Seal and Imprint Digitization Procedures Guidelines

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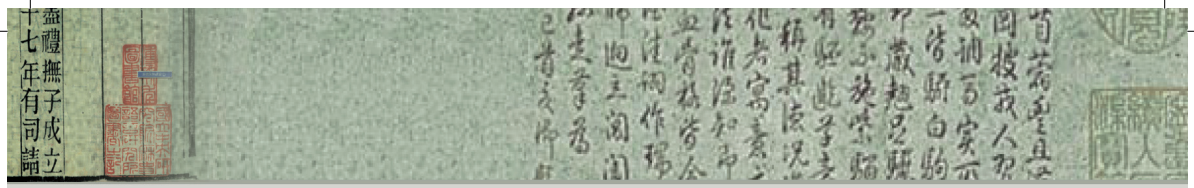
Taiwan e-Learning and Digital Archives Program
Taiwan Digital Archives Expansion Project



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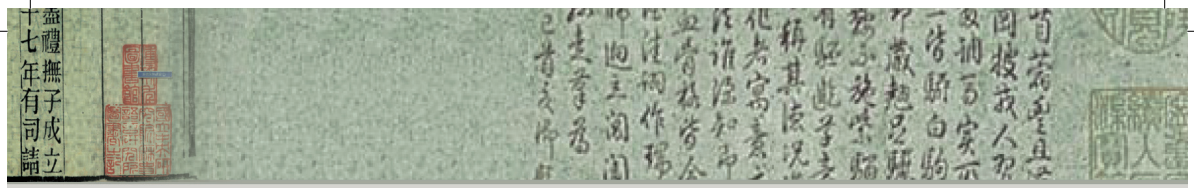
Publisher's Preface

After the "National Digital Archives Program" was initiated in 2002, members of numerous institutional projects and request-for-proposals projects joined our team to engage in digital work that covered countless categories and massive amounts of content. The first phase of the five year project was successfully completed in 2006. The following year, the "National Digital Archives Program" and "National Science and Technology Program for e-Learning" were integrated into the "Taiwan e-Learning and Digital Archives Program (TELDAP, http://teldap.tw/)", striving to achieve the ultimate goal of "presenting Taiwan's cultural and natural diversity" as it continued to expand digital resources in various fields, and systemically promoted digital achievements in education, research and industries. TELDAP is preparing to actively collaborate with the private sector to drive growth in related industries, not only preserving important cultural assets, but also accelerating the development of a new culture in the digital age of today.

Originally named the "Content Development Division" during the first phase, we were renamed "Taiwan Digital Archives Expansion Project" (http://content.teldap.tw) as a subproject of TELDAP, and took more active measures to expand the sources of digital content, extending our reach to the collections of private institutions and even individuals. We have widely requested proposals for digitization projects related to archives, archeology, philology, geography, ethnicity, art, daily life, animals and plants, and hope to better integrate digital content with different characteristics, to develop them into fun and inspiring digital materials, and to provide them free of charge to the public for education and research; this will also help firms and public or private holding institutions to find cooperation opportunities in value-added applications. Collaboration between the "Taiwan Digital Archives Expansion Project" and other projects under the "Taiwan e-Learning and Digital Archives Program" will help speed up development of educational, research and commercial value-added applications of digital content, which will benefit the presentation of Taiwan's cultural and natural diversity, and allow people everywhere around to understand and appreciate the richness of our history and culture, as well as the beauty of our natural ecology.

While collecting and developing value-added applications of digital content, whether it may be during the "Content Development Division" or "Taiwan Digital Archives Expansion Project" period, members of this project have continuously followed up on digital workflow related technologies used by public and private institutions and open request-for-proposals projects, and compiled a series of "Digitization Procedures Guideline Books" that introduce



various international standards and provide information on digitization technologies and workflows. Since 2005, we have written 21 digitization procedures guidelines on different themes (the full text of all of the 21 books can be downloaded from the "Taiwan Digital Archives Expansion Project" website under "Virtual Library: Digitization Books"), selecting exquisite digital objects, such as ceramics, paintings, calligraphy, and string-bound books, combining the experiences of different institutional projects, and supporting them with domestic and foreign theories and practice results.

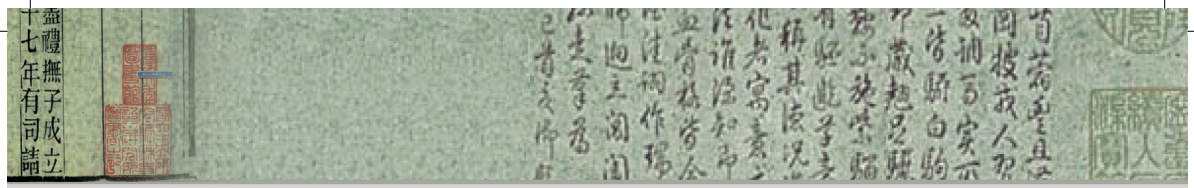
Since 2008, we have continuously revised and expanded our "Digitization Procedures Guideline" book series, hoping to expand distribution channels so that they may be provided to even more museums, libraries, institutions and individuals for reference. Our preparations are mainly divided into revising existing guidelines for "selected objects" and compiling new guidelines on "common principles". The former refers to revising the existing 21 guidelines with a focus on introducing new digitization technologies and specifications, more practical software and hardware, and digital content protection mechanisms; we expect to revise seven books per year and complete all 21 books within three years. As for compiling guidelines on "common principles," our emphasis will be on the introduction of key concepts, such as the "life cycle" of digital information and quality control, studying multiple types of objects instead of a single type of object, and adopting common principles as the guideline framework. The so called common principles refer to project planning, integrated workflow, audiovisual data, text data, color management, outsourcing management, and digital content protection and authorization. These eight common principles are topics of which we will investigate, study and write guidelines for; we expect to publish eight guidelines in three years.

Guidelines for selected objects and guidelines on common principles in fact complement each another. Guidelines on common principles emphasize on the analysis of important topics in digitization work, guiding readers to thoroughly consider the advantages and disadvantages of digitization. Guidelines on selected objects describe practices and techniques for digitizing specific objects, helping readers to select the most suitable, most effective digitization workflow. By publishing this "Digitization Procedures Guideline" book series, we believe that we are providing institutions and individuals with the intention to engage in digitization work with a series of practical guidelines that provide an overall view, while guiding them step by step through the digital workflow. Here we must stress that the theoretical foundation of this book series is the precious experiences

of institutional and request-for-proposal project teams accumulated throughout the years. These experiences allow higher quality digital content to be produced, presented and maintained with less cost, further enriching our digital archives and e-learning content. As we continue to publish our "Digitization Procedures Guideline" book series, we must give special thanks to working partners who were interviewed and colleagues who were a part of writing the guidelines, and are grateful to the scholars and specialists that reviewed and provided their advice on the book series. Finally, we hope that readers will not be reluctant to correct any mistakes or make recommendations that will help us be even better.

Taiwan e-Learning and Digital Archives Program
Taiwan Digital Archives Expansion Project ·
Digital Archives Sub-project of Project Integration

Project Director
February 10th, 2010



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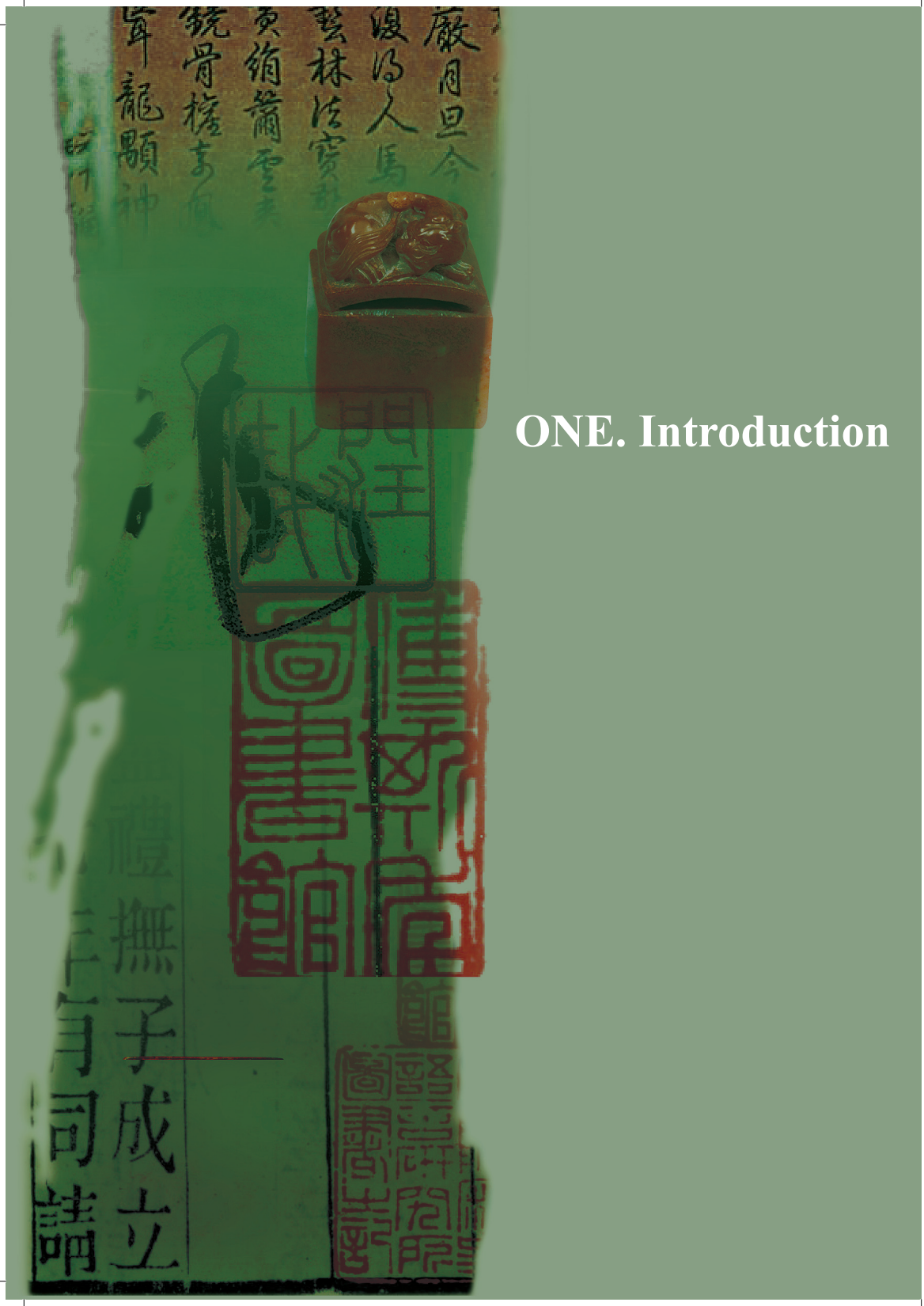


ONE. Introduction

I. Applicable Subjects

Digitization projects are a complicated process, involving not only the specialized field of digitization technology, but also budget planning, quality control, implementation, and metadata establishment, each of which has numerous details and principles. This book combines the experiences of institutions that have taken part in the seal or imprint digitization work, collects digitization workflows of various projects, and supports the workflows with theories and supplementary explanations. We expect users of this book to include public and private holding institutions of various scales, allowing those already engaged in digitization work to further understand principles and specifications of digitization procedures, and use this knowledge as a basis for adjusting their digital workflow; for those that intend to implement digitization projects, this book will help them plan suitable digitization projects; and for those who are interested in digitization work, this book will rapidly help them become familiar with digitization procedures and planning digital workflows. Although technology advances with every passing day and the circumstances change along these advancements, we believe that by providing past experiences in the field of digitization, we are building a foundation that will benefit future digitization workflows, even if it is only to a slightest extent.

II. Digitization Objects

Mysterious legends on seal usage have appeared along with the ancient saints, and records of a seals being used appeared as early as the "Chunqiu・Yundou shu." The popular use of seals is generally believed to have started during the Spring-Autumn and War Period. Before the Qin Dynasty, official and personal seals were all called "Xi (璽)." After Qin conquered the six nations, only the emperor's seal was referred to as "Xi (璽)," the seals of imperial officials and civilians were referred to as "Yin (印)." Seals in the Qin and Han Dynasty were mainly used for sealing orders or on wooden slips, making impressions or embossments in wax that sealed the envelopes that were used to authenticate that letters were not tampered with. The book "Shuowen jiezi (Explaining Simple and Analyzing Compound Characters)" by Hsu Shen stated that "Seals are tokens held by the administration." Seals have served multiple functions in China's history, and in early production strict rules were applied to the material, decoration, and size. Besides being used for authenticating letters, seals indicated identity, even symbolized a dynasty; seals are the product of growing social and national complexity.

From an artistic perspective, seals are a combination of calligraphy and carving techniques. A seal comprises of the bottom cutting, side-engraving, and head. The bottom cutting is the presentation of carving techniques, seal scripts and composition, each stroke has to be elaborately arranged, opposite corners must correspond with each

other, and the composition emphasizes on the conflict and balance between Yin and Yang, delicately creating a sense of incomparable fluency in a very limited space.

The rich variety of materials used to make seals also indicates the diverse appearances of seals. Official seals were generally made with copper; seals made with jade were the most precious, followed by gold and then silver, some seals were even made from pottery. Personal seals were mainly made of jade, ivory and animal bones. During the late Yuan Dynasty, after Wang Mien used flower stamen stone to make seals, it developed into a trend for ancient scholars to make seals, scholars and painters began carving seals in the Ming Dynasty, and the original three arts: poetry, painting and calligraphy, that scholars strived for excellence in, developed into four arts with the addition of seals. The art of seals is a large branch of knowledge that comprises the composition of the bottom cutting and material selection, not only do seals require superb craftsmanship, but also a design of unique originality.

Fig.1-1 Seal (Ancient beast)

Fig.1-2 Seal (長養我心)

Fig.1-3 Imprint (聖峰庵主人)

Image authorization: Fig.1-1 and 1-2 are authorized by Ms. Weng Yu-Chuan, Fig.1-3 is authorized by Mr. Katorijunya

III. Contents of Digitization Work

Among the participants of TELDAP, the National Palace Museum and National Museum of History have collections of both seals and imprints, the Academia Sinica Institute of History and Philology Fu Ssu Nien Library has extracted digital images of imprints in ancient string-bound books, and the Academia Sinica Institute of Taiwan History – "Taiwan Archives Online" and "Taiwan Calligraphy Artist Role Model Chen Ting-Chi Digital Museum" have implemented digitization of ancient books, paintings and calligraphy; imprint related data are mainly described with metadata.

Due to different object properties and purposes, different institutions have somewhat different digital workflows. Therefore, this book hopes to combine the experiences of different institutions, and provide readers with a complete workflow to help them through digitization procedures and management. This workflow is designed specifically for seals and imprints, and comprises digitization work planning, digitization methods, metadata design, and equipment procurement.

Seals are relatively small solid objects, therefore two-dimensional (2D) digital photography or 3D object VR imaging is adopted as the digitization method. This book mainly introduces digitization procedures for static images, and does not include discussions on video recording and related equipment. Different digitization equipment is selected for different types of imprint collections, but cameras and scanners are the main options; imprints on implements are not discussed here. In addition, this book discusses the image post processing, quality examination, storage, and digital content protection that come after object digitization, whether its digital photography or scanning, the focus is always on processing digital files that are output. Some institutions have printing considerations and output proofs after completing digital images, but this involves more details on proofing procedures and budget planning, and is therefore not discussed in this book.

TWO.
Digitization Flowchart

I. Digitization Workflow Planning

The execution of digitization work should be well organized, systematic, and have specific procedures. How will digitization be carried out? Which tools, methods and techniques will be used? These matters should all be discussed prior to project execution; such preparations build the foundation of the digitization workflow. One of the most effective ways to aid project completion is to construct an execution flowchart, dividing tasks according to their purposes, and using the flowchart as an indicator for testing whether or not execution is reasonable.

The digitization flowchart is a blueprint of project execution, each level in the project framework takes a step towards achieving the project' s ultimate goal, and helps define the scope of work, procedures and timetable. The digitization flowchart transforms a complicated project into simple steps that if completed one by one completes the entire project. By establishing Standard Operating Procedures (SOP) operators will better understand the specifications and methods used in the digitization workflow, allowing them to be more in control of project execution, achieve stable quality, and complete the project according to schedule. However, SOP is a general framework and execution direction, details still need to be revised as the project progresses, so pay special attention to improving specifications and methods for project execution to be under the most suitable conditions.

II. Digitization Flowchart

A number of digitization projects related to artifacts, paintings, calligraphy and ancient string-bound books have contents related to seals and imprints. Therefore, we have gathered these experiences with seals and imprint to create a digitization flowchart specific to seals and imprints (as shown in Fig.2-1). This digitization flowchart is a general direction and execution framework, different colors in the chart represent different work content; at the top of the flowchart represents major work items; represents detailed tasks; represents an inspection of whether or not results are correct; indicates document output; represents file storage; represents database operations. Preliminary procedures of digitization work include a thorough examination of data, organizing lists, verifying digital objects, and evaluation and analysis of metadata requirements; these are basic tasks that also benefit future human resource planning. Besides scanning or photographing actual objects and converting digital images, data cataloging and system development and establishment are also a part of digitization work; these involve complicated procedures that are all linked together, connections between different procedures must be verified to ensure the quality of digital images. Data preservation is a part of the digitization workflow that requires long-term strategies, including digital file storage, duplication, and remote

backup mechanisms. Value-added applications give digital content more space for development, and are a strategy for achieving sustainable operation. Further details of project execution and planning will be described in the following chapters.

