Research Article

Assessment of the Fingerprint Identification System and Digitization Project of The National Bureau of Investigation (NBI) Towards Automated Fingerprint Identification System (AFIS) Implementation

Arianne Joy Portugal, Wilfredo Dalugdog*, Govinda Dasi Arayata, Joyce Garcia

De La Salle University - Dasmarinas, Philippines

ABSTRACT

This study aims to assess the National Bureau of Investigation's (NBI) fingerprint identification system and provide recommendations for enhancing the ongoing fingerprint card digitization project, which is crucial for establishing an Automated Fingerprint Identification System (AFIS). The findings indicate that, while the current digitization project aligns with AFIS development, there are opportunities for improvement. One key area is the simultaneous digitization of fingerprint specimens from various government agencies to enhance efficiency. Furthermore, data analysis revealed variations in respondents' evaluations based on years of service and job positions. Specifically, those using the manual fingerprint identification system expressed different perspectives compared to those handling digital fingerprint records, likely due to differences in procedural familiarity and operational adaptation. Most respondents acknowledged the benefits of digitization, highlighting its potential to support law enforcement in criminal prosecution and to contribute to crime reduction, the criminal justice system, and other government initiatives. Based on these findings, the study recommends that the NBI collaborate with other law enforcement agencies to ensure connectivity and minimize redundancy in fingerprint digitization. Additionally, the NBI should conduct local workshops and international seminars on AFIS to continuously improve personnel skills and system capabilities. The study recommends enhanced inter-agency collaboration, regular training programs, and the systematic integration of digitized fingerprint records to ensure the successful implementation of AFIS.

Keywords: *Automated fingerprint identification system, Fingerprint identification system, National Bureau of Investigation (NBI), Digitization*

Introduction

Fingerprint identification is one of the earliest recognized fields in forensic science. Over time, it has proven to be one of the quickest, most accurate, and most cost-effective methods for identifying unknown deceased individuals, particularly during large-scale disasters (Kaushal & Kaushal, 2011). As noted by Barnes (2012), for over a century, fingerprints have provided reliable identification for individuals and formed the foundation for criminal history records in police agencies worldwide, making them the most widely used form of forensic evidence.

Building on its historical roots, the technique of fingerprint identification, initially developed in the late eighteenth century, has evolved significantly. Originally used to identify individuals based on unique ridge patterns, it became a foundational method in criminal justice. In the twenty-first century, advancements have led to the digitalization of fingerprint technology, which has greatly enhanced the investigation and prosecution of criminal cases (Smith et al., 2018).

In line with this evolution, Moses et al. (2017) reported that during the 1960s, agencies such as the FBI (USA), the Home Office (UK), the Paris Police (France), and the Japanese National Police initiated the development of Automated Fingerprint Identification Systems (AFIS). These efforts aimed to replace the labor-intensive manual classification and matching of tenprint cards with computerized systems.

Supporting this technological shift, Komarinski (2005) described AFIS as comprising four main components. The system eliminates the need for manual comparisons of physical fingerprint cards by using digitally scanned images stored in a searchable database. AFIS facilitates the identification of individuals by comparing captured fingerprints against local, national, or even international databases, thanks to its interoperability and integration with other identification systems.

A major milestone in fingerprint digitization was achieved in 2014, when Verton reported that the FBI had completed a 20-year effort to digitize over 30 million criminal history files, civilian identity records, and 83 million fingerprint cards. These records, previously stored in large steel filing cabinets, are now digitally archived and preserved until a person either passes away or reaches 110 years of age.

To enhance the reliability of automated systems, Barua et al., (2011) introduced a methodology for fingerprint identification based on frequency content and ridge orientation, emphasizing that the accuracy of minutiae extraction is essential to the effectiveness of any automatic fingerprint recognition system.

Further illustrating the value of AFIS, Langenburg et al. (2015) demonstrated that combining AFIS tools with expert analysis reduces the likelihood of false exclusions and enhances efficiency in reviewing both open and closed cases.

In terms of operational efficiency, Rao et al. (2023) emphasized that automation has significantly reduced the time and cost associated with manual fingerprint matching, resulting in improved productivity and reliability in identification processes.

The Philippine context mirrors this global trend. Defante (2014) noted that the Philippine National Police (PNP) Crime Laboratory began operating its AFIS in September 2004. The system addressed the inefficiencies of manual fingerprint processing and aimed to aid in the identification of crime suspects, unresolved cases, and victims of disasters.

Complementing the PNP's efforts, Republic Act 10867 mandates the modernization of the National Bureau of Investigation (NBI) and designates it as the national clearinghouse for criminal records and related information. It also obliges the NBI to provide technical assistance to other government agencies when necessary.

Despite this legislative mandate, the NBI still relies on the manual FBI Henry Filing System. Fingerprint records—whether criminal, civilian, or alien—are physically stored in steel cabinets and manually retrieved in response to requests from internal offices or external law enforcement agencies for identification or criminal history checks.

In response to modernization goals, the NBI began digitizing fingerprint cards in October 2019. This initiative marks the initial phase in

establishing its own AFIS. However, transitioning from manual to digital systems presents several logistical and operational challenges that must be addressed.

Recognizing these potential issues, Zhang and Gourley (2014) recommend that for such a large-scale project to succeed, project managers must clearly understand the process and anticipate implementation obstacles. This enables contingency planning and ensures alignment with the project's goals, timelines, and budget.

Given these contextual developments and challenges, this study aims to assess the NBI's fingerprint identification system—particularly its ongoing digitization project—and evaluate the alignment of current organizational policies with the objectives of implementing an AFIS. The goal is to identify areas for improvement and provide actionable recommendations to ensure the project's success.

Objectives of the Study
1. To determine the profile variables of the respondents in terms of sex, highest educational attainment, years of experience, and job description.
2. To assess the current digitization project of National Bureau of Investigation (NBI) in terms of programs and policy, standards and guidelines, maintenance and management, and project implementation.
3. To determine the perspective of the respondents on the benefits and opportunities on the current fingerprint cards digitization.
4. To test the significant difference on the respondents' assessment of the current digitization project of NBI and level of perspective of the benefits and opportunities of the current project when grouped by profile variables.

