT EXAMINERS WITH AUTOMATED FINGERPRINT IDENTIFICATION SYSTEM

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Article DOI: https://doi.org/10.36713/epra31335
DOI No: 10.36713/epra31335

ABSTRACT

Automated Fingerprint Identification Systems (AFIS) are often romanticized as instant solutions, creating a stark disconnect between algorithmic capacity and the lived realities of forensic examiners working within hybrid digital-manual workflows. Using a phenomenological design, this study investigated the lived operational experiences of ten active fingerprint examiners in centralized Manila forensic ecosystems. Data gathered through in-depth, semi-structured interviews were analyzed using Reflexive Thematic Analysis under strict data privacy and research ethics protocols. The empirical findings revealed that AFIS functions strictly as a candidate-generation tool, requiring meticulous manual template adjustments, thereby upholding human agency and dismantling media-driven myths. However, computational speed was severely hindered by expired vendor maintenance contracts, causing software freezes that directly conflicted with daily production quotas (50-60 cards). While cold-case matches elevated professional morale, operational reach remained constrained by biometric database silos. Consequently, examiners resorted to personal time sacrifices to bridge resource gaps: unpaid overtime, weekend shifts, and multi-terminal workarounds. Automation does not replace human expertise; rather, it elevates examiners from manual archivists to critical validators of algorithmic outputs. Long-term laboratory viability requires transitioning away from informal practitioner workarounds toward structured socio-technical alignment. The study recommends institutionalizing the proposed Forensic Socio-Technical Enhancement Framework (FSTEF), specifically mandating ring-fenced vendor maintenance budgets, dynamic quota calibrations during technical downtime, interagency biometric data connectivity, dual-monitor workstation layouts, and mandatory cognitive fatigue safeguards.

KEYWORDS: *Automated Fingerprint Identification System (AFIS), lived experiences, forensic fingerprint examiners, socio-technical systems theory, human agency*

INTRODUCTION

The continuous advancement of digital technology has transformed the practice of forensic science, particularly in the field of fingerprint identification. As criminal investigations become increasingly complex, forensic laboratories have adopted technological innovations to improve the efficiency, accuracy, and reliability of evidence processing. One of the most significant developments in biometric identification is the Automated Fingerprint Identification System (AFIS), a computerized system designed to store, classify, and compare fingerprint records within large-scale databases. AFIS enables forensic practitioners to perform rapid searches among thousands or even millions of fingerprint records, thereby reducing the time required to identify possible suspects and strengthening the efficiency of criminal investigations (Rogers et al., 2023; Hicklin et al., 2020). Despite these technological advancements, the accuracy and admissibility of fingerprint evidence continue to depend primarily on the expertise and professional judgment of fingerprint examiners, who remain responsible for evaluating and verifying all potential matches before they are accepted as forensic evidence.

Fingerprint identification has long been recognized as one of the most reliable methods of personal identification because friction ridge patterns are unique to every individual and remain permanent throughout a person's lifetime (Cole, 2021). Before the introduction of automated systems, fingerprint comparison relied almost entirely on manual examination, requiring examiners to search extensive physical records through meticulous visual comparisons. Although this traditional method demonstrated high reliability, it demanded considerable time, technical expertise, and sustained concentration, particularly when processing large volumes of fingerprint evidence. The development of AFIS addressed these operational limitations by automating the search process while preserving the role of fingerprint examiners as the final authority responsible for confirming individual identity (Rogers et al., 2023).

Modern forensic laboratories increasingly rely on AFIS because of its ability to perform complex fingerprint comparisons within seconds. Rather than replacing forensic professionals, however, AFIS functions as a search optimization tool that generates candidate matches based on algorithmic similarity scores. The system assists examiners by reducing the number of possible candidates requiring manual evaluation, but the responsibility for determining whether two fingerprint impressions originate from the same individual remains exclusively with qualified fingerprint examiners (Bennett & Gallagher, 2021; Busey et al., 2023). This collaborative

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interaction between human expertise and automated technology illustrates that forensic identification remains a socio-technical process in which technological capability complements, rather than substitutes for, professional judgment.

Although technological innovations have significantly improved forensic efficiency, their successful implementation depends upon more than computational performance alone. Human interaction with automated systems introduces cognitive, organizational, and operational factors that directly influence forensic practice. Fingerprint examiners must continuously interpret algorithmic outputs, assess fingerprint quality, perform detailed ridge-by-ridge comparisons, and ensure that every identification complies with established scientific and legal standards. Consequently, successful forensic automation requires not only advanced technology but also adequate organizational support, continuous professional training, and effective institutional management (Smith & Sharpe, 2022; Parker & Grote, 2022).

Previous studies have extensively examined the technical performance of AFIS, focusing on biometric algorithms, search accuracy, matching efficiency, and database management (Hicklin et al., 2020; Rogers et al., 2023). Research consistently demonstrates that automated fingerprint identification significantly accelerates investigative processes and improves the management of extensive biometric repositories. Likewise, studies on human-machine collaboration emphasize that automation should be viewed as an assistive technology that enhances professional performance without eliminating the need for expert human decision-making (Bennett & Gallagher, 2021; Busey et al., 2023). However, despite these technological developments, relatively few investigations have explored how fingerprint examiners themselves experience working with AFIS in actual forensic environments. Most existing research emphasizes system capabilities rather than the perceptions, challenges, adaptations, and professional realities encountered by frontline forensic practitioners.

Understanding these lived experiences has become increasingly important as forensic laboratories continue integrating digital technologies into routine investigative practice. While automation enhances operational efficiency, it also introduces new challenges related to technological dependence, cognitive workload, infrastructure limitations, institutional policies, and organizational support. Fingerprint examiners are expected to maintain scientific objectivity while balancing increasing workloads, production targets, and technical system constraints. Consequently, examining the experiences of forensic practitioners provides valuable insights into the interaction between technology, organizational structures, and human performance within modern forensic laboratories.

To address this research gap, the present study explored the lived experiences of fingerprint examiners utilizing the Automated Fingerprint Identification System within the Philippine National Police Forensic Group. Rather than evaluating the technical accuracy of AFIS, the study sought to understand how fingerprint examiners perceive and interpret their interactions with the technology during actual forensic investigations. Specifically, the research examined the participants' experiences in using AFIS, the operational challenges they encountered, the influence of automation on investigative outcomes, the adaptive strategies they employed to address institutional constraints, and the organizational improvements necessary to optimize forensic operations. Through this phenomenological inquiry, the study contributes a deeper understanding of the human dimension of forensic automation while recognizing the indispensable role of professional expertise in ensuring the integrity of fingerprint identification.

Theoretical Framework

The study was anchored on three complementary theoretical perspectives that explain the interaction among technology, organizational resources, and human performance. First, **Socio-Technical Systems Theory** posits that organizational effectiveness is achieved through the balanced interaction of technological systems and the individuals who operate them (Sony et al., 2022; Clegg et al., 2021). Applied to forensic science, this theory suggests that the effectiveness of AFIS depends not only on software capability but also on examiner competence, organizational policies, workplace design, and institutional support. Successful forensic practice therefore requires technological advancement to be complemented by human expertise and supportive organizational structures.

Second, **Cognitive Load Theory** explains how the limitations of human working memory influence performance during complex cognitive tasks (Paas & van Merriënboer, 2020; Sweller, 2023). Fingerprint examination requires sustained attention, visual discrimination, analytical reasoning, and continuous decision-making. Although AFIS automates fingerprint searching, examiners remain responsible for validating search results through detailed manual comparison. Heavy workloads, production quotas, and prolonged interaction with digital systems may therefore increase cognitive demands that affect examiner performance and decision-making.

