# Proposal for a Capacity Building Model in Cultural Heritage ODA: A Case Study of Photogrammetry Training for Gandhara Heritage Documentation

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**Abstract**

This study proposes and validates an effective digital documentation capacity-building model tailored for developing countries, based on an in-depth analysis of the 'Cultural Heritage Photogrammetry Capacity Building Program' in Pakistan from 2022 to 2025. We adopted a field-oriented, action-learning approach, incorporating a Training of Trainers component and considering the unique characteristics of the recipient organization and trainees. This systematic approach, encompassing technology introduction, acquisition, application, and internalization, successfully integrated digital techniques into the recipient country's existing workflows, significantly boosting efficiency. A notable achievement was the trainees' journey to technical self-reliance, culminating in their transition to 'educators.' This, coupled with the active engagement of recipient country managers, spurred the Pakistani Government to independently pursue digital documentation initiatives. While this model is a pioneering proposal specific to Pakistan, its demonstrated success through a customized, field-centric approach highlights its potential for broader application and adaptation in diverse contexts. We anticipate this research will serve as a crucial reference, contributing to sustainable capacity building and dissemination models in cultural heritage international development cooperation.

## 1. Introduction

This study aims to develop a model for enhancing digital documentation capabilities for cultural heritage, tailored to the needs of developing countries, and to assess its effectiveness. The model is grounded in a detailed analysis of the *Cultural Heritage Photogrammetry Capacity Building Program*, a four-year initiative (2022–2025) implemented under Pakistan’s Cultural Heritage Official Development Assistance (ODA) project. By holistically addressing how to strengthen field-oriented practical skills and overcome the technical and resource limitations of recipient countries, this research ultimately seeks to contribute to the establishment of a sustainable heritage preservation and management system led by the recipient nations themselves.

The Republic of Korea's Government has been pursuing Cultural Heritage ODA projects, starting in 2013 with the conservation and restoration of the "Hong Nang Sida Temple" within Laos's World Heritage site, "Vat Phou and Associated Ancient Settlements within the Champasak Cultural Landscape." The scope of these projects has since expanded to include countries such as Cambodia, Bangladesh, Myanmar, DR Congo, Egypt, Uzbekistan, Pakistan, and Kyrgyzstan. Initially, these projects were primarily focused on technical support, with Korean experts directly undertaking the repair and restoration of local cultural heritage. However, with accumulated experience, the approach gradually shifted towards supporting the self-reliant capacity building of experts in recipient countries, which is the original purpose of international development cooperation. In particular, the "Development of Cultural Promotion and Tourism Resources of the Gandhara Heritage of Pakistan" project is a prime example of this shift. While seeking to transition from initial technical support to self-reliant support for recipient countries, the Gandhara Cultural Heritage project in Pakistan is evaluated as a pioneering case. It was the first to introduce annual training objectives, task adjustments based on proficiency, and action-learning methods centered on field practical training, there by maximizing the practical outcomes of capacity building, enabling recipient countries to manage their cultural heritage independently.

The Korea Heritage Service and the Korea Heritage Agency have been promoting this project from 2021 to 2025. As part of this initiative, the Gandhara Cultural Heritage Research Center was established in Islamabad in March 2023. The center operates research and conservation science laboratories, performing tasks such as digital documentation of Gandhara cultural heritage, database construction, and artifact conservation treatment (Park, D., 2024). Furthermore, based at the center, various capacity-building training programs were planned and implemented for local cultural heritage experts. The 'Cultural Heritage Photogrammetry Capacity Building Program,' the main subject of this study, was operated as a core program among them (Park, D., Kim, G., 2024).

This training program was designed to develop practical and field-oriented competencies tailored to the needs of developing countries, in alignment with the core objectives of the ODA project. Particular consideration was given to the institutional role of the recipient organization—the Department of Archaeology and Museums (DoAM) in Islamabad—and the professional backgrounds of its working-level staff. Accordingly, rather than relying on conventional theory-based approaches, the program adopted an *Action Learning* methodology, emphasizing field-based practice and the resolution of practical challenges encountered in actual heritage documentation contexts, including various constraints and limitations that may arise during on-site investigations. *Action Learning* is a practice-oriented learning approach in which participants actively acquire knowledge and produce results through real-world problem-solving and hands-on engagement (Shim, S., 2020). Additionally, to maximize the ripple effect of the program, a *Training of Trainers (ToT)* model was applied, encouraging initial beneficiaries to become future trainers. Through these combined strategies, local experts were empowered not only to acquire technical skills, but also to

develop the capacity to autonomously preserve, manage, and actively utilize their own cultural heritage.