Methodology
This study utilized the descriptive cross-sectional research design to assess the current digitization project of National Bureau of Investigation in terms of programs and policy, standards and guidelines, maintenance and management, and project implementation. Likewise, the perspective of the respondents on the benefits and opportunities on the current fingerprint cards digitization was also the objective of the study.

This research study was conducted at the National Bureau of Investigation head office located in Manila, Metro Manila. NBI's fingerprint central repository is located at its headquarters office under the management and supervision of the Identification and Records Division (IRD). Research respondents are from NBI's employees who are utilizing the manual fingerprint identification system and digitization project which came from the three divisions namely Identification and Records Division (IRD), Dactyloscopy Division and, Information Communication Technology Division (ICTD). The respondents of this study are selected through a stratified random sampling technique. Respondents were selected and identified in the IRD (125 out of 203); dactyloscopy (10 out of 10); and ICTD (54 out of 80), with a total of 189, with 90% confidence level and 5% margin of error.

A self-designed survey questionnaire consists of three parts: Part 1 covers the respondents' demographic profile, Part 2 assesses their level of satisfaction with the implementation of the digitization project, and Part 3 identifies the benefits and opportunities associated with the project. The questionnaire was developed based on established principles and guidelines for digitization project implementation, as well as the standard requirements for the Automation Fingerprint Identification System (AFIS). To ensure clarity and consistency, the questionnaire was validated and tested for reliability and accuracy by three experts in Fingerprint Identification Systems from the National Bureau of Investigation (NBI). Additionally, a pilot test was conducted to assess its internal consistency and reliability. Using Cronbach's Alpha, the questionnaire achieved a reliability coefficient of 0.70, indicating that it is both valid and reliable for use in this study.

Prior to the distribution of the questionnaire, the researchers secured a certification from the Ethics Review Committee of De La Salle University – Dasmariñas, under protocol code DLSU-DERC-2020-0294T2. No respondents in this study were coerced or threatened, and they were informed that they could

withdraw from answering the questionnaire at any time. The request letter was secure first before the distribution of the survey questionnaire to the target respondents of the study. Likewise, an informal interview was also conducted to explain to the respondents the content and objectives of the study. After the data collection, the researchers start encoding the data in the Microsoft Excel in preparation for the application of statistical software. The researchers sought the permission of NBI's present director to grant them to access the necessary data about the fingerprint digitization project and NBI's modernization program. Likewise, it was also approved that employees from IRD, Dactyloscopy, and ICTD participate in the conduct of a survey to assess the current digitization project. A separate letter of the invitation was attached to the survey questionnaire for the research respondents which explains the time consumed in answering the survey, there is no risk on participating in the research study, their rights to withdraw anytime, the confidentiality of their personal information, and research responses. Each research respondents were given a code number used during the encoding and tallying of their response. All the data gathered was used as one consolidated report in which no personal data of the research respondents will be disclosed. Data gathered was used solely for academic purposes and basis for the recommendation for the enhancement of the fingerprint digitization project. The study is limited to the head office and three divisions and may not reflect perspectives from regional NBI offices.

Results and Discussion

Table 1. Distribution of Frequency and Percentage According to Respondents' Profile Variables

	Counts	Percentage	Rank
Sex			
Male	113	59.8	1
Female	76	40.2	2
Highest Educational Attainment			
College graduate	136	72	1
With units in Masters'	21	11.1	3
Masters' Degree graduate	32	16.9	2
With Post Graduate Units	0	0	0
Doctoral Degree Graduate	0	0	0
Years of Experience			
1 to 5 years	97	51.3	1
6 to 15 years	26	13.8	2
16 to 25 years	32	16.9	3
25 years and up	34	18	4
Job Position			
Fingerprint Examiner	91	48.1	1
Administrative Officer	37	19.6	3
Fingerprint Scanner	61	32.3	2

Table 1 presents the demographic distribution of the respondents. The majority were male, accounting for 113 respondents (59.8%) of the total sample population, while female respondents comprised 76 (40.2%).

In terms of educational attainment, college graduates made up the largest portion, with 136 respondents (72%). This was followed by master's degree holders, who accounted for 32 respondents (16.9%). Additionally, 21 respondents (11.1%) were currently enrolled in master's degree programs. Notably, a significant number of master's degree graduates held supervisory positions in their respective departments.

Regarding work experience, most respondents had 1 to 5 years of experience in their current position, with a frequency of 97 (51.3%).

This was followed by individuals aged 25 and older, with 34 respondents (18%). Meanwhile, respondents with 16 to 25 years of experience accounted for 32 respondents (16.9%). Lastly, those with 6 to 15 years of experience constituted 26 respondents (13.8%). These findings indicate that the majority of respondents were newly employed permanent staff or contractual workers engaged in fingerprint encoding or scanning as part of the ongoing fingerprint digitization project.

Table 1 also details the job roles of the respondents. Fingerprint Examiners represented the highest percentage, with a frequency of 91 (48.1%), while Fingerprint Scanners accounted for 61 respondents (32.3%). Lastly, Administrative Officers comprised 37 respondents (19.6%). The dominance of Fingerprint Examiners suggests their crucial role in fulfilling legal responsibilities, which include obtaining fingerprints, analyzing fingerprint patterns, comparing ten-print to latent prints, and providing expert testimony in court (Civil Service Commission, Position Description). Additionally, Fingerprint Examiners oversee the manual fingerprint identification process and play an active role in the transition to a digital system. They are involved in the phase-by-phase digitization of both old and current fingerprint records.