Finally, **Resource Dependency Theory** provides an organizational perspective by emphasizing that institutional performance depends on the availability and effective management of critical resources (Hillman et al., 2020; Drees & Heugens, 2022). Within forensic laboratories, technological infrastructure, software maintenance, hardware availability, financial support, and interagency collaboration represent essential resources that directly influence operational efficiency. When these resources become limited, practitioners develop adaptive strategies to compensate for organizational deficiencies. This theoretical perspective offers an appropriate framework for understanding how institutional constraints shape the daily experiences of fingerprint examiners using AFIS.

Guided by these theoretical foundations, the study employed a qualitative phenomenological approach to examine the meanings that fingerprint examiners assign to their experiences with automated fingerprint identification. By focusing on the participants' personal narratives and professional interpretations, the research sought to generate a comprehensive

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understanding of the interaction between human expertise and technological innovation within forensic science. Ultimately, the findings provide valuable evidence for strengthening forensic laboratory management, improving institutional policies, enhancing examiner well-being, and supporting the responsible implementation of biometric technologies within the Philippine criminal justice system.

Statement of the Problem

This study explored the lived experiences of fingerprint examiners in Manila in their use of the Automated Fingerprint Identification System (AFIS).

Specifically, this study addressed the following research questions:

1. What were the lived experiences of fingerprint examiners when using AFIS during investigations?
2. How did fingerprint examiners perceive the challenges and limitations encountered when utilizing AFIS for fingerprint matching and identification?
3. In what ways did AFIS users describe the impact on the outcomes of their investigative work?
4. What coping strategies and adaptive practices did fingerprint examiners employ to address issues encountered while using AFIS in their daily operations?
5. Based on the findings, what program may be proposed?

METHODOLOGY

This study employed a qualitative phenomenological research design to explore the lived experiences of fingerprint examiners utilizing the Automated Fingerprint Identification System (AFIS) in forensic investigations. Phenomenology is an appropriate qualitative approach when the objective is to understand how individuals interpret, experience, and assign meaning to a particular phenomenon within their personal and professional lives (Neubauer et al., 2020; Zahavi, 2021). Rather than measuring the technical performance of AFIS through quantitative indicators, the study focused on examining the participants' firsthand experiences, perceptions, challenges, and adaptive practices while interacting with the automated fingerprint identification system during actual forensic operations. This approach enabled the researcher to capture the human dimensions of forensic automation that cannot be adequately explained through numerical data alone.

Phenomenological inquiry seeks to describe the essence of lived experiences by allowing participants to narrate their personal encounters with a phenomenon in their own words (Smith, 2018; Smith & Osborn, 2015). Since the primary objective of this study was to understand how fingerprint examiners perceive and experience AFIS within their professional responsibilities, the phenomenological design provided an appropriate methodological framework. It enabled the researcher to identify common meanings shared by participants while recognizing the unique contexts in which those experiences occurred. Consequently, the study generated rich descriptions that revealed the interaction between technology, professional expertise, institutional practices, and organizational resources in forensic laboratories.

The research was conducted at the Philippine National Police Forensic Group, specifically within units responsible for fingerprint examination and biometric identification. The research setting was selected because the participating forensic laboratories routinely utilize AFIS in criminal investigations and maintain experienced fingerprint examiners who possess extensive operational knowledge of automated fingerprint identification. Conducting the study within an actual forensic environment allowed the researcher to obtain authentic descriptions of participants' experiences while ensuring that the findings accurately reflected the realities of professional fingerprint examination.

The participants consisted of ten (10) active fingerprint examiners who were purposively selected based on predetermined inclusion criteria. Purposive sampling was employed because qualitative phenomenological research requires participants who possess direct experience with the phenomenon under investigation (Babik & Lloyd, 2022). To ensure the credibility of the data, only fingerprint examiners who had formal AFIS certification, practical experience in fingerprint examination, and current involvement in forensic investigations were included in the study. Individuals without operational experience or who were not directly engaged in fingerprint identification were excluded from participation. This sampling strategy ensured that all participants possessed sufficient knowledge to provide meaningful insights into the implementation of AFIS within forensic practice.

Before data collection commenced, the researcher secured the necessary institutional approvals and obtained informed consent from all participants. Ethical considerations were observed throughout the conduct of the research to ensure voluntary participation, confidentiality, and respect for the rights of the respondents. Participants were informed about the objectives of the study, the nature of their involvement, the voluntary nature of participation, and their right to withdraw from the research at any stage without any adverse consequences. Confidentiality was maintained through the use of participant codes instead of personal identifiers, while all interview recordings, transcripts, and research documents were securely stored and made accessible only to the researcher.

Data were collected primarily through semi-structured, in-depth interviews. This method enabled participants to freely describe their experiences while allowing the researcher to ask follow-up questions that clarified emerging ideas and explored significant issues in greater depth. A researcher-developed interview guide served as the primary data collection instrument. The guide contained open-ended questions aligned with the research objectives and was designed to encourage participants to provide comprehensive descriptions of their experiences using AFIS. Prior to the conduct of the actual interviews, the interview guide underwent expert validation to ensure that the questions were relevant, comprehensible, and capable of eliciting meaningful responses consistent with the objectives of the study.

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Each interview was conducted individually in a setting that promoted privacy and minimized distractions. With the participants' permission, all interviews were audio-recorded to ensure the completeness and accuracy of the collected information. The researcher likewise maintained field notes throughout the interview process to document participants' non-verbal expressions, contextual observations, and emerging analytical insights that supplemented the verbal responses. After each interview, the recordings were transcribed verbatim to preserve the authenticity of the participants' narratives before proceeding to data analysis.

To enhance the trustworthiness of the findings, the study implemented several qualitative validation procedures. Member checking was conducted by allowing selected participants to review portions of the interview transcripts and verify the accuracy of their recorded responses. Peer debriefing and consultation with the research adviser were likewise undertaken to strengthen the consistency of the coding process and thematic interpretation. In addition, the researcher maintained an audit trail documenting methodological decisions, coding procedures, and analytical reflections throughout the research process. These strategies contributed to the credibility, dependability, confirmability, and transferability of the qualitative findings, consistent with accepted standards for phenomenological research (Babik & Lloyd, 2022).

The interview transcripts were analyzed using Braun and Clarke's Reflexive Thematic Analysis, a widely accepted qualitative analytical framework that systematically identifies recurring patterns across participants' narratives. The analysis began with repeated reading of the interview transcripts to achieve familiarity with the data. Initial codes were then generated to capture meaningful statements related to the participants' experiences with AFIS. Similar codes were subsequently grouped into broader categories that reflected common ideas emerging across multiple interviews. Through iterative review and refinement, these categories evolved into overarching themes that represented the shared lived experiences of fingerprint examiners. Finally, the themes were interpreted in relation to the study's theoretical foundations and existing literature to construct a comprehensive understanding of the phenomenon under investigation (Braun & Clarke, as cited in the thesis; Smith & Osborn, 2015).

The thematic analysis generated five major themes corresponding to the research questions. These themes described the participants' experiences with AFIS, the operational challenges encountered during system utilization, the effects of automation on investigative performance, the coping mechanisms employed to address institutional constraints, and the proposed Forensic Socio-Technical Enhancement Framework (FSTEF), which synthesized the study's findings into a practical institutional model for improving forensic operations. The systematic application of thematic analysis enabled the researcher to organize the participants' experiences into coherent patterns while preserving the richness and authenticity of their individual narratives.

Ethical principles remained central throughout every phase of the investigation. The study adhered to the principles of voluntary participation, informed consent, confidentiality, anonymity, beneficence, and non-maleficence. No participant was compelled to participate in the study, and all information gathered was used exclusively for academic purposes. The identities of the respondents were protected through anonymization procedures, ensuring that no personal or organizational information capable of revealing individual identities appeared in the research report. The researcher likewise ensured that all digital records were securely stored and destroyed after the completion of the research in accordance with institutional ethical guidelines.