This study analyzes the composition and execution of the conducted training program by year. In the first year (2022), the focus was on enhancing the technical understanding of local experts, centering on the acquisition of basic theory and fundamental techniques of photogrammetry. In the second year (2023), practical competencies were strengthened through hands-on field training and applied technology education. In the third year (2024), autonomous problem-solving and advanced technical application skills were developed through team-based project execution. In the final year (2025), comprehensive training was conducted to strengthen the planning, management, and utilization capabilities of digital cultural heritage content.

Through this training process, this study proposes an effective digital documentation capacity-building model applicable to cultural heritage ODA projects in developing countries. Furthermore, by utilizing qualitative and quantitative data collected from the field, such as self-assessment survey results from participants, observation records from instructors, and in-depth interviews with participants, the study aims to objectively verify the effectiveness of the training and suggest possibilities for its application and strategic approaches in similar future ODA projects.

## 2. Design Background and Strategy of the Cultural Heritage ODA Digital Documentation Capacity-Building Program

This digital documentation training program was designed for working-level public officials from the Department of Archaeology and Museums (DoAM), under Pakistan's Federal Ministry of National Heritage and Culture. For successful training program design, especially in Official Development Assistance (ODA) projects, a deep understanding of the recipient organization's institutional and administrative context, as well as the characteristics of the trainees, is essential. This preliminary analysis critically influences the setting of educational goals, curriculum development, and the selection of effective learning methodologies. Therefore, this chapter provides a comprehensive analysis of DoAM's historical and administrative background, its current state of cultural heritage documentation, and the characteristics of the trainees. Based on this analysis, the established educational strategy will be presented.

### 2.1 DoAM's Historical and Administrative Context, Current Status, and Cultural Heritage Documentation

DoAM is an institution that continues the institutional lineage of the 'Archaeological Survey of India (ASI),' established in 1861 during the British Indian Empire. ASI was founded as a Government body for the management and protection of cultural heritage, but it also functioned as an administrative tool for colonial governance. After the partition of Pakistan and India in 1947, the Pakistani Government established DoAM to ensure the continuity and independence of cultural heritage administration, inheriting much of ASI's functions. However, since its independence, Pakistan has experienced continuous political instability due to coups, wars, and terrorism. This has led to a chronic shortage of personnel and budget at DoAM, gradually shrinking its organizational size and functions. Particularly after the 2011 decentralization reforms, as cultural heritage management authority was transferred from the Federal Government to Provincial Governments, most major national cultural heritage sites came under provincial management. Consequently, DoAM, as a Federal Government agency, lost its direct field management functions. Core practical functions such as excavation, survey, and conservation were curtailed, and the organization's weakening continued as there was no recruitment of new personnel or specialized training after existing experts retired.

Considering these circumstances, the cultural heritage documentation work performed by DoAM has also gradually decreased. While actual measurements, photography, and report writing accompanying excavation or maintenance work were carried out, they were limited to small-scale operations. Notably, even as digital methods for documentation became global practice, new technologies were not adopted, and past methods continued to be used.

### 2.2 Characteristics of the Trainees

As previously discussed, DoAM lacked personnel dedicated to digital documentation. The training program was therefore designed to cultivate specialists in this field and to enhance institutional capacity. Four staff members were selected as trainees. Although candidate selection was conducted in consultation with the recipient organization, the trainees exhibited heterogeneity in their academic backgrounds, job roles, and prior experience with technical training. These disparities in baseline knowledge and proficiency highlighted the need for a customized, learner-centered training approach throughout the program.

| Trainee | Assigned Duty | BPS(Grade) | Gender |
|---|---|---|---|
| A | Civil Engineer | 11 | M |
| B | Photographer | 11 | M |
| C | Associate Engineer | 7 | M |
| D | Draftsman | 8 | M |

Table 1. Basic Information of Assigned Trainees

The trainees comprised individuals with different academic backgrounds and work experiences, leading to clear disparities in their prior understanding and technical capabilities related to digital documentation. Table 2 presents the instructor's observations on the characteristics and backgrounds of each trainee.

**[Trainee A]** Majored in civil engineering and currently manages projects at cultural heritage restoration sites within DoAM. Prior to DoAM, he worked for the KP Province Department of Archaeology and Museums, possessing extensive experience in cultural heritage conservation and field management. Therefore, he could understand the necessity of digital documentation in relation to field work, but lacked direct experience in digital documentation or background knowledge in photogrammetry.
**[Trainee B]** Majored in photography and was employed by DoAM as a dedicated photographer. He had previous experience attempting 3D modeling using photogrammetry on museum collections at DoAM. Although that project was not successfully completed, he had basic knowledge and understanding of photogrammetry. However, he tended to be reluctant to participate in work areas other than photography, especially surveying or drafting, which made it difficult to perform a wide range of tasks.
**[Trainee C]** Majored in civil engineering in his undergraduate studies, but primarily performed

| |
|---|
| administrative duties at DoAM. He was recommended by a research officer from the recipient organization to participate in this training program, as he was deemed to have an appropriate background for performing drafting work using photogrammetry and 3D modeling. He was the youngest and least experienced among the trainees, but his existing duties rarely required external fieldwork, allowing him to participate most actively in this training. Indeed, he was the trainee who asked the most questions and showed the most active participation throughout the training. |
| **[Trainee D]** After graduating high school, he underwent short-term vocational training related to drafting and was employed as a draftsman at DoAM. Although his academic qualifications and theoretical background were lower than other trainees, he had the longest work experience and was accustomed to drafting work, giving him the highest understanding of drafting-related content. He was particularly meticulous and diligent, consistently following the provided manuals and training guidelines. |

Table 2. the characteristics and backgrounds of each trainee.

