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Risk Management approach for Cultural Heritage Projects Based on Project Management Body of Knowledge

M.R. Hajialikhani, Civil Engineer,
MSc. in Project Management
hajialikhani_mr@yahoo.com

1. Introduction

The idea of using “Project Management Body of Knowledge “(PMBOK guide), for managing cultural heritage sites, was developed under a dissertation topic for graduation in master of science degree in project management. It was discussed that PMBOK may be useful as an alternative approach for management of some cultural heritage sites, which was presented in the 1st International Conference on:”Sustainable Local Heritage Conservation, The Transdisciplinary Approach”, (17-19 November 2006, Udonthani, Thailand.).

One area of PMBOK guide has guidelines for risk management of projects, to be specifically discussed for cultural heritage risk management. This paper tries to adapt the project risk management guide lines for heritage sites risk management, which is proposed to be accommodated to theme 6 of the symposium, “Heritage disasters and risk preparedness”. Heritage sites are continuously threatened by different risks, having different probability of occurrence and different impacts on the heritage site.

In case of extreme heritages the problem is that they are either out of the control region of responsible organizations or are less accessible. Thus it is important to have a prepared and ready risk response plan for treating various possible risks. PMBOK (Published by Project Management Institute - PMI, USA) introduces a systematic approach for risk management of the projects.

2. Project Management Body Of Knowledge (PMBOK)

“The Project Management Body Of Knowledge (PMBOK) is the sum of knowledge within the profession of project management. The complete PMBOK includes proven traditional practices that are widely applied, as well as innovative practices that are emerging in the profession”. “Managing a project includes identifying requirements, establishing clear and achievable objectives, balancing the competing demands for quality and scope and time and cost, adapting the specifications and plans and approaches to the different concerns and expectations of the various stakeholders”.

The “Project Management Institute (PMI)”, USA, has developed a procedure for project management, known as “A Guide to the Project Management Body of Knowledge (PMBOK Guide)” in 2000, improved in 2004 edition. The guide arranges a systematic procedure for management of any kind of projects (i.e. construction, IT, aerospace, etc.), with relevant methods, techniques and tools for a successful management. PMBOK guide and its construction extension divide the project management knowledge into 13 areas (Figure 1):

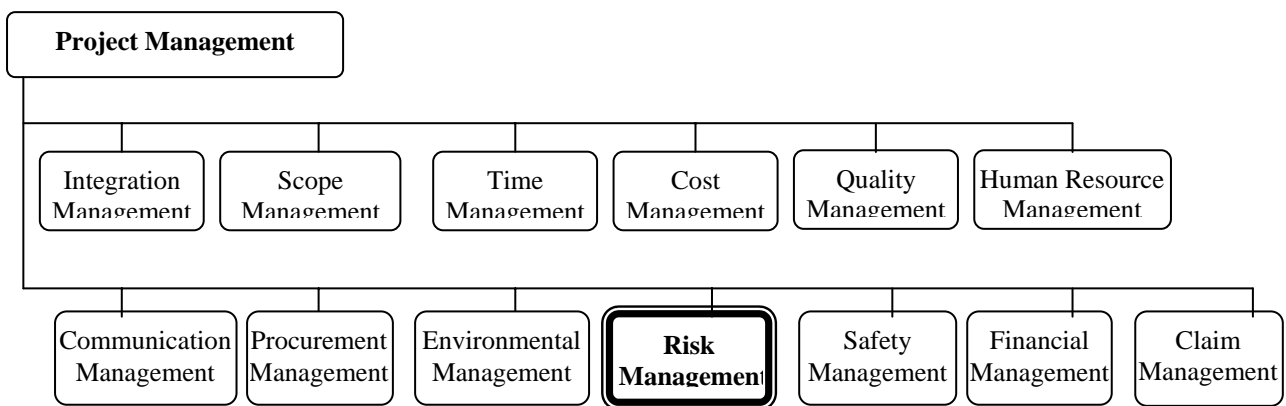


Figure 1- PMBOK Structure for project Management

- 1- Project Integration Management: describes processes needed to identify, and coordinate the various elements of project management.
- 2- Project Scope Management: describes processes that ascertain the project includes all and only the work required, to complete the project successfully.
- 3- Project Time Management: describes processes concerning timely completion of the project.
- 4- Project Cost Management: describes processes involved in planning, estimating, budgeting, and controlling costs, so that the project is completed within the approved budget.
- 5- Project Quality Management: includes activities that determine quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken.
- 6- Project Human Resource Management: organize and manage the project team.
- 7- Project Communication Management: describes processes for timely and appropriate generation, collection, dissemination, storage and ultimate disposition of project information.
- 8- Project Risk Management: (see below).
- 9- Project Procurement Management: describes the processes that purchase or acquire products, services or results and also contract management.
- 10- Project Safety Management: describes the processes required to assure that the project is executed with appropriate care to prevent accidents that cause injury or damages.
- 11- Project Environmental Management: describes the processes required to ensure that the impact of the project execution to the surrounding environment will remain within the legal permits.
- 12- Project Financial Management: describes the processes to acquire and manage the financial resources, and more concerned with revenue sources and analyzing and updating net cash flow.
- 13- Project Claim Management: describes the processes required to eliminate or prevent claims from arising and for the expeditious handling of claims if they do occur.

3. Risk Management as per PMBOK Guide

Risk is an uncertain event or condition that, if it occurs, has a positive effect (opportunities) or a negative effect (threats) on at least one project objective (time, cost, scope, quality). Project Risk Management describes processes concerned with planning identification, analysis, responses planning, monitoring and control of risks. The objectives of Risk Management are to increase the probability and impact of positive events, and decrease the probability and impact of events adverse to the project. The Risk management processes as per PMBOK shall include the below (Figure 2):

- 1- Risk Management Planning – deciding how to plan, and execute the risk management activities, briefly preparing *Risk Management Plan*.
- 2- Risk Identification – determining which risks might affect the project
- 3- Qualitative Risk Analysis – prioritizing risks for further analysis
- 4- Quantitative Risk Analysis – numerically analyzing the effect on overall project objectives
- 5- Risk Response Planning – developing actions to enhance opportunities, and reduce threats
- 6- Risk Monitoring and Control – tracking identified risks, monitoring residual risks, executing risk response plans, and evaluating their effectiveness throughout the project life cycle.

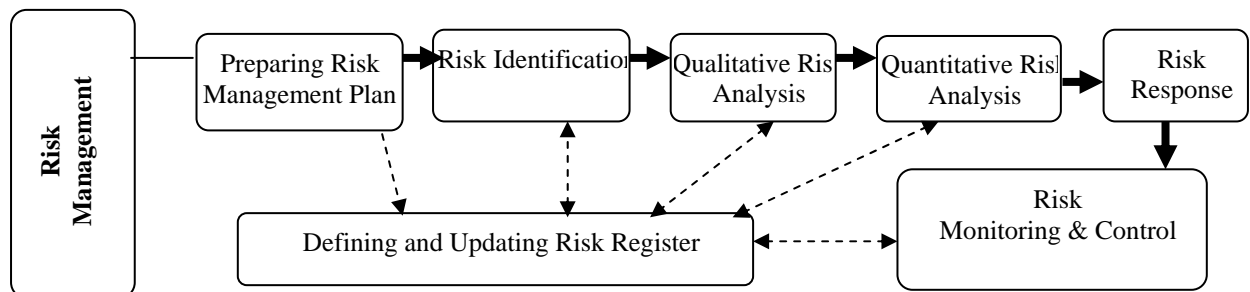


Figure 2- Risk Management Processes

4. Risks of Cultural Heritage Sites

As above mentioned, a risk breakdown structure (RBS) shall be defined in the risk management plan (as in Figure 3), a general RBS may be defined for all cultural sites to help the risk management, and not to forget any possible risks. The risks may be positive (opportunity) or negative (threats):

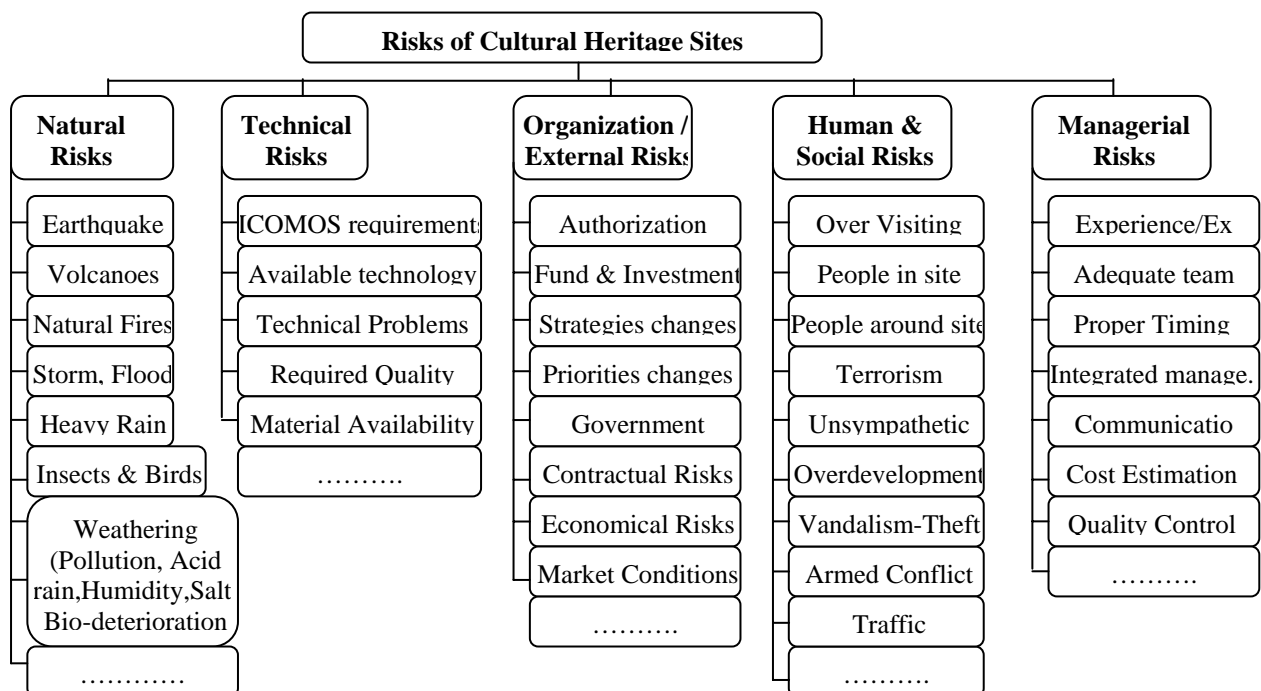


Figure 3- Risk Breakdown Structure for Heritage

5. Risk management plan

It describes how risk management will be structured and performed and shall include the followings:

- **Methodology:** Defining the approaches, tools, and data sources to perform risk management
- **Roles and responsibilities:** Defining people for each type of activity in the risk management plan
- **Budgeting:** Assigning resources and estimates costs needed for risk management
- **Timing:** Determining when and how often the risk management process will be performed
- **Risk categories:** Providing a structure for systematically identifying risk. A risk breakdown structure (RBS) is proposed in Figure 3 for cultural heritage conservation project.
- **Definitions of risk probability and impact:** A relative scale representing probability values from “very unlikely” to “almost certainty” can be used. The impact scale reflects the significance of impact (negative for threats or positive for opportunities), on each project objective if a risk occurs. Relative scales for impact such as “very low,” to “very high,” can be used. Numerical scale (e.g., 0.1, 0.3, 0.5, 0.7, 0.9 or from 10% to 90%) may be used for both probability and impact (Table-1).

Table-1: Definitions of risk impact On Objectives

Objective	Negative Risk (Treat)					Positive Risk (Opportunity)				
	0.1	0.3	0.5	0.7	0.9	0.1	0.3	0.5	0.7	0.9
Cost / Funds	Little Cost increase/ less funds	< 10% cost increase / less funds	10-20% cost increase / less funds	20-40% Cost increase/ less funds	> 40% cost increase / Less fund	Little Cost decrease/ more Funds	< 5% cost increase/ <5% more fund	5-10% cost decrease / 5-10% more funds	10-20% Cost decrease/ less funds	>20% cost decrease / less funds
Time	Little Time increase	< 5% time increase	5-10% time increase	10-20% time increase	> 20% time increase	Little Time decrease	< 2% time decrease	2-5% time decrease	5-10% time decrease	> 10% time decrease
Quality	Quality as ICOMOS approved	Few tolerance, negligible	Threaten ICOMOS rules	ICOMOS not accept the work	ICOMOS rejecting manage	Quality as ICOMOS approved	Little better than planned			
Scope	No scope change	Few part of Site affected	Site partly affected / Damage	Major damage to site	Site mostly affected /damaged	No scope change	Few part of Site affected	Site partly affected	Major affect to site	Site mostly affected

- **Probability and impact Matrix:** Risks are prioritized according to their potential implications on project objectives, as shown in a Probability and Impact Matrix (Table-2). Combinations of probability and impact lead to a risk being rated as “high,” “moderate,” or “low” importance (for planning responses to the risk), are usually set by the organization.
- **Revised stakeholders’ tolerances:** A cultural heritage project may have various stakeholders such as client, government authorities, sponsors, ICOMOS, environmental preservation organizations, researching institutes, consultants, contractors, final users, local people in and around the site, etc. Stakeholders’ tolerances regarding the specific project objects shall be defined.
- **Reporting formats:** The content and format of the risk register (see below), and any other risk reports and documentations, analyzes, and communications shall be defined.

Table-2: Probability and Impact Matrix (Risk Importance Factor)

Impact \ Probability	Negative Risk (Treat)					Positive Risk (Opportunity)					Description
	0.1	0.3	0.5	0.7	0.9	0.9	0.7	0.5	0.3	0.1	
0.1	0.01	0.03	0.05	0.07	0.09	0.09	0.07	0.05	0.03	0.01	Risk Importance Factor (RIF) RIF < 0.05 : Low Importance 0.05 < RIF < 0.15 : Moderate Importance RIF > 0.15 : High Importance
0.3	0.03	0.09	0.15	0.21	0.27	0.27	0.21	0.15	0.09	0.03	
0.5	0.05	0.15	0.25	0.35	0.45	0.45	0.35	0.25	0.15	0.05	
0.7	0.07	0.21	0.35	0.49	0.63	0.63	0.49	0.35	0.21	0.07	
0.9	0.09	0.27	0.45	0.63	0.81	0.81	0.63	0.45	0.27	0.09	

- **Tracking:** Documents how all facets of risk activities will be recorded for the benefit of the current project, and future needs, and whether and how risk management processes will be audited.

6. Risk Identification

After preparing the risk management plan that shows the basis of the work, how the work shall be done and the risk main categories, the primary risk breakdown structure (RBS) is set up. Then other possible risks of the site may be identified, nothing to be forgotten, and will be added to the RBS. It is recommended that at this stage all the site management team, risk experts, experts of similar cultural site, other site managers, stakeholders' representatives, ICOMOS risk experts (having experience