Overall, the chosen methodology enabled the researcher to generate an in-depth understanding of the lived experiences of fingerprint examiners using AFIS within the Philippine National Police Forensic Group. By combining purposive sampling, semi-structured interviews, rigorous thematic analysis, and established ethical safeguards, the study produced trustworthy qualitative evidence that captured the interaction between technological innovation, organizational structures, and professional expertise in contemporary forensic science.

RESULTS AND DISCUSSIONS

This section presents and discusses the findings of the study based on the five research questions. Through Braun and Clarke's Reflexive Thematic Analysis, five major themes emerged from the participants' narratives. The themes describe how fingerprint examiners experience the implementation of the Automated Fingerprint Identification System (AFIS), the operational challenges they encounter, the influence of automation on forensic investigations, their adaptive coping mechanisms, and the institutional improvements necessary to optimize forensic laboratory operations. The discussion integrates the participants' experiences with the theoretical foundations and related literature to provide a comprehensive understanding of the socio-technical realities of automated fingerprint identification.

Lived Experiences in Using AFIS During Investigation

In exploring Research Question 1, the empirical findings capture the concrete, daily lived experiences of AFIS operators as they navigate the transition from traditional friction ridge techniques to automated digital workflows. Far from experiencing an effortless, instantaneous digital process, operators engage in labor-intensive digital grooming, manual template building, and rigorous point-by-point ridge verification. The operator’s daily reality consists of calibrating software parameters, adjusting ridge traces on low-clarity latent prints, and serving as the absolute authority over algorithmic outputs.

The textural description of “The Supremacy of Human Agency: Dismantling the Myth of the “CSI Effect” emerged from three interrelated experiences: (1) dismantling media-driven misconceptions through manual template grooming and algorithmic calibration, (2) asserting human agency and expert verification as the sole determinant of identification accuracy, and (3) alignment between automated candidate scoring and human

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analytical judgment. Collectively, these emergent themes demonstrate that the participants experienced AFIS not as an autonomous system that independently produces forensic conclusions, but as a technological tool whose effective use remains dependent on human expertise, preparation, interpretation, and verification.

The **first emergent theme, dismantling media-driven misconceptions through manual template grooming and algorithmic calibration**, reflects the participants' transition from unrealistic expectations about fingerprint technology to a more accurate understanding of the actual AFIS workflow. Informant 6 described initially expecting AFIS to function like the systems portrayed in television programs such as *CSI*, where a fingerprint is scanned and an identification immediately appears. However, actual operational experience revealed that AFIS-assisted identification involves a more complex process requiring proper fingerprint preparation, template handling, search procedures, and system processing. This experience dismantled the misconception that forensic identification is instantaneous and completely automated. The participant's narrative therefore illustrates how professional exposure to AFIS reshaped earlier media-driven perceptions and developed a more realistic understanding of the human and technical processes involved in fingerprint identification.

The **second emergent theme, asserting human agency and expert verification as the sole determinant of identification accuracy**, highlights the participants' recognition that the final responsibility for determining a fingerprint match remains with the examiner. As expressed by Informant 3, AFIS serves primarily as an assistance tool and cannot independently make the final forensic determination. The examiner remains responsible for evaluating the fingerprint evidence, examining corresponding characteristics, interpreting similarities and differences, and verifying whether the candidate generated by the system is scientifically defensible. This finding strongly emphasizes the supremacy of human agency because the technological system may assist in narrowing or retrieving possible candidates, but it is the professional expertise and judgment of the fingerprint examiner that ultimately determine the conclusion.

The **third emergent theme, alignment between automated candidate scoring and human analytical judgment**, demonstrates that the participants did not necessarily perceive AFIS as being in competition with human expertise. Instead, Informant 4 described an experience in which the system-generated candidate results generally corresponded with the examiner's manual assessment. This suggests that AFIS and human judgment may operate in a complementary manner. The automated system provides candidate information that supports the examination process, while the examiner applies independent analytical judgment to confirm the reliability of the result. The alignment between automated candidate scoring and manual analysis may also strengthen examiner confidence in the system when technological outputs are consistent with professional evaluation.

Overall, the emergent themes collectively explain the central theme of **The Supremacy of Human Agency: Dismantling the Myth of the "CSI Effect."** The participants' experiences reveal a progression from unrealistic beliefs about fully automated fingerprint identification toward an understanding of AFIS as a supportive technology embedded within a human-centered forensic process. Although AFIS improves search capabilities and assists in identifying potential candidates, the findings demonstrate that human expertise remains indispensable in preparing fingerprint data, interpreting system outputs, exercising professional judgment, and making the final identification decision. Thus, the informants' lived experiences reinforce the view that AFIS enhances, but does not replace, the critical role of the fingerprint examiner in forensic identification.

When reflecting on how AFIS changed their initial understanding of what it means to be an examiner, Informant 6 recalled how their idealized expectations were challenged by real-world forensic workflows: *"Nung una kasi ma'am, ang akala natin ang mga criminology para siyang CSI na kapagka iniscan mo yung card, automatic na lalabas agad yung ano… iniinclude pa po pala 'yun ng mga template operator then inaayos pa po yung prints so meron po tayong area off, area on. Tinitignan yung mga tamang menu sa points counts kung tama po ba yung placement… yung ridge line. Kung tama po ba yung ridge line na nadedetect ng system so may ganun pa po pala siya then pagka-submit, doon palang po siya magkaka-comparison. Hindi po agad ka ganon ka bilis kagaya ng mga lumalabas sa TV. Kaya, nag-iiba yung perception namin pagdating sa ano, sa na introduce na namin."* (At first, ma'am, we thought criminology was just like CSI where when you scan the card, the identity automatically pops out… In reality, the template operators still must input and meticulously adjust the prints. We must do 'area off' and 'area on' adjustments. We check the menu for point counts to ensure proper placement of the ridge lines. We must verify that the system is detecting the correct ridgelines. So it requires all those steps before submission, and only then will the comparison start. It does not happen instantly, as you see on television. Our perception completely changed once we were introduced to the actual system).

When detailing the balance between computer metrics and professional judgment, Informant 3 firmly asserted that technology cannot function independently of human expertise: *"Ang nag-dedecide po kasi ng accuracy is yung fingerprint examiner so assistance lang ang AFIS kas nakikita naming siya sa monitor… Yes po. Kumbaga, ma'am, hindi niya po kaya mag-stand alone without the fingerprint examiner."* (The one deciding the accuracy is still the fingerprint examiner; the AFIS is merely an assistance tool because we evaluate everything on the monitor… Yes, ma'am. In other words, ma'am, the system cannot stand alone without the fingerprint examiner).

When questioned about potential conflicts between human judgment and automated scoring, Informant 4 explained that the two work in harmony rather than in opposition: *"Kasi diba nagbibigay ng candidate yung AFIS, it's either match siya or hindi siya match. Kung hindi siya match, malaki po talaga ang*

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chance na… sa experience ko, sa experience namin dito, hindi po kami nakakapag-decide na hindi siya match tapos match siya sa ano. So hindi po siya talaga… parang walang chance na [magcontrast.]" (The AFIS gives candidates—it is either a match, or it is not a match. If it is not a match, based on our experience here, there is no chance for a contrast where we decide it is a match, but the system completely rejects the configuration. It is always aligned).

The human-centric dynamic is enforced by the institutional requirements of the ACE-V Methodology and local legal frameworks. Legally, an automated system cannot testify in a Philippine court; only a qualified human examiner can defend an identification. Structurally, the laboratory maintains safety protocols requiring that any automated candidate retrieval be verified through manual comparison. This match must be evaluated and signed off in accordance with standardized verification routines, ensuring continuous human oversight across operational shifts.

