A PROGRAMMED PROCEDURE FOR SELECTING MEASURED SURVEY METHODS

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ABSTRACT

Measured surveys of heritage buildings are done by a variety of methods for a variety of purposes. Survey planning calls for using the most appropriate methods for the documentation project at hand, and this study subscribes to that calling. Recognizing the need for a decision making process for selecting measured survey methods, the leading author, in previously published papers, has developed and described a selection procedure. This study is aimed at converting the procedure from its *descriptive* form into a computer *programmed* form. The complementary expertise of the authors (in documentation and programming analysis) facilitates the conversion. The resulting programmed procedure, like its descriptive predecessor, has a data collection function and a data processing function. The programmed procedure, or selection software, has been applied in a demonstrative documentation project for a heritage building in Bowling Green, Ohio. The procedure's inherent attributes, including systemic entry of data and automated processing of data, mark its potential as a heritage resource documentation tool.

1. INTRODUCTION

For long a commonplace modality in the heritage resource documentation, measured surveys are used to produce graphic documentation for architectural, archaeological, and other resource types. Survey projects are undertaken for resources of diverse contextual conditions to satisfy pre-determined project requirements. In case of buildings, a familiar resource type, survey projects are undertaken for buildings having different physical configurations (height, surface complexity) and site characteristics (size, intervening obstructions) under a range of climatic conditions (temperature, daylight). These survey projects are done for buildings of obviously different heritage values and for diverse purposes (restoration, archival). Such values and purposes, in turn, have influences on the required levels of accuracy, thoroughness, and rate of the documentation expected from the survey methods used. The Secretary of the Interior's Guidelines for Architectural and Engineering Documentation (2003) recognize such influences. This situation brings to the fore the question of what methods are appropriate to use in measured survey projects? Stated otherwise, what would prompt a survey team to select one method for one project, such as hand measurement, and another method for a second project, such as rectified photography? This study falls within the theme of measured survey method selection. It capitalizes on the results from two former papers: the first (Elwazani, ICOMOS 2002) has established a set of *standards* for evaluating the effect of contextual conditions on the performance of measured survey methods; the second paper (Elwazani, CIPA 2003) has outlined a *procedure* for applying the developed performance standards. The purpose of this study was to convert the obtained procedure from its *descriptive* language into a computer *programmed* form. In either form, the selection procedure deals with three aspects of the documentation situation: a) performance of survey methods in accuracy, thoroughness, and rate; b) the contextual conditions pertaining to the documentation subject, such as complexity of building surfaces; and c) the project requirements (or fundamental parameters) emanating from the purpose of survey, significance of the structure, and urgency of documentation. The process of converting the procedure descriptive form to its programmed form went through three major steps:

1. Recalling the descriptive procedure—as the background for the study
2. Converting the procedure's descriptive form into a programmed form
3. Applying the programmed procedure (software) Because this study addresses the need of the documentation and conservation community through attempting to yield a measured survey method selection tool, only the first and the third steps are relevant, and therefore, will be highlighted in the discussion below. The second step of "converting the procedure into a programmed form" is a programming analyst's exercise, and although important in its own right, it does not coincide with the interest of documentation audience, and therefore, will not be highlighted.

This study takes advantage of a number of opportunities: a) an adaptability of the procedure to an automated, programmed form, b) the value such form would add to the viability of the procedure as a documentation practice tool, and c) the potential of the programmed procedure for universal applicability and, hence, contribution to international collaborative documentation efforts by fostering survey practice common grounds.

2. RECALLING THE DESCRIPTIVE PROCEDURE

The previous research efforts for selecting measured survey methods for heritage buildings have resulted in the following:

- Clarifying variables in the documentation situation
- Establishing a set of *standards* for evaluating the effect of contextual conditions on the performance of measured survey methods
- Outlining a *procedure* for applying the developed performance standard

The paper "A Procedure for Evaluating Performance of Measured Survey Methods" (Elwazani 2003) has been the main source of background information for this study. The paper involved the following tasks: a) laying out the basis for the procedure, b) describing the procedure's data collection function, and c) describing the procedure's data processing function. Selected information based on the source paper appears below under three headings: Definitions and Groundwork, The Data Collection Function, and The Data Processing Function.