Table 2.1. Programs and Policy for the current digitization project of the National Bureau of Investigation

Indicators	Weighted Mean	Verbal Interpretation	Rank
1. The digitization policy laid out and clearly define the objective and direction of the fingerprint digitization project	4.35	Extremely Satisfied	1
2. Policy on collection management of data is presented	4.32	Extremely Satisfied	2
3. Data preservation policy is in place and presented	4.14	Extremely Satisfied	3
4. Workflow and process are presented	4.13	Extremely Satisfied	4
5. Policy on Data Privacy Law compliance is in place	4.01	Extremely Satisfied	8
6. Monitoring and evaluation of project progress are in place	4.12	Extremely Satisfied	5
7. Policy on the management of digital data is presented	4.10	Extremely Satisfied	6
8. Rate your overall satisfaction level on the program and policy	4.06	Extremely Satisfied	7
9. The research program is designed and implemented for the digitization project	3.98	Very Satisfied	9
10. The timescale of the digitization project is presented	3.94	Very Satisfied	10
Composite Mean	**4.12**	**Extremely Satisfied**	**--**

Table 2.1 presents the programs and policies implemented for the current digitization project of the National Bureau of Investigation (NBI). The survey results highlight varying levels of satisfaction among respondents regarding different policy indicators. The findings indicate that Indicator 1, which states that "*the digitization policy is laid out and clearly defines the objective and direction of the fingerprint digitization project,*" received the highest mean score of 4.35, with a verbal interpretation of "*extremely satisfied.*" Similarly, Indicator 2, referring to the *presence of a policy on collection management of data*, ranked second with a mean score of 4.32, also interpreted as "*extremely satisfied.*" Following closely, Indicator

3, which emphasizes the existence of a data preservation policy, ranked third with a mean score of 4.14, maintaining the same verbal interpretation of "*extremely satisfied*." The results suggest that the respondents hold a high level of satisfaction regarding the clarity of the digitization policy's objectives and direction. This finding underscores the effectiveness of the NBI's strategic framework in ensuring that stakeholders understand the overarching goals of the fingerprint digitization initiative. Additionally, the strong rating of the collection management and data preservation policies indicates confidence in the organization's ability to systematically handle and secure digital fingerprint records. As inferred by Azim et al. (2018), policies play a critical role in all digitization processes and a practical guide is required as a working tool for planning digitization initiatives, as many libraries and archives always want to plan these projects but lack expertise in doing so.

On the other hand, Indicator 9, which addresses whether "*the research program is designed and implemented for the digitization project,*" received a lower mean score of 3.98, with

a verbal interpretation of "*very satisfied*." Likewise, Indicator 10, *concerning the presentation of the digitization project's timescale*, had the lowest ranking with a mean score of 3.94, also verbally interpreted as "*very satisfied.*" It implies that the lower ranking of these indicators implies that respondents perceive gaps in research initiatives supporting the digitization project, as well as in the clarity or communication of the project's timeline. As affirmed by Bansode (2019), when processing documents, each and every employee working for a company waste nearly more than four to five hours a year searching for a physical copy record that are stored as tangible files in a disorganized manner with characterized by restrictions on time and space, as well as the possibility of fraud in obtaining these records, the notion of digitalization emerges as a delightful substitute. Furthermore, Pandey and Kumar (2016), have said that most digitization initiatives encounter difficulties while trying to digitize and preserve cultural and historical resources, including a lack of technological infrastructure, limited finance, and a lack of national digital preservation policies.

Table 2.2. Standards and Guidelines for the current digitization project of the National Bureau of Investigation

Items	Weighted Mean	Verbal Interpretation	Rank
1. Metadata is defined which includes but is not limited to authorship/ownership, information management, access authorization, editing/upgrading, cataloging, and indexing	4.13	Extremely Satisfied	1
2. Image quality and format are specified	4.07	Extremely Satisfied	2
3. Document Management System (DMS) is available	3.85	Very Satisfied	3
4. DMS provides storage, access security, indexing, and retrieving	3.84	Very Satisfied	4
5. Rate your overall satisfaction level on standards and guidelines	3.80	Very Satisfied	5
6. Digital fingerprints have a remote backup system	3.67	Very Satisfied	6
Composite Mean	**3.27**	**Very Satisfied**	**--**

The findings indicate that Item 1, *"Meta is defined which includes but is not limited to authorship/ownership, information management, access authorization, editing/upgrading, cataloging, and indexing,"* ranked first with a mean score of 4.13, interpreted as "extremely

satisfied". This suggests that metadata standards are well-established and strongly supported by the respondents, reflecting a high level of satisfaction in this area. As affirmed by Sakaria et al. (2018), the organization must have a defined metadata policy in order to

prevent potential losses. With metadata, updating software formats will be easier to do and data loss changes may be prevented. A comprehensive metadata strategy will protect the data and enable seamless updates.

Item 2, *"Image quality and format are specified,"* received a mean score of 4.07, also interpreted as "extremely satisfied." This demonstrates strong confidence in the technical specifications of digital image processing, a key component in successful digitization. It implies that respondents are extremely satisfied that the picture quality obtained from scanning fingerprint cards or files is sufficient to meet the next step of the automation fingerprint identification system's requirements.

In third place, Item 3, *"Document management system is available,"* obtained a mean score of 3.85, with a verbal interpretation of "very satisfied." This shows that while the availability of a document management system is generally viewed positively, there may still be room for improvement in usability or system integration. As the respondents observed that the existing software's document management system was organized and easy to manage. The barcode or unique code per fingerprint card or file makes retrieving requested fingerprint cards simple.

Conversely, the lowest-rated item was Item 6, *"Digital fingerprints have a remote backup system,"* with a mean score of 3.67, interpreted as "very satisfied." Although this score still reflects a positive evaluation, its ranking suggests relative concern or lower prioritization in terms of data backup reliability. As mentioned by Salkute (2019), the scanner software, document management, record management, testing, record management functionality, and control should all be priorities when carrying out the action plan.

Overall, the digitization project achieved a general mean score of 3.27, which falls under the category of "very satisfied." This indicates that while the NBI's digitization efforts are positively received, there remain areas for enhancement—particularly in data security and system infrastructure. Similarly, all aspects of the digitization projects must be taken into account and guided by clear policy and procedures from the digitization, as the first phase of the modernization program, until to the designing and implementation of the NBI Automated Fingerprint Identification System.

Table 2.3. Maintenance and Management for the current digitization project of the National Bureau of Investigation

Items	Weighted Mean	Verbal Interpretation	RANK
1. Personnel handling fingerprint quality control is trained and knowledgeable of the fingerprint identification features and process	4.17	Extremely Satisfied	1
2. The digital format of fingerprints can be easily transferred to new types and formats	4.04	Extremely Satisfied	2
3. A file migration strategy is in place	3.79	Very Satisfied	3
4. Rate your overall satisfaction level on maintenance and management	3.63		4
5. A backup strategy of digitized files in in place	3.58	Very Satisfied	5
6. There is secured off-site storage for files	3.55	Very Satisfied	6
Composite Mean	**3.79**	**Very Satisfied**	**--**

The data reveal that Item 1, *"Personnel handling fingerprint quality control is trained and knowledgeable of the fingerprint identification features and process,"* ranked first with a mean score of 4.17, which corresponds to an interpretation of "extremely satisfied." This suggests that the technical expertise and training of personnel involved in fingerprint quality control are highly appreciated and perceived as a strength of the project. Elnaga and Imran

(2013) affirmed that in order for new hires and existing staff to be competent in their jobs and carry them out effectively, training is essential.