The themes exemplify Socio-Technical Systems Theory (STST). It demonstrates that optimal forensic performance is achieved not by prioritizing technological capability alone, but by successfully balancing the *technical subsystem* (AFIS algorithms) with the *social subsystems* (the examiner's specialized skills, tacit knowledge, and ethical responsibilities). These findings contrast with the acute risks of "automation bias" raised by Steward (2025) and Kukucka et al. (2021), and instead show that structured human verification protocols within local culture can successfully keep algorithmic dependencies in check.

Perceived Challenges and Limitations Encountered While Utilizing AFIS

Under Research Question 2, the concrete lived experiences of operators highlight an acute operational tension. Operators experience extreme frustration caused by backend processing latency and system freezes resulting from unmaintained software subscriptions. Their daily work involves staring at prolonged loading screens while attempting to satisfy strict administrative quotas of processing 50-60 fingerprint cards per day.

The main theme "The Efficiency Paradox: Digital Acceleration and System Maintenance Bottlenecks" describes the contrasting experiences of fingerprint examiners regarding the benefits and limitations of AFIS. The theme emerged from three interconnected experiences: (1) algorithmic speed versus manual searching capacity constraints, (2) system processing slowdowns resulting from expired software maintenance subscription, and (3) operational bottlenecks impacting daily administrative quotas and report generation. Collectively, these emergent themes reveal a paradox in AFIS utilization: while the technology possesses the capacity to dramatically accelerate fingerprint searching and improve operational efficiency, its actual benefits may be constrained by technical and maintenance-related problems.

The **first emergent theme, algorithmic speed versus manual searching capacity constraints**, highlights the substantial difference between traditional manual searching and AFIS-supported processing. Informant 6 explained that an examiner could previously search approximately 100 fingerprint cards per day, whereas AFIS is capable of processing an extremely large number of searches within a short period. This finding illustrates the significant technological advantage of automation in expanding the capacity and speed of fingerprint database searches. AFIS therefore has the potential to reduce the time required to identify possible candidates and to support examiners in managing large volumes of fingerprint records that would be difficult and time-consuming to process manually.

However, the **second emergent theme, system processing slowdowns resulting from expired software maintenance subscription**, reveals that technological capability does not always translate into consistent operational performance. Informant 4 described experiencing system lapses and slowdowns because the maintenance subscription was no longer active. This indicates that the effectiveness of AFIS depends not only on the sophistication of its software but also on continuous technical maintenance and institutional support. When maintenance requirements are not sustained, the system's capacity for rapid processing may be reduced, creating a gap between its intended technological performance and the actual experience of users.

The **third emergent theme, operational bottlenecks impacting daily administrative quotas and report generation**, demonstrates the practical consequences of system slowdowns on the daily responsibilities of fingerprint examiners. Informant 4 explained that delayed system results affect the completion of required quotas and the preparation of reports. Although AFIS is intended to accelerate the identification process, loading delays may interrupt the workflow and prevent examiners from immediately completing subsequent administrative tasks. This creates additional pressure, particularly when personnel are required to meet daily productivity expectations.

Overall, the three emergent themes explain the efficiency paradox experienced by the participants. AFIS offers exceptional computational speed and the potential to significantly surpass manual searching capacity; however, this technological advantage is dependent on reliable system performance and sustained maintenance. When maintenance support is inadequate, technical problems such as system slowdowns can transform a tool intended to improve efficiency into a source of operational delay. Thus, the participants' experiences demonstrate that the effectiveness of AFIS should not be evaluated solely according to its algorithmic capability. Its actual value depends on the availability of institutional resources, continuous software maintenance, and a reliable technological infrastructure capable of supporting the operational demands placed on fingerprint examiners.

Informants experience a distinct friction between rapid automated processing and long loading screens that disrupt downstream workflows. Examiners are highly confident in the tool's ability to narrow down complex latent search arrays, particularly in high-volume property crimes like robbery, yet they feel acutely constrained in meeting their rigid institutional production quotas. Faced with a daily operational target of processing 50-60 biometric cards, the system's sluggish performance forces a state of anxious waiting, preventing them

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from starting their physical comparative analysis or completing documentation on time.

The raw searching capability of the software was further elaborated by Informant 6, who contrasted the automated system's search rate against historical manual units: *"Previously kasi ma'am, ang searching capacity capability ng isang examiner previously, ma'am, is 100 cards per day. Ngayon, ma'am, ang AFIS natin is capable to 500 search per seconds, 500,000 search per seconds. So ganun siya kabilis… in 3 seconds, kaya niya nang magbigay agad ng mga candidates."* (Previously, Ma'am, the searching capacity and capability of a single examiner was only 100 cards per day. Now, our AFIS can perform 500,000 searches per second. That is how fast it is… In just 3 seconds, it can easily provide the candidates).

However, this technological velocity is structurally disrupted by procurement lapses and expired technical contracts. Informant 4 detailed this negative aspect of their daily reality: *"Sa negative po sa ngayon, nakaka-experience po kami ng medyo ano [lapses] ma'am sa system namin since hindi po kami currently naka-subscribe sa maintenance and maintenance ng examination… so may pagbagal po ng… upgrading or maintenance… may pagbagal po ng system."* (On the negative side as of now, we are experiencing some issues with our system since we are not currently subscribed to the maintenance and servicing of the examination system… So there is a slowdown… in upgrading or maintenance, there is a slowing down of the system). This drop in performance directly compromises the examiner's ability to meet organizational expectations under pressure. Informant 4 shared the psychological and practical strain this slowdown causes: *"Pinaka pumapasok talaga sa isip ko personally, ma'am, is yung pagbagal ng… na… kasi ngayon may quota kami including criminals and non-criminals. Meron po kaming kailangan mapasok… sa akin, 50 or 60… so yung examination po kasi naming, may timeline na sinusunod. So, 'pag nag-hit yung isang kaso naming, ma-input po yung isang case, hindi po agad lalabas yung results since ang tagal mag loading. So doon po sa case na 'yun, nakakaapekto po siya sa paggawa ng report kasi kailangan po hintayin naming lumabas yung examination naming bago namin gawan ng report or bago namin gawan ng comparative analysis."* (What really enters my mind personally, ma'am, is the slowdown because right now we have a quota including criminals and non-criminals. We have a set amount we need to enter… For me, it is 50 or 60 cards… Our examination follows a strict timeline. So, when a case is entered, the results do not appear immediately because it takes so long to load. In that case, it affects report generation because we must wait for our examination output to appear before we can write the report or perform comparative analysis).

This efficiency paradox arises from a bureaucratic framework in which administrative procurement protocols, national budget allocations, and technical service subscriptions fail to keep pace with daily operational demands. The crime laboratory functions under strict, time-bound organizational performance metrics (the 50-60 card quota), but it does so using an algorithmic infrastructure that is occasionally neglected by central administrative units. Consequently, the absence of an active maintenance subscription turns a system optimized for extreme speed into a source of localized friction.

The themes strongly align with Cognitive Load Theory (CLT). As emphasized by Paas and van Merriënboer (2020), interface bottlenecks and information delays directly increase the extraneous cognitive load imposed on users. The mental strain experienced by examiners does not stem from the primary task of comparing ridge characteristics (intrinsic load) but rather from system-induced delays and external quota pressures (extraneous load). Furthermore, these findings support local research by Lagos et al. (2024), which noted that digital transformation initiatives within Philippine law enforcement remain highly vulnerable to procurement gaps, administrative delays, and uneven technical maintenance cycles, leaving advanced forensic tools underutilized.

Impact of AFIS Automation on Investigative Outcomes and Casework

For Research Question 3 the concrete lived experiences of operators reveal a dual reality of professional pride and structural isolation. Operators experience intense gratification when an AFIS "hit" links a latent print to a cold case. However, their operational reach is hindered by database limits, specifically, the inability to process palm prints or footprints, and the lack of biometric data sharing across civil government agencies.