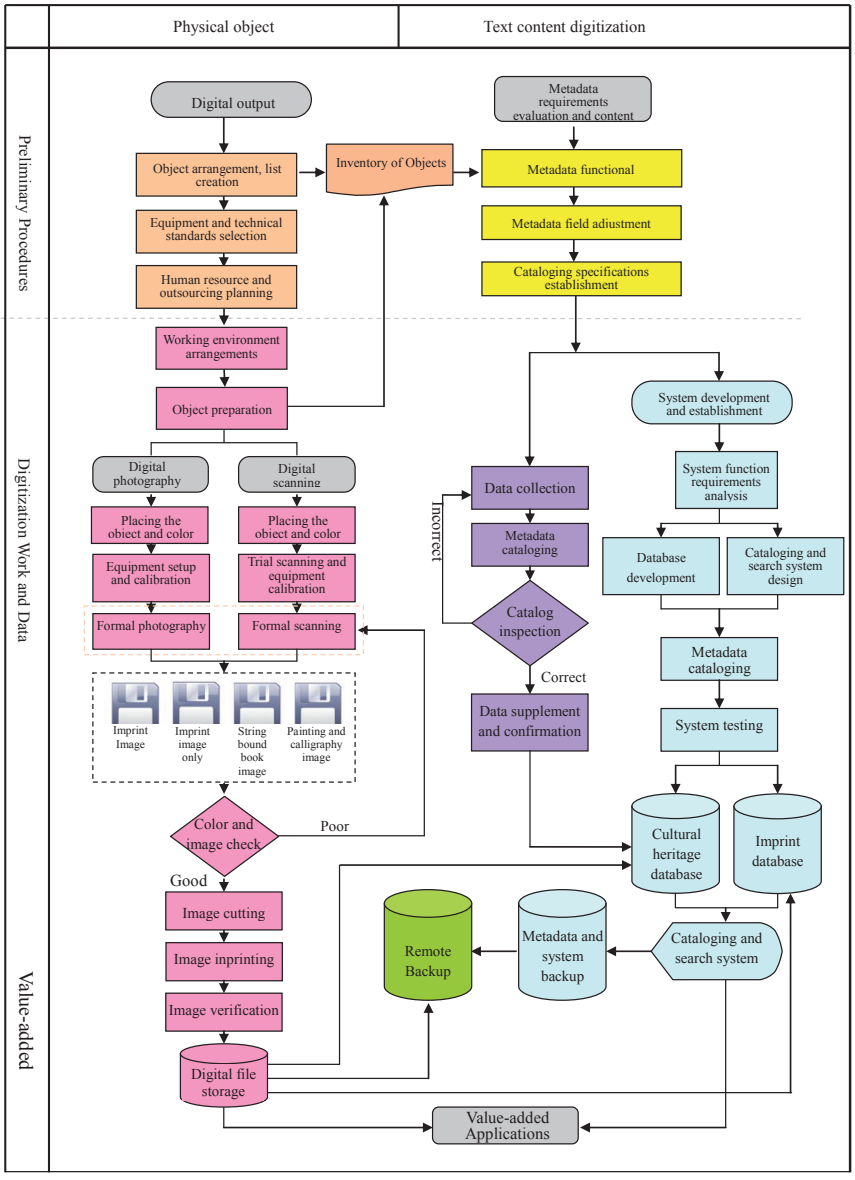
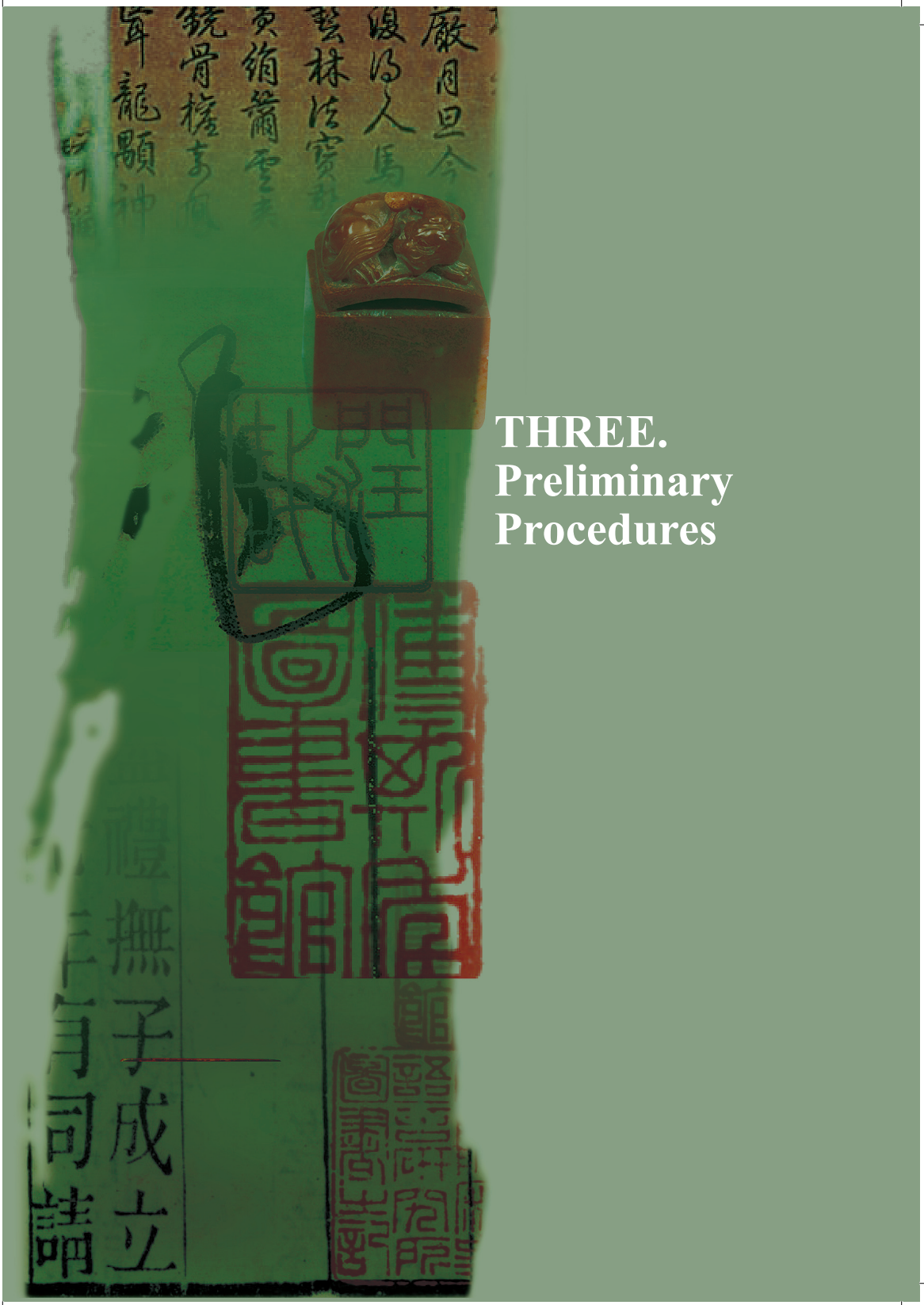


Fig.2-1 Seal and Imprint Digitization Flowchart



THREE.
Preliminary Procedures

I. Object Arrangement, List Compilation

Priority of objects for digitization can be based on criteria, such as historical value, significance, and rareness. Therefore, when making an inventory of seals and imprints, be sure to understand the object' s value, origin, text contents, scripts used for poem-engravings, and theme, and then arrange them accordingly. Seals and imprints often involve seal materials, poetry, and textual research. Therefore, object selection and verification of related data is usually handled by researchers and the project director.

1. Collection Work

All objects must first be examined and collected so that nothing is missing. Unless under limited funds, for which objects with higher value should be given priority, digitize all selected seals in the collection. Imprints could be distributed in different paintings, calligraphy or ancient books, so compare seal data of different collections and make an inventory of imprints to digitize.

2. Cataloging

"Cataloging is the most important branch of all knowledge, and the only way to access other branches of knowledge," said Ming-Sheng Wang, a scholar of Chinese Classics living during the Ching Dynasty. We live in a rapidly changing era, in which user requirements on catalogs and search functions are continuously changing. Therefore, compiling a complete catalog of objects is the foundation of object development and utilization. Elaborate metadata and database design can be used to achieve an integrated cross search function. To benefit studies on specific objects, compile thematic catalogs using object catalogs, joint catalogs, and according to research requirements.

II. Equipment Selection, Standards Establishment

1. Equipment Selection

Main considerations when selecting digitization equipment include properties and the condition of objects to be digitized, and digitization operations. Digital photography is adopted for digitizing seals because they are relatively small solid objects. Imprints are categorized as flat plane objects and can be divided into those on paintings and calligraphy and those on ancient books; most paintings and calligraphy are larger than the platforms of scanning equipment and are mounted, so digital photography is adopted as the digitization method; ancient books are considered to be small flat plane objects, so digital scanning is used. However, considering that the scanning process requires contact with the object itself, if the book is in poor condition (including bindings that are too tight) and you have doubts of damaging it, then use digital photography as a safety measure. Best digitization results can only be obtained via equipment selection that gives consideration to characteristics of different objects (Table 3-1).

Holding institutions should determine equipment arrangements based on the quantity of objects. For example, large holding institutions have relatively more collections with widely varying object sizes, while most institutions have both photography and scanning equipment, if cost is a consideration and only one type of equipment can be used for digitizing objects of different sizes, then digital photography is recommended because it has a wider range and lens can be changed for different purposes. (Detailed descriptions of digitization related equipment will be provided in chapter four.)

Table 3-1 Equipment selection based on object properties (for reference only)

Operation characteristics	Small surfaces	Large surfaces	Small solid objects	Object records
Content	Documents, books, imprints	Paintings, scrolls, and large ink rubbings	Different types of seals	Seal production techniques and process
Operation method	Scanning or photographic reproduction	Photography	Photography	Photography or video recording
Equipment	Scanner, copy stand, lighting system, photography system, personal computer and software	Copy stand, lighting system, photography system, personal computer and software	Camera platform, lighting system, photography system, personal computer and software	Photography、video recording system, personal computer and software
Notes		Requires high-end photography to prevent distortion and satisfy resolution requirements	An additional rotating disc or arm is required for producing a 3D VR image	Allocated according to actual requirements

Taiwan Digital Archives Expansion Project, "Content development open request-for-proposal projects digitization operations (for reference only)", 2006

2. Digitization procedures specification establishment and selection

(1) Digitization Purpose:

Object digitization hopes to achieve object preservation in a different form via technology, reducing damage caused by regular withdrawals to original objects,

at the same time spreading the beauty of and knowledge intrinsic to objects via other presentation methods and applications, such as websites and publications. The two most important purposes of digitization are preservation and sharing; for preservation purpose, digitization specifications must be of the highest quality that can be provided by digitization equipment, this way the number of withdrawals can be reduced. Different file formats are used for different purposes, which is why specifications should give consideration to whether the purpose is permanent preservation or online browsing (Table 3-2).

i. Permanent preservation

Permanent preservation can only be achieved if digital images are maintained in the best condition in terms of file format, color mode, and resolution. Long-term preservation technologies include migration, emulation, system preservation (outdated necessary software and hardware), standards application, encapsulation (including metadata), and printing onto paper sheets or other mediums that can be browsed; in which "migration," "emulation," and "system preservation" are the three core preservation technologies; "encapsulation" is a basic procedure of the three core preservation technologies, putting digital information and metadata in packages that can be interpreted, emulated or migrated, and provided to users.[1]

ii. Online browsing

The resolution of a typical computer monitor is 72dpi. Images displayed on a computer monitor are measured in pixels/inch and represented in the form of width × height, e.g. 640×480 and 1024×768. Recommendations are based on possible image resolutions in the future.

(2) Digitization format selection:

Table 3-2 Recommendations for file format establishment

Purpose	Analysis	Resolution
Permanent preservation, publication printing	If the holding institution plans to publish or reproduce digital content, then the quality of digital images should have stricter requirements.	The purpose of TELDAP is permanent preservation and promotion of applications. Therefore, higher resolution is required; the standard is "TIFF files with resolution of 300dpi and above".
Online browsing	When establishing the digitization format, besides the clarity of digital images, the data transfer speed of internet is also a major consideration.	The purpose of online browsing is convenient transfer and popular utilization, rapidly providing large amounts of clear image files for users under limited funds. Therefore, the resolution of image is set between 72dpi and 180dpi.

[1] National Archives Administration, "Electronic Records Long-term Preservation Strategies," Search date: January 2010, http://wiki.archives.gov.tw/index.php?option=com_content&view=article&id=169&Itemid=101

Purpose	Analysis	Resolution
	the data transfer speed of internet is also a major consideration.	amounts of clear image files for users under limited funds. Therefore, the resolution of image is set between 72dpi and 180dpi.

File format selection should be based on the form of the collection and the platform it will be presented on (Table 3-3), different choices should be made for files for permanent preservation, commercial purposes or general browsing.

Typical digital images have different specifications that best suit different

Table 3-3 File formats of the National Digital Archives Program

	Permanent Preservation Level	Commercial Applications Level	Public Access Level
Description	Retain the original file for permanent preservation.	Provided to users for reproduction, compression, or other image processing and exchange purposes.	Online browse
File format	RAW or TIFF	TIFF	JPEG
Color mode	RGB (24 bit/pixel) or above	RGB (24 bit/pixel)	RGB (24 bit/pixel)
Resolution and size	Original size, 300dpi or higher	Original size, 300dpi	Based on website requirements, 72 dpi

purposes, recommended considerations include file format, color mode, color depth, resolution and image size.

i. File format

Numerous image files formats have been developed for different hardware and software (Table 3-4). JPEG is the most common file format that is capable of processing continuous colors, and is suitable for images that require smooth edges, such as photos. Although JPEG can process continuous colors and is easy to transfer and convert, but image details are somewhat distorted due to its lossy compression method. A new development of the JPEG file format is JPEG2000, compared with JPEG, an apparent advantage of JPEG2000 is its wavelet compression method, which achieves at least 20% better compression performance without image distortion. GIF is a type of LZW compression format that only supports RGB; its main purpose is to minimize file size for webpage display, but can be adjusted based on transfer speed. PNG combines the strengths of JPEG and GIF, has smoother edges, supports transparent images, and has better anti-aliasing performance than

GIF, but its downside is that PNG files can not be normally displayed on some browsers. TIFF is the most flexible bitmap image format, the "mother file" of all file images, and has the highest image quality; TIFF files can be converted into other file formats depending on its usage. TIFF files are not compressed and not distorted, and is therefore the best option for both permanent preservation and conversion into other file formats.

Most digital cameras currently in the market can store images as RAW files. This file format is an uncompressed image that was not processed by the camera, and records the complete situation of a photograph. The colors, levels, white balance, highlights and shadows of RAW files can easily be adjusted, making it a good storage format for permanent preservation and various applications.[2] Although RAW files can only be opened with specialized software, it holds an unprocessed image that takes less storage space than TIFF files, institutions engaged in digitization work have thus gradually adopted it as a file format for permanent preservation.

ii. Color mode

Table 3-4 Characteristics of various file formats

File format	RAW	TIFF	EPS	JPEG	GIF	BMP	PICT	PSD	PNG
Supports RGB full color	●	●	●	●		●	●	●	●
Supports 256 colors	●	●	●		●	●	●	●	●
Supports CMYK	●	●	●	●				●	
Image compression		●	●	●	●		●		●
Supports layers								●	
Supports masks			◎		●			●	●
Supports web page display				●	●				●
Suitable for general image storage		●		●				●	●
Suitable for long-term preservation		●							
Suitable for printing		●	●						
● Indicates the function is supported ◎ The new TIFF format supports masks									

Source: Digital Photography Technology, Hsu Ming-Ching, 2001

[2] Most RAW files can only be read by software developed by the camera's manufacturer. However, Adobe Photoshop and Lightroom currently support RAW files generated by most cameras (Reference: http://www.adobe.com/tw/products/ photoshop/cameraraw.html, search date: December 2009), and are without doubt very good tools for preserving digital files. Perhaps, they will support RAW files generated by all cameras within the foreseeable future, allowing the RAW file format to be fully utilized for permanent preservation.

The recommended color mode is RGB[3] because it contains more colors (color gamut) than the CMYK[4] color mode, and photographed images are always first observed on a monitor. A simple conversion can be carried out when digital images are used for other purposes, such as output.

iii. Color depth

Color depth affects the number of levels an image can display and file size. Color depth is related to the color mode chosen, in the RGB color mode R, G and B each has 8 bits (1 Byte), so the color depth of typical computer monitors is 24 bits , also known as 24 bits full color mode. Today, digital products in the market have light sensing devices that can sample 16 bits5 or higher for R, G and B, but this means that equipment with higher specifications are required to process such image files.

iv. Resolution[6] and image size

Resolution is a relative value, not an absolute value, and unless its background is defined, otherwise it would be meaningless. For example, the number of pixels per inch on a monitor is determined by the monitor size (17" , 20" , etc.) and resolution settings (800 x 600 pixels, 1024x768 pixels, etc.). The number of pixels in a photographed image is fixed, meaning that the output size is also determined by the output resolution (Table 3-5).

[3] RGB is the most commonly used color mode. RGB stands for the three primary colors Red, Green and Blue.

[4] CMYK refers to the four colors used in printing, C for Cyan, M for Magenta, Y for Yellow and K for Skeleton or Black.

[5] In a computer, colors are stored as binary digits; 1 bit ("bi" from binary and "t" from digit) can only have two values, 0 and 1; each color is represented with 8 bits, which can be used to represent 256 color levels (2 to the power of 8 is 256); since each color has 8 bits, RGB full color has 8 bits*3 = 24 bits, which can be used to represent 16,777,216 colors (2 to the power of 24); color models with 24 bits or more are referred to as true color because they have reached the extent of which the human eye can differentiate; in theory, the more bits that are used to represent colors, the more real colors will look. Reference: "Introduction to Imaging" by Howard Besser, translated by Lin Yen-Hung, TELDAP Taiwan Digital Archives Expansion Project, October 2009 First Edition.

[6] Digital images are basically maps of bits; resolution (spatial resolution) can be expressed in two forms, the first is pixels, which are recorded at the input end, and represented in the form Pixel Per Inch, or ppi; the other is dots, which are components of images at the output end, and represented in the form Dot Per Inch, or dpi.

Table 3-5 Pixels and Output Size[7]

Image resolution	Camera pixels	Output size when printing with 200ppi (pixels/inch)	Output size when printing with 300dpi (pixels/inch)
640×480	300 K-pixels	Inch: 3.2×2.4 Cm: 8.13×6.1	Inch: 2.1×1.6 Cm: 5.3×4.06
2048×1536	3.2 Megapixels	Inch: 10.2×7.7 Cm: 25.91×19.56	Inch: 6.8×5.1 Cm: 17.27×12.95
2592×1944	5 Megapixels	Inch: 13.0×9.7 Cm: 33.02×24.64	Inch: 8.6×6.5 Cm: 21.84×16.51
3264×2448	8 Megapixels	Inch: 16.3×12.2 Cm: 41.4×30.99	Inch: 10.9×8.2 Cm: 27.69×20.83
4256×2848	1.21 Megapixels	Inch: 21.3×14.2 Cm: 54.1×36.07	Inch: 14.2×9.5 Cm: 36.07×24.13

III. Human Resource Planning, Outsourcing Management

1. Analysis and evaluation of the overall environment and status quo

Evaluations before project execution are foundation stones of project completion; evaluations can be directed in three directions: "objects," "human resources," and "resources," analyzing the potential way of digitization of objects, understanding human resources that can be utilized for project execution, and understanding resources that can be applied for.

(1) Original objects:

Evaluate whether if the object can be digitized and what digitization method will be adopted. For example, digitization of seals should be carried out with digital photography, and considering the form and condition of imprints, either digital photography or scanning can be used for digitization.

(2) Human resources:

Analysis of human resources in the digitization process can include whether or not personnel have related work experience, and competencies of collection maintenance and management personnel and information technicians; this is to avoid spending more cost on personnel training during project execution. Suitable training can be provided and project quality can be ensured via human resource management mechanisms, and although different institutions have different personnel systems and human resources, human resource utilization arrangements can be made in the following two categories.

[7] Printing sizes are still based on inches; the centimeter dimensions provided in the table were calculated for easier understanding by domestic users and are for reference only.

i. Staff members:

Staff members who are researchers or assistants have an in-depth understanding of operations and objects, and a professional academic background. They greatly benefit the implementation of preliminary procedures and metadata planning, especially in the digitization workflow, in which their comprehensive understanding of objects allow them to present digital objects to the fullest.

ii. External personnel:

Primary considerations of external personnel are efficiency, quality and cost. For outsourcing, both parties should clearly state the objective and accountability to gain maximum benefits.

a. Technician: Mainly refers to personnel that specialize in digitization technology and information technology, e.g. professional photographers and database or web designers.

b. Cataloging personnel: Cataloging is an extremely time consuming task in database establishment. It can either be carried out by museum staff or external personnel with related academic backgrounds. To ensure the correctness of data, cataloging personnel must be able to verify and correct data as they key data into the system.

(3) Resources:

Resource analysis can make project execution more efficient. Analyzing current resources and learning of applicable cooperation resources can help the rapid planning of project execution procedures and scope, and avoid waste of time and human resources.

2. Outsourcing Management

Outsourcing is when an institution authorizes an external contractor to provide products or services originally provided by the institution. Whether or not outsourcing is implemented depends on the institution's operation guidelines, in which a key consideration is cost effectiveness. Digitization involves numerous procedures that require a professional background, institutions can consider outsourcing to reduce training and equipment cost. Since outsourcing involves budget allocation, it should be considered at the preliminary planning stage of projects. According to experiences of implementation units in TELDAP, motives of outsourcing can be generalized into the following:

(1) To focus on core values and allow human resource allocation to be more flexible.

(2) To reduce cost or maintain flexibility of resource allocation.

(3) To utilize technologies specific to certain contractors.