Item 2, *"The digital format of fingerprints can be easily transferred to new types and formats,"* ranked second, with a mean score of 4.04, also interpreted as "extremely satisfied." This finding highlights the flexibility and adaptability of the fingerprint format, which is crucial for ensuring long-term usability and compatibility.

Item 3, *"A file migration strategy is in place,"* ranked third, obtaining a mean score of 3.79, which is verbally interpreted as "very satisfied." This implies that while migration strategies are generally effective, they may still need enhancements to meet higher standards or expectations.

On the other hand, Item 6, *"There is secured off-site storage for files,"* received the lowest

mean score of 3.55, yet still interpreted as "very satisfied." This suggests that although respondents remain satisfied with off-site storage security, this aspect is comparatively weaker and may require prioritization for future improvement.

Overall, the maintenance and management component of the digitization project attained a general mean score of 3.79, corresponding to "very satisfied." This indicates a favorable assessment of the current system, while also pointing to areas where additional efforts may enhance reliability and operational security. As Titu et al., (2021) have said that disaster backup and recovery plans should be developed at a level that guarantees their adequacy and implementation in the event of a data and database protection incident in organizations that perform intellectual property protection activities

Table 2.4. Project Implementation for the current digitization project of the National Bureau of Investigation

Items	Weighted Mean	Verbal Interpretation	Rank
1. Quality of equipment, hardware, and software, scanning software, etc	4.09	Extremely Satisfied	1
2. The hiring of new employees who are in charge solely of the digitization project	4.07	Extremely Satisfied	2
3. The ratio of existing personnel handling the digitization of fingerprints is enough to meet the project timeline	3.97	Very Satisfied	3
4. Assignment of designated working station specifically for digitization activities	3.97	Very Satisfied	4
5. Simultaneous implementation of digitization on new and old fingerprint specimens (Civilian, Criminal, Alien)	3.92	Very Satisfied	5
6. Sufficient facilities and workspace for all personnel	3.86	Very Satisfied	6
7. Training for employees on the necessary skills for the digitization project	3.85	Very Satisfied	7
8. Digitization system is compatible and can be integrated on other systems such as but not limited to Automated Fingerprint System (AFIS)	3.84	Very Satisfied	8
9.Rate your overall satisfaction level on digitization project implementation	3.80	Very Satisfied	9
10. Compliance with data privacy law	3.79	Very Satisfied	10
11. Opportunity for in-house digitization of fingerprints	3.79	Very Satisfied	11

Items	Weighted Mean	Verbal Interpretation	Rank
12. Opportunity for contracting provider digitization of fingerprints	3.78		12
13. The existing information technology system for digitization is sufficient and secured	3.77	Very Satisfied	13
Composite Mean	**3.89**	**Very Satisfied**	**--**

The highest-rated item was Item 1, *"Quality of equipment, hardware, and software, scanning software, etc.,"* which garnered a mean score of 4.09, interpreted as "extremely satisfied." This suggests that the technological infrastructure supporting the digitization project is perceived to be of excellent quality and is a critical strength of the implementation process. As affirmed by Alam (2016), that one of the key strategies for digitization project is to choose the right equipment depending on the what is needed, while acquiring and purchasing the appropriate hardware is one of the most crucial steps in developing a digitization project but with an effort in searching, it can be worthwhile.

Item 2, *"The hiring of new employees who are in charge solely of the digitization project,"* ranked second, with a mean score of 4.07, also interpreted as "extremely satisfied." This indicates a high level of satisfaction with staffing strategies, particularly the allocation of dedicated personnel, which is essential for focused and efficient project execution.

Item 3, *"The ratio of existing personnel handling the digitization of fingerprints is enough to meet the project timeline,"* ranked third, receiving a mean score of 3.97, which is verbally interpreted as "very satisfied." Although satisfaction remains high, this slightly lower score may reflect concerns about workload balance or staffing sufficiency. During the informal interview of the researchers from the respondents, there are currently twenty (20) functioning stations for scanning fingerprint cards and encoding personal information and criminal case disposition for criminal cards. They also offer one (1) station where barcodes can be printed and connected to fingerprint cards for a unique code. Regular employees (fingerprint examiners and other fingerprint scanners) are in charge of barcoding and grooming of fingerprint cards and overseeing fingerprint scanners. Other Fingerprint Examiners and Administrative Officers work directly with manual fingerprint identification systems, while others maintain fingerprint data.

Conversely, Item 13, *"The existing information technology system for digitization is sufficient and cured,"* received the lowest mean score of 3.77, though it was still interpreted as "very satisfied." This suggests that while the IT system is generally adequate, there may be areas that require refinement or further assurance regarding its reliability and long-term sustainability.

In summary, the overall project implementation received a general mean score of 3.89, which falls under the category of "very satisfied." The data indicate that while respondents express strong approval of technological and staffing aspects, there remains room for enhancement in the supporting IT systems.

Table 3. Benefits and Opportunities on the Current Fingerprint Cards Digitization

ITEMS	Weighted Mean	Verbal Interpretation	Rank
1. All National Bureau Investigation's offices have fingerprint biometric scanners linked to the existing and/or future system used in digitization	4.43	Strongly Agree	4
2. Outside sources (e.g. National Bilibid Prison, Correctional Institutional Correction women, etc.) of fingerprint specimens have fingerprint biometric	4.12	Strongly Agree	10

ITEMS	Weighted Mean	Verbal Interpretation	Rank
scanners linked to the existing and/or future system used in digitization			
3. Implementation of Automated Fingerprint Identification System (AFIS) in five years	4.40	Strongly Agree	5
4. Implementation of Integrated Automated Fingerprint Identification System (AIFIS) across all government agencies in ten years	4.37	Strongly Agree	7
5. Standard format	4.28	Strongly Agree	9
6. International training, licensing, accreditation, and membership of personnel	4.33	Strongly agree	8
7. Collaborative, local, and international, on research innovations in automated fingerprint identification and criminal justice	4.38	Strongly Agree	6
8. Crime reduction through immediate identification of the suspect through AFIS	4.51	Strongly Agree	2
9. State of the art facilities and equipment for fingerprint identification	4.50	Strongly Agree	3
10. Accurate and fast o comparison, analysis, and extraction of data	4.54	Strongly Agree	1
Composite Mean	**4.38**	**Strongly Agree**	--

The highest-rated item was Item 10, *"Accurate and fast on comparison, analysis, and extraction of data,"* which obtained a mean score of 4.54, corresponding to the verbal interpretation of "strongly agree." This indicates that respondents highly recognize the system's capability to enhance the speed and precision of fingerprint data processing—an essential element in modern forensic investigation. As agreed by Kadic, et al. (2016), digitization software should be used to extract data from figures; hand estimate should be avoided.