The main theme **"Professional Pride and Institutional Silos: The Drive for Interagency Biometric Connectivity"** describes how fingerprint examiners experience both the professional benefits and institutional limitations of AFIS. The theme emerged from three interconnected experiences: (1) elevation of professional standing and morale through successful cold-case latent print matches, (2) structural software boundaries restricting biometric processing to 10-print fingerprint profiles, and (3) practitioner advocacy for cross-agency biometric data interconnectivity. Together, these emergent themes reveal that while AFIS enhances professional accomplishment and investigative confidence, its full potential remains constrained by limited databases and the absence of broader institutional connectivity.

The first emergent theme, **elevation of professional standing and morale through successful cold-case latent print matches**, demonstrates the positive impact of AFIS on the professional identity of fingerprint examiners. Informant 3 explained that successful matches, particularly from previous or cold cases, increase the sense of professionalism and accomplishment among examiners. The ability of AFIS to generate potential matches from latent fingerprints provides examiners with opportunities to contribute to the resolution of cases that may have remained unsolved for extended periods. These successful outcomes reinforce the perceived value of the examiner's work and contribute to professional pride, morale, and confidence. The findings suggest that AFIS is not merely experienced as a technical tool but also as a source of professional fulfillment when it contributes to meaningful investigative outcomes.

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 12| Issue: 8| August 2026|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2026: 8.753|| ISI Value: 1.188

The second emergent theme, **structural software boundaries restricting biometric processing to 10-print fingerprint profiles**, highlights the limitations of the current AFIS infrastructure. Informant 6 pointed out that the system is primarily limited to fingerprint data and does not accommodate other forms of biometric evidence, such as palm prints and footprints. This restricts the scope of investigative searches and may limit the ability of examiners to maximize available biometric evidence. The finding demonstrates that although AFIS offers substantial advantages in processing fingerprint information, its usefulness is determined by the range and completeness of the biometric data available within the system.

The third emergent theme, **practitioner advocacy for cross-agency biometric data interconnectivity**, reflects the participants' recognition that institutional limitations may be addressed through broader database integration. Informant 6 described ongoing efforts and research aimed at establishing connectivity among agencies such as COMELEC, SSS, and NBI. This demonstrates that fingerprint examiners do not merely experience institutional silos as passive limitations; they also recognize the need for organizational and technological solutions. Cross-agency connectivity may expand the available pool of biometric records, improve search capabilities, and strengthen the capacity of forensic practitioners to identify potential matches across institutional databases.

Overall, the three emergent themes explain the relationship between **professional pride and institutional silos**. Successful AFIS-supported identifications can strengthen examiners' morale and professional identity, particularly when the system contributes to solving cold cases. However, these positive experiences are tempered by the structural limitations of the existing system and the fragmentation of biometric information across different institutions. The participants' advocacy for interagency connectivity therefore represents a desire to overcome institutional silos and maximize the investigative value of AFIS. The findings suggest that the continued enhancement of fingerprint identification should involve not only improvements in software capability but also the development of secure, standardized, and appropriately governed mechanisms for biometric data sharing and interagency collaboration.

The informants experience a strong sense of professional pride and a boost in morale, especially when utilizing AFIS to link latent prints from old, unsolved cases to newly entered suspects. They feel connected to an international standard of forensic excellence. However, this pride is accompanied by frustration when they encounter database limitations in their software that prevent it from storing palm prints or footprints. They also have a strong desire for structural change, hoping to overcome agency boundaries to build a unified national biometric network.

Informant 3 described how working with AFIS elevates their professional standing and morale: *"Mas nakaka-boost ng professionalism as examiner kasi kapag sinabing AFIS, kilala 'yan. Sikat 'yan, international kasi ginagamit din siya ng ibang bansa… Lalo na ma'am, every time na may nag-hi-hit from previous cases, ito nakaraan lang may mg ana hit kaming latent themes. Ayun yung mga cold cases. So it means, na identify na naming kung sino may-ari ng pins. Ayun ma'am yung effect ng AFIS sa mga fingerprint examiner."* (It boosts our professionalism as examiners because when people hear about AFIS, it is widely recognized. It is famous and international because it is used by other advanced countries… It increases our confidence… especially every time we get a 'hit' from previous cold cases. Recently, we matched latent prints from cold cases. It means we identified the owner of the prints after a long time. That is the true positive effect of AFIS on a fingerprint examiner's morale).

Despite this high morale, Informant 6 expressed frustration regarding software data boundaries and structural fragmentation: *"Ang limitation kasi ng AFIS fingerprint lang… wala po siyang database ng pumping… pumping tsaka footprint… as of now ma'am, ang datang kinukuha naming, lahat ng arrested suspect and yung mga civilian naming is for clearance travel approve, ma'am. Wala kaming data kagaya nung sa inyo na everyday may kumukuha ng NBI clearance… Kung makakapag-gather po kami ng mga Police clearance, NBI clearance, mas mataas yung chance na makapag-identical kami ng isang examination ng latent theme sa mga standard."* (The current limitation of our AFIS is that it only processes fingerprints… It does not have a database for palm prints… Palm prints and footprints… And as of now, ma'am, the biometric data we gather is limited to arrested suspects and civilians applying for travel clearances. We do not have an expansive database like the NBI, where thousands get clearances daily… If we could harvest data from all police clearances and NBI clearances nationwide, the probability of matching a latent print from a crime scene against a standard card would be significantly higher."

This desire for systemic modernization has driven examiners to advocate for broader technological integration and policy updates according to Informant 6: *"Nag-conduct naman po kami dati ng research diyan… ongoing pa po… para po sana magkaroon ng interconnectivity sa bawat agency like COMELEC, SSS, and NBI."* (We have previously conducted research on this, and it is still ongoing… our goal is to establish cross-agency interconnectivity between different government institutions like COMELEC, SSS, and NBI).

This experience is shaped by institutional silos within the national justice and administrative sectors. Because there is no unified national biometrics architecture linking law enforcement agencies with civil registries, the database remains isolated. The examiners operate a system theoretically capable of expansive storage, yet it remains limited due to a lack of interagency integration. This gap leaves their tools underutilized and limits their investigative reach. The themes align with the strategic priorities of the Philippine Development Plan 2023-2028, which emphasizes institutional efficiency through digital transformation and cross-agency data integration. The examiner's push for interconnectivity also aligns with the targets of United Nations Sustainable Development Goal 16 (Peace, Justice, and Strong Institutions), demonstrating that reliable, interconnected forensic technologies enhance the investigative credibility and

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EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 12| Issue: 8| August 2026|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2026: 8.753|| ISI Value: 1.188

accountability of justice systems worldwide. It supports the local assertions of the NBI Digitization Project assessment (2025), which called for stronger interagency connectivity and continuous capacity building to overcome national transition boundaries.

Coping Strategies and Adaptive Practices to Address Operational Issues

In answering Research Question 4, the lived experiences of AFIS operators illustrate individual adaptive strategies deployed to keep the laboratory functioning. To overcome equipment shortages and software delays, operators routinely make personal sacrifices such as working unpaid overtime and weekends. Within the workspace, operators adopt a coping mechanism of running two to three physical computer terminals simultaneously, loading queries on one while working on another, which causes physical overcrowding and displaces colleagues.

The main theme **"Adaptive Coping and Structural Improvisation: Personal Sacrifices in a Shared Resource Environment"** describes how fingerprint examiners adapt to technological limitations, resource constraints, and workload pressures in their daily operations. The theme emerged from three interconnected experiences: (1) multi-terminal operation workarounds to bypass system loading delays, resulting in workspace crowding; (2) personal time sacrifices, including extended work hours and weekends; and (3) formal administrative incident reporting paired with manual paper-card backlog processing. Collectively, these themes demonstrate that examiners do not simply accept AFIS-related limitations but develop practical strategies to maintain workflow continuity and meet organizational demands.