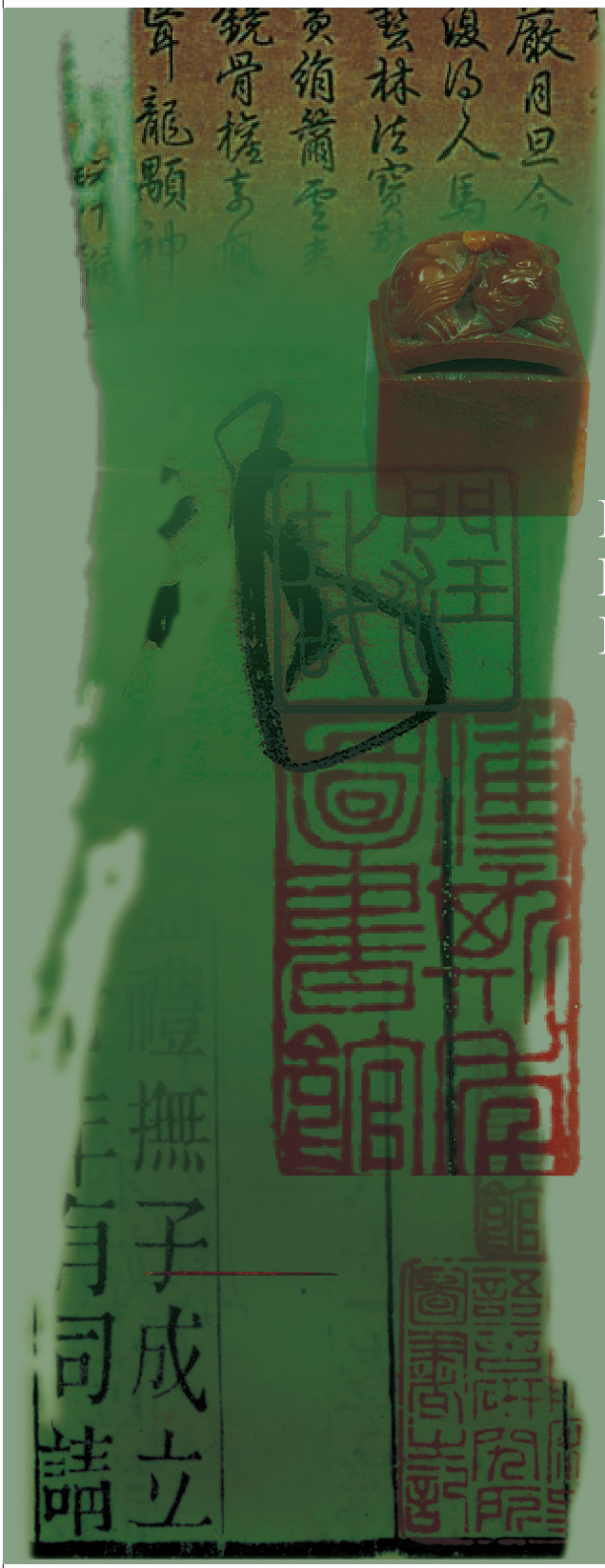
(4) To improve the quality of certain affairs.

Different degrees of outsourcing represent different cooperation models. After establishing outsourcing motives and core values, implementation institutions should consider which outsourcing model will help them gain maximum benefits, and whether or not the institution is capable of fully supporting the outsourcing policy. Evaluations can be directed in three directions: a. the institution's need for outsourcing; b. the scope of outsourcing; and c. the feasibility of outsourcing, finding a balance between outsourcing and self-production that will maximize benefits.

Finding a suitable contractor is a major issue in the digitization process. To save human resources and cost of purchasing equipment, most institutions may choose to outsource object scanning and photography, which even more shows the importance of finding a suitable contractor. In the outsourcing experience of the rare and ancient books thematic group, the specification lists three main items for contractor selection: proposal, briefing and Q&A, and software/hardware testing; the proposal lists workflow planning, goal achievement reliability, professional competencies of the work team, cost analysis, past achievements, total cost and prices of individual items, specific descriptions and answers regarding operation procedures, number of cases received within the past two years, total amount, and final reports. Software/hardware testing includes operating digital image scanning, testing and backing up software and hardware, and evaluating different digitization processes.

The Taiwan Digital Archives Expansion Project published a book that focuses on the topic "outsourcing management," providing detailed descriptions of matters related to specifications writing, selection methods, execution, and management. Please refer to the book if you have such requirements.

[8] "Digitization Procedures Guideline: Outsourcing Management" by Kao Chih-Tung, Chen Hsiu-Hua, Chen Mei-Chih and Lin Fang-Chih, TELDAP Taiwan Digital Archives Expansion Project, April 2009.



FOUR. Object Digitization Procedures

The selection of digitization procedures and formats is greatly influenced by characteristics of the object and operations. Seals are solid objects; therefore, either 2D photography or object VR is used as the digitization method. Imprints might be independent works, or they could be a part of paintings, calligraphy, ancient rare books, metal and stone rubbings, and documents; different digitization equipment may be selected for different types of imprint collections. If the digitization target is a painting, calligraphy, metal or stone rubbing, or document larger than A0 (1189*841mm) size, scanners are no longer suitable for digitization, so digital photography is adopted. Most institutions will choose digital photography for books that are in poor condition or too large. In addition, scanning books that are too thick might result in shadows or distorted text near the middle of the book[9], so pages are photographed individually. After objects are digitized, whether it may be by camera or scanner, subsequent procedures, such as image post processing, quality examination, storage, and digital content protection, are all related to the digital image; these procedures will further discussed in the second half of this chapter.

I. Digital Photography

1. Photography studio arrangements and selection

A suitable working environment is a prerequisite to photographing both flat and solid objects. Studio arrangements aim to eliminate any factors that might affect image quality and facilitate the digitization process. Therefore, take notice of the following principles:

(1) Photography studio arrangements: The optimum wall color is Kodak 18% gray, followed by white or black. The main consideration of wall color selection is to avoid affecting color management; lights used for photographing objects will reflect of the wall and ground, and indirectly affect image quality.

(2) Photography studio location: The location is best away from vibration sources, such as the street, railways, MRT, crowds, and elevators, because they could result in blurry images. Furthermore, the photography studio should be as close to the collection as possible to reduce potential damage caused to objects during transportation, and to reduce transportation time and cost.

(3) Light control: To prevent stray light from affecting image quality, windows and doors of the photography studio must have blinds that can control external light, or specially designed opaque windows; this allows more accurate images to found by the camera’ s viewfinder.

(4) Spatial planning of the photography studio: Minimum equipment requirements include a camera stand, lights, light stand, photography platform, computer, and space for personnel to move around. Larger space allows easier arrangement of

[9] Google Book Search currently has an advantage in scanning that is unparalleled by any other, its ability to correct curved pages when scanning books is a patented technology; infrared scanning is used together with 3D photography to create a 3D surface, and then the image is processed and flattened. Search date: January 2010, http://www.zdnet.com.tw/news/web/0,2000085679,20138014,00.htm.

equipment. When deciding the size of the photography studio, keep in mind the largest object that can be photographed in such arrangements, not only make it easy for personnel to enter and exit, but also prevent objects from being damaged.

(5) Photography platform set up: Besides considering the size of the object being photographed, the background paper also greatly affects image quality, and should be as close to the studio's wall color as possible, which is preferably gray, white and black. However, be careful if the object's color is too close to the background paper. In addition, consider using a photo box if objects are relatively small and require little photography space.

2. Equipment setup and calibration

(1) Monitor

In order for image colors to be correctly displayed on the monitor, the monitor has to complete color calibration before objects are photographed[10]. It is recommended to execute monitor color calibration at least thirty minutes after turning on the monitor to ensure stability. A light mask is also recommended to be added on the monitor to prevent light from entering through the sides, preventing image quality and clarity from being affected by external light sources, which will lower the accuracy of color calibration. Besides using testing purpose color patches of graphics software for monitor color calibration, ColorSync and Adobe Gamma are also options, but these methods rely on the naked eye for initial calibration of color temperature, brightness and contrast, and will vary along with different users. The most accurate color calibration method is to use a color calibrator. Details on hardware calibration methods are provided in "Digitization Procedures Guideline: Color Management"[11] published by the Taiwan Digital Archives Expansion Project; no further details will be discussed in this section.

(2) Camera

Set up the camera on the pan head of the tripod, besides using a level to measure whether or not the camera is level, make sure the camera is parallel with the object to ensure the object is completely in the image. A light mask can be added to the lens to prevent light spots on the image caused by reflection of lights, and also increase the image's saturation.

(3) Color chart placement and light measurement

Lighting equipment may vary with different models, so warm up lights at least thirty minutes to bring their color temperature close to natural light (5000K), or use

[10] For more details on the monitor calibration process, please refer to P77-86 of the "Paintings and Calligraphy Digitization Procedures Guideline" by Chen Hsiu-Hua and Kao Lang-Hsuan, TELDAP Taiwan Digital Archives Expansion Project, April 2009.

[11] "Digitization Procedures Guideline: Color Management" by Li Pei-Ying, Wang Ya-Ping, Kao Lang-Hsuan, Taiwan Digital Archives Expansion Project, April 2009.

a color meter to measure whether or not light color is stable. When photographing objects, no matter what type of light source is used, continuous or flash, use at least two lights and adjust the object' s position to minimize shadows. Furthermore, a soft light mask (shadow mask) can suitably control contrast, preventing too many shadows from being produced by lights that are too bright. Also, place a color chart next to the object for adjusting the camera' s aperture value; Color Separation Guide (Fig.4-1) is usually used for books and paintings, while ColorChecker (Fig.4-2) is used for solid objects. Personnel should be at a distance when measuring light to avoid affecting the readings.

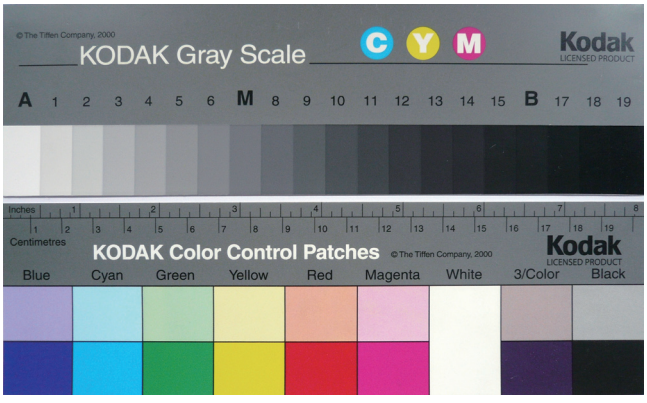


Fig.4-1 Color Separation Guide

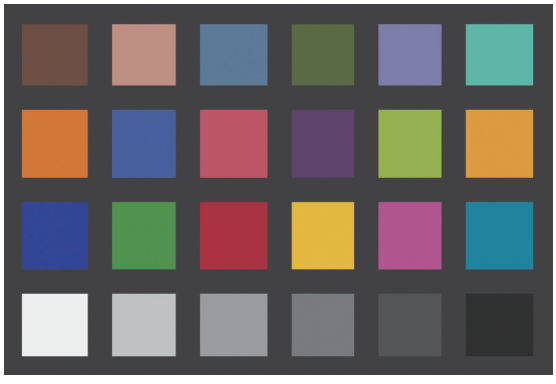


Fig.4-2 Gretag Macbeth Mini ColorChecker

3. Borrowing and positioning objects

(1) Borrowing objects

The preservation departments of different institutions have different regulations for loaning object, so staff members are usually asked to fill in the loan form. Fig.4-3 shows a loan form of the National Museum of History; loan forms are used as proof of incoming and outgoing objects, and help collection departments manage the collection.

「國家歷史文物數位典藏計畫」文物數位拍攝提借清單

日　期：_____年_____月_____日

登錄總號	品名	數量	單位	文物提借異動狀況	文物歸還異動狀況	提借日期時間	歸還日期時間	備註

（提借）承辦人：　　展覽組經管人：　　典藏組經管人：

（歸還）承辦人：　　展覽組經管人：　　典藏組經管人：

Fig.4-3 Loan form of the National Museum of History

For the protection of objects, abide by the following rules when moving objects to the photography area:

i. When holding objects, be careful of its balance; use the palm of your hand to prevent objects from falling and being damaged.

ii. Move objects as a complete set. For example, any paper pieces, wooden clips affiliated to an object should be moved along with the object. This is to prevent pieces from becoming scattered or missing.

iii. Remove any bracelets, watches, rings, and necklaces, and wear clean gloves before touching objects; this is to prevent accessories and sweat from damaging objects.

(2) Repairing objects

Before photographing objects, examine the whole object to see if it is intact. Seals are made from materials with a certain degree of hardness, but ancient seals still might face repair issues; the principle of repair is to restore the seal to its original appearance, but also depends on the conservator. In addition, clean the object of any dust to avoid affecting image quality. If the bottom side has too many traces of red ink paste, the traces should also be cleaned. Before placing the seal in the photography area, use a brush, air bubble machine, vacuum to clean the background paper of dust. Do not let dust from the previous object affect the digital image of the next object.

(3) Positioning objects

Some seals have elaborate sculptures on its head-part. Placing the seal on its side when photographing the bottom can avoid damaging the head-part. Special clips can be used to position the object at a slant angle if there are considerations for the photography angle. However, be careful to avoid placing seals on weaker parts. If you are still worried that the seal is still not stable, acid-free paper clay can be attached to the back of the seal, but make sure that the clay is not photographed into the digital image.

4. Photographing objects

After photography preparations are completed, professional photographers will adjust the shutter and aperture to produce a suitable view depth, allowing a clear image to be correctly displayed. To prevent shaking the camera when taking pictures, the camera can be connected to a computer or shutter line to control picture taking. Furthermore, since most seals are small objects, the view depth will easily become too shallow if the aperture is too large, causing the back of the object to become blurry; wide-angle cameras also might result in distorted object images. Therefore, use the focal length of a middle throw zoom lens with F16 or larger aperture for objects to be clearly photographed. Seals are solid objects that sometimes have sculptures on the head-part or side-engravings, so when positioning seals take notice of its overall presentation, and make adjustments according to future application purposes. Imprints that are a part of paintings, calligraphy, or ancient books can be extracted after the entire painting, calligraphy, or ancient book is photographed; or, a macro lens can be used to directly photography only the imprint part to gain larger and better quality images. Digital photography is highly sensitive to light; hence, light source control is even more important when photographing objects. Light shone on objects must be measured (see figures 4-5 to 4-7 for light source positioning), and a soft light mask or polarizer must be used to prevent differences of light sources from becoming to obvious, e.g. seals are made from relatively smooth materials that might produce too many bright spots.

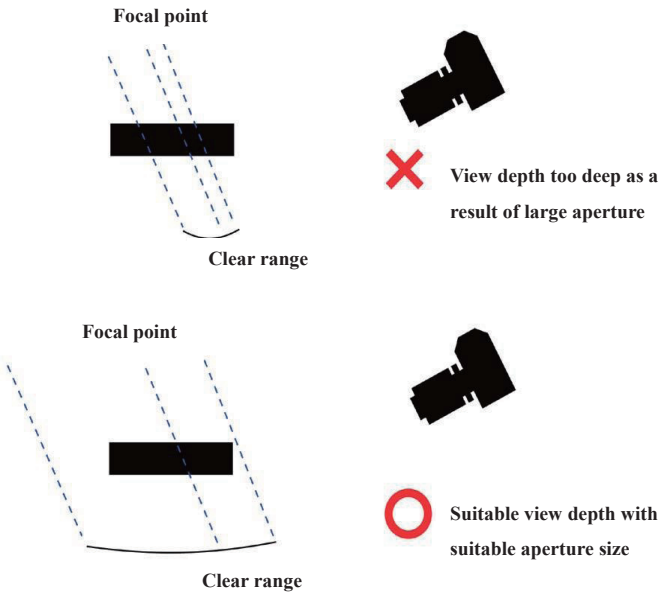


Fig.4-4 View depth issue caused by aperture size

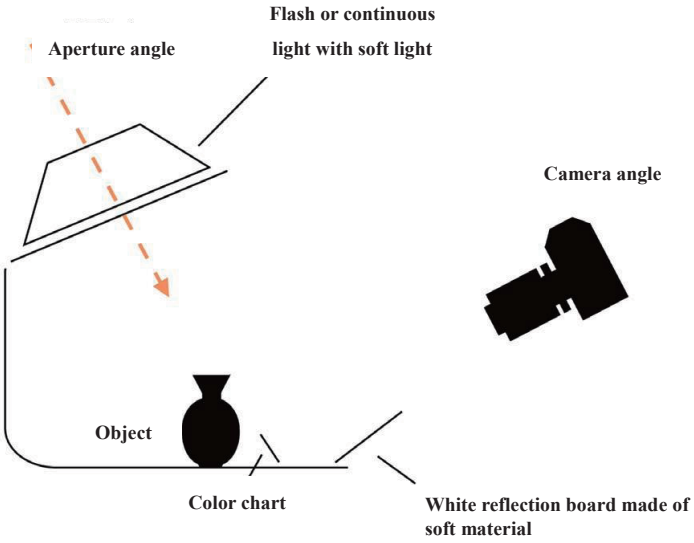


Fig.4-5 Arrangements for photographing solid objects

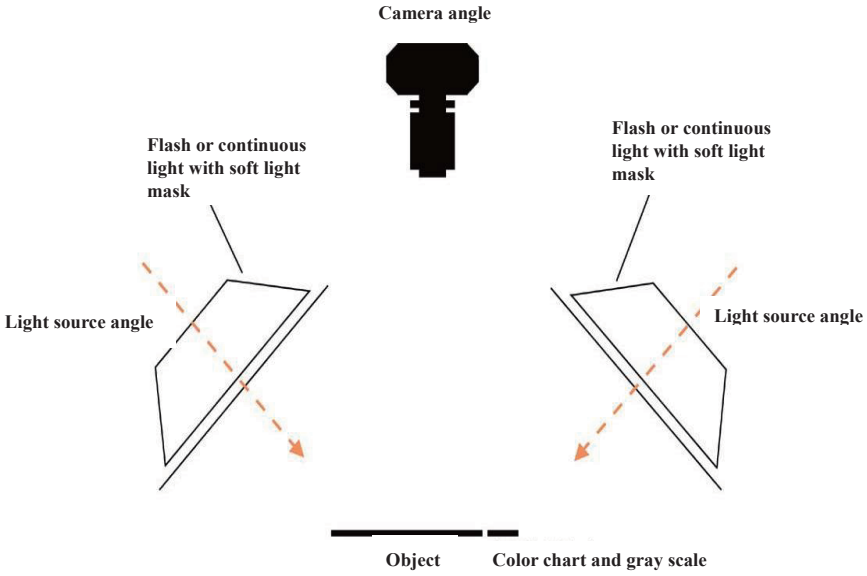


Fig.4-6 Position of light sources when photographing small flat plane objects

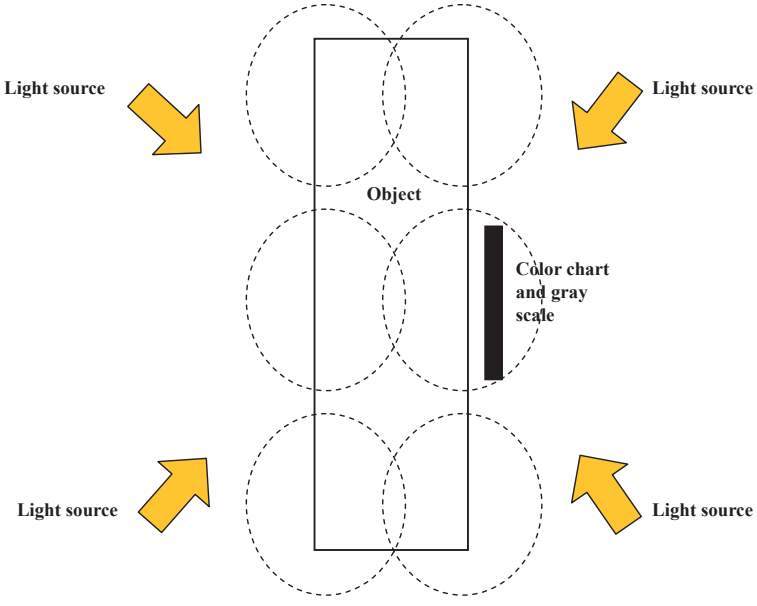


Fig.4-7 Position of light sources when photographing large flat plane objects

5. Object VR

Besides taking 2D photos for solid objects, 360 or 720 degrees object VR can be created. Depending on the size of the object, object VR can be divided into: small objects, fixed camera with the object rotating 360 degrees; for large objects that are hard to move, the camera is positioned at a fixed distance from the object and rotated 360 degrees from above, level and under. After taking pictures of every angle of the object, virtual reality software is used to create 3D effects. In the case of seals, merely taking a few 2D photos may not be enough to fully present the entire object, especially the sculpture on the head-part, but this problem is resolved of 3D imaging is utilized.

Using the National Palace Museum's experience with creating 3D images as an example[12], equipment includes a control unit (controls the object rotating device and the vertical rotating arm that holds the camera), an object rotating device (360 degree horizontal rotation), a vertical and horizontal rotating arm that holds the camera (the control unit controls the vertical rotating arm, which drives the horizontal rotating arm), a camera (for photographing object images), a camera pan head (connects the camera with the horizontal rotating arm, and fixes or adjusts the camera's angle), a personal computer, and image control and synthesis software. During the digitization process, an image control software is used to take pictures after rotating a fixed angle (10 to 15 degrees) vertically and horizontally, lighting is adjusted accordingly to maintain consistency of images, and finally image processing software is used to stitch the photos together, creating a 3D image for users to rotate and view at different angles by moving their mouse.