Before this training, DoAM's cultural heritage documentation relied on manual measurements, simple drafting, and general photography. Thus, the concept and methodology of digital 3D documentation were unfamiliar to all trainees. Furthermore, due to the highly segmented job responsibilities within Pakistan's administrative structure, trainees showed strong resistance to performing tasks outside their designated roles. For instance, the photography specialist avoided tasks other than shooting, and some trainees tended to postpone drafting work, considering it outside their scope of responsibility. These differing levels of understanding, technical skills, and unique work attitudes among trainees could have significantly hindered collaborative digital documentation and integrated capacity building in the future, strongly underscoring the need for a customized training strategy.

### 2.3 Developing a Training Strategy Tailored for Cultural Heritage ODA

To overcome the institutional limitations, functional weakening, existing documentation methods of DoAM, and the heterogeneity of trainee backgrounds, a comprehensive strategy for this digital documentation training program was formulated. To address these specific challenges and achieve practical capacity building, a field-oriented action learning approach was adopted as the core training methodology, based on in-depth discussions with recipient organization managers. Specifically, the program focused on precise architectural cultural heritage drafting using photogrammetry to overcome the limitations of DoAM's existing drafting practices and facilitate a digital transformation.

The detailed curriculum of the training program included GNSS surveying, drone photography, image alignment, 3D point cloud generation, mesh and texture generation, and finally, architectural drawing creation (refer to Figures 1 and 2). To objectively measure training performance and promote practical learning linked to each trainee's current duties, a 'Technical Competency Matrix' was developed and applied. This evaluation system allowed for setting step-by-step goals based on technical proficiency and providing customized feedback that accounted for differences in trainee skill levels. This contributed to implementing a performance-oriented model that differentiated itself from conventional standardized training approaches.

## 3. Phased Implementation and Performance Analysis of the Digital Documentation Training Program

The digital documentation training program was systematically implemented in phases over four years, from 2022 to 2025. This training course was designed not merely for skill acquisition, but to achieve long-term, sustainable digital documentation capacity building for the recipient organization, the Department of Archaeology and Museums (DoAM) under the Federal Government. This chapter details how field-oriented practical training was conducted under the specific objectives set for each year, and it analyzes the direct outcomes and evaluation results derived from each stage. This will empirically demonstrate how the training strategies presented in Chapter 2 were realized and how they proved effective in the field.

### 3.1 Site Selection and Preparatory Process

To establish an efficient and strategic digital documentation training methodology, a 'Gandhara Cultural Heritage Digital Documentation Working-Level Workshop' was held in the initial phase of the program. Key stakeholders, including DoAM officials, Korea Heritage Agency researchers, local experts, and advisors, participated in this workshop. It played a crucial role in determining the scope and methods of the training and selecting the target heritage sites necessary for the training's progression. Considering historical value and preservation status comprehensively, a total of 60 sites were finally selected: i) 16 sites in Taxila and its vicinity, ii) 15 sites in Peshawar and its vicinity, and iii) 29 sites in Swat and its vicinity. Simultaneously, discussions were held to standardize survey methods and documentation formats, differentiate survey content based on whether excavation had occurred, devise a plan for listing Gandhara sites across Pakistan, implement photogrammetry-based drawing methods, and establish a cooperation system with local governments for practical integration. This preparatory process successfully laid the groundwork and cooperative structure crucial for ensuring that the working-level training was closely linked to the actual work environment.

### 3.2 Digital Documentation Process Applied in Training

The digital documentation process largely consists of six stages: pre-planning, image acquisition and pre-processing, photo alignment, 3D point cloud generation, mesh and texture creation, and final model output.

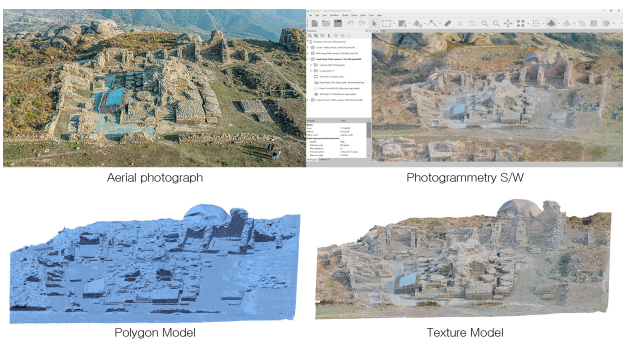


Figure 1. Digital Documentation Case (Ranigat site).