The first emergent theme, **multi-terminal operation workarounds to bypass system loading delays, resulting in workspace crowding**, illustrates the examiners' resourcefulness in responding to slow system performance. Informant 4 explained that some personnel use two or three terminals simultaneously so that while one terminal is loading, another can be used for other tasks. This practice allows examiners to minimize idle time and sustain productivity despite system delays. However, the strategy also reflects a structural resource problem because the need to share or operate multiple terminals may contribute to workspace congestion and inefficient use of available facilities. Thus, the workaround demonstrates both examiner adaptability and the limitations of the existing technological infrastructure.

The second emergent theme, **personal time sacrifices, including extended work hours and weekends**, highlights the human cost of managing heavy workloads and technical delays. Informant 3 reported that personnel extend their working hours and, at times, work during weekends to address accumulated cases. This indicates that examiners compensate for operational inefficiencies by contributing additional personal time. While such practices demonstrate commitment, responsibility, and dedication to completing forensic tasks, they may also increase fatigue and potentially affect employee well-being when sustained over long periods. The finding therefore illustrates how institutional demands can be transferred to individual personnel when technological and operational resources are insufficient.

The third emergent theme, **formal administrative incident reporting paired with manual paper-card backlog processing**, demonstrates how examiners respond when AFIS becomes completely unavailable. Informant 3 explained that system shutdowns are immediately reported through appropriate administrative channels and documented through written reports. At the same time, examiners continue processing accumulated fingerprint cards through manual procedures. This demonstrates the importance of maintaining a contingency workflow in which traditional fingerprint examination serves as an alternative when automated systems are unavailable. The practice also shows that examiners must balance compliance with administrative reporting requirements and the practical need to continue processing an existing backlog.

Overall, the three emergent themes demonstrate that **adaptive coping among fingerprint examiners is both individual and structural**. Examiners use multiple terminals to overcome system delays, sacrifice personal time to meet workload requirements, and revert to manual procedures when AFIS becomes unavailable. These practices reflect considerable resourcefulness and professional commitment, but they also expose underlying organizational and infrastructural limitations. The findings suggest that operational continuity should not depend excessively on personal sacrifices or improvised solutions. Instead, sustained AFIS effectiveness requires adequate terminals and workspace, reliable system maintenance, appropriate staffing, contingency procedures, and institutional mechanisms that protect examiner well-being while ensuring timely forensic service delivery.

The informants experience a profound blurring of their personal and professional boundaries, frequently feeling compelled to forgo their weekends or work late into the night. Within the laboratory's physical space, they experience a competitive, dynamic sharing environment. Examiners must navigate a crowded office where some individuals occupy multiple terminals simultaneously to keep their workflows moving while waiting for slow computers to load. This practice inevitably displaces other colleagues and forces them into alternative shifts. Informant 3 explicitly detailed how time sacrifices serve as their primary coping mechanism to manage heavy workloads: *"Extend hours… nag-eextend po sila ng oras, ma'am. Or minsan weekends."* (They extend their working hours, ma'am, or sometimes they work during weekends).

To maximize productivity during system slowdowns, examiners use informal terminal-sharing strategies, as explained by Informant 4: *"Yung iba po sa practice naming gumagamit ng dalaw o tatlong terminal. Sabay-sabay na gumagamit para lang ano… Kagandahan naman kapag dalawang PC, kasi habang loloading yung isa, nakakapag-load na rin yung isa at yung isa nakakagawa."* (In our practice, some of us use two or three computer terminals at the same time. We operate them simultaneously just to… the advantage of having two PCs is that while one is loading, you can already input data into the other, and you can keep working on the third one).

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However, this structural improvisation creates friction within the shared environment, causing an operational domino effect, as narrated by Informant 1: *"Nawawalan ng pwesto yung iba"* (Others are left without a workspace or terminal to use).

When complete technical shutdowns or software freezes occur, the examiners balance formal reporting with manual backlog management to prevent case congestion, as shared by Informant 3: *"Kapag nag-shutdown ma'am, i-rereport naming agad sa taas na nagshutdown siya… Written report… Yes po, ma'am, kasi tambak po kami ng cards."* (When it completely shuts down, ma'am, we report it immediately to higher management… Written report… Yes, ma'am, because we have a ton of deliverables).

This pattern of behavior is shaped by a resource-constrained environment where fingerprint examiners must share a limited number of functional AFIS workstations. Because the physical infrastructure cannot guarantee an individual, high-speed terminal for every expert on duty, the personnel must step in to bridge the gap. They use personal adjustments, such as working unpaid weekend hours and managing multi-terminal configurations, to satisfy organizational performance standards despite equipment shortages.

The themes provide empirical validation for Resource Dependency Theory (RDT), which argues that an organization's internal behaviors and social structures adapt dynamically to compensate for the absence of critical environmental resources. It also echoes the work of Fraser-Mackenzie et al. (2022), who observed that the success of forensic technologies relies heavily on human improvisation and the willingness of frontline staff to make personal sacrifices to overcome structural deficiencies. Nationally, it aligns with Busey's (2022) observations, which linked laboratory resource strain to fatigue and altered decision-making contexts among latent print examiners.

Socio-Technical Alignment and Proposed Institutional Enhancement

To comprehensively illustrate how mechanical, organizational, and human elements interact within the forensic laboratory environment, the structural layers of the operational landscape were synthesized into an integrated framework. As detailed in Table 1, this synthesis maps the dynamic interplay between the technical and social subsystems, highlighting the structural boundaries, adaptive behaviors, and core phenomenological realities that define modern fingerprint examination. The findings demonstrate that automation does not diminish human agency; rather, it elevates the examiner from a manual archivist to a critical validator of algorithmic outputs.

The table presents the integrated phenomenological essence of AFIS integration by organizing the findings into three interconnected layers: the Institutional Silos (Macro-Environment), Technical Subsystem (Algorithmic Environment), and Social Subsystem (Human-Centric Environment). The table demonstrates that the lived experience of fingerprint examiners cannot be understood by examining AFIS technology alone. Instead, their experiences emerge from the continuous interaction among institutional structures, technological capabilities, and human responses. The final synthesis identifies the core phenomenological essence of AFIS integration as a process of continuous human negotiation and behavioral adaptation between technological potential and structural limitations.

The first layer, the Institutional Silos or Macro-Environment, represents the broader organizational and institutional conditions surrounding AFIS. The findings indicate that the database operates in relative structural isolation from civil registries, while the absence of comprehensive national repositories for other biometric identifiers, such as palm prints and footprints, restricts the breadth of available investigative information. The uneven pace of digital transformation across regional units further contributes to differences in technological capacity. These structural conditions create investigative data gaps that may limit the ability of local enforcement units to access and cross-reference biometric information from other government sources. In response, frontline examiners advocate for greater interagency biometric connectivity, demonstrating that users recognize institutional fragmentation as a significant limitation and actively envision broader information-sharing mechanisms to improve investigative capability.

The second layer, the Technical Subsystem or Algorithmic Environment, focuses on the actual technological characteristics of AFIS. The system possesses high-speed computational capabilities and can rapidly generate potential candidate matches, representing a substantial improvement over traditional manual searching. However, the findings reveal an efficiency paradox: although the underlying algorithm is capable of extremely rapid processing, system slowdowns caused by inadequate or expired technical maintenance can produce lengthy loading times for users. These delays become particularly problematic when examiners are required to meet rigid daily production quotas and administrative deadlines. Thus, the technological potential of AFIS is not automatically translated into operational efficiency because system performance remains dependent on maintenance, technical support, and infrastructure.