II. Digital Scanning

1. Trial scanning for calibration

Trial scans before formally scanning objects help calibrate colors and produce more accurate images, they also help reduce human errors in the digitization process. It is recommended to print the trial scanned image after completing calibrations in full color, and for both scanning and verification personnel to sign the printed image; the printed image can be kept for future comparison, trial scan results can be recorded as used as a basis for formal scanning work.

Every day before formal scanning, execute the scanner and monitor color calibration program to examine lights and scanning results. Scan objects along with a standard color chart and scale, which are used for color calibration and determining the original size of the object; clip paper to the surroundings of the scanning panel to make the panel clearer and cleaner. When necessary, preview the image to avoid color difference in the image. Depending on the original object, formal digital scanning can be divided into two

[12] National Palace Museum, "3D Imaging Process for Artifacts," "Digital Archives Technology Collection 2007." Search date: December 2009. http://www2.ndap.org.tw/eBook08/showContent. php?PK=214.

methods; generally, if book bindings are not taken apart for scanning, then the top panel is usually left open to avoid damaging the book; if the bindings are taken apart, then the top panel should be closed to gain better results. If the original copy is blurry, lines are too thin, characters are too small, or the institution has other requirements, scanning resolution can be increased to 600dpi to avoid missing any details, but the principle is still to reach a balance between object sizes and file settings.

2. Image examination

Basically the first image examination is completed at the scanning location, and the second examination is completed by responsible staff. Images are usually checked for distortion, slant, dark sides, blurry areas, and inappropriate cutting; any problems found with the image are noted in the list of examination items, and a third examination is carried out on images that require correction; however, all digital procedures give priority to the preservation of the original object.

After generating an image, check the image to see if the exposure is correct and whether or not there is noise, then examine if the image has spots or shows signs of color shift. If the image displays wrong colors or has noise, recalibrate lighting and other equipment and rescan the object, or in Adobe Photoshop select "Tools" → "Image" → "Adjustments" → "Levels," and then select black, gray and white color patches under "set darkest point," "set gray point" and "set brightest point" to remove color shift. If the image is correct, then use image editing software, such as Photoshop, to cut off excess parts.

3. Image extraction

After digital image files are created, if information on imprints were not recorded at the same time, then finding specific imprints would be extremely time consuming, considering that they are located on different areas of ancient books, printings and calligraphy. The conventional way of finding imprint images is for personnel to search through images in the database one by one. This requires them to view every single image to know the exact location of imprints. Even if the number of imprints is recorded when creating digital images, post processing still requires numerous procedures. In the case of the Fu Ssu Nien Library, the library uses an Excel form to keep a record of imprints that it will create individual images for; the record was created when the library established its imprint database. However, imprints are personal objects, and it is hard to guess exactly which page on a book an imprint will appear. In the case of the Fu Ssu Nien Library, after accumulating a certain amount of information, the library observed that early people tended to leave their imprints on specific pages; if you look at the Fu Ssu Nien Library's list of imprints, you will see that there is a column for the page that the imprint is on.

Finding digital images with imprints in them is a relatively time consuming and tiring task using the conventional method. Among current information technologies, there is

a new image content search and extraction technology that compared characteristics of homogenous regions. It uses function calculations to directly find similar image characteristics and efficiently extract data, using data mining technologies to provide more human and intelligent image extraction.

III. Image Post Processing

1. Image repair, Chinese red complement

Image repair (in painting) is unlike repairing mountings or objects, and refers to the repair of the imprint image in ancient books, paintings and calligraphy. Image repair comprises of the following three procedures:

(1) Image extraction

The ancients were quite particular about seal usage; seal size was often matched with painting or calligraphy size. The size of paintings and calligraphy are normally several times the size of imprints, so make sure the image being used for extracting the imprint was originally intended for permanent preservation, because this way its image resolution would be high enough to produce clear imprint images. Besides resolution, considering that imprints may be found in a variety objects, such as paintings and calligraphy, metal and stone rubbings, documents, and ancient books, institutions should also pay special attention to the fast and accurate extraction of imprint images. In addition, imprints might not all be squares, so images must be adjusted accordingly.

(2) Background removal

After selecting an imprint image file with the best quality, to prevent the background from being too complicated, which is the result of extracting imprints from larger objects, the background must be removed. Background removal is the most complex procedure in all imprint digitization procedures. Different artists have their own preferences for imprints, which not only affects preliminary image processing stages, but also makes background removal more complicated.

(3) Image inpainting (Chinese red)

Chinese red is the color of red ink paste used for seals. Red ink paste can be divided into water-based and oil-based, the former is made from organic dyestuff, water, honey and bolbostemma paniculatum, while the later is made from oil, plant fiber and cinnabar; the ink paste is evenly covered on the seal and then imprinted on to the book or painting. This action is executed after background removal and uses software functions to select areas on the image with the same color, painting Chinese red over the areas; if the new layer of Chinese red cannot follow lines of the original imprint, then it is better not to execute this procedure at all. The appendix is an example of using Adobe Photoshop for imprint image inpainting, please see the appendix for details.

After repairing an image, besides checking that the imprint image is intact, also verify that metadata is consistent with the image. If there are several images of the same imprint, choose one with the best quality. If the imprint on the original collection needs to be referenced, link the metadata to the original file to make data presentation more complete.

2. Object VR

Virtual reality (VR) refers to seamless panoramic images generated by software that combine images of an object taken from 360 degree or 720 degree angles; this is an option that can be considered for seals, which are solid objects, if they have elaborate head carvings. Besides the image file, the most important part of Object VR is the software. Such software currently can be downloaded from the internet for trials, some are able to correct color balance and camera angles, and support different file formats, such as JPEG, TIFF and RAW.

The purpose of object VR is to allow users to interact with precious artifacts that are normally impossible to come in contact with. Virtual reality technology creates illusions using computers so that users may touch and even play with precious artifacts.

3. Embedding color profiles

To resolve the issue of image conversion between different devices, the International Color Consortium (ICC) established a standard format for device profiles called ICC Profile.[13] Color profiles are generated for various input and output devices, such as digital camera, scanner, monitor, and printer, after going through standard calibration procedures. These color profiles are used as a basis for color space conversion between different devices, achieve the purpose of color management and reproducing colors of the original object. Therefore, image files that have completed color calibration can be saved with Adobe RGB 1998, which is popular color space that has a wide color gamut; embed the ICC Profile into the image file or use the image' s default ICC Profile when saving the image and name it according to the planned file naming method. After digitization work is completed for the day, it is recommended to backup all files to a server or another computer; files can also be backed up to other mediums, such as a DVD recorder, on a monthly basis.

IV. Quality Control

A project is a temporary endeavor to develop a specific object or obtain a certain result. It is the production of an original product, service or activity under limited time and cost. Project quality control involves the connection between sequential procedures.

[13] "The International Color Consortium (ICC) is an organization that has been promoting open specifications, neutral, cross-platform color management system framework and standard devices; it is also the developer of the ICC profile. Common file formats for color management are established based on color profile specifications.

The success of a project can be measured by its quality, cost, and delivery; a flaw in any one of these three will take its toll on the other two. Therefore, targets of all three standards QCD must be reached for a project to be deemed as successful.

1. Product Quality:

The first step of project quality control is the definition of quality, to define a quality standard that will satisfy user requirements is to take a step towards creating a successful digital image. By defining a quality standard, you not only avoid creating low standard digital images with low competitiveness, or high quality digital images that waste cost, but also establish a standard for evaluating digitization procedures.

Digitization procedures involve many professional fields, including photography, optics, information, chromatics, and image processing, proficiency in these fields allow better control of digital image quality; image quality is the sum of all details accumulated in the digitization process. Digital image quality control can be divided into two basic items, resolution and color. Using digital image quality control and audit items of the U.S National Archives & Records Administration[14] as an example, inspection items include: hardware generated flaws, e.g. CCD spots, loss of detailed information in highlights and shadows, asymmetrical color value, and overall brightness and contrast; disturbance during the photography process, e.g. Newton ring or exposure problems, image clarity, unnatural sides and halo; incomplete images or cutting and distortion problems, color shift as a result of incorrect color balance, scan line and pixel loss, poor quality of converted files, whether or not image size, resolution and color mode is correct, and whether or not file naming is correct. Quality control items of the National Palace Museum for digital images include: focal length, exposure and color level, gray balance, ICC Profile, and output's levels and curve. Furthermore, according to the "Digital Archives Technology Collection" and "Quality Evaluation and Assessment of Digital Archives," specifications for digitization procedure evaluations can be divided into the following:[15]

(1) Digital image extraction system uses a high resolution image system. At present, the global trend is to replace pixel based digital image technology with multi-spectral digital image technology to gain more realistic digital images.

(2) Image reproduction quality inspection system uses ICC standards to inspect image mode, chroma, brightness, clarity, resolution, and detail performance.

(3) File formats for storage, appreciation, browsing, and indexing use uncompressed file formats (RAW, TIFF) and compressed file formats (JPEG, GIF).

The various quality inspection items listed above are all key points of examination in the digitization process. Institutions can self-inspect the quality of

[14] U.S. National Archives and Records Administration, search date, December 2009, http:/archives.gov.

[15] "An Analytical Study of the Evaluation Method of Digital Archive Image Quality" by Wei Yu-Change, Tang Ta-Lun, Hsu Ming-Ching, and Hsu Wei Chin, January 2010, http://faculty.pccu.edu.tw/~tdl/digit-quality.pdf.

digital images generated by their projects to enhance quality control and assurance; inspections should be implemented according to the actual situation.

2. Cost Control:

Costs of digitization projects include human resources (includes outsourcing), equipment, training, business trips, and miscellaneous. The purpose of cost control is to keep all costs within the predetermined budget. Normally, after digitization procedures of a project are established, object digitization is a repeated action, so there will be considerable expenditure on human resources. Therefore, the key to controlling costs within the budget is to establish and efficiently implement digitization procedures, and suitably control costs during project implementation.

3. On-schedule Delivery:

The life cycle of digital information comprises of creation, acquisition, cataloging & identification, storage, preservation, and access.[16] The establishment of digitization procedures can help break down complicated tasks into simple systematic steps. Emphasis on methods, functions, and specifications for each stage of digitization and development of Standard Operating Procedures (SOP) benefits on-schedule project completion, not only reducing differences that might result from different operators in system establishment, but also achieving the goal of quality enhancement and cost reduction.

V. Digital Rights Declaration and Usage

1. CC Licenses

CC (Creative Commons) is an open copyright licensing method that licenses creative works non-specifically; Taiwan currently uses CC 2.5 licenses. If an author marks his work with "Attribution – Non-Commercial – Share Alike," then the work is protected by terms of the CC license, others may remix, tweak and build upon the work non-commercially, as long as they credit the author and license their new creations under the identical terms. If a creative work is marked with , which means "Attribution – No Derivatives," then it can be shared and downloaded as long as they mention and link back to the creator, but it can't be changed in any way or else there will be legal liabilities. Users who wish to use CC can select "Choose licensing terms" on the CC website[17], follow instructions on the webpage to choose a licensing method, and add the system generated code to their own website to complete licensing for their creative works.

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[16] "A Discussion on the Establishment of Digital Workflow from the Perspective of Digital Information Life Cycle" by Hsieh Yi-Keng and Tsai Shun-Tzu, January 2010, http://content.ndap.org.tw/index/?p=766.

[17] Creative Commons website, search date, January 2010, http://creativecommons.org.tw/blog/

2. DRM and Watermark

Following the popularization of the internet, information sharing has brought great convenience, but also severely impacted intellectual property rights. Effective digital content protection mechanisms should be proposed under the concept of information sharing to prevent illegal file sharing and unauthorized users from infringing the creator's rights. At present, digital content protection mechanisms are still being developed, including encryption technology, conditional access mechanism, digital watermark, digital fingerprint, and digital right management mechanisms, and have their scopes and limitations. These technologies must be integrated in order for them to complement each other. In addition, DRM (Digital Right Management) involves royalty payments, and is a technology for controlling digital file usage rights, mainly achieved by adding digital right limitations to digital files, e.g. number of times a file can be played, whether or not the file can be copied to another computer, and file expiration date. DRM is an access and control mechanism that integrates both software and hardware, adding access rights to digital content that continuously monitor usage within the life cycle of digital files to provide complete digital information and rights management.

Watermark is also a technology developed to protect intellectual property rights. Watermarks are similar to seals of the creator imprinted on digital files that help prove the legitimate owner of digital images when they are illegally used. Adobe has currently developed a digital seal mechanism based on the concept of actual seals, and adds symbols (trademarks, personal images) to files that it hopes to protect, such as text files, photos, animations and audio files. Digital watermarks divided into visible and invisible watermarks. Visible watermarks are visible on the object, but raise doubts of damaging the image; however, visible watermarks have better effects in preventing the unauthorized use of digital content. Although invisible watermarks do not damage the image, it requires a creditable third party to use special decoding algorithms to extract the digital watermark for verification, making it relatively less effective.

3. Rights Declaration

Current digital cameras are able to record related information when photographing objects, including the camera's model, lens, photograph date, aperture and shutter, ISO value, and light measuring model. In addition, image editing software, such as Photoshop and ACDsee, are able edit image descriptions. For example, in Photoshop if you select "File" → "File Information," then you will not only be able to edit camera data, but also IPTC[18], contact person information, image, content, state, subject,

[18] The IPTC (International Press Telecommunications Council) is an organization established by a group of the world's major news organizations. IPTC strives to develop various technology standards to enhance news exchange ability. At present, IPTC has established numerous XML standards for exchanging news information. Search date: January 2010, http://www.iptc.org/cms/site/index.html?channel=CH0086.

and rights declaration (Fig.4-8). After completing the file’ s basic information, the image file can be circulated on the internet while being protect.

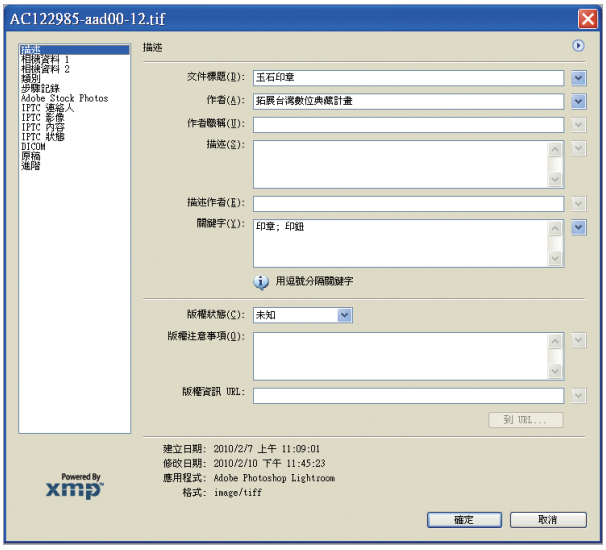


Fig.4-8 Editing the Image’s Description

VI. Image Storage, Remote Backup

1. File naming and storage

In principle, file names should not be too long. Using the metadata structure of the Fu Ssu Nien Library’ s imprint database (Fig.4-9) as an example, after verifying the image, the image file will be named; file names consist of two parts, the first part is an eight digit “unique code,” of which the first six digits represent the number of strokes in the creator’ s name, and the remaining two digits are serial numbers added to in case different names have the same numbers of strokes, starting from 01; the second part is a three digit “imprint running number,” and is separated with a “.” when combined with the first part.

項目名稱		欄位值
類型		民國印記
來源		傅斯年圖書館館藏
其他印譜資料	書名	篆刻年歷
	編著者	黃嘗銘編著
	出版者	真微書屋
	出版年	2001
	頁碼	821
Imprint Number	File name	09080800-1.JPG
	影像格式	JPG
	解析度	200DPI
	壓縮比	
	網址	
	開放顯示	
	優先顯示	
印主		柯昌泗
印文		膠西柯氏藏金石文字

Fig.4-9 Metadata cataloging structure of the Fu Ssu Nien Library's imprint database

Different operating systems have specific naming principles. Therefore, refer to the principles listed in Table 1 when deciding file name. Avoid using illegal characters or file names listed in the table to prevent file incompatibility in different operating systems. Although naming files in Chinese make them easier to identify, Chinese characters sometimes cannot be displayed on the internet due to coding issues. Therefore, English letters or digits are recommended for file names.

	DOS and Windows 3.1	Windows 95/98/ Me/XP /NT/2000	Mac OS (Standard)	UNIX/Linux
Maximum number of characters in file name	File name limited to 8 characters with a 3 character extension	The file name and the extension combined is limited to 255 characters	1-31 characters	14-256 characters (depends on the UNIX/Linux version), including the length of the file extension
Are spaces allowed	No	Yes	Yes	No
Are numbers allowed	Yes	Yes	Yes	Yes
Illegal characters	* / [ ] ; " = \ : , | ?	* / < > " \ : | ?	:	* ! @ # $ % ^ & ( ) { } [ ] " 、? ; < >

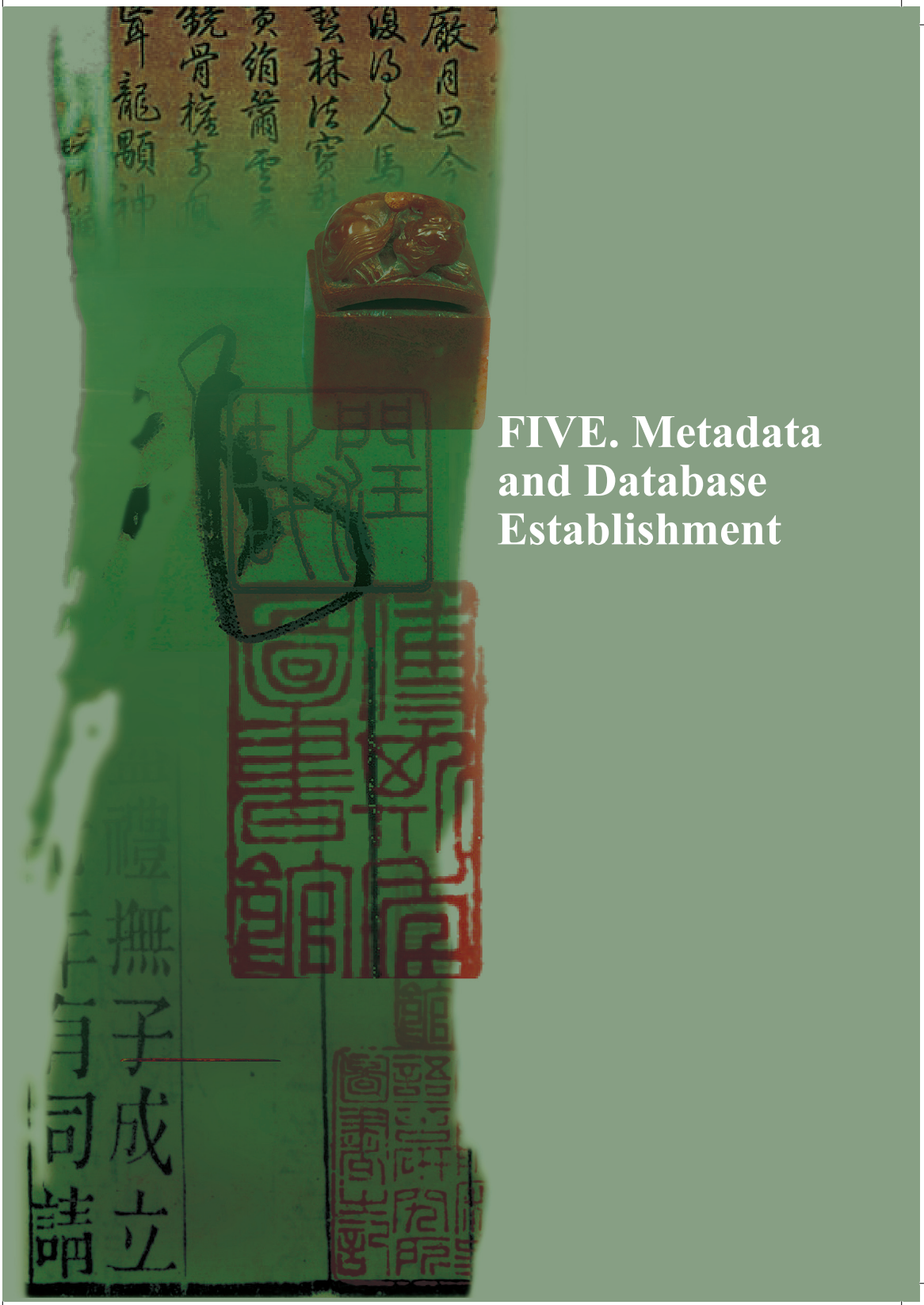
	DOS and Windows 3.1	Windows 95/98/ Me/XP /NT/2000	Mac OS (Standard)	UNIX/Linux
Illegal file names	Aux, Com1, Com2, Com3, Com4, Con, Lpt1, Lpt2, Lpt3, Prn, Nul	Aux, Com1, Com2, Com3, Com4, Con, Lpt1, Lpt2, Lpt3, Prn, Nul	All file names are allowed	Depends on the UNIX/Linux version
Are uppercase and lowercase considered the same	No	No	No	Yes (uses lowercase letters)

Different institutions can combine digital archive management with file naming, e.g. adding an institution code or collection code. The National Repository of Cultural Heritage provides a set of rules for file naming and file structure[19] that is applicable to all objects in its database; this set of rules can be used as reference when planning file names. For 3D images, the same object is photographed at numerous different angles, so the file name of each individual photograph should specify which photo it is or which angle it was taken from.