In the Planning and Preliminary Survey stage, basic information such as the location, scale, accessibility, and current state of preservation of the target site was collected. Based on this, a work plan was established, including shooting methods,

equipment configuration, GCP (Ground Control Point) placement, and personnel operation.

During the Image Acquisition stage, aerial photography using a drone (DJI Mavic 2 Pro) was conducted in parallel with ground photography using a DSLR camera (Canon EOS 200D). Ground Control Points (GCPs) were set using a total station (Sokkia IM-55) to secure ground reference points. The acquired images were immediately backed up. In the Image Pre-processing stage, RAW image files were exposure and color-corrected and then converted into consistent quality JPEG images.

Next, in the Photo Align stage, the pre-processed images were aligned to estimate camera positions and external reference points based on overlapping areas between images. When GCPs were collected, "GCP Registration" was simultaneously performed to enhance the accuracy of the alignment results.

Based on the aligned data, Point Cloud Generation was performed, a crucial step for creating a dense point cloud containing the shape and spatial information of the heritage object. The generated point cloud led to the Mesh Generation stage, where a 3D mesh was constructed based on surface information, and through the Texture Mapping process, a high-resolution model was completed with visual information based on actual images.

In the Export Model stage, the completed model was converted and saved into various formats (e.g., OBJ, FBX, PDF 3D) for diverse uses. Based on this, current status maps, floor plans, and elevations were produced to derive drawing data necessary for archiving and conservation planning.

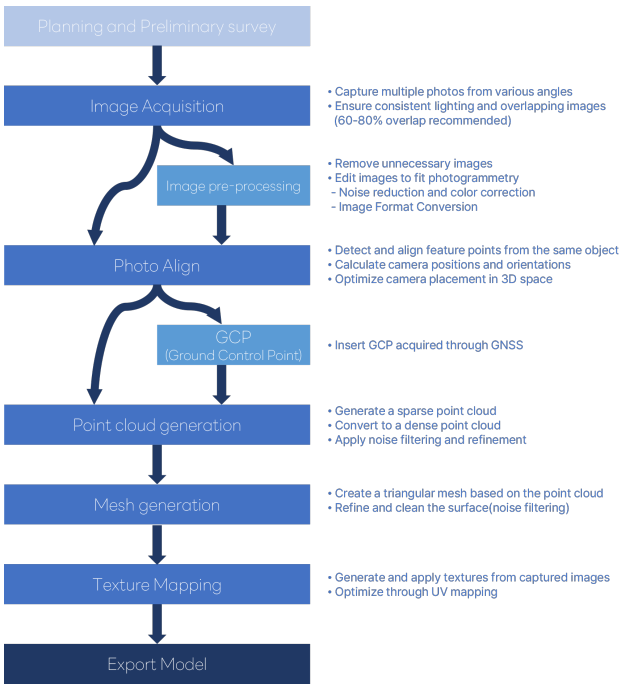


Figure 2. Digital Documentation Work Flow

Drawing creation was done in AutoCAD-based DWG format and included floor plans and main structural elevations based on 3D models. The drawing style and creation standards were coordinated through discussions with Federal and KP Provincial officials during the local technical training for digital documentation in December 2023, enhancing local applicability and usability.

### 3.3 Year 1 (2022): Establishment and Pilot Operation of the Research Lab

2022 marked the pilot operation phase for establishing the foundation of Gandhara cultural heritage digital documentation training. This included setting up a research lab within the Gandhara Cultural Heritage Research Center and applying digital documentation work in the field for the first time. This was an important preparatory process aimed at securing practical standards and reference points for the design and operation of the subsequent training stages.

The survey work was carried out by the Korea Heritage Agency, which hired one local employee with a Ph.D. and one with a bachelor's degree, forming a survey team that included one external consultant at the professor level. The survey team divided tasks by role, including historical research data collection, field documentation, and drawing production.

The main purpose of the work was to produce layout drawings of the sites and to secure photo-based visual materials. For this, drone aerial photography, internal and external photographic documentation using general cameras, and actual measurement work using a total station were conducted in parallel. In particular, images captured by the drone were converted into 3D data using the photogrammetry software 'Agisoft Metashape,' and based on this, a horizontal layout map was produced.

Through this pilot operation, the recipient organization, DoAM, clearly recognized the practical demands for digital documentation technology, such as not only generating simple 3D models but also securing accurate drawings based on the current site layout, accumulating data for tourism development and structural monitoring, and examining the possibility of replacing existing manual drawings. Furthermore, DoAM working-level officials who experienced the entire survey process gained a basic understanding of the administrative and technical significance of digital documentation. This indicated that future training courses should be structured as practical, application-oriented training, considering their potential for actual administrative use, rather than being theory-centric. As a result, the 2022 pilot operation provided key information regarding the appropriateness of the technology, suitability for the survey environment, and identification of the needs of the requesting agency. It also fostered a consensus among both trainees and DoAM managers about the necessity of digital documentation, laying the groundwork for continuous trainee input over four years.