The third layer, the Social Subsystem or Human-Centric Environment, emphasizes the continuing importance of examiner expertise. Fingerprint identification remains dependent on meticulous manual adjustments during template preparation and the application of professional examination procedures such as the ACE-V methodology. Successful AFIS-assisted identifications, particularly cold-case matches, also contribute to examiners' professional pride and morale. However, when technological and infrastructural limitations interfere with workflow, personnel compensate through adaptive practices. These include operating multiple terminals, extending work hours, and working on weekends. The social subsystem therefore demonstrates both the professional agency and resilience of examiners and the personal costs that may arise when institutional and technological systems fail to adequately support operational demands.

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Table 1.
Socio-Technical Alignment and the Phenomenological Essence of AFIS Integration

Structural Layer	System Components and Characteristics	Operational Tension and Human Adaptations
Institutional Silos (Macro-Environment)	Database operates in structural isolation form civil registries Biometric restrictions (absence of national palm print and footprint repositories) Digital transformation remains uneven across regional units	Creates investigative data gaps that isolate local enforcement from civil networks Drives a collective interagency push among frontline examiners for national cross-connectivity
Technical Subsystem (Algorithmic Environment)	High-speed computational scanning engines Rapid generation of closest-candidate match profiles System slowdowns caused by expired technical maintenance and servicing subscriptions	The Efficiency Paradox: Fast backend algorithms versus long loading screens on the frontend Delayed processing routines directly conflict with rigid daily production quotas
Social Subsystem (Human-Centric Environment)	Meticulous manual adjustments during template building of the ACE-V protocol Elevated professional standing driven by cold case "hits"	Frontline personnel step in to bridge infrastructural gaps through personal sacrifices Examiners extend shift hours, surrender personal weekends, and run multi-terminal configurations
The Core Phenomenological Essence	A constant human negotiation and behavioral adaptation that bridges the gap between technological potential and structural limitations	The lived reality extends far beyond simple digital entry; automation does not replace human expertise but elevates the examiner from a manual archivist to a critical validator of algorithmic codes

Note. Framework adapted from Socio-Technical Systems Theory (STST) variables mapped against participant reflections

The interaction among these three layers produces the Core Phenomenological Essence: "a constant human negotiation and behavioral adaptation that bridges the gap between technological potential and structural limitations." This represents the central meaning derived from the participants' lived experiences. AFIS is not experienced as a fully autonomous technological solution; rather, its effectiveness depends on continuous human intervention, adaptation, judgment, and institutional support. Examiners adjust their practices when systems slow down, compensate for resource limitations, maintain manual procedures when AFIS is unavailable, and independently verify automated candidate results. Their experiences therefore reveal a dynamic relationship in which technology and human expertise remain interdependent.

The final statement—that "automation does not replace human expertise but elevates the examiner from a manual archivist to a critical validator of algorithmic codes"—captures the broader transformation brought about by AFIS. The examiner's role shifts from predominantly manual searching and record management toward a more analytical and evaluative function. While AFIS expands the speed and scope of biometric searching, the examiner remains responsible for validating the significance and accuracy of its outputs. Consequently, the phenomenological essence of AFIS integration is not simply technological modernization but the redefinition of professional practice through continuous interaction between automation, human judgment, and organizational conditions.

Overall, Table 1 demonstrates that successful AFIS integration requires more than advanced algorithms. It requires interoperable databases, reliable technical infrastructure, continuous maintenance, adequate resources, appropriate institutional support, and highly skilled examiners. The findings therefore support a socio-technical perspective in which improvements to AFIS should simultaneously address the technological system, institutional environment, and human needs of the forensic personnel who operate it.

In direct response to the operational gaps, system limitations, and practitioner needs identified in the empirical findings (RQ5), an institutional optimization program was formulated: the Forensic Socio-Technical Enhancement Framework (FSTEF). Designed to transition laboratory operations away from reactive, informal workarounds toward institutionalized technical sustainability, cognitive balance, and cross-agency data integration, the FSTEF is structured across four primary pillars corresponding directly to the study's emergent themes.

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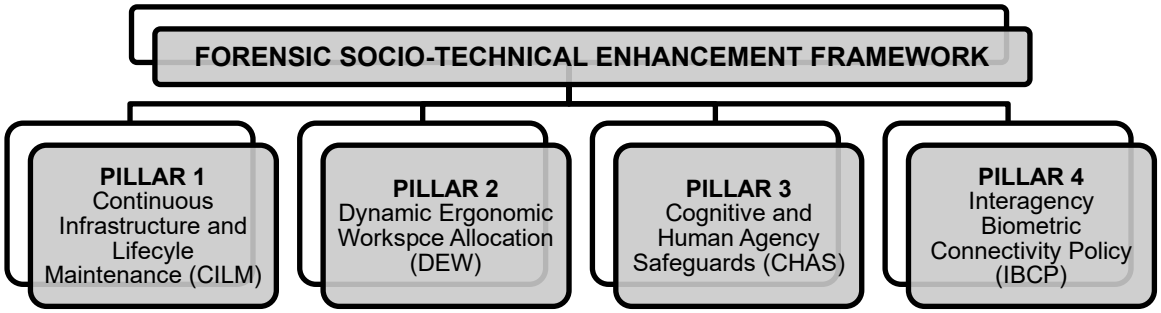

Figure 1. ***The Four Structural Pillars of the Proposed FSTEF***

Pillar 1: Continuous Infrastructure and Lifecycle Maintenance (CILM)

Objective: To eliminate the severe system slowdowns, processing delays, and report-congestions caused by lapsed service agreements, thereby aligning fronted operational timelines with backend computational capabilities

Action Components

1. Institutionalization of Dedicated Forensic Maintenance Funds

Transition from ad hoc, unpredictable regional procurement cycles to an institutionalized, ring-fenced annual budgetary allocation specifically dedicated to AFIS software updates, hardware optimization, and subscription maintenance

2. Service Level Agreement (SLA) Mandates

Establish strict, legally binding SLAs with third-party biometric vendors. These agreements must mandate 24/7 technical support and routine predictive server maintenance, and automated system patches to prevent the software freezes that trigger long loading screens

3. Dynamic Quota Calibration

Formally revise the rigid production quotas (50-60 biometric cards daily) during periods of documented technical maintenance downtime. This ensures that administrative metrics do not place an unreasonable burden on the examiner's workflow when software capacity is diminished

Pillar 2: Dynamic Ergonomic Workspace Allocation (DEWA)

Objective: To eradicate the workspace friction and desk shortages caused by examiners running multi-terminal configurations, optimizing physical space through structured resource scheduling

Action Components

1. Phased Shift and Workstation Scheduling

Establish a formalized, staggered shift deployment matrix that distributes the 58 fingerprint examiners evenly across continuous operational blocks. This structural change ensures that terminal access is balanced throughout the day, eliminating workspace crowding

2. Dual-Monitor Single-Terminal Infrastructure

Replace informal workarounds, in which practitioners use two or three separate physical computers, by upgrading the laboratory layout to high-speed, single-CPU workstations with dual-display monitors. This configuration allows examiners to input data on one screen while analyzing candidate lists on the other, maintaining workflow speed without taking up multiple desks

3. Automated Technical Incident Logging

Replace traditional paper-based, written notifications during software failures with a digital, real-time incident tracking system. This system automatically informs higher management of technical issues, creating transparent records that account for case backlogs

Pillar 3: Cognitive and Human Agency Safeguards (CHAS)

Objective: To mitigate the extraneous cognitive load imposed on examiners while protecting human analytical authority required by the ACE-V methodology

Action Components

1. Cognitive Fatigue and Wellness Mandates

In compliance with RA 11036 (Mental Health Act), introduce mandatory, structured micro-breaks during long monitor-evaluation sessions to prevent eye strain and decision fatigue. This initiative provides institutional support to help personnel manage the visual demands of electronic comparisons