2. Remote backup

Remote backup is a strategy for permanent preservation. Consideration factors include hardware equipment with high availability, suitable network connection and data duplication channels, applications, downtime acceptable by services, efficient backup duplication, time from file duplication to back initiation, convenience, automation, and efficient management tools. If these considerations are not factored in, maintenance and management cost will quickly become a heavy burden following the rapid accumulation of data.

[19] Executive Yuan Council for Cultural Affairs National Repository of Cultural Heritage digital file naming, Search date: October 2009, http://km.cca.gov.tw/download/數位檔案命名原則_v20(20040608).pdf



FIVE. Metadata and Database Establishment

I. Metadata Planning Considerations

1. The concept of metadata

Metadata is a set of structural and standardized background information associated with objects that falls into three categories: descriptive, structural, and administrative, describing the contents and characteristics of each object in terms of semantics, syntax, and lexicology. Metadata allows digital collections to achieve optimal resource discovery performance in a digital environment or system, and effectively provides search, display, management, control and execution functions that facilitates digital resource interoperability and sharing, fulfilling its role as basic information for the permanent preservation of digital collections. In the light of this, digitization projects all consider metadata planning and implementation to be the most fundamental procedure in the digital workflow.

For different collection types, different metadata standards can be adopted accordingly; find the most suitable international standard and integrate it to meet your requirements. The Dublin Core (DC) is an international metadata standard that was established to facilitate the circulation and maintenance of digital resources around the world. The Dublin Core only defines 15 core elements as an exchange format for different types of metadata, achieving interoperability between metadata established for different fields. Metadata standards for artwork collections in museum currently include CDWA (Categories for the Description of Works of Art) , VRA (Core Categories for Visual Resources) , and REACH (for Shared Description of Museum Objects); adoption of any metadata in these standards should be based on the collection itself. From a scientific perspective, seals and imprints are categorized as works of art; therefore, the recommended metadata standard is CDWA, which was developed by the Art Information Task Force (AITF) of the J. Paul Geety Trust. The reasons are as follows:

(1) CDWA is a standard developed specifically for works of art.

(2) Compared with other standards, the metadata elements of CDWA have more layers and cover a broader scope, which better meets the requirements of digital archive projects.

(3) Most large domestic museums and holding institutions, such as the National Palace Museum, use this standard, using the same standard is recommended based on considerations for information exchange.

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[20] Metadata Architecture and Application Team, Search Date: December 2009, http://metadata.teldap.tw/index.html

[21] Dublin Core element list, Search Date: December 2009, http://www.sinica.edu.tw/~metadata/standard/dublincore-chi.htm

[22] CDWA, Categories for the Description of Works of Art elements list, Search date: December 2009, http://www.sinica.edu.tw/~metadata/standard/CDWA/Element%20List.htm

[23] VRA core categories 3.0 Chinese version, Search date: December 2009, http://metadata.teldap.tw/standard/standard-big5/vra-big5.pdf

2. Seal and imprint metadata planning considerations

Object element analysis is a specific task in metadata establishment. The relationship between elements must be described structurally based on the logic and levels of knowledge and then organized into metadata. Descriptions of Chinese artworks – seals and imprints are bound to emphasize on different points compared with Western artworks. Therefore, although metadata establishment aims to bring collections in-line with international standards, it should still provide clear descriptions of objects. At present, metadata for artworks in Taiwan are based on CDWA categories, and then modified to record features or special characteristics of collections. Modifications can be based to the application environment, characteristics of users, academic features, material features, data structure, and catalog structure.

Metadata for seals can be established based on appearance, and further be divided into more detailed descriptions under dimensions, materials, and physical description. Furthermore, seal contents and inscriptions are also important information of seals, providing details of basic information, collection management data, object research and maintenance data, object display data, and object image files. Below are metadata fields for seals established by the National Museum of History (Fig.5-1).

Institutions that are a part of TELDAP have all designed different metadata elements according to the characteristics of their collections. The National Palace Museum’ s metadata elements cover all characteristics that might appear in their collections; its databases, including antiquities database, cataloging database, decorations database, exhibition database, and image files database, are established as relational databases that can access data from each other. The National Museum of History designed several sets of metadata elements, each specific to a type of collection. Both examples have their own features and designed metadata according to their own collection characteristics and management methods, which are important factors during metadata design.

元素名稱			代表碼				
尺寸 Dimensions	組件編號 Component Number						
	印拓 Seal Mark	數值 Value	長x寬				
		單位 Unit	公分				
	印章 Seal	數值 Value	長x寬x高				
		單位 Unit	公分				
材質 Materials	類別 Type		金屬 Metals	石料 Stones	木材 Woods	象牙 Ivory	其它 Others
	名稱 Name		青銅／鐵／金／銀／其他（手填）	壽山／昌化／青田／芙蓉／滑石／其他（手填）	手填	手填	瑪瑙／水晶／琥珀／煤精／其他（手填）
形制 Physical Description	印面形式 Form of seal		長方形／正方形／圓形／橢（圓）形／缺角／三合／鼎彝形／葫蘆形／花瓣形／瓶形／桃形／扇形／獸形／合同／其他（手填）				
	紐式 Forms of Seal Button		鼻紐／瓦紐／橋紐／壇紐（覆斗紐）／臺紐／亭紐／觸紐／橛紐／動物紐（龜紐／駝紐／羊紐／馬紐／蛇紐（虺紐）／虎紐／獅紐／龍紐／魚紐）／人形紐／平紐／杵紐／泉紐／其他（手填）				
印文 Content of Seal	組件編號 Component Number						
	類別 Type		鑑藏寶璽／收藏印記／齋館印／姓名印／閒章／紀年印／詩詞印／圖形章／其他（手填）				
	語文 Language						
	書體 Script		楷書／行書／隸書／草書／甲骨文／篆書／金文／花押／其他（手填）				
	刻法 Relief		朱文／白文／朱白相間／其他（手填）				
	內容 Transcription						
款識 Inscription	組件編號 Component Number						
	無款識 No Inscription						
	有款識 Inscription/ Description	類別 Type	代表碼				
		面 Side	一面／二面／三面／四面／五面				
		語文 Language					
		書體 Script	楷書／行書／隸書／草書／甲骨文／篆書／金文／其他（手填）				
		刻作 Relief	陰刻／陽刻／其他（手填）				
		技巧 Technique	單刀／雙刀／其他（手填）				
		內容 Transcription					

Fig.5-1 Metadata fields for seals of the National Museum of History
Source: Website of Academia Sinica TELDAP Metadata Architecture and Application Team[24]

[24]National Museum of History: National Historical and Cultural Artifacts Digital Collection Project metadata –

Imprints are often found on documents, books, or metal and stone implements. Therefore, when planning and establishing metadata for imprints, it is necessary to clearly describe the original object on which the imprint is found, as well as contents of the imprint. Do not view the object and the imprint as two unrelated objects. An imprint database should contain all imprint data of its collection; it should be able to record imprints that appear on more than one object, and be integrated with to other databases via common columns and links. When the Fu Ssu Nien Library was planning its database, it also gave consideration to imprint collections, and designed the metadata field "Image of Collection" (Fig.5-2), which not only records the appearance and source of the original object, but also allows linking back to the original object if the imprint is unclear.

Fig.5-2 Fu Ssu Nien Library imprints metadata planning

Item name		Field value
Type		Minguo Imprint
Source		Fu Ssu Nien Library
Other book data	Book name	Calendar of seal cutting
	Writer	By Huang Chang-Ming
	Publisher	Jhen Wei Shu Wu
	Year of publication	2001
	Page	821
Imprint No.		09080800
Imprint	File name	09080800-1.JPG
	Image format	JPG
	Resolution	200 DPI
	Compression rate	
	Website	
	Access allowed	
	Priority for access	
Owner of seal		Ke Chang-Ssu
Content of seal		Jiao Si Ke Shih Cang Jin Dan Wun Zih
Dimensions	Values	2.9 x 3
	Unit	Cm
Shape		Square
Relief		Yang relief
Script		Small seal style

seals, Search date: January 2010, http://metadata.teldap.tw/project/project-frame.html

Item name				Field value
Seal cutter				Unknown
Year of seal cutting	Chinese calendar		Dynasty	Minguo
			Era name	
			Year	
	Western calendar			1911-1958
Inscription				
Imprint of holding institution		Accession No.		00081
		Name given by holding institution		Image of Yong Jian Dining Hall
Imprint of holding institution		Accession No.		00076
		Name given by holding institution		Image of Wun Shu Yang Dining Hall
Imprint of holding institution		Accession No.		00019-1
		Name given by holding institution		Image of southwest side of Nan Wu Yang Huang Sheng Cing Cyue
Language		Language		Chinese
		Language code		Chi
Remarks				
Reference		Book name		
		Writer		
		Publisher		
		Year of publication		
		Page		
Seal information		Seal Storage		
		Photo of seal	File name	
			Image format	
			Resolution	
			Compression	
			Website	
			Access allowed	
			Priority for access	
		Seal reference	Book name	
			Writer	

Item name			Field value
		Publisher	
		Year of publication	
		Page	
Literature citation	Book name		
	Writer		
	Publisher		
	Year of publication		
	Page		
Usage restrictions	Exhibition restrictions		Restricted
	Browse restrictions		Online imprint image display
	Copy restrictions		Copy Prohibited
Current collector			Fu Ssu Nien Library
Copyright reserved			Copyright owned by Academia Sinica Institute of History and Philology

After ages of development, imprints have become rich with diversity. A variety of languages can be found, including Han, Hui, and Manchu. For just Han characters, a great number of calligraphy styles have been used as script continues to evolve. The diversity of languages and scripts used have created difficulties with recognition and missing characters. In computer systems, Chinese characters have limited encoding space, and characters that were not encoded are often found in imprints. In the light of this, DAAL[25] developed a technology based on the Han characters database to solve the issue of missing Chinese characters[26]. This technology is currently being used by numerous systems, including: Scripta Sinica, the Digital Archives System of Fu Ssu Nien Library, Digital Archives System for Rubbings, Online Public Access Catalogue for the Digital Archives of Archaeological Data, Digital Archives of Han Wooden Slips, Grand Secretariat Archives System, and the Digital Archives of Bronze Images and Inscriptions, and makes the digitization of ancient Chinese text less difficult.

[25] Digital Archive Architecture Laboratory, Search date: January 2010, http://daal.iis.sinica.edu.tw/Chinese/System/Introduction.htm

[26] Missing character system website, Search date: January 2010, http://char.ndap.org.tw/

II. Database Management System and Website Establishment

Metadata design is a bridge between project execution, metadata analysis, and system development. Metadata can be used to evaluate the development potential of a system, depending on presentation and management requirements, whether the system can be developed into a small website or a large interconnected database. A requirements specification should first be written before developing the database system. During system establishment, metadata planners and system developers should continue to engage in discussions, exchange opinions, and feedback test results for making corrections. The database management system or website is like a communication channel between users and the database, converting user requirements into programs that link to and access files in the database (Fig.5-3).

Depending on user requirements, the complexity of designing the database management system and website may vary. For example, if only a display of search results was required, then the entire system of website would only require one page to display database contents that is extracted by the system. However, if user requirements also included collection management and data cataloging, then several relational databases would have to be established and linked together by the database management system. Using the database system of the Fu Ssu Nien Library as an example, it designed four functions to satisfy management and integrated work requirements, including imprint cataloging, imprint search, system management, and imprint access (Fig.5-4), a brief description of each function is as follows:

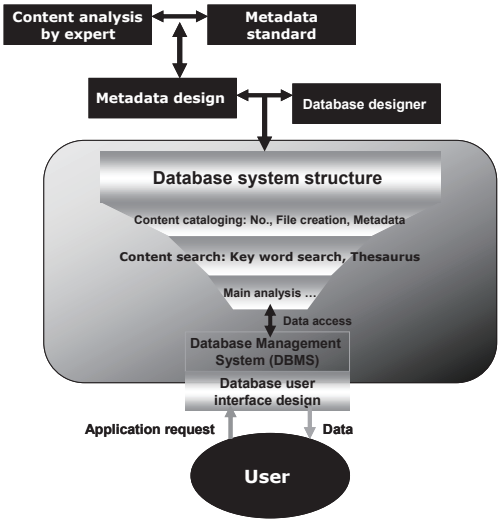


Fig.5-3 Interaction between Database Management System Users and the Database[27]

1. Imprint cataloging

In the imprint management workflow, content establishment is

[27] Reference: Rob Peter & Coronel Carlos, Database Systems: Design, Implementation and Management, 7th

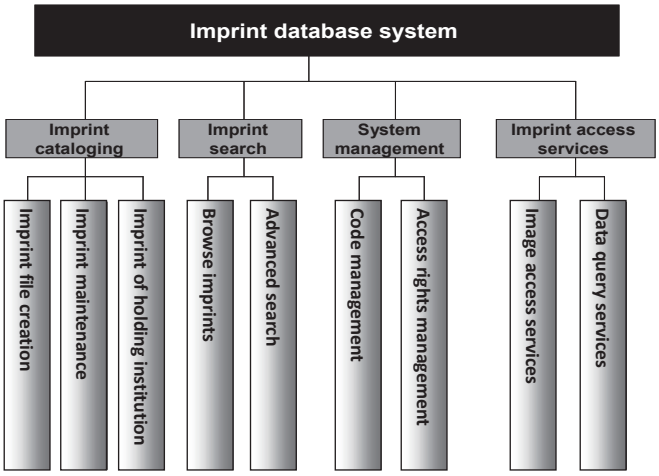


Fig.5-4 Framework of the Database System of Academia Sinica Institute of History and Philology Fu Ssu Nien Library

the foundation of database establishment. This function allows project personnel to catalog imprint data, and categorize imprint data by project using rights management mechanisms, at the same time providing an integrated search function to satisfy various requirements of imprint database management.

(1) Imprint file creation: This function allows the addition of new imprint files, and is used to catalog metadata and image data related to each imprint. When adding new imprint files, make sure that imprint numbers are not repeated.

(2) Imprint maintenance: This function is used to search for imprint files in the database, and can modify metadata fields, including basic information, image of collection, image files, references, and other imprint data.

(3) Image of collection: This function is also a metadata element that records which objects the same imprint can be found on, and was established by the Fu Ssu Nien Library. This function creates links from the imprint database to other systems.

ed. Boston, Mass.: Thomson/Course Technology, c2007

2. Imprint search

This function comprises of a browse and advanced search function that allows users to easily and rapidly search for imprint data. In its design, searches can be conducted according to category or key words, and search results can be browsed.

3. System management

Access rights must be properly managed to ensure data safety. Suitable access rights should be provided to different users, who are identified by user codes, as a measure for data upload and protection.

4. Imprint access service

The purpose of imprint databases is to organize and record project collections. Therefore, an imprint database not only has to provide management functions, but also give consideration to integration with other databases. This function comprises of an image link service, which allows other digital archive systems to link to image files of this imprint database, and a data search service, which is provided as a web service that allows digital archive systems to search for imprints in the database, and further displays imprint data according to requirements

Fig.5-5 Antiquities search system of the National Palace Museum

III. Current Status of Seal and Imprint Digital Resources

At present, digital collections of seals and imprints in TELDAP can be divided into three forms: (1) Digital collections of seals (2) Digital collections of imprints (3) Metadata of imprints, but not independent imprint images. No matter what objects the imprints are carried on and how metadata is established, if you have data of both the seal and the imprint, or both ancient books and imprints, then metadata fields should not only include data of imprints, but also data of the seal or ancient book to make access more convenient in the future.

1. Digital collections of seals

(1) National Palace Museum Department of Antiquities – Antiquities Database[28]

The National Palace Museum Digital Archives Subproject of Antiquities is a subproject under its digital archive project and was implemented in 2001; its collections are divided into numerous categories, including bronze ware, jade, ceramic, lacquer ware, wood, bamboo, metal and fabrics. The National Palace Museum Department of Antiquities has six types of databases, including antiquities database, inscription database, exhibition database, image file database, cataloging database, and decoration database. Seals are under the antiquities category, and metadata fields include ID number, storage case number, acquisition, holding institution, holding location, current status, ratings, name, cataloging level, era, size and weight, type, function, form description, records and copyright.

[28] Antiquities search system of the National Palace Museum, Search date: January 2010, http://antiquities.npm.gov.tw /~textdb2/NPMv1/sindex.php

(2) National Museum of History – A small but ingenuous seal database [29]

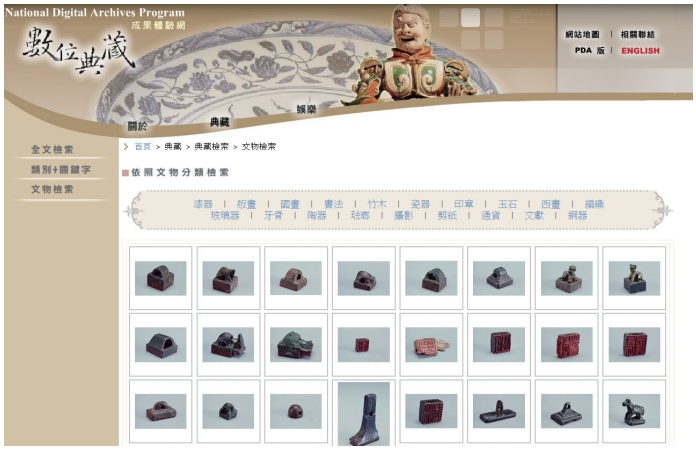


Fig.5-6 National Museum of History: National Historical and Cultural Artifacts Digital Collection Project

The National Museum of History' s collections are divided into 19 categories, including bronze ware, printmaking, Chinese painting, ceramic, wooden and bamboo, lacquer ware, Western painting, Jade and stone, seal, and a few imprints. Different digitization methods are selected for different objects. Seals are 3D objects, so digital photography is used to create 3D images of seals. Imprints are 2D objects that can be on books or paintings and calligraphy; due to the great difference in size, different digitization methods are selected; platform or flatbed scanners are used for the digitization of imprints on ancient books, while digital photography is used for the digitization of imprints on paintings and calligraphy, or carriers that won' t fit on scanners, which is the same equipment used for seals.

The basic principles of metadata are "interoperability" and "standardization," aiming to exchange and share information with other holding institutions in coordination with international standards and collection features. Metadata fields of this database include: dimensions (component number, seal mark, seal), materials (type, name), physical description (form of seal, forms of seal button), contents of seal (component number, type, language, script, relief, transcription), and inscription (component number, no inscription, inscription/description); it is a small but relatively complete seal and imprint database.

[29] National Museum of History: National Historical and Cultural Artifacts Digital Collection Project, Search date: December 2009, http://digital.nmh.gov.tw/ndap/2_c_3_2.aspx?oid=8&keyword=

(3) The Digital Project of Presidential Collections and Valuable Historical Documents[30]

Fig.5-7 Academia Historica Collections Online Search Service

Academia Historica is dedicated agency for the management of presidential collections, gathering cultural and historical materials derived from the exercise of presidential rights scattered in government agencies, private organizations and individuals. These collections include letters, manuscripts, personal notes, diaries, memos, speech drafts, photos, video tapes, audio tapes, text, CDs, medals, gifts, and non-text data or objects; based on their form and characteristics, these are divided into five series: documents, implements, photos, audiovisual data, and books. Digital content established via 2D photography, 3D photography and digital scanning related to seals in Academia Historica are currently somewhere near 250 entries; metadata fields include: name, measurements (length, width, height and weight), materials (type, description), physical description, technique, source (acquisition method, copyright owner, origin, acquisition date, remarks), creation (creator, time, location, remarks), and interpretation.