Item 8, *"Crime reduction through immediate identification of the suspect through AFIS,"* ranked second, with a mean score of 4.51, also interpreted as "strongly agree." This suggests that the Automated Fingerprint Identification System (AFIS) is seen as a powerful tool in supporting law enforcement by expediting suspect identification and thereby contributing to public safety and crime deterrence. As mentioned by Mokwele (2016), in order to help expertise to identify the suspects with the crime scenes throughout the comparison process, it is crucial that the suspects' fingerprints are accurately collected during the arrest. By doing this, the number of searches on AFIS and/or for manually contrasting.

Item 9, *"State-of-the-art facilities and equipment for fingerprint identification,"* was rated third, garnering a mean score of 4.50, likewise interpreted as "strongly agree." This result underscores the stakeholders' confidence in the technological resources being employed for the digitization effort. As stated by Nakanishi and Western (2007), higher degrees of security can be achieved by combining the data and functionalities of unimodal systems into multibiometric systems. Unimodal solutions could not be enough as security demands rise, and terrorists and criminals become more skilled with biometric technology.

On the other hand, the lowest-rated item was Item 10, *"Outside sources (e.g., National Bilibid Prison, Correctional Institution for Women, etc.) of fingerprint specimens have fingerprint biometric scanners linked to the existing and/or future system used in digitization,"* which recorded a mean score of 4.12. Despite being the lowest, it still falls within the "strongly agree" range, indicating room for improvement in the integration of external bio-

metric data sources into the centralized digitization system. As stated by Jain et al. (2016), bibliometric recognition will continue to be greatly influenced by advancements in biometric algorithms (feature extraction, matching, and security fixes). However, it's crucial to remember that shifts in enabling products and technologies will also have a big impact on how biometric recognition systems develop in the future.

In general, the overall general mean score of 4.38 reflects a consensus of "strongly agree" among respondents regarding the benefits and opportunities brought by the digitization of fingerprint cards. These findings suggest widespread acknowledgment of the system's value

in improving forensic accuracy, crime-solving efficiency, and the modernization of investigative infrastructure. Based on the PNP – Crime Laboratory, a fully integrated AFIS is important in law enforcement agencies since it may quickly detect or identify unidentifiable suspects using fingerprints, allowing for faster crime-solving and justice administration. It can also aid in the identification of people who have gone unidentified as a result of natural and man-made disasters. They are now using AFIS in its entirety, however, they are still improving their system to have the most efficient and fastest database possible. They also use an AFIS in their regional offices, which are linked to the main office, where the AFIS is placed or housed.

Table 4.1. Test the Significant Differences on the Assessment in The Current Digitization Project when Grouped to Respondents' Sex

		T	Df	Sig. (2-tailed)	Decision
Program and Policy	Equal variances assumed	-0.560	187	0.576	Failed to Reject Ho
Standards and Guidelines	Equal variances assumed	-0.285	187	0.776	Failed to Reject Ho
Maintenance and Management	Equal variances assumed	-0.505	187	0.614	Failed to Reject Ho
Project Implementation	Equal variances assumed	-0.597	187	0.551	Failed to Reject Ho

Table 4.1. presents that Independent Sample T-Test was performed to test for significant difference on the assessment in the current digitization project in terms of programs and policies when grouped according to respondents' sex, the results yielded a not significance difference with p-value of .576, which is greater than the conventional alpha level of .05, hence, accept the null hypothesis, indicating that there is no significant difference in the respondents' assessment on the National Bureau of Investigation's (NBI) digitization project in terms of programs and policies when grouped according to sex. It suggests that both male and female respondents are generally satisfied with the programs and policies associated with the digitization of fingerprint files and records. Respondents recognize the importance of these initiatives as part of the Bureau's modernization efforts. They perceive the policies as well-

structured and necessary for improving operational efficiency. As such, the management of the current digitization project is continuously upgrading technology and enhancing the overall system.

Similarly, the analysis of standards and guidelines yielded a not significance difference with a p-value of .776, which is also greater than the p-value threshold of .05. This result confirms the acceptance of the null hypothesis, indicating that there is no significant difference in the assessment of the respondents between male and female regarding the standards and guidelines of the digitization project. Respondents expressed satisfaction with the current standards and procedures, which align with the protocols established by the National Institute of Standards and Technology (NIST).

For the domain of maintenance and management, the computed p-value of .614, again

exceeding the critical p-value of .05, which supports the acceptance of the null hypothesis. This result implies that satisfaction levels regarding the maintenance and management components of the digitization project are similar across both genders.

Lastly, the project implementation aspect of the digitization project received a significance value of .551, leading to the same conclusion—no significant difference in satisfaction levels when respondents are classified by sex.

Overall, the findings reveal that respondents, regardless of gender, share a consistent view of the NBI's current fingerprint digitization initiative. This consistency in perception underscores the effectiveness and perceived necessity of the technological improvements implemented in the Bureau's operations. The continual advancements in this field have enhanced the accuracy, reliability, and speed of fingerprint identification systems.

According to Sharma and Selwal (2021), data-driven fingerprint presentation attack detection techniques outperform hardware-based methods in terms of performance and reliability. This observation aligns with the NBI's transition toward more advanced, automated systems. The shift in the machine-to-manpower ratio reflects this evolution, as semi-automated and fully automated classification and search systems are increasingly being adopted to replace traditional, labor-intensive methods.