2. Contextual Bias and Quality Assurance Protocols

Institutionalize regular blind peer-review cycles and strict validation protocols within the unit. These safeguards require that high-confidence automated matches be independently verified by a senior examiner using manual ridge-counting techniques, preventing automation bias

3. Advanced Reflexive Forensic Training

Expand basic training programs (BFPIC) to include specialized courses focused on the human-algorithmic interface. This curriculum will train examiners in digital image enhancement, artifact identification, and the management of uncertain edge-case variations, ensuring they can confidently audit software suggestions

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Pillar 4: Interagency Biometric Connectivity Policy (IBCP)

Objective: To break through structural institutional silos and expand the isolated 1.4-million-record database into a comprehensive, national biometric repository

Action Components

1. Legislative Initiatives for National Data Interconnectivity

Draft and champion policy modifications aimed at establishing cross-agency data sharing frameworks with organizations like the NBI, COMELEC, and the SSS. This initiative creates an integrated biometric network that maximizes investigative match capabilities

2. Multi-Biometric Software Modernization

Secure targeted development funding to upgrade the existing system architecture, expanding it beyond isolated 10-print fingerprint records to include palm print and footprint repositories. This expansion addresses technical design limitations and enhances cold-case matching capabilities

3. Data Security and Privacy Audits

In compliance with the RA 10173 (Data Privacy Act), incorporate automated cryptographic logging and strict data-access tracking into all shared networks. These measures ensure that large-scale interagency biometric integration never compromises individual data protection rights or legal chain-of-custody protocols.

Conclusions

Based on the empirical findings, the following conclusions are drawn:

1. AFIS does not replace human analytical authority or eliminate manual labor; rather, AFIS serves as an assistive search optimization tool, elevating the examiner's role from a manual archivist to a critical validator whose expert judgment and verification protocols remain the ultimate legal and technical basis for identification.

2. While AFIS offers massive computational velocity, its practical efficiency is severely compromised by administrative procurement lapses and unmaintained software subscriptions, creating an operational bottleneck where processing delays directly undermine rigid institutional production quotas and timely casework completion.

3. Automated biometric technology significantly enhances examiner morale and professional standing through cold-case resolutions, yet its full investigative potential remains unfulfilled due to database limitations, specifically, the restriction to 10-point records and institutional isolation from civil registries, which necessitates systemic interagency data integration.

4. Under conditions of equipment scarcity, terminal friction, and system processing delays, forensic laboratory personnel actively bridge institutional resource gaps through personal sacrifices, including unpaid overtime, weekend work, multi-terminal workarounds, and manual fallback procedures to ensure uninterrupted operational output.

5. Resolving the systemic gaps between technical capabilities, workplace ergonomics, examiner well-being, and database isolation requires a structured, programmatic response, demonstrating that long-term laboratory viability is achieved through institutionalized solutions like the FSTEF rather than informal practitioner workarounds.

4.3 Recommendations

To resolve the identified socio-technical tensions and optimize forensic performance, the following recommendations are presented for operational practice, institutional policy, and future academic research:

1. Training pipelines should expand curricula to include specialized modules on human algorithmic interaction, digital image enhancement, and artifact auditing. To preserve the primacy of human judgment and prevent automation bias, laboratory standard operating procedures strictly enforce mandatory, double-blind peer reviews where senior examiners independently confirm high-confidence AFIS matches using standard ACE-V manual ridge-counting.

2. Upper management must establish ring-fenced, annual budget allocations designated specifically for active AFIS software updates, hardware servicing, and binding vendor Service Level Agreements to eliminate processing freezes. Simultaneously, laboratory leadership should formally calibrate daily individual production targets during documented periods of technical maintenance, ensuring administrative metrics do not impose extraneous stress when software capability is diminished.

3. Legislative bodies and agency executives (including PNP, NBI, COMELEC, and SSS) should formulate national data-sharing policies to link isolated criminal databases with civil biometric registries. Furthermore, financial and technical resources must be allocated to modernize current system architectures, expanding storage capabilities beyond 10-print fingerprint records to include national palm print and footprint repositories.

4. To resolve physical terminal shortages and end the multi-computer workarounds that displace colleagues, laboratories should deploy high-speed, single-CPU workstations equipped with dual-display monitors and establish staggered shift scheduling. Additionally, in compliance with the Republic Act 11036 (Mental Health Act), management must mandate structured micro-breaks and formal shift support to reduce visual fatigue, eliminating the reliance on unpaid overtime and weekend work.

5. Forensic laboratory directors should formally adopt and execute the FSTEF to transition operations away from informal practitioner workarounds toward programmatic sustainability. Consequently, future researchers should conduct longitudinal impact evaluations measuring the long-term effectiveness of the FSTEF in reducing case backlogs, as well as replicating this socio-technical methodology across other regional forensic facilities to compare operational adaptations nationwide.

Acknowledgement

The researcher sincerely expresses her profound gratitude and appreciation to all individuals and institutions

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whose invaluable guidance, encouragement, assistance, and support contributed significantly to the completion of this dissertation proposal. Their contributions, whether academic, professional, personal, or spiritual, have been instrumental in sustaining the researcher throughout this academic endeavor.

Foremost, she extends her deepest appreciation to her dissertation adviser, **Dr. Marlyn P. Wacnag**, for her invaluable guidance, expertise, patience, and constructive feedback. Her scholarly insights, thoughtful recommendations, and continuous encouragement greatly contributed to the refinement of the research problem, framework, methodology, and overall direction of the study. The researcher's learning and development were significantly enriched through her mentorship and academic guidance.

She also conveys her sincere gratitude to the **members of the Dissertation Examination Committee** for generously sharing their time, knowledge, and expertise. Their critical observations, insightful comments, and scholarly recommendations provided valuable perspectives that helped strengthen the content, organization, and methodological rigor of this dissertation proposal. Their thoughtful evaluation encouraged the researcher to further improve the quality and relevance of the study.

Moreover, she gratefully acknowledges the administrators, faculty members, and staff of the **Philippine College of Criminology**, particularly the **Graduate School**, for providing an academic environment that fostered learning, research, and professional growth. The support, assistance, and institutional resources extended throughout the research process were invaluable in facilitating the completion of this academic undertaking. Special appreciation is extended to the **Dean, Atty. Joaquin R. Alva, PhD**, for his leadership, encouragement, and commitment to promoting academic excellence and scholarly development among graduate students.

Additionally, she likewise expresses her sincere appreciation to the **fingerprint examiners and participating agencies** who generously shared their time, experiences, knowledge, and professional perspectives. Their willingness to participate and provide relevant information was essential to the development of this study. Their cooperation and openness provided meaningful insights that contributed to a deeper understanding of the research topic and helped ensure the relevance and significance of the proposed investigation.

Heartfelt gratitude is also extended to the researcher's **family, friends, and colleagues** for their unwavering encouragement, patience, understanding, and moral support. Their constant presence and reassuring words provided motivation during challenging moments and inspired the researcher to remain committed to completing this academic journey. Their support served as a source of strength and encouragement throughout the preparation of this dissertation proposal.

Finally, she also acknowledges all other individuals who, in one way or another, extended their assistance, encouragement, and kindness throughout the course of this undertaking. Although their names may not be individually mentioned, their contributions are sincerely valued and deeply appreciated.

Above all, she offers her **deepest gratitude to God Almighty** for granting her strength, wisdom, guidance, patience, and perseverance throughout this academic endeavor. In moments of difficulty and uncertainty, her faith provided courage and renewed determination to continue. The researcher recognizes that the completion of this dissertation proposal would not have been possible without God's grace and blessings.

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ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 12| Issue: 8| August 2026|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2026: 8.753|| ISI Value: 1.188

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