[30] Academia Historica Collections Online Search Service, Search date: January 2010, http://weba.drnh.gov.tw/index.jspx

2. Inscription imprints digital resources

(1) National Palace Museum Department of Paintings and Calligraphy – Inscription Imprint Database (Under construction)

Fig.5-8 National Palace Museum inscription imprint database[31]

This inscription imprint database is among a number of resources that the National Palace Museum Digital Archives Subproject for Paintings and Calligraphy plans to integrate. This database was jointly established by the Institute of Information Science, Academia Sinica and the National Palace Museum, and is an integrated search platform for digital content of the National Palace Museum Department of Paintings and Calligraphy, Department of Antiquities, and Department of Rare Books and Documents. Metadata of this database was established according to metadata specifications of the Metadata Architecture and Application Team, DADT (Digital Archive Database Tool), DAAL (Digital Archive Architecture Lab), ROSS, and international common standards. Metadata fields include the following 12 items: imprint number, type, content of seal/inscription, seal owner (era, owner), imprint source (object name, object number), dimensions, shape of sea, language, script, transcription, text reference, and image file.

[31] National Palace Museum Department of Painting and Calligraphy — Inscription Imprint Database, additional application required, Search date: December 2009, http://ndweb.iis.sinica.edu.tw/npmseal/index.jsp

(2) Academia Sinica Institute of History and Philology Fu Ssu Nien Library – Imprint Database[32]

Fig.5-9 Fu Ssu Nien Library – Imprint Database System

Using the imprint database system of the Fu Ssu Nien Library as an example, the database supports objects, such as ancient and rare books, metal and stone rubbings, and mainly collects imprints on ancient books; it does not collect physical seals. When collecting imprints, all inscriptions or figures found in books are digitized for preservation, if the same imprint is found in several places, then the clearest and most complete imprint is selected. When two objects have the same imprint, the issue of repeated digitization will occur. Therefore, an additional metadata field "Image of Collection" was established for imprints, which not only indicates which objects the imprint can be found, but also links to the original digital archive system. When using the Fu Ssu Nien Library Imprint Database System, non-members can conduct basic searches according to type, source, shape, method of seal cutting, script, language, and language code, but they have to become members to print forms or browse images.

[32] Fu Ssu Nien Library – Imprint Database System, Search Date: December 2009, http://ndweb.iis.sinica.edu.tw/sealdb/System/Assort.jsp

3. Metadata description

(1) Taiwan Calligraphy Artist Role Model Chen Ting-Chi Digital Museum[33]

Fig.5-10 Taiwan Calligraphy Artist Role Model Chen Ting-Chi Digital Museum

Mr. Chen Ting-Chi (1911-1994) enjoys the reputation "Calligraphy Master of Southern Taiwan." His calligraphy has learned from Japan, the ancients and modern theories, and his teaching and materials give consideration to both artistic views and scientific methodology. His creations are a combination of strength and technique that is innovative and dynamic. Mr. Chen Ting-Chi left a great number of calligraphy creations, books, teaching materials and theories. The "Taiwan Calligraphy Artist Role Model Chen Ting-Chi Digital Museum" Project implemented by National Chiayi University Department of Chinese Literature uses photography and scanning digitization procedures to gradually establish a complete digital archives database. In the database, metadata established for seals of Mr. Chen Ting-Chi include: type, imprint, creator, position, inscription, script, and transcriptions.

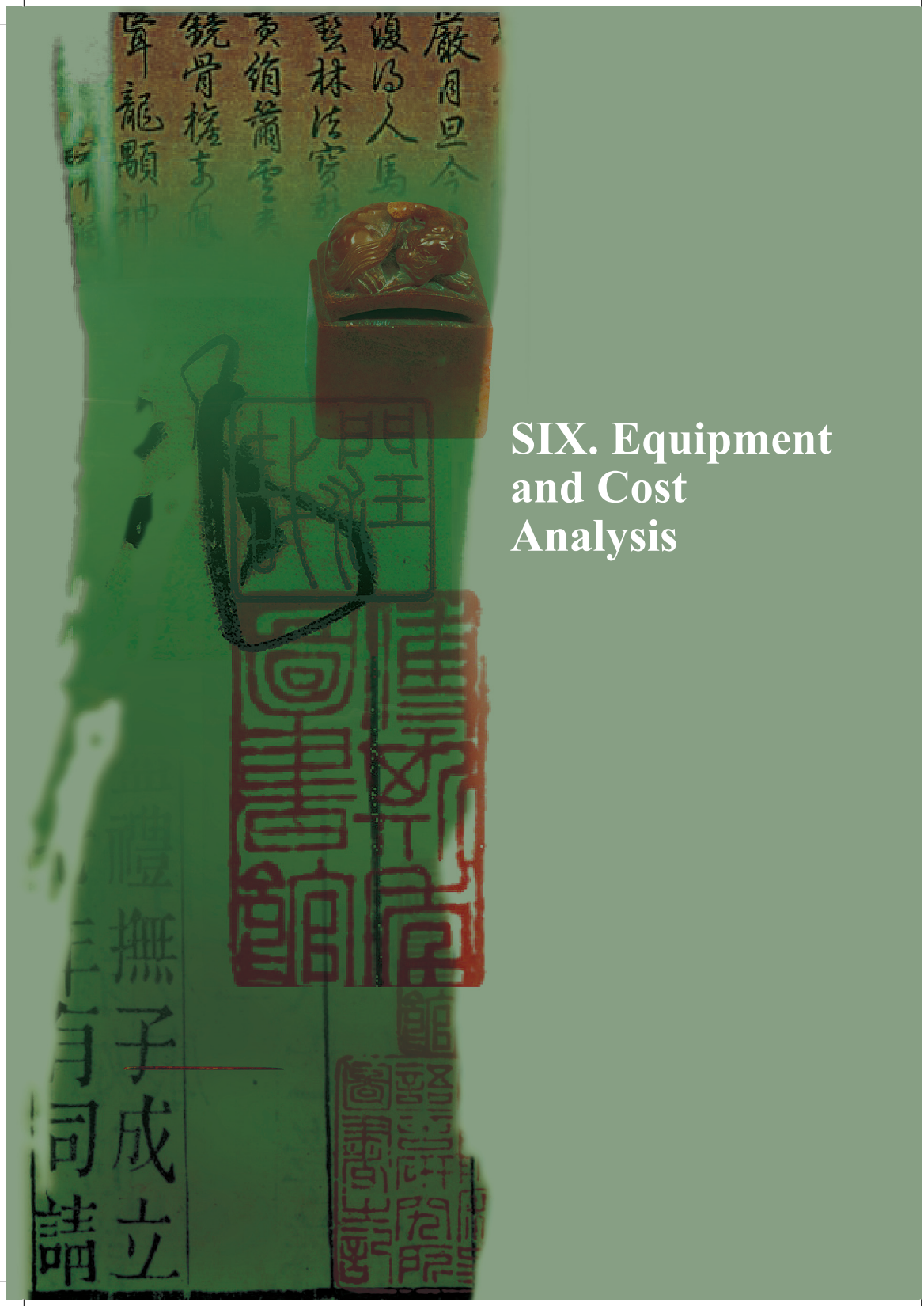
[33] Taiwan Calligraphy Artist Role Model Chen Ting-Chi Digital Museum, Search: January 2010, http://140.130.48.5/search/index.php

(2) Academia Sinica Institute of Taiwan History – Taiwan Archives Online[34]

Fig.5-11 Taiwan Archives Online

Academia Sinica Institute of Taiwan History has conducted in-depth field surveys of every corner of Taiwan’ s society since the Taiwan History Field Research period (from August 1986 to June 1993). After the preparatory office was established in 1993, it set up an ancient book collection room to continue traditions of private book collections. In 2009 the Institute of Taiwan History formally established the “Archives Repository,” which systematically collects, catalogs, and provides for access archives related to Taiwan History. Current collections are divided into three categories based on the form and source of historical materials, including ancient books and records, rare books and literature, and image files. In its digitization process, eight metadata fields related to imprints were established: page, image file, position on page, transcription, translation, remarks (position, transcription, translation), imprint (imprint type, contents of seal, shape, relief, position on page, notes, image file link), and notes.

[34] Taiwan Archives Online, Search date: January 2010, http://ithda.sinica.edu.tw/?action=news&id=16



SIX. Equipment and Cost Analysis

I. Digital Photography Equipment and Cost

1. Digital equipment selection

(1) Cameras, Digital Camera Backs, Lens, and Video Recorders

The rapid development of digital cameras was mainly the result of the mutually beneficial relationship between internet developments and digital image applications. The main consideration of digital camera selection is the purpose of digital images that will be produced. For digital archive projects, the objective should be to obtain high resolution images, therefore DSLR cameras are recommended. Even better photography results can be obtained by using medium or large format digital cameras with a digital camera back. DSLR cameras produce better image quality than ordinary digital cameras because they can change lenses according to object size, and make more detailed adjustments of aperture size, shutter and view depth.

The functionality of digital cameras is equal to that of electronic image printing equipment, meaning that after the camera shutter is pressed, the image captured is printed into a digital image. The main components of a camera responsible for carrying out this process include CCD, Lens, exposure control, view finding device, image pixels, auxiliary light source system , color calibration system, power system, storage system, subsidiary functions, and expandable accessories; each of which can further be divided into more detailed items. Therefore, when there are too many consideration factors for selecting digital cameras or digital camera backs, keep in mind two relatively important factors, number of pixels and the size of the CCD or CMOS; the quality of the digital image is greatly related to these two factors. For example, for two cameras with 1.3 megapixels and 5 megapixels and the same CCD size of 1/2.7 inches, the density of light sensing devices for the 5 megapixel camera will be higher than that of the 1.3 megapixel camera; when photos taken by the two cameras are printed into A4 size images, the 5 megapixel camera will naturally produce a more detailed image (Fig.6-1). Although more pixels mean higher resolution, but if light sensing devices of 1 pixel is smaller in the 5 megapixel camera, the area it can receive light will be smaller, so the image quality will not necessarily be better that of the 1.3 megapixel camera. Therefore, if the CCD size is 1/1.8 inches and its density is the same as when the CCD size was 1/2.7 inches, then the area per pixel will be larger (Fig.6-2), allowing it to receive more color information (luminance and chroma) and produce better image quality. At present, the market has full frame DSLR cameras that are the equivalent of the traditional 135 film camera; its detail performance in shadows and highlights is better than the typical APS frame or 3/4 frame, and is better for producing large digital images.

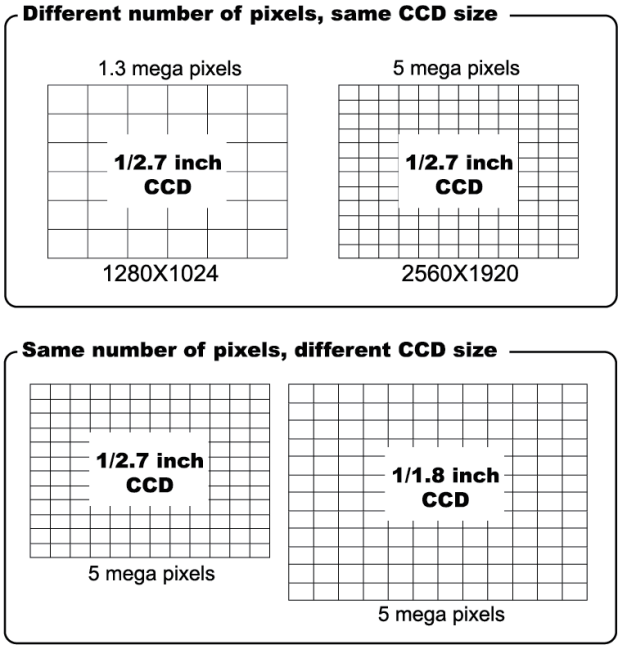


Fig.6-2 Same number of pixels, different CCD sizes

Lens selection also affects image quality. The size of light sensing device, CCD or CMOS, of ordinary DSLR cameras is smaller than conventional camera film. Therefore, by installing them behind the lens, the focal length will have multiplied effects (generally 1.5 or 1.6 times, the focal length is not multiplied for full frame cameras after adding a lens). For still life photography, which limits the photography location to within the photography studio, zoom lens is usually used because it can change focal length by simply rotating the lens, and changing position is not required. Seals are relatively small objects compared to ceramics and copper ware. To take clearer photos of object details, an additional macro lens can be purchased, or a relatively cheaper extension tube or close-up lens can be used to reduce the focal distance with objects. For camera brand selection, selecting well-known manufacturers will allow easier purchase of accessories and maintenance. Furthermore, a stable tripod and pan head that allows minute adjustments are also necessary for setting up the camera.

(2) 3D Photography equipment

3D Photography is mostly used for the digitization of large objects or solid art

works; seals are relatively small objects and provide less opportunity for its use. However, considering that there are often elaborate sculptures (mainly auspicious beasts, such as hornless dragon, lion, dragon, phoenix, tiger, Chinese unicorn, camel and turtle) on the head-part of seals that are worth savoring, whether it may be its form, charm, lines, concept or meaning, and that the sculptures are half rounds requiring at least three photos, one in the front and two on both sides, that still might not be able to fully present the sculpture, 3D photography becomes a preferable option. The simplest way to create 3D images is to purchase one rotation table, manually rotate the object and photograph the object every fixed number of degrees. A more refined photography method is to purchase a complete vertical and horizontal rotating arm and table control system, which uses software to control and take more pictures at more angles; the 3D image is completed after the photos are synthesized by the software.

(3) Lights

A flash light or a cold continuous light are both options. The advantages of using a flash light include using a high speed shutter that can gain standard color temperature, and the ability to instantly generate relatively large brightness to gain better color saturation. The advantages of using a cold continuous light include low power consumption, relatively long service life, no worries of damaging objects with high temperature; however, such lights have lower brightness, so the shutter needs to be slower or the ISO value needs to be higher.

Besides the light and stand, also purchase suitable soft light masks. Be careful to use the same brand of lights and not to mix new and old light masks, or it might cause inconsistency of color temperature.

(4) Others

i. Color chart: Used to calibrate colors of digital image files. Color charts are placed next to objects being photographed and used a basis for color calibration. However, considering that most seals are smaller than the color chart, an alternative is to first photograph the color chart and use it for calibrating digital images that produced that day.

ii. Light meter: Used to ensure that image colors will not be distorted by uneven light.

iii. Level: Used for measuring whether the camera is level with the object.

Before purchasing any equipment, it is important to consider the requirements of project execution, compare your options, and ask for advice, this way you can purchase the most suitable equipment for reasonable prices. Outsourcing digital photography to professional photographers is also an option, eliminating the need to purchase additional photography equipment, such as cameras and lighting equipment; outsourcing cost is based on the number of objects. Using the Li Shih-Chiao Art Museum Project as

an example[35] , the cost for outsourcing the digitization of 200 objects was roughly NT$127,000, or NT$635 per object. This price makes outsourcing an option suitable for institutions with smaller collections, but understanding the functions of different equipment is still a prerequisite for communicating with the photographer and establishing image specifications that meet requirements.

2. Digital photography cost analysis

The purpose of digit images may include educational or commercial value-added applications, which might involve usage fees of digital content, so the cost of each image file must be calculated and used as a basis for collecting usage fees.

(1) Digital photography costs can be divided into three categories: material cost, labor cost and miscellaneous costs.

i. Material cost is the cost of consumables used for digitization work.

ii. Labor cost is mainly the salaries of project execution personnel.

iii. Miscellaneous costs can be divided into direct costs and indirect costs:

a. Direct costs: Amortization expenses of information equipment and digital cameras.

b. Indirect costs: This is further divided into digitization work space and database (website) system space; digitization work space may include amortization expenses or rent, renovation cost, insurance fee, utilities and other; database system space may include system establishment and maintenance fees.

(2) Cost estimation

The cost analysis of this guideline only makes an initial estimation of material cost, labor cost, direct costs and indirect costs. Cost calculation can be divided into two methods based on equipment amortization.

i. Service life:

Definition	Material cost	DVDR disc
	Labor cost	Personnel salaries
	Equipment amortization expenses	(Camera software/hardware + System establishment software/hardware) / Service life
Formula	Material cost (NTD) / Digital output (Objects) + {[Labor cost (NTD) + Equipment amortization expenses (NTD)] / Digital output (Objects)} ＝ Cost per object (NTD/Object)	

[35] China University of Technology Li Shih-Chiao Art Museum Project [Western Paintings] workflow survey, Search date: December 2009, http://content.ndap.org.tw/main/doc_detail.php?doc_id=486&class_vision=12

Definition	Material cost	DVDR disc
	Labor cost	Personnel salaries
	Equipment amortization expenses	(Camera software/hardware + System establishment software/hardware) / Service life
Formula	Material cost (NTD) / Digital output (Objects) + {[Labor cost (NTD) / Digital output(Objects)] + [Equipment software/hardware + System establishment software/hardware] / Digital output (Objects)} ＝ Cost per object (NTD/ Object)	

ii. Total digital output:

(3) Budget planning

The selection of different equipment and the amount of human resources all result in different cost per object digitized. Table 6-1 lists possible requirements on equipment and human resources for projects to use as reference when planning their budget:

Table 6-1 Example of budget planning

	Content	Quantity	Work contents / Equipment specifications	Price / Salary
i. Human resources requirements	Collections manager		Provide list of objects or assist with inventory making	Depending on the policy of each institution, collections managers and researchers may have extra bonuses
	Researcher		Overall planning, content analysis, and data provision	
	Full-time assistant	1~2	Has related academic background, in which at least 1 assistant should be proficient in still life photography	Using the NSC standard, the salary for assistants with a bachelor's degree is NT$30,400 and master's degree is NT$34,000

	Content	Quantity	Work contents / Equipment specifications	Price / Salary
i. Human resources requirements	Part-time assistant	1~2	Has related academic background. System developers can assist with data cataloging or database and web design	Using the NSC standard, the salary for a part-time assistant with a bachelor's degree is NT$4000 and a master's degree is NT$8000
ii. Equipment requirements	Photography platform			
	Background paper or black velvet		Used for the photography background	
	Cotton gloves		For moving objects	
	Bruch		For cleaning the photography background	
	Tape measure		For measuring objects	
	PC or MAC (monitor included)	1~2	For word and image processing	PC: NT$25,000 ~ 30,000 MAC: NT$60,000
	DSLR camera	1	10 megapixels or higher	NT$30,000 ~ 50,000
	Lens	1	17-70mm, supports macro photography	NT$15,000
	Metal tripod	1		NT$5,000
	Pan head	1		NT$2,000
	Color chart	1	Includes gray scale and color scale	NT$1,200
	High frequency cold light	2	Frequency of 30000 - 55000Hz	NT$15,000 per light
	Light stand	2		NT$3,000 per stand
	Hand-held electronic light meter	1	Support, transmission, reflection and continuous light measuring	NT$7,000

II. Digital Scanning Equipment and Cost

The digitization of imprints is an independent image extraction procedure that comes after objects are digitized. In the case of paintings and calligraphy, digital imprint images are extracted after digital images paintings and calligraphy are stored. Different digitization methods are selected for collections with different characteristics. The selection of scanning equipment is also based on considerations of collection characteristics, such as the form and size of objects. For example, scanning equipment is more often used for digitizing string-bound books, so if the collection consists of books, then a scanner will be used to digitize imprints on the books.

1. Scanner selection

Most string bound books are digitized using "platform scanners" and "flatbed scanners." Below lists suitable digital scanning equipment that are currently available in the market.

(1) Platform scanner

Platform scanners are relatively cheap and similar to copy machines. The object is placed on the glass and the object's image is captured by CCD arrays under the glass. However, the original copy cannot be larger than the glass part if this type of scanner is used. Platform scanners are suitable for documents consistent in size and books that are in good condition. The pages of string bound books are faced downward and the action is repeated for every single page, so platform scanners are not suitable for digitizing books in poor condition.