### 3.4 Year 2 (2023): Regular Personnel Deployment and Practical Capacity Building Training

In 2023, full-scale practical training, based on Action Learning, was conducted to internalize digital documentation technology. Regular working-level staff were first assigned to the Research Lab of the Gandhara Cultural Heritage Research Center, under the Department of Archaeology and Museums (DoAM) in Islamabad. These staff then carried out digital documentation tasks while simultaneously undergoing field-based, practical training with experts from the Korea Heritage Agency. Four regular Government staff worked with the Korea Heritage Agency 's experts to perform digital documentation tasks for five heritage sites, combining surveying and training. The goal was to acquire practical documentation capabilities and establish a foundation for future autonomous task execution.

Meanwhile, to disseminate the training's outcomes, a Terms of Reference (ToR) agreement was signed with the KP Provincial Department of Archaeology and Museums. Together with working-level staff from KP Province, 10 heritage sites were jointly digitally documented. This process was not merely a division of tasks but a collaboration that combined training, contributing to establishing a foundation for technical exchange between federal and provincial governments. The Provincial Government's survey and documentation process included monitoring with field and remote technical support, providing manuals, and digital documentation technical training (December 2023).

2023 was a year that both established the foundation for DoAM working-level staff's technical self-reliance and demonstrated the potential for spreading digital documentation technology within Pakistan through joint execution with Provincial Government staff. Furthermore, through practical training linked to the usability of documentation data (e.g., for maintenance plans, enhancing tourism convenience, policy data), a strategic capacity-building approach beyond simple skill acquisition was implemented.

### 3.5 Year 3 (2024): Autonomous Task Performance and Capacity Deepening

2024 marked a turning point year for deepening the autonomy and professionalism of the Gandhara Cultural Heritage Digital Documentation Program. Having accumulated basic competencies through two years of training and practical work, the recipient organization's working-level staff became the primary operators of the Gandhara Cultural Heritage Research Center's research lab starting in 2024, practically performing digital documentation and cataloging tasks. This functioned as a pilot case for establishing an indigenous cultural heritage documentation system within Pakistan, going beyond mere skill acquisition.

In this stage, the digital documentation of 29 Gandhara cultural heritage sites within the Swat region was fully entrusted to the recipient organization. The research lab independently carried out field surveys, photogrammetry-based 3D modeling, drawing creation, and literature-based historical verification. The Institute provided technical support and evaluated the results to assess their level of self-reliance. In the field, practical technical advice was provided, including adjustments to photogrammetry techniques for vertical sites like rock-carved Buddhas, securing GNSS-based scale reference points, and designing a standard folder tree structure.

Furthermore, to encourage the horizontal dissemination of digital documentation training within Pakistan, a 'Training of Trainers' program was implemented. During the local technical training conducted in November 2024, existing trainees from the recipient organization participated as instructors, leading hands-on training for archaeology students from Quaid-i-Azam University. This represented the practical implementation of a cyclical learning structure where trainees transition to trainers, and it laid the foundation for establishing a sustainable talent development system for cultural heritage digital documentation in Pakistan.

Moreover, the achievements of this year advanced on an academic level. At the 2024 Gandhara International Symposium, Muhammad Shahid Nawaz, a working-level official from the recipient organization, presented the survey results. This provided the local official with an opportunity to directly present survey outcomes at an international symposium, thereby externally demonstrating their self-reliant capabilities.

2024 is assessed as the year that achieved the practical self-reliance of the recipient organization. It moved beyond short-term technical transfer, empirically proving the potential for development into a "training-documentation-utilization" linkage system that enables medium-to-long-term regional strategies. This project is evaluated as a leading case that progressed towards the broader goal of establishing a sustainable cultural heritage digital documentation system, rather than merely delivering outcomes.

### 3.6 Year 4 (2025): Job Integration of Digital Documentation and Operation of Evaluation System

In 2025, the program transitioned to a stage of integrating digital documentation technology into the recipient organization 's core functions and promoting the internalization of practical skills based on this integration. Crucially, the Research Lab within the Gandhara Cultural Heritage Research Center functioned not as a training recipient but as an organization proactively leading digital documentation practices, solidifying its self-reliant foundation.

The core of this period was to identify areas within the recipient organization's unique responsibilities where digital documentation technology could be directly applied, and for each working-level staff member to undertake these as individual tasks. To this end, job-centric local technical training was conducted for approximately five months, from February to June 2025, combining practical work and theory into a customized curriculum. Each staff member was assigned individual tasks covering the entire digital documentation process, including basic cultural heritage surveys, field survey planning, photogrammetry and 3D modeling, post-processing, and drawing. The results of these tasks were presented and evaluated in technical review meetings.