Presently, there are multiple simultaneous advancements in computer-aided technical search, automated search systems, and fingerprint image storage and retrieval technologies. These innovations point toward the realization of a highly automated fingerprint identification system, characterized by minimal human intervention, scalability, and near-perfect reliability.

Table 4.2. Test the Significant Differences on the Assessment in The Current Digitization Project when Grouped to Respondents' Highest Educational Attainment

		Sum of Squares	Df	Mean Square	F	Sig.	Decision
Program Policy	Between Groups	0.568	2	0.284	1.045	0.354	Failed to reject H*o*
	Within Groups	50.575	186	0.272			
	Total	51.144	188				
Standard and Guidelines	Between Groups	1.205	2	0.602	1.954	0.145	Failed to reject H*o*
	Within Groups	57.335	186	0.308			
	Total	58.540	188				
Maintenance and Membership	Between Groups	0.697	2	0.349	0.998	0.371	Failed to reject H*o*
	Within Groups	64.957	186	0.349			
	Total	65.654	188				
Project Implementation	Between Groups	0.857	2	0.428	1.677	0.190	Failed to reject H*o*
	Within Groups	47.500	186	0.255			
	Total	48.357	188				

Table 4.2 presents the results of a one-way ANOVA conducted to determine whether there were significant differences in respondents' assessments of the current digitization project when grouped according to their highest educational attainment. The results revealed that no significant differences were found in the respondents' assessments across all domains: Program and Policy: $F(2, 186) = 1.045$, $p = .354$; Standards and Guidelines: $F(2, 186) = 1.954$, $p = .145$; Maintenance and Management: $F(2, 186) = 0.998$, $p = .371$; and Project Implemen-

tation: $F(2, 186) = 1.677$, p = .190. As all p-values were greater than the alpha level of .05, the null hypothesis was accepted in each case. Therefore, it can be concluded that there were no statistically significant differences in respondents' assessments of the current digitization project based on their highest educational attainment. It implies that that current condition of the fingerprint digitization project is well understood by the respondents. As

affirmed by Rodrigue-Buelos et al. (2020), education affects workers' perceptions of automation, do indeed support the hypothesis that people who have received more education are less fearful of automation. Increased education levels also raise the likelihood that workers will be ready for an automated future. Surprisingly, though, a higher degree of knowledge does not necessarily translate into a higher perceived opportunity from automation.

Table 4.3. Test the Significant Differences on the Assessment in The Current Digitization Project when Grouped to Respondents' Years in Service

		Sum of Squares	Df	Mean Square	F	Sig.	Decision
Program Policy	Between Groups	0.231	3	0.077	0.280	0.840	Failed to reject Ho
	Within Groups	50.912	185	0.275			
	Total	51.144	188				
Standard and Guidelines	Between Groups	3.226	3	1.075	3.597	0.015	Reject Ho
	Within Groups	55.314	185	0.299			
	Total	58.540	188				
Maintenance and Membership	Between Groups	7.091	3	2.364	7.467	0.001	Reject Ho
	Within Groups	58.563	185	0.317			
	Total	65.654	188				
Project Implementation	Between Groups	1.576	3	0.525	2.077	0.105	Failed to reject Ho
	Within Groups	46.781	185	0.253			
	Total	48.357	188				

Table 4.2 presents the results of a one-way ANOVA conducted to examine whether there were statistically significant differences in respondents' assessments of the current digitization project when grouped according to their years in service. The findings revealed that there were significant differences in respondents' assessments in the following domains: Standards and Guidelines: $F(3, 185) = 3.597$, p = .015; and Maintenance and Management: $F(3, 185) = 7.467$, p = .001. These results indicate that the number of years in service had a significant influence on how respondents evaluated the standards and guidelines and the maintenance and management aspects of the digitization project. Respondents with varying lengths of service may have had different levels of exposure or experience with the digitization processes, possibly accounting for the variation in their assessments.

However, the results also showed no significant differences in the respondents' assessments in the following areas: Program and Policy: $F(3, 185) = 0.280$, p = .840; and Project Implementation: $F(3, 185) = 2.077$, p = .105. Since the p-values for these areas were greater than the alpha level of .05, the null hypothesis was retained, indicating that the length of service did not significantly influence the respondents' evaluations of the program and policy and project implementation domains. It implies that the years in service significantly influenced certain dimensions of the project evaluation, particularly in technical and operational aspects, while perceptions of strategic planning and implementation appeared consistent across experience levels. As mentioned by Alobidyeen et al. (2022), employees might be the largest motivators or the biggest obstacles to digital transformation, depending on the experience of other

service sectors with digital transformation. As such, you ought to give the employee experience the same careful consideration as the customer service experience.

Table 4.4. Test the Significant Differences on the Assessment in The Current Digitization Project when Grouped to Respondents' Job Position

		Sum of Squares	Df	Mean Square	F	Sig.	Decision
Program Policy	Between Groups	0.152	2	0.076	0.278	0.758	Failed to reject Ho
	Within Groups	50.991	186	0.274			
	Total	51.144	188				
Standard and Guidelines	Between Groups	1.720	2	0.860	2.816	0.062	Failed to reject Ho
	Within Groups	56.820	186	0.305			
	Total	58.540	188				
Maintenance and Membership	Between Groups	2.640	2	1.320	3.897	0.022	Reject Ho
	Within Groups	63.014	186	0.339			
	Total	65.654	188				
Project Implementation	Between Groups	0.536	2	0.268	1.043	0.354	Failed to reject Ho
	Within Groups	47.820	186	0.257			
	Total	48.357	188				

Table 4.4 presents the results of a one-way analysis of variance (ANOVA) conducted to determine whether respondents' assessments of the current digitization project significantly differed based on their job position. The analysis revealed a statistically significant difference in respondents' assessments of the maintenance and membership domain, $F(2, 186) = 3.90$, $p = .022$. This indicates that job position had a meaningful effect on how respondents perceived the maintenance and membership aspect of the digitization project.

However, no statistically significant differences were found in the other domains: program and policy ($F(2, 186) = 0.28$, $p = .758$), standards and guidelines ($F(2, 186) = 2.82$, $p = .062$), and project implementation ($F(2, 186) = 1.04$, $p = .354$). Since the p-values for these three domains exceeded the alpha level of .05, the null hypotheses for each were retained. These results suggest that job position did not significantly influence respondents' assessments of the program and policy, standards and guidelines, or project implementation dimensions of the current digitization project.