(2) Flatbed scanner

This type of scanner uses high performance color top light for non-contact scanning, which effectively protects the original copy from being damaged, and allows digitization of literature, books, and journals up to A1 size (841×594mm). Flatbed scanners are especially suitable for scanning large maps, paintings, posters, and photos, which all require higher resolution. Flatbed scanners are usually used for scanning string bound books because of its non-contact characteristic, which is made possible by its light source at the top of the machine. However, pay special attention to the book bindings to avoid inappropriate operations that will damage the book.

Table 7 Comparison of various flatbed scanners

	Ancient book photography platform	Zeutschel (German)	Professional multi-purpose Dig Book
Model	Domestically developed	Omniscan6000Color	2000LC
Price	NT$300 thousand	NT$4.5-6 million (including software)	NT$1.6-3.5 million
Color of backing material	Black velvet (prevent reflection)	White	Green
Movable panel	Magnetic panel that moves up and down	Up and down	Up and down
Micro adjustment method	Stepper motor (micro adjustment)	Electric micro adjustment	Manual micro adjustment
Fixing device	Glass lid	Fixed glass	None
Book positioning and distance with the glass	Does not come in contact with books	Tight	Hand-pressed
Maximum shooting range (using a ratio of 1 : 1)	86 cm × 105 cm (A0 and above)	A1 size	A1 size
Width of center seam	> 5 cm	< 5 cm	< 5 cm
Center seam mobility	More flexible	Standard	Standard
Applicable objects	Ancient books, artifacts, sculptures, periodicals, newspapers, documents.	Ancient books, periodicals, newspapers, documents.	Ancient books, periodicals, newspapers, documents, maps.
Rating	Semi-automatic	Fully Automatic	Semi-automatic
Notes	Lighting equipment and digital camera back need to be purchased separately.	No additional equipment required.	No additional equipment required.

2. Digital scanning cost analysis

Digital scanning cost analysis is the same as digital photography, and is calculated based on material costs, labor costs, and miscellaneous expenses:

(1) Platform scanners

i. Basic equipment requirements

Basic requirements		Arrange for three personnel, two to be responsible for scanning, putting things in order and inspection, and the other for system establishment and maintenance. Use two computers and one platform scanner.		
Category		Description	Quantity	Price
Scanning equipment	Hardware	Computer equipment	2	NT$60,000
		Platform scanner	1	NT$130,000
	Software	Adobe Photoshop	1	NT$20,000
System establishment software/hardware		Ancient string-bound book digitization management system establishment cost	1	NT$600,000
Human resources		Salary	3	NT$90,000 per month
File size		Scanning an A3 full color 300dpi image	1	Takes roughly 90 seconds
Output		Monthly digital output (20 working days)	4000 Pages	
Service life		Equipment service life (Hardware + Software)	4 Years	
Consumables		DVDR	1 Disc	NT$15

ii. Cost calculation example

Calculation example	Equipment amortization expenses based on service life	
	Scanning cost estimation (platform scanner)	
Definition	Material cost	DVDR (4.7GB＝4700MB)
	Labor cost	Personnel salaries
	Equipment amortization expenses	(Scanning equipment software/hardware + System establishment software/hardware) / Service life
Formula	(Material cost (NTD) / Digital output (Pages) + [Labor cost (NTD) + Equipment amortization expenses (NTD)] / Digital output (pages) = Cost per page (NTD/Page)	

Calculation example	Material cost	Scanned pages	4700/50 (MB) = 94 (pages)
		DVD cost per page	15/94 = 0.15 NTD/page
		Required amount × 2 sets	0.15×2 = 0.3 NTD/page
	Labor cost	30,000*3 = NT$90,000	
	Equipment amortization expenses	(60,000+130,000+20,000)/4 = NT$52,500 per year, or NT$1,375 per month	
	Cost per page	(90,000+4,375)/4000 = 23.6 NTD/Page, 0.15 NTD/Page + 23.6 NTD/Page = 23.75 NTD/Page	

(2) Flatbed scanner

i. Basic equipment requirements

Basic requirements		Arrange for three personnel, two to be responsible for scanning, putting things in order and inspection, and the other for system establishment and maintenance. Use two computers and one flatbed scanner.		
Category		Description	Quantity	Price
Scanning equipment	Hardware	Computer equipment	2	NT$60,000
		Flatbed scanner – Ancient book photography platform	1	NT$350,000
		Lighting equipment		NT$1,200,000
		Digital camera back		NT$150,000
	Software	Adobe Photoshop	1	NT$20,000
System establishment software/hardware		Ancient string-bound book digitization management system establishment cost	1	NT$600,000
Human resources		Salary	3	NT$90,000 per month
File size		Scanning an A3 full color 300dpi image	1	Takes roughly 90 seconds
Output		Monthly digital output (20 working days)	4000 Pages	
Service life		Equipment service life (Hardware + Software)	4 Years	
Consumables		DVDR	1 Disc	NT$15

ii. Cost calculation example

Calculation example	Scanning cost estimation (Flatbed scanner – Ancient book photography platform)		
Definition	Material cost	DVDR (4.7GB＝4700MB)	
	Labor cost	Personnel salaries	
	Equipment amortization expenses	(Scanning equipment software/hardware + System establishment software/hardware) / Service life	
Formula	(Material cost (NTD) / Digital output (Pages) + [Labor cost (NTD) + Equipment amortization expenses (NTD)] / Digital output (pages) = Cost per page (NTD/Page)		
Calculation example	Material cost	Scanned pages	4700/50 (MB) = 94 (pages)
		DVD cost per page	15/94 = 0.15 NTD/page
		Required amount × 2 sets	0.15×2 = 0.3 NTD/page
	Labor cost	30,000*3 = NT$90,000	
	Equipment amortization expenses	(60,000+1700,000+20,000)/4 = NT$445,000 per year, or NT$37,083 per month	
	Cost per page	(90,000+37,083)/4,000 = 31.77 NTD/Page, 0.15 NTD/Page + 31.77 NTD/Page = 31.92 NTD/Page	

The cost calculations listed in this book are only preliminary evaluations. Institutions implementing digitization projects may use the simple formulas above to roughly estimate their cost, which is mainly based on human resources and software/hardware equipment. When planning the digitization workflow, simple operations that need to be repeated many times can be executed by part-time assistants after some professional training, reducing labor cost. However, in order to ensure image quality, it is recommended to hire full-time professionals for handling operations that require expertise, such as image inspection.

Although hardware equipment might be expensive, if it accelerates digital output, it will reduce labor cost, meaning that the overall cost will not necessarily increase. On the contrary, using cheap equipment with lower digital output will result in higher labor cost, and the overall cost will not necessarily decrease. In addition, although software development is expensive, it can increase productivity and control quality, which further controls cost and reduces labor cost; its transparent procedures allow easier project management and benefits goal achievement.

Using the Academia Sinica Institute of History and Philology Fu Ssu Nien Library as an example, the Library experimented on an "imprint image extraction model," but found that the time and benefits did not meet cost considerations. After extracting the imprint image, image file adjustments and Chinese red inpainting was relatively time consuming, and normally at most two imprint images were completed a day; calculating based on a daily labor cost of NT$800 for the part-time assistant, the digitization cost of one imprint was NT$400. In order to digitize their collection in batches to save time, the library outsourced system development to a contractor, listing requirements of imprint image extraction. The image processing system saves time on image extraction, can identify Chinese red of the imprint image, and provide a recommended a color after analysis, increasing economic benefits at imprint image processing stage.

III. Computer equipment

1. Hardware equipment:

(1) Computers

Common computers are divided into two categories: personal computers (PC) for general word processing, and Macintosh computers (MAC) for graphics processing. Computer selection should be based on project requirements; if project execution will be in different locations, then a notebook is recommended as the first equipment for word processing.

i. Personal computers

Key points of selecting a PC include CPU speed, motherboard functions, and memory; computer performance is determined by its components. Following the development of digital image capture equipment, digital files are gradually growing in size, so consider hardware equipment that are highly compatible and capable of processing large quantities of images when selecting computers.

ii. Macintosh computers

Macintosh computers have a closed architecture, so they doesn't face stability and compatibility issues faced by PCs due to different brands of hardware equipment. Macintosh computers have always been favored for graphics processing, thanks to its processing ability and the convenience of its functions. At present, Macintosh computers allow the use of some PC hardware and software, including memory, graphics card, DVD recorder, and operating system, but not at the expense of its stability and high performance. With sufficient funding, Macintosh computers are a good option for digitization.

iii. Notebooks

Notebooks can be divided into fully functional, thin and light, and super

portable. Besides usage requirements, also consider the compatibility between software and hardware. If notebooks are to be used for 3D image processing, then it will require long operation time and generate a large amount of heat, which prevents it from being stable like desktop computers, which is why notebooks should be used in coordination with desktop computers.

(2) Random Access Memory (RAM)

The memory is where computers really work, all data, including system drivers, operating system, work data, products, and semi-products, must first be loaded into the memory before it can be processed by the CPU. RAM is internal memory used for directly exchanging data with the CPU, and is also known as the main memory. RAM is usually where the operating system and other programs store their temporary data, and its capacity affects the number of programs that can be stored. For the smooth execution of various applications, the amount of RAM in your computer is the bigger the better, but do not exceed the largest amount supported by the motherboard. Generally speaking, graphics software or image editing software require at least 2GB of RAM.

(3) Graphic card

Besides the ability and speed to process large numbers of RAW files and other digital files, the most important part of digital image processing is to show detailed color performance, so select graphics cards with better graphics processing ability for computers responsible for image processing. If the computer is for word processing, then a low-end graphics card or the motherboard' s built graphics chip would suffice.

(4) LCD Monitor (High-end monitor)

LCD monitors are currently the mainstream in the market; selection considerations include dimensions, dead pixels, input interface, brightness, contrast, and response time. At present, most LCD monitors are 19~22 inch, so the main principle of monitor selection is "higher brightness, larger contrast, and shorter response time." In addition, light in the working area might reflect off the monitor and into the user' s eyes, and prevent accurate determination of colors; this can be resolved by adding a dark color light mask on the monitor.

(5) Hard drive

As storage space for image files, of course hard drives are the larger the better. However, the total storage space required should still be calculated based on the size of image files. To enhance system performance, it is recommended to create two partitions, one for storing the operating system and applications and the other for storing digital image files. Furthermore, portable hard drives can be purchased as an alternative to remote backup.

(6) DVD recorder

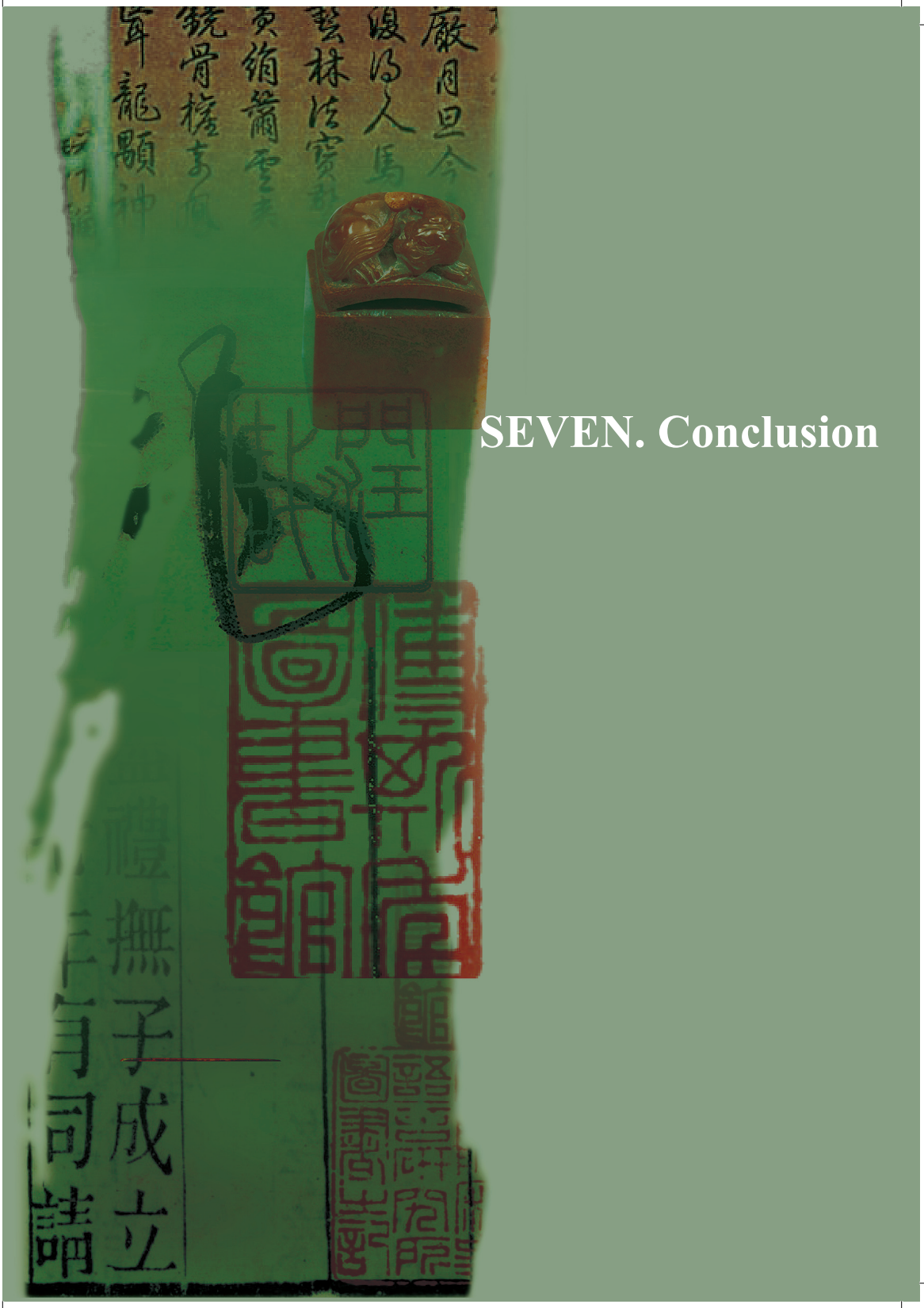
DVD recorders today are very cheap due to its popularity. One blank DVD can record 4.7GB, or even 8.5GB if it is single layer double sided, making it a good option as an alternative method for data backup. However, data on DVD can still be corrupted by humidity and light hazard, so besides establishing a good environment for preserving DVDs, file transfer should still be arranged after a certain period of time. There are currently recorders in the market that use Blue-Ray technology, a single layer single sided blue-ray disc can store up to 25GB or 27GB of data, while double layer, 4 layer and 8 layer blue-ray discs can store 46GB, 100GB and even 200GB of data. However, blue-ray discs are still very expensive, but it might become a very good tool for backup once its technology matures or prices drop.

(7) Interface card

Some digital cameras or external storage equipment use the FireWire (IEEE 1394) interface for data transfer. FireWire is a good choice considering that it is faster and more stable than USB. You can either purchase a motherboard that supports IEEE1394, or purchase an additional 1394 interface card.

2. Software

Once you have hardware, your computer has a "body," but for it to have a "soul," you will have to select suitable software. Besides functional considerations, take notice of the minimum hardware requirements when selecting software; requirements may include CPU speed, memory size, hard drive size, monitor resolution, DVD player, operating system, and other input/output devices.



SEVEN. Conclusion

Seals and imprints are objects associated with different digitization procedures. Seals can make multiple imprints on different objects, and are a symbol of social status and art. Imprints not only possess artistic value, but also serve as records. And although imprints are derived from seals, institutions make different plans for the two. In the following section we will describe difficulties faced by different institutions when digitizing seals and imprints for future projects to use as reference.

I. Source Verification and Authentication

Scholars or book collectors of the past often wrote a foreword or afterword on new collections to describe the book's contents, age, circulation, origin, and how it was acquired, and they also made imprints on it with their own seals, which provided information on the establishment that the book was held in, the collector's name, courtesy name, collection of the book, appreciation, special collection and revision. These all serve as records that help determine a book's history, thus foreword, afterword and imprints serve as a reliable basis for verifying a book's authenticity. Researchers can use imprint data to find the original object, and use different imprints on an object to authenticate the object.

Even with advancements in technology, source verification and authentication is still a difficult and time consuming task as objects have been passed down from the ages. Although this task is performed by etymology or history scholars, it requires time and cross comparison with a great amount of data. Before the source of an image is authenticated, even if digitization has already been completed, it can only be temporarily kept as research data to prevent incorrect information from being circulated.

II. Objects from Multiple Sources

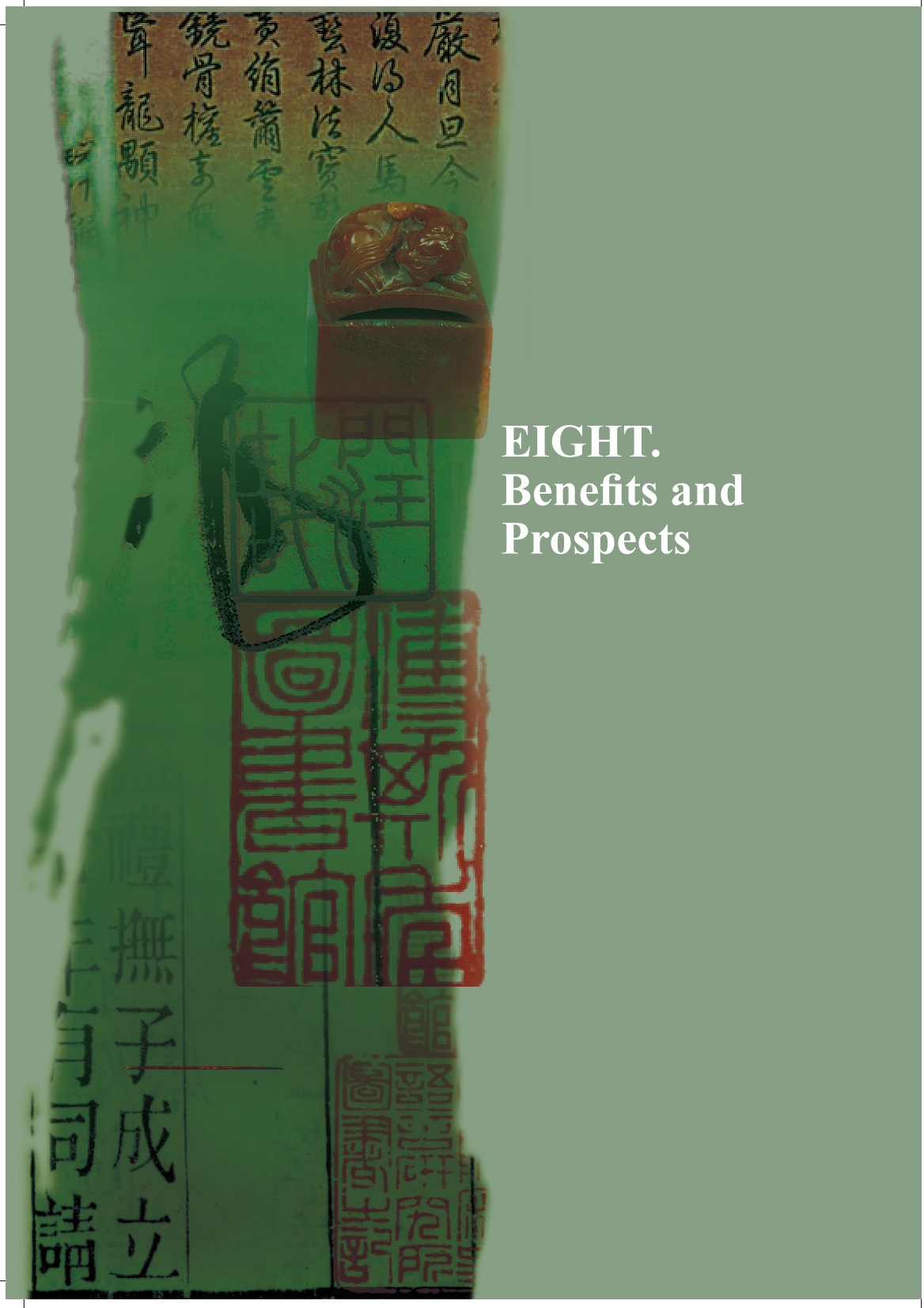
Making and collecting seals became a trend led by scholars during the Ming and Ching Dynasty, and the use of seals on paintings and calligraphy, ancient books and implements was popularized. At present, seals are not only found in holding institutions, but even more are scattered in non-government circles. Therefore, seal and imprint databases not only focus on database establishment, but also surveying collections of private collectors so that digitization planning will be able to give a more complete presentation of resources.