2. 1 Definitions and Groundwork

2.1.1 Basic Elements:

- o Survey subject: A building in its entirety is the documentation subject. Building "part" is the survey operational subject.
- o Significance of building:
  - Primary
  - Secondary
  - Tertiary
- o Purposes of surveys:
  - Preservation
  - Rehabilitation
  - Restoration
  - Archival
- o Survey methods (only three methods are appropriated):
  - Hand measurement (HM)
  - Estimation practices (EP)
  - Rectified photography (RP)
- o Contextual factors
  - Building factors: height, size, condition, complexity, concealment level
  - Site factors: size of property and surroundings, topography, obstructions
  - Climatic factors: temperature, humidity, wind, precipitation, daylight

2.1.2 Performance Types:

- o *Optimal* performance of a method requires the most conducive contextual conditions (factors) at the time of survey.
- o *Actual* performance of a method ensues from reducing optimal performance by the (reducing) effect of contextual factors.
- o *Absolute* performance of a method (in any attribute) is 100%.
- o *Required* performance of a survey project is a function of the purpose of the survey, significance of the subject, and urgency for the survey.

2.1.3 Performance Standards:

(A) Optimal Performance Standards. An optimal performance pertains only in the hypothetical case where all thirteen contextual conditions act at "most conducive" mode. Optimal performance values are established with a reference to absolute performance value in the attribute. For example, the rectified photography has an accuracy optimal performance of 90%, that is, 90% of the absolute accuracy—the accuracy that is attributed to some method, which may or may not be in the population of methods under consideration. The optimal performances of various methods are listed below:

Survey Method	Accuracy	Thoroughness	Rate
Hand measuring	80	80	70
Estimation practices	70	70	100
Rectified photography	90	100	80

(B) Standards for Measuring the Effect of Contextual Factors. Table 1 shows a matrix to help understand the interface of contextual factors with the performance attributes (accuracy, thoroughness, and rate) of the survey methods under discussion (in this case, hand measuring, estimation practices, and rectified photography).

Class	Attribute								
	Accuracy			Thoroughness			Rate		
	HM	EP	RP	HM	EP	RP	HM	EP	RP
Building Factors Category									
BF1: Height									
BF2: Size									
BF3: Condition									
BF4: Complexity									
BF5: Concealment									
Site Factors Category									
SF1: Size									
SF2: Topography									
SF3: Obstructions									
Climatic Factors Category									
CF1: Temperature									
CF2: Humidity									
CF3: Wind									
CF4: Precipitation									
CF5: Daylight									

Table 1. A matrix of contextual factors interface with the performance attributes

To help measure the *effect* of the 13 contextual factors on the accuracy, thoroughness, and rate performance of methods, a set of standards need to be developed. Using the factor "BF4: Complexity of building part" as an example, such intent (measuring the effect) was pursued through two steps: a) Breaking down individual factors into classes.

Class 1: Plain surface
Class 2: Somewhat complex surface
Class 3: Complex surface

b) Devising reference performance standards for each attribute. This was done by assessing the effect of this contextual factor (BF4) on the performances of the three methods in the attributes of accuracy, thoroughness, and rate. The schedule below shows the results, with numbers indicating the performance rankings of methods.

	Accuracy			Thoroughness			Rate		
Class	HM	EP	RP	HM	EP	RP	HM	EP	RP
Class 1	0	0	0	0	0	0	0	0	0
Class 2	2	3	1	2	3	1	3	1	2
Class 3	2	3	1	2	3	1	3	1	2

Three sets of standards will result:

- A set for assessing effect on accuracy
- A set for assessing effect on thoroughness
- A set for assessing effect on rate

(C)Establishing Project Required Performances

This begins with developing level scales for required performances of the three attributes:

- Required accuracy
- Required thoroughness
- Required rate

1. Defining universal performance levels:

- Level 1 (L1), high performance

- Level 2 (L2), medium performance
- Level 3 (L3), low performance

2. Assessing Required Accuracy and Required Thoroughness
Required accuracy and required significance are assessed simultaneously by correlating both purpose of documentation and significance of the structure as shown below.

Level of Significance	Purpose of Documentation			
	Restr.	Rehab.	Preser.	Arch.
Primary	L1	L2	L1	L1
Secondary	L1	L2	L2	L2
Tertiary	L2	L3	L3	L3

3. Assessing Required Rate
The more urgent the need for documentation, the higher the level of required performance:
- Intense urgency requires Level 1
- Moderate urgency requires Level 2
- Light urgency accepts Level 3

2.2 The Data Collection Function

This function deals with collecting data on the purpose of survey, significance of the structure, and urgency of survey, and contextual factors:
a) To answer
- whether the purpose is restoration, rehabilitation, preservation, or archival;
- whether the subject is of primary, secondary, or tertiary significance;
- whether urgency level is intense, medium, or light.

b) To determine "contextual severity" for each contextual factor. For example, the effort involving the BF4 "complexity of building part surfaces" will end up with determining that the surface under consideration is either a) plain, b) somewhat complex, or c) complex. Let's assume that the BF4 has been determined as Class 3: "complex surface." This fact will be checked against the established performance standards to locate the comparative rankings of performance of the methods in the accuracy, thoroughness, and rate attributes. Method rankings emanating from the BF4 scenario above will be as follows:

Peformance attruibute	Performance Rank		
	HM	EP	RP
Accuracy	2	3	1
Thoroughness	2	3	1
Rate	3	1	2

The checking process will result in thirteen comparative rankings of methods in accuracy, thoroughness and rate.
Table 2 illustrates a hypothetical itemization of the thirteen accuracy comparative rankings of methods. Similar itemizations can be completed for comparative rankings in thoroughness and rate.

2.3 The Data Processing Function

The procedure's design handles data processing function under the following tasks: -Assessing actual performances -Defining required performances -Matching required performances with actual performances -Selecting methods

2.3.1 Assessing actual performances: This is a rather intricate task with six consecutive steps repeated to assess the actual performance of each attribute separately. The percentage expressions below are the results of the actual accuracy assessment. Percentage expressions for actual thoroughness and actual rate are similarly obtained—and listed.

Method	Actual Accuracy Performance	Actual Thoroughness Performance	Actual Rate Performance
HM	74.597%		
EP	58.415%		
RP	90.000%		

Factor and Class	HM Rank	EP Rank	RP Rank
Building Factors			
BF1, Height: C2	3	2	1
BF2, Size: C3	1	3	1
BF3, Condition: C2	3	1	1
BF4, Complexity: C3	2	3	1
BF5, Concealment: C2	1	2	3
Site Factors			
SF1, Size: C2	1	2	3
SF2, Topography: C3	1	2	3
SF3, Obstructions: C2	1	2	3
Climatic Factors			
CF1, Temperature: C3	3	2	1
CF2, Humidity: C3	3	2	1
CF3, Wind: C2	3	2	1
CF4, Precipitation: C2	2	3	1
CF5, Daylight: C2	1	2	3
Summation of Actual Rankings	25	27	24

Table 2. Hypothetical itemization of the thirteen accuracy comparative rankings of methods

Percentage expressions of actual performances help classify these performances into levels, thus a level scale ensues. This scale applies to the three attributes of performance.

Level	Description
Level 1	High, $\geq$ 80%
Level 2	Medium, $\geq$ 60% to < 80%
Level 3	Low, < 60%

2.3.2 Defining Required Performances:
- Required accuracy
- Required thoroughness
- Required rate

a) Define universal performance levels:
- Level 1 (L1), high performance
- Level 2 (L2), medium performance
- Level 3 (L3), low performance

b) Assess Required Accuracy and Required Thoroughness
Required accuracy and required significance are assessed simultaneously by correlating both purpose of documentation and significance of the structure as shown below.

Level of Significance	Purpose of Documentation			
	Restor.	Rehab.	Preser.	Arch.
Primary	L1	L2	L1	L1
Secondary	L1	L2	L2	L2
Tertiary	L2	L3	L3	L3

c) Assess required Rate
The more urgent the need for documentation, the higher the level of required performance:

- Intense urgency requires Level 1;
- Moderate urgency requires Level 2;
- Light urgency accepts Level 3.

2.3.3 Matching Required Performances with Actual Performances.

The matching process would be guided by a matrix like the one shown below:

Method	Accuracy		Thoroughness		Rate	
	Act.	Req.	Act.	Req.	Act.	Req.
HM EP RP						

Matching results could be tabulated as follows:

Required Performances	Satisfying Methods
Accuracy	HM, RP
Thoroughness	RP
Rate	EP, RP

2.3.4 Selecting Methods.

Determine what methods would independently satisfy the entire set of performance factors. Referring to the preceding scenario, it is obvious that rectified photography (RP) is the only method that would, by itself, satisfy the entire set of required performances— for this part of survey subject.

3. APPLYING THE PROGRAMMED PROCEDURE

The use of the programmed procedure will be explained below through its application to a documentation subject, the Detention Home in Bowling Green, Ohio (Figure 1). The discussion will be tackled from the point of view of using the programmed procedure which addresses the "survey planner's" concerns—not the programming analyst's concerns. This means the focus will be on the data collection function of the procedure. The data processing function, although embedded in the core of the software design, will not be highlighted.

Figure 1. The Detention Home, Bowling Green, Ohio, the Survey Subject

Explaining the application of the selection procedure to documenting the Detention Home will go through two steps: a) collecting the data about the project, subject, and context, and b) using the software, including entering the data. The handling of data throughout the above two steps will not be all-encompassing; handling will go only far enough to provide sufficient explanation

3.1 Collecting the data about the project, subject, and context

3.1.1 Determining the Project Fundamental Parameters:

- Significance: Primary
- Purpose: Rehabilitation
- Urgency: Light

3.1.2 Determining Building Parts:

1. North Elevation, Ground Level
2. North Elevation, Above Ground Level
3. East Elevation, Ground Level
4. East Elevation, Above Ground Level
5. South Elevation, Ground Level
6. South Elevation, Above Ground Level
7. West Elevation, Ground Level
8. West Elevation, Above Ground Level
9. Roof
10. Interior

3.1.3 Determining Contextual Factors Conditions for Each Part.: Using Part 1, North Elevation, Ground Level as an example, the contextual factors data have been determined as in Table 3.

Contextual Factors	Condition/Class
Building Factors	
BF1: Height	Class 1: One story, ground level
BF2: Size	Class 2: 500-3000 square feet
BF3: Condition	Class 1: Safe
BF4: Complexity	Class 2: Somewhat complex
BF5: Concealment	Class 1: Unconcealed surface
Site Factors	
SF1: Size of property	Class 1: Suitable for Photography & Sighting
SF2: Topography	Class 1: Level & Plain Topography
SF3: Obstructions	Class 2: Some Obstructions
Climatic Factors	
CF1: Temperature	Class 2: Somewhat uncomfortable Temp.
CF2: Humidity	Class 3: Uncomfortable humidity
CF3: Wind	Class 1: Moderate wind
CF4: Precipitation	Class 2: Some precipitation
CF5: Daylight	Class 2: Somewhat insufficient

Table 3. Contextual factors data for Part 1, North Elevation-Ground Level

3.2 Using the Software

The use of the software will be explained below through steps, illustrated by figures depicting the respective windows in the software.

Window 1: Subject Name and Parts (Figure 2)

- Name of Building to Be Documented
- Number of Parts

Figure 2. Window 1: Subject Name and Number of Parts

Window 2: The Project Fundamental Parameters Information (Figure 3)

- Significance of the Detention Home Building
- Purpose of Documentation of Detention Home Building
- Urgency of Documentation of Detention Home Building

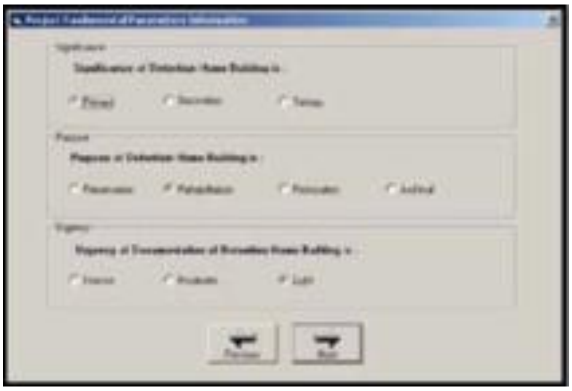

Figure 3. Window 2: The Project Fundamental Parameters Information

Window 3: Contextual Factors Conditions, Building Factors (Figure 4)

- Height of Building Part: One story, ground level (Class 1)
- Size of Building Part: 500-3000 square feet (Class 2)
- Condition of Building Part: Safe (Class 1)
- Complexity of Building Part Surfaces: Somewhat complex (Class 2)
- Concealment of Building Part Surfaces: Unconcealed surface (Class 1)

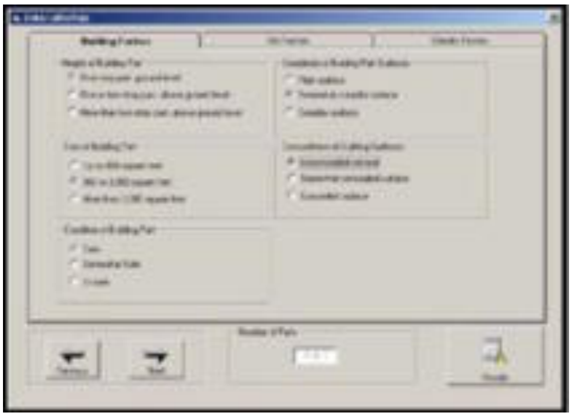

Figure 4. Window 3: Contextual Factors Conditions, Building Factors

Window 4: Contextual Factors Conditions, Site Factors (Figure 5)

- Site of Property: Expanded, Suitable for photography and sighting (Class 1)
- Topography of Site: Level and plain (Class 1)
- Obstructions on Site: Some obstructions (Class 2)

Figure 5. Window 4: Contextual Factors Conditions, Site Factors

Window 5: Contextual Factors Conditions: Climatic Factors (Figure 6)

- Temperature: Somewhat uncomfortable temperature (Class2)
- Humidity: Uncomfortable humidity (Class 3)
- Wind: Moderate wind (Class 1)
- Precipitation: Some precipitation (Class 2)
- Daylight: Somewhat insufficient (Class 2)

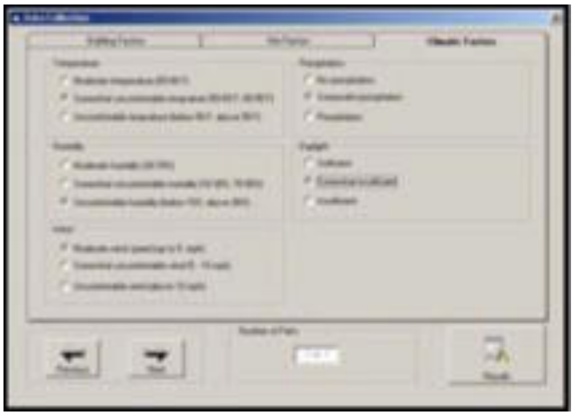

Figure 6. Window 5: Contextual Factors Conditions, Climatic Factors

Window 6: Selection Results (Figure 7)

Restating identification information

Name of Building; Number of Parts

Level of Significance

Purpose Urgency

Methods that satisfy performances—Per Part

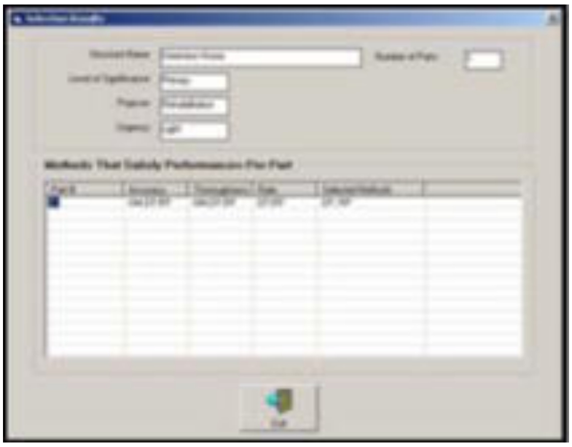

Figure 7. Window 6: Selection Results

4. CONCLUSIONS

In attempting to arrive at a programmed procedure for measured survey method selection, this study capitalized on the results from previous work of the leading author, wherein a descriptive procedure had been developed and described. Having diverse but complimentary backgrounds, the authors collaborated on three tasks: first, recalling the descriptive procedure and preparing it for conversion; second, converting the procedure into a computer programmed form—software; and third, applying the program to a demonstrative documentation project. Although the second task (converting the procedure) was performed—and was the basis for the third task—it has not been included in the discussion because it is tangential to the "use" purpose of the programmed procedure (software). The success of the programmed procedure depends on the soundness of three factors: the procedure design, the computer program development (conversion process), and the aptitude of the user. Concerning the latter, the user's sufficient knowledge of survey methods, their application, and project context is necessary to enable appropriate collection or determination of data. In comparison, entering the data is relatively easy and the obtaining of selection results is rather speedy.

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