Table 5.1. Test of significant difference for Respondents' Perspective of the Benefits and Opportunities of digitization project when Grouped to Sex

		T	Df	Sig. (2-tailed)	Decision
Benefits and Opportunities	Equal variances assumed	2.057	187	0.041	Reject Ho

Table 5.1 presents the results of the Independent Sample T-Test conducted to assess the differences in respondents' perspectives of the benefits and opportunities of the digitization project based on sex. The findings reveal a significant difference in perspectives between male and female respondents (p = 0.041, df = 187). This suggests that gender plays a role in how individuals assess the benefits and potential of the NBI's fingerprint identification system digitization project.

Table 5.2. Test of significant difference for Respondents' Perspective of the Benefits and Opportunities of digitization project when Grouped to Educational Attainment

		Sum of Squares	Df	Mean Square	F	Sig.	Decision
Benefits and Opportunities	Between Groups	2.318	2	1.159	3.801	0.024	Reject Ho
	Within Groups	56.701	186	0.305			
	Total	59.019	188				

Table 5.2 presents the results of an ANOVA test showing a significant difference in respondents' perspectives of the benefits and opportunities of the NBI's fingerprint identification system digitization project based on their educational attainment (F = 3.801, p = 0.024). These findings indicate that educational attainment significantly influences the perceptions of the project's benefits and opportunities.

Table 5.3. Test of significant difference for Respondents' Perspective of the Benefits and Opportunities of digitization project when Grouped to Years in Service

		Sum of Squares	Df	Mean Square	F	Sig.	Decision
Benefits and Opportunities	Between Groups	1.726	3	0.575	1.858	0.138	Failed to Reject Ho
	Within Groups	57.293	185	0.310			
	Total	59.019	188				

Table 5.3 presents the results of an ANOVA test with a total degree of freedom of 188, an F-value of 1.858, and a p-value of 0.138, indicating that there is no significant difference in the respondents' perspectives of the NBI's Identification digitization project when grouped by years of service. The findings indicate that all respondents, irrespective of their length of service, recognize the potential advantages of the digitization project, such as crime reduction, enhanced collaboration with other government agencies, improvements in existing policies and procedures, and increased collaboration with NBI's foreign counterparts. These results suggest that the benefits of the project are viewed uniformly across employees, regardless of their tenure.

Table 5.4. Test of significant difference for Respondents' Perspective of the Benefits and Opportunities of digitization project when Grouped to Job Position

		Sum of Squares	Df	Mean Square	F	Sig.	Decision
Benefits and Opportunities	Between Groups	0.386	2	0.193	0.613	0.543	Failed to Reject Ho
	Within Groups	58.632	186	0.315			
	Total	59.019	188				

Table 4.4 presents the results of an ANOVA test showing that there is no significant difference in the perspectives of respondents grouped by work title regarding the benefits and opportunities of the NBI's digitization project (F = 0.613, p = 0.543). This suggests that work title does not influence how respondents perceive the digitization project. The findings show that regardless of their work titles, all personnel involved in the first phase of the Automated Fingerprint Identification System (AFIS) share the same perspective on the benefits of digitization. Specifically, they agree that the system offers a faster and more reliable way of processing fingerprints. Additionally,

respondents also believe that there is significant potential for further improvement in the digitization project.

Conclusion

The demographic profile of employees significantly influences the initial phase of the NBI's Fingerprint Identification System Automation—digitization. Having the right personnel supports the achievement of organizational objectives. Both male and female respondents were given equal opportunities, and many placed high value on educational advancement, viewing it as a means for career growth and improved job performance. Respondents gave positive feedback on the current digitization project, particularly in terms of programs and policies, standards and guidelines, system maintenance, and implementation. This suggests that essential documentation, plans, and procedures are in place and being followed. However, areas for improvement remain, such as simultaneously digitizing fingerprint records from various government agencies. Digitizing these fingerprint specimens is essential for the success of the system's second phase. It must consider the integration requirements of the automated system, including specimen format, design, and other technical specifications. Automated fingerprint identification enhances crime reduction efforts and streamlines individual identification processes. Respondent feedback varied significantly when classified by years of service and job position. Younger staff, more involved in the digitization process under the new policy, had more favorable views. In contrast, experienced employees viewed aspects such as standards, maintenance, and system access differently, likely due to differences between old and new policies. Overall, respondents acknowledged the benefits and potential of the digitization project. Their openness to innovation and professional development contributes to both individual career advancement and organizational success.

Recommendations

To strengthen its forensic capabilities, the National Bureau of Investigation (NBI) should implement a comprehensive capacity-building initiative over the next 12 months. This includes organizing quarterly training sessions, both locally and internationally, focused on essential areas such as clear and legible fingerprint collection techniques, effective use of the Integrated Automated Fingerprint Identification System (AFIS), and basic training in automated facial recognition and iris identification systems. These sessions should aim to reach at least 80% of current fingerprint examiners to enhance their technical competence in modern forensic technologies. In addition to technical training, the NBI should prioritize professional development and accreditation. By the end of the calendar year, all fingerprint examiners must be given the opportunity to apply for professional memberships and certifications from relevant local and international forensic and biometric associations. The goal is for at least 70% of the staff to be accredited or actively pursuing accreditation within one year. To ensure consistency across government agencies, the NBI should collaborate with the Philippine National Police (PNP), the Land Transportation Office (LTO), the Bureau of Immigration, and other relevant institutions to establish standardized digitization policies. This collaboration, to be completed within the next 18 months, should focus on aligning system architecture, specimen formatting, cataloguing, and indexing procedures to promote seamless integration and minimize redundancy in national systems. Furthermore, the NBI must pursue interagency data consolidation by establishing a memorandum of agreement (MOA) within the next six months with law enforcement agencies using similar fingerprint scanning technologies. This agreement would allow for the centralized transmission and consolidation of fingerprint data to the NBI, thereby eliminating repetitive digitization processes and improving efficiency. To continuously improve the digitization project, a biannual evaluation mechanism should be implemented beginning in the next quarter. This evaluation should include structured surveys and focus group discussions among employees, targeting at least 90% of fingerprint system users to gather feedback that will inform system enhancements and policy development. Lastly, the NBI should allocate at

least 10% of its annual forensic systems development budget to fund in-house research focused on fingerprint identification systems. This research must be disseminated by publishing or presenting findings at a national or international conference within 12 months to guide the future direction of the AFIS project.