III. Resource Integration and Inter-agency Collaboration

The main purpose of digital archives is to ensure the usability, persistence, and integrity of digital data. Therefore, "digital archives" in Taiwan is defined as "the transformation of collections into digital form via digitization procedures, and to ensure the long-term storage, maintenance and availability of digital resources." The concept

of digital archiving is to establish cross-system information integration, and provide a digital platform for knowledge collection, preservation, maintenance and search.

Different institutions with seal and imprint collections may have different considerations when deciding object digitization priority and image description. Using imprints as an example, some institutions establish numerous metadata fields to describe imprints from an artistic perspective, while others may take on a historical perspective and focus on the carrying object, using only a single metadata field to describe the imprint. Different perspectives result in different approaches to digitization, especially metadata establishment. This makes it hard to establish common metadata fields for imprint resources; as a compromise, metadata of imprint images can only do its best to link back to the original object. If the objective is to establish an imprint database, then data must collected extensively and continuously.

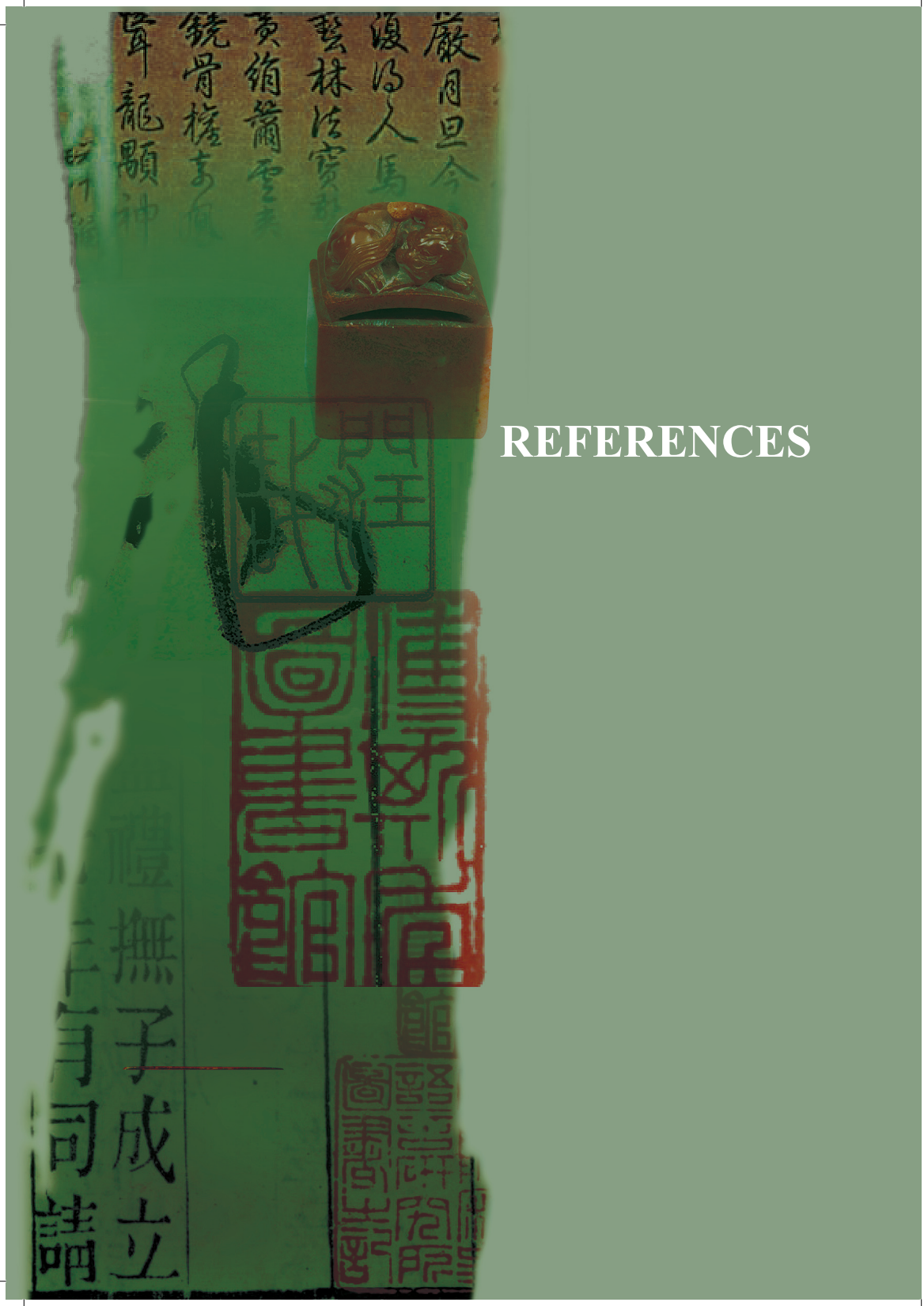


EIGHT.
Benefits and Prospects

Professor Rebecca Grinter of the Georgia Institute of Technology indicated that when the first website appeared in 1991, it was established by a group of physicists for the purpose of information sharing. After years of development, the internet today is filled with websites that satisfy daily needs, including shopping websites and interactive communities, and it has changed the way modern people live. Technology not only shows the intelligence of human beings, but also makes digital resource sharing possible, allowing users to explore without boundaries. The National Science Council's TELDAP is a massive and complicated program that doesn't merely focus on object digitization, but more importantly resource sharing and value-added applications. Although different goals involve different work content and procedures, they are tightly linked together. One of the principal missions of digital archives is to utilize project implementation to help the expansion of knowledge fields, as well as the creation of a cultural image.

After devoting years of efforts, TELDAP has accumulated a wealth of digitization results, and database establishment is already on track, but the development of a friendlier interface that will provide better usability will prove to be a greater goal and challenge. A single database can help users gain an in-depth understanding of objects under the same category in the same institution. However, if users wanted to find data under the same category but scattered in different databases, it will take a significantly longer amount of time, and not without the possibility of users becoming lost in a vast sea of data; users do not have access to complete information, and precious resources are thus neglected. The best solution is to establish an integrated database, using current databases as a foundation so that searches to do not stop at any single database, but link different databases into an integrated knowledge pool. This will not only increase the value of databases, but also provide the public with complete data on fields of knowledge associated with specific types of objects.

Collaboration with scholars and the industrial sector is required if digital content and technologies are to become a part of educational and the cultural and creative industry's development. Imprints are a part of Chinese culture that features Han characters in the form of artistic calligraphy styles. Digital imprint data not only serve the purpose of literary research and online browsing, but is also considered an important asset for promoting the art of calligraphy. Applications of digital resources all require collaboration with scholars and firms in each respective field. Like in a production line, each person is responsible for different tasks, but jointly works towards a common goal. In terms of digital archives, this goal is for the general public to gain integrated information of different fields with only a mouse click, turning hidden collections into valuable knowledge via organization, creation and sharing.



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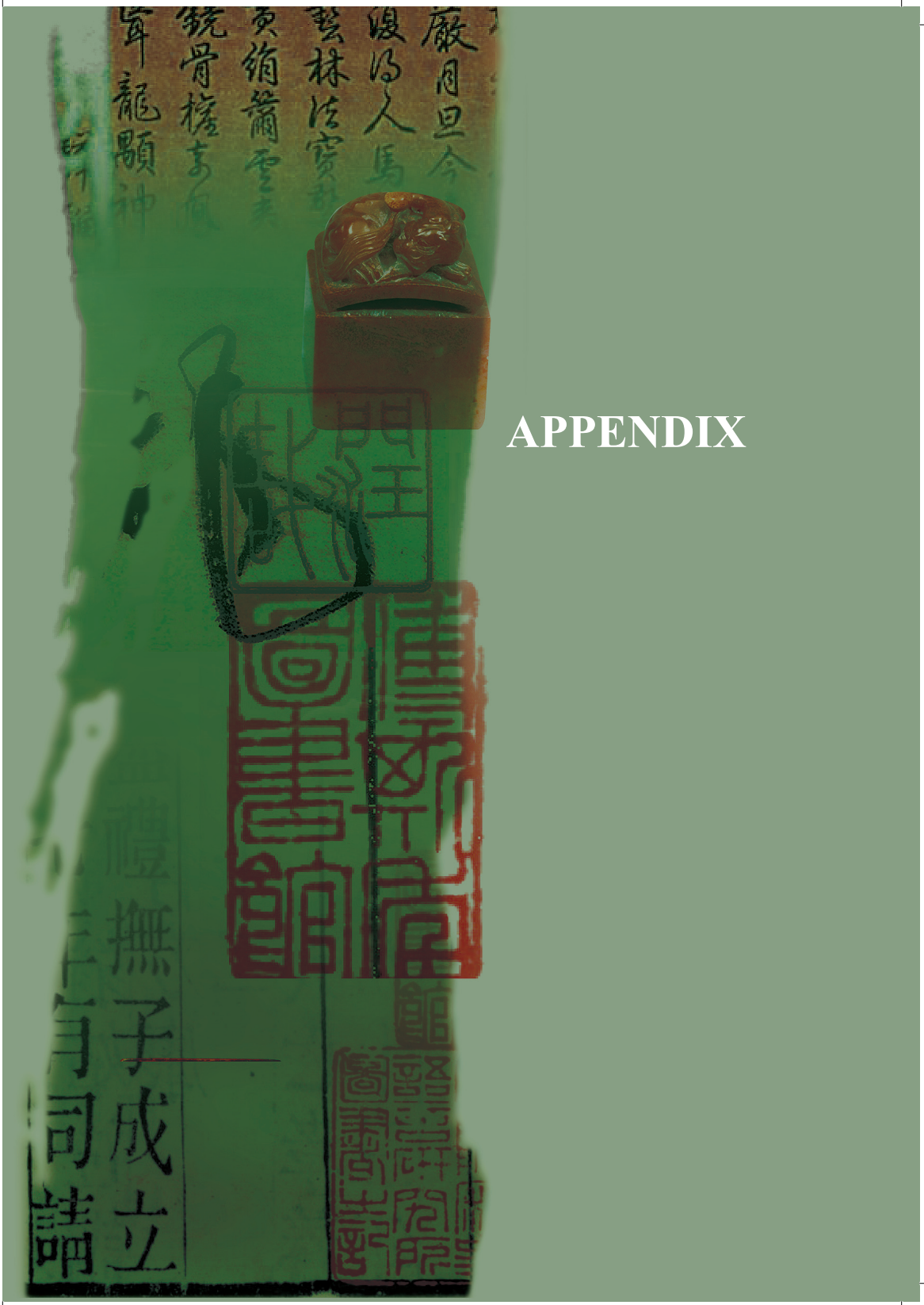

APPENDIX

Appendix 1 Introduction to Imprint Image Extraction Methods – Using Photoshop to Extract an Imprint Image

To preserve complete imprint images, below is a demonstration of using Photoshop tools to differentiate between the imprint and the painting or calligraphy. "Color swatch card" is used to remove the background and extract the imprint; the complete operation consists of "text removal," "background removal," and "image inprinting and adjustment," procedures are as follows:

1 Text removal

(1) Most imprints are extracted from paintings, calligraphy and ancient books. To extract an image of the imprint only, the background needs to be removed because imprints often overlap with text or drawings. First, select the "color swatch card" function, the image will only display two colors, black and white, and view which swatch card for the colors red, green, and blue (RGB) show the greatest contrast between black and white. This step benefits image inprinting and adjustments, and establishes the correct selection area. After comparing the three colors, you will see that the red swatch card shows the greatest contrast between the text and imprint. Therefore, the red swatch card is selecting in this step for text removal.

(2) Click right on the red swatch card and choose "copy swatch card" to create a "red copy" swatch card.

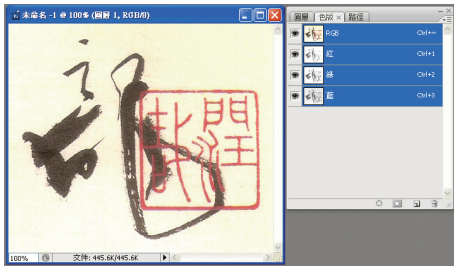

Fig.1-1 Original imprint

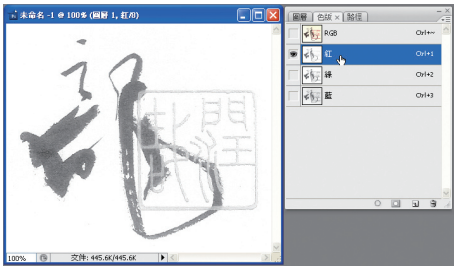

Fig.1-2 Red swatch card

(3) After selecting "red copy," in the tools menu select "image" → "adjust" → "curve." In the "curve" menu, select "sample image to set darkest point," move your mouse cursor to over the image and select the text portion to make the black part more apparent. Next, select "sample image to set brightest point," move your mouse cursor to over the imprint to make the imprint less apparent; this will make the contrast between black and white parts greater. Repeat the steps until the imprint completely disappears.

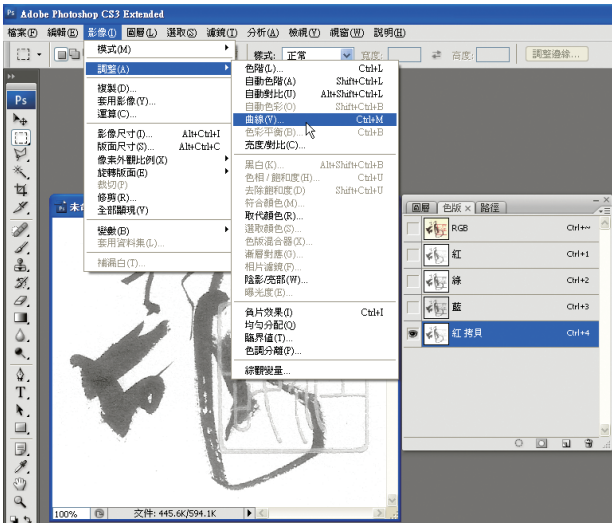

Fig.1-3 Select the curve function

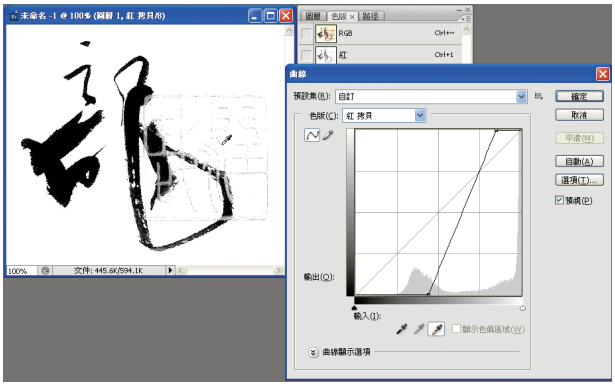

Fig.1-4 Adjust image contrast

(4) After making adjustments, press down on the “Ctrl” button and select the “Red Copy” swatch card to select white parts aside from the text. In the tools menu “select” → “inverse” to inverse the selected text portion.

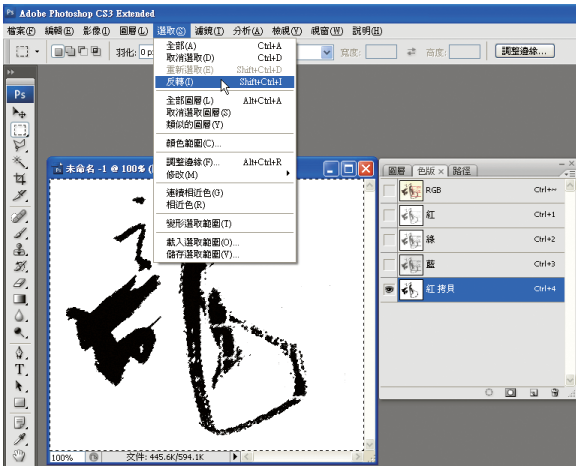

Fig.1-5 Selecting Inversion

(5) Return to "layer" and you will see the text portion selected, press the "Delete" button to remove the text portion.

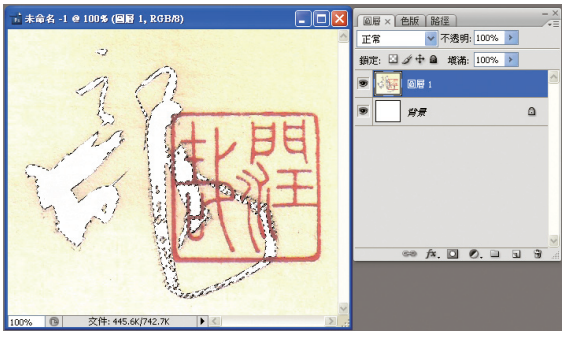

Fig.1-6 Text removal

2. Background removal

Most of the time imprint image extraction will be from ancient paintings or books. Due to its age, the paper might be slightly yellowish, however, even white paper might not appear white after being photographed or scanned. Therefore, to make the image clear with a uniform background, besides text removal, background removal also needs to be completed.

(1) After removing the text portion, reenter the "color swatch card" function, compare the swatch cards for red, green and blue, and determine which swatch card creates the greatest contrast between the imprint and the background color.

At this time, you will see the green swatch card provides the best effects.

Fig.1-7 Green swatch card

(2) The follow procedure is similar to "Text removal." First, create a "green copy" swatch card, and then in the tools menu select "image" → "adjust" → "curve" to adjust the image. For background removal, we need to make the imprint portion more apparent, so for "sample image to set darkest point" click on the imprint portion, and for "sample image to set brightest point" click on the white background. Repeat the steps until the background becomes completely white.

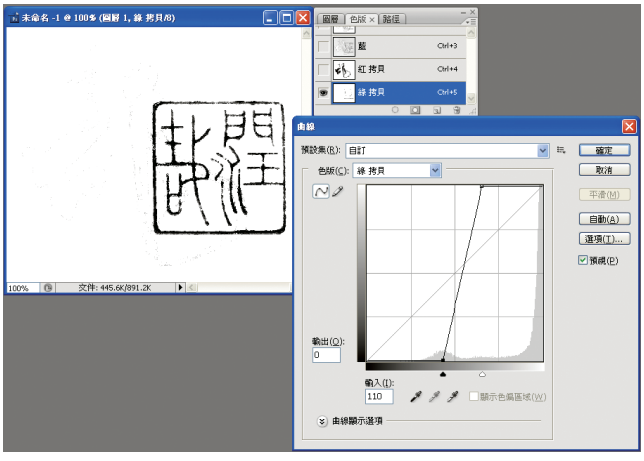

Fig.1-8 Copy the green swatch card, use the curve function adjust the image

(3) After making adjustments, press down on the "Ctrl" button and select the "Green Copy" swatch card to select white parts aside from the text. Return to "layer" and press the "Delete" button to remove the background with only the red imprint remaining.

Fig.1-9 Select the background

Fig.1-10 Delete the background

3. Image inprinting and adjustment

In the process of using color swatch cards for background removal, it is hard to completely remove the entire background. For remaining parts or parts of the imprint that has become blurry, use the "eraser" and "stamp" tool of Photoshop to make adjustments. The most important principle of making adjustments is to retain the overall style and lines of the original imprint. If the imprint is slant, in the tools menu select "Edit" → "Rotate." To adjust colors, select color calibration functions in "Image" → "Adjust" to make the imprint's color the same as its original. Finally, use the "cutting tool" to cut the imprint file into a suitable size to complete imprint image extraction.

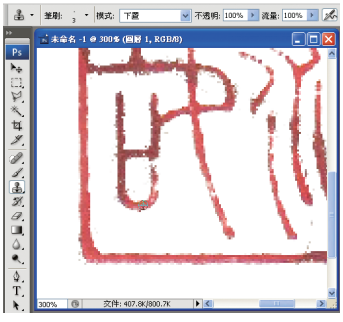

Fig.1-11 Stamp tool

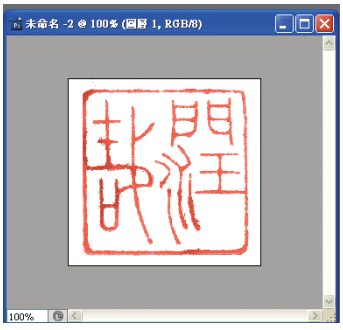

Fig.1-12 Imprint background removal complete

Seal and Imprint Digitization Procedures Guideline

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