During this process, feedback on technical errors encountered during practical application was provided, along with in-depth discussions on how to utilize the survey data. This was an attempt to go beyond mere technical transfer and internalize the capacity for each staff member to actively utilize digital documentation techniques, thereby strengthening the technical foundation applicable to actual cultural heritage management and survey work.

Furthermore, this training course experimented with a cooperative model aimed at ensuring the sustainability of the digital documentation operating system at the management level, by assigning planning and evaluation roles to the recipient organization's manager (Archaeological Engineer Muhammad Azeem). Joint planning of training content, target sites, and schedules was conducted with the manager, and by also undertaking evaluation roles, the aim was to establish a sustainable operational foundation for the research lab.

This stage particularly demonstrated that digital documentation technology can be practically utilized in the recipient organization's core duties, thereby securing its status as a tangible technology capable of complementing or replacing existing manual work in cultural heritage management.

Such a practical training model not only yielded short-term results but also concretely demonstrated the field-oriented internalization and sustainable dissemination potential of

cultural heritage digital documentation technology, serving as a significant case study.

### 3.7 Application of the Technical Competency Matrix

Another distinguishing feature of this training program was the annual technical competency evaluation system. The Technical Competency Matrix was designed to objectively assess trainees' performance by organizing key technical elements required for digital documentation into 3 items for theoretical competency and 17 items for practical competency.

This evaluation was updated at the end of each year, based on a baseline survey (March 2023), allowing both managers and trainees to clearly identify changes and progress in competencies. As a result of the evaluation, the average technical score improved from 56.75 points to 75.33 points in 2024, confirming that all working-level staff in the research lab reached a level capable of independently performing digital documentation tasks.

This evaluation provided recipient organization managers with an indicator of their staff's competency levels and could be used as a practical basis for decision-making regarding future job assignments and organizational operations.

Name Date.

❑ Photogrammetry technical competency evaluation items

| evaluation contents | | Lv.1 | Lv.2 | Lv.3 | Lv.4 | Lv.5 |
|---|---|---|---|---|---|---|
| theoretical ability | Theory of data acquisition | ① | ② | ③ | ④ | ⑤ |
| | Theory of after processing data | ① | ② | ③ | ④ | ⑤ |
| | The theory of data backup | ① | ② | ③ | ④ | ⑤ |
| practice ability | Ground photo acquisition | ① | ② | ③ | ④ | ⑤ |
| | Drone photo acquisition | ① | ② | ③ | ④ | ⑤ |
| | Coordinate points acquisition | ① | ② | ③ | ④ | ⑤ |
| | Photo editing | ① | ② | ③ | ④ | ⑤ |
| | Photogrammetry S/W processing | ① | ② | ③ | ④ | ⑤ |
| | Enter coordinate points in 3D model with Photogrammetry S/W | ① | ② | ③ | ④ | ⑤ |
| | Editing 3D model with S/W | ① | ② | ③ | ④ | ⑤ |
| | Capturing the 3D model and resizing for drawing | ① | ② | ③ | ④ | ⑤ |
| | line drawing | ① | ② | ③ | ④ | ⑤ |
| | Data Folding and Backup | ① | ② | ③ | ④ | ⑤ |
| | Ability to Response Error | ① | ② | ③ | ④ | ⑤ |
| | Self-error checking | ① | ② | ③ | ④ | ⑤ |

| division | Technical competency level |
|---|---|
| Lv.1 | Not experienced processing work |
| Lv.2 | Experience of processing work but carrying these expertise in professionally is not easy |
| Lv.3 | Can perform the work but need expert review and guidance on each process |
| Lv.4 | Steps where work can be performed independently by referring to educational materials |
| Lv.5 | Self-performance is possible, application technology can be improved, and creative application of the technology to work is possible. |

Figure 3. Photogrammetry technical competency evaluation

## 4. Proposal for a Cultural Heritage ODA Digital Documentation Capacity-Building Model

This chapter proposes an effective digital documentation capacity-building model applicable to cultural heritage ODA projects in developing countries, building on the in-depth analysis of the implementation experience and outcomes of the Pakistan Gandhara cultural heritage digital documentation capacity-building program discussed in Chapters 2 and 3. The proposed model is structured based on a four-stage annual goal and training flow: technology introduction, acquisition, application, internalization, and evaluation. This model is unique because it doesn't just focus on technical transfer; it also comprehensively considers the recipient organization's self-reliant work performance and policy linkage for the sustainable use of the acquired technology. This aims to build the recipient country's practical cultural heritage management capabilities.


Figure 4. Training Program Structure.

### 4.1 Preparation and Pilot Operation Stage (Year 1)

This stage focuses on conveying the concept and necessity of digital documentation to the recipient country and creating a foundation for technology acceptance. This involves collaborative work through inter-governmental agreements and workshops or meetings between recipient organization managers to select target heritage sites and establish the implementation environment and cooperation system for digital documentation. Concurrently, all digital documentation equipment, including cameras, software, and precision surveying instruments, are provided to the local site, along with basic training for equipment utilization. This process aims to promote an understanding of how digital documentation can contribute to the recipient organization's current cultural heritage management system and to secure the foundation for transitioning to subsequent capacity-building stages.

Furthermore, a pilot operation is conducted to directly apply digital documentation technology in cultural heritage sites, examining its applicability to the survey environment and the conditions of the recipient organization. During this pilot operation: i) a future operating organization (team) is established, ii) necessary equipment is provided, and iii) the entire digital documentation process is carried out on actual cultural heritage sites. Through this process, the recipient organization can directly experience the administrative and technical significance of digital documentation technology.

The pilot operation serves not merely as a preliminary test, but also as a reference point for the overall training design, including future trainee selection, curriculum development, equipment operation, and field documentation methods. Most importantly, it helps recipient organization managers and working-level staff gain a shared understanding of the technology's necessity, enabling continuous cooperation for subsequent training. This is considered the most crucial stage of the entire process.

### 4.2 Collaborative Training Stage (Year 2)

In the collaborative stage, trainees (working-level staff) are selected, and the entire digital documentation process is systematically learned through field-oriented practical training.

Specifically, an action learning approach is adopted, combining theoretical education with hands-on practice. Instructors and local working-level staff are encouraged to form teams and perform tasks directly at heritage sites. This stage is designed not for simple observational participation, but as a repetitive learning structure where staff perform the entire documentation process, identify errors, and incorporate feedback. Through this, the recipient organization gains practical operational capabilities beyond a basic understanding of the technology, laying the groundwork for future independent execution.

### 4.3 Application and Dissemination Stage (Year 3)

The application and dissemination stage involves integrating digital documentation into the recipient organization's core tasks, such as assigning specific projects, and deepening the specialization of the technology based on this integration. Working-level staff from the recipient organization lead the entire process within the research lab, including field surveys for digital documentation of heritage sites, photogrammetry software processing, and drawing creation, thus functioning as the central entity for survey and documentation work. From this point, the instructors focus on technical support and evaluation, while the recipient organization primarily leads the digital documentation work. Especially if trainees lecture new trainees, assuming the role of educators, it simultaneously internalizes the technology and establishes a foundation for its dissemination within the region. This cyclical learning structure contributes to building a sustainable talent development system for cultural heritage digital documentation within the recipient country, going beyond mere repetitive training.

### 4.4 Job Internalization and Institutionalization Stage (Year 4)

In the final stage, the digital documentation technology is integrated into the recipient organization's core operations, and the processes are managed to ensure that application and operation are led by working-level staff. The key to this stage is not just skill acquisition but establishing a practical operating structure where the recipient organization can independently identify and lead digital documentation tasks. The focus of the training also expanded from individual performance capabilities to the autonomous implementation system of the entire organization.

The training was conducted by selecting tasks where digital documentation technology could be applied in actual job functions, in consultation with the recipient organization, and then assigning these as job-linked individual tasks to the working-level staff. Project-Based Learning (PBL), which integrated the entire digital documentation process—including basic cultural heritage surveys, field survey planning, photogrammetry-based 3D modeling, data post-processing, and drawing—was applied in the locally-centered training. Staff members autonomously designed and executed each task, presenting their deliverables in performance-sharing meetings and improving them based on feedback from colleagues and managers.

Furthermore, this stage emphasized strengthening the participation of management-level personnel to ensure the sustainability of the operating system. Training target sites, schedules, and evaluation systems were jointly planned with the recipient organization's managers, who were also assigned roles to perform planning and evaluation functions for the overall training. This cooperative structure contributed to realizing the internalization of an operating system that enhances the entire organization's execution capability, not just individual staff training.

Notably, this stage demonstrated that digital documentation technology is practically usable in the recipient organization's core duties, thereby securing its status as a tangible technology capable of complementing or replacing existing manual work in cultural heritage management.

This practical training model not only achieved short-term results but also concretely demonstrated the field-oriented internalization and sustainable dissemination potential of cultural heritage digital documentation technology, serving as a significant case study.

## 5. Achievements of the Digital Documentation Capacity-Building Program

This chapter analyzes and evaluates the key achievements of the cultural heritage digital documentation capacity-building program conducted in Pakistan from 2022 to 2025. This program transcended simple technical transfer, becoming a significant case study that transformed the paradigm of cultural heritage management in the recipient country and demonstrated its potential for sustainable development.

The most crucial achievement was the successful completion of high-precision digital documentation for 60 Gandhara cultural heritage sites. Securing accurate and permanent current status information for outdoor sites, which are highly vulnerable to natural weathering and loss due to development, holds significant scientific merit for cultural heritage preservation. This data will serve as a reliable foundation for future site restoration and maintenance planning, drastically improving the efficiency and precision of cultural heritage management. Furthermore, as utilization is a prerequisite for digital documentation, the digital data can be reprocessed and presented on various platforms. Notably, this project used digital data to create immersive content related to Gandhara culture, which is being screened in a digital exhibition hall established through the ODA project.

In addition, the superiority of digital documentation over traditional manual methods in terms of accuracy and speed became internalized among the working-level staff and managers of the recipient organization, the Department of Archaeology and Museums (DoAM) in Islamabad. This provided a turning point for firmly establishing a digital paradigm in Pakistan's cultural heritage management sector. In particular, digital documentation technology began to be practically integrated into various existing tasks, such as monitoring conservation status, planning maintenance, producing tourism content, and drafting administrative reports, strongly demonstrating the practical utility of this training program. This shows how digital technology deeply permeated and innovated the recipient country's inherent work processes.

The most notable achievement of this program is the successful internalization and self-reliance of digital documentation capabilities among DoAM working-level staff. Through annual training objectives and the Action Learning approach, trainees acquired practical problem-solving skills in real-world settings. Specifically, in the third year (2024), the recipient organization’s staff independently digitally documented 29 cultural heritage sites as the operational core of the Gandhara Cultural Heritage Research Center's research lab, clearly

demonstrating their self-reliant capabilities. Furthermore, during the local technical training in November 2024, former trainees directly lectured new trainees, embodying a cyclical learning structure where "trainees become trainers." This signifies that the recipient country's talent development system began to function autonomously, making a decisive contribution to establishing a sustainable dissemination base for cultural heritage digital documentation technology within Pakistan.

The success of this program was not limited to strengthening the capabilities of individual trainees. It was crucial that a deep understanding and consensus on the utility of the training spread to management-level personnel in the recipient country. Their support and participation indicate that the ODA project's outcomes are not ephemeral but can be linked to the recipient country's own policies. Indeed, the Pakistani Government plans to pursue its own digital documentation of 6 World Heritage sites and 26 tentative list sites starting in July 2025, using its own budget and personnel. This is strong evidence that Korea's ODA project successfully fostered the recipient country's capacity to proactively formulate and implement cultural heritage management policies based on its own needs.

In conclusion, the Pakistan Cultural Heritage Digital Documentation Capacity-Building Program went beyond mere technical transfer, genuinely contributing to strengthening the recipient country's self-reliant capabilities and establishing a sustainable cultural heritage management system. The field-oriented Action Learning, customized annual training, and institutional linkage through the participation of recipient country managers proved to be an optimized approach for overcoming the recipient country's limitations and enhancing self-reliant capabilities. The achievements derived from this program will serve as important reference material for planning and implementing similar future cultural heritage ODA projects, and it can be evaluated as a pioneering international development cooperation case contributing to the establishment of a cultural heritage management system led by the recipient country.

## 6. Conclusion

This study deeply analyzed the case of the digital documentation capacity-building program conducted as part of Pakistan's Cultural Heritage ODA project from 2022 to 2025. Based on this analysis, it aimed to propose a yearly training model optimized for developing countries and empirically verify its effectiveness. By applying a field-oriented action learning approach that considered the characteristics of the recipient organization and the backgrounds of the trainees, the program successfully fostered systematic capacity building, from technology introduction to acquisition, application, and internalization. The fact that digital technology was integrated into the recipient country's existing work processes, dramatically improving efficiency, proves the practical value of this model. Notably, the technical self-reliance of the trainees and their transition into 'educators,' along with the active participation of recipient country managers, led to a policy expansion where the Pakistani Government is now pursuing digital documentation projects independently. This demonstrates that the capacity-building model proposed in this study successfully strengthened the recipient country's sustainable cultural heritage management capabilities.

The objective of ODA is to promote sustainable development in developing countries in accordance with OECD/DAC standards. Ultimately, ODA aims to support capacity building in partner countries, enabling them to take ownership of their development processes and achieve self-reliance. Therefore, the yearly training model proposed in this study holds significant meaning as it sets a new standard for digital documentation capacity building in cultural heritage ODA projects in developing countries. Of course, since this model is a first proposal based on the unique environment of Pakistan, it may have limitations. However, this study clearly demonstrated that even in such a specific environment, a field-oriented, customized approach can yield successful results. This suggests the possibility of the model being sufficiently universal and applicable when adapted to other developing countries or cultural heritage types in the future, through flexible improvements and customized adjustments that consider each country's cultural, administrative, and technical characteristics. This study provides an important starting point for such progressive applications and is expected to contribute to illuminating the future of sustainable capacity building and dissemination models in the field of cultural heritage international development cooperation.

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