References

Alam, M. N. (2016). *Scanners For Digitization: An Overview*. Available at https://www.klibjlis.com/3.1.7.pdf

Alobidyeen, B., Al-Edainat, S., Al-Shabatat, S., and Al-Shabatat, S. (2022), Digitalization and its Impact on Employee's Performance: A Case Study on Greater Tafila Municipality, *International Journal of Business and Administrative Studies* 8(1). Available at https://kkgpublications.com/wp-content/uploads/2022/04/ijbas.8.10004-1.pdf

Azim, N. A. M., Yatin, S. F. M., Jensonray, R. C. A., & Ayub@Mansor, S. (2018). *Digitization of Records and Archives: Issues and Concerns*. International Journal of Academic Research in Business and Social Sciences, 8(9), 170–178. Available at http://dx.doi.org/10.6007/IJARBSS/v8-i9/4582

Barnes, J.G., (2012). *History of the fingerprint.* Available at https://www.ncjrs.gov/pdffiles1/nij/225321.pdf

Barua, K., Bhattacharya, S. and Mali, K. (2011). *Fingerprint Identification.* Global Journal of Computer Science & Technology. Volume 11 Issue Version 1.0 April 2011. https://computerresearch.org/index.php/computer/article/view/782

Defante, Renlord (2014). *AFIS Automated Fingerprint Identification System (AFIS)* Available at https://www.academia.edu/28862320/AFIS_AUTOMATED_FINGERPRINT_IDENTIFICATION_SYSTEM_AFIS

Elnaga, A. and Imran, A (2013), *The Effect of Training on Employee Performance* Available at https://core.ac.uk/download/pdf/234624593.pdf

Jain, A, K. (2016). *Bridging the gap: from biometrics to forensics* Phil. Trans. R. Soc. B3702014025420140254 Available at http://doi.org/10.1098/rstb.2014.0254

Jain, A. K., Nandakumar, K. and Ross, A. (2015). *50 years of biometric research: Accomplishments, challenges, and opportunities*. Pattern Recognition Letters, 2015. Volume 79,2016, Pages 80-105, Available at https://doi.org/10.1016/j.patrec.2015.12.013.

Kadic, A.J., V. K., Dosenovic S., Sapunar D. and Puljak L. (2016). *Extracting data from figures with software was faster, with higher interrater reliability than manual extraction*, Journal of Clinical Epidemiology. Volume 74, 2016, Pages 119-123, Available at https://doi.org/10.1016/j.jclinepi.2016.01.002.

Kaushal, N., & Kaushal, P. (2011). *Human identification and fingerprints: a review*. J biomet biostat, 2(123), 2. Available at https://www.hilarispublisher.com/open-access/human-identification-and-fingerprints-a-review-2155-6180.1000123.pdf

Komarinski, P. (2005). *Automated Fingerprint Identification Systems (AFIS). Available at https://shop.elsevier.com/books/automated-fingerprint-identification-systems-afis/komarinski/978-0-12-418351-3*

Mokwele, M. E. (2016). *The Value of the Automated Fingerprint Identification System* AS A TECHNIQUE IN THE IDENTIFICATION OF SUSPECTS. Retrieved from https://core.ac.uk/download/pdf/43178428.pdf

Moses, K. R., Higgings, R., McCabe, M., Prabhakar, S., and Swann, S. (2017), *Automated fingerprint identification system (AFIS).* The fingerprint sourcebook 1. https://www.ojp.gov/pdffiles1/nij/225326.pdf

Nakanishi, A. Y. J. and Western, B. J. (2007). *Advancing the State-of-the-Art in Transportation Security Identification and Verification Technologies: Biometric and Multibiometric Systems* 2 IEEE Intelligent Transportation Systems Conference, Bellevue, WA, USA, 2007, pp. 1004-1009. Available at https://ieeexplore.ieee.org/document/

Pandey, R. and Kumar, V. (2020). *Exploring the Impediments to Digitization and Digital Preservation of Cultural Heritage Resources: A Selective Review.* https://www.degruyterbrill.com/document/doi/10.1515/pdtc-2020-0006/html

Preservation, Digital Technology & Culture, vol. 49, no. 1, 2020, pp. 26-37. Available at https://doi.org/10.1515/pdtc-2020-0006

Rao, P., Singh, S., Dey, A., Rawtani, D. and Parikh, G. (2023). *Automated Fingerprint Identification System.* Available at https://doi.org/10.1002/9781119763406.ch6

Salkute, S. R., (2019). *Effective Management in District Court Record Scanning & Digitization.* International Journal of Information, Business and Management, Vol.11, No.4, 2019. https://www.proquest.com/docview/1903811739?forcedol=true&pq-origsite=summon&sourcetype=Scholarly%20Journals

Sharma, D., Selwal, A. (2021). *FinPAD: State-of-the-art of fingerprint presentation attack detection mechanisms, taxonomy and future perspectives*, Pattern Recognition Letters, Volume 152,2021, Pages 225-252, Retrieved from https://doi.org/10.1016/j.patrec.2021.10.013.

Sharma, K., Shingatgeri, V. and Pal, S. (2021). *Role of Data Digitization on Data Integrity*. Quality Assurance Implementation in Research Labs pp 221–245 Available at https://link.springer.com/chapter/10.1007/978-981-16-3074-3_13

Smith, M., Mann, M., & Urbas, G. (2018). *Biometrics, crime and security*. Routledge. Available at https://www.taylorfrancis.com/books/mono/10.4324/9781315182056/biometrics-crime-security-marcus-smith-gregor-urbas-monique-mann

Titu, A.M., Moisescu, R. and Oprean, C. (2021). *Quality and Digitalization of the Data Backup Process Management in Organizations having as Object of Activity the Protection of Intellectual Property* Available at https://atna-mam.utcluj.ro/index.php/Acta/article/view/1712

Verton, D. (2014). FBI nears completion on massive digitization effort. *FedScoop*. Retrieved from https://www.fedscoop.com/

Zhang, A. and Gourley, D. (214). *Creating digital collections: a practical guide.* Elsevier. Available at https://www.sciencedirect.com/science/article/pii/B9781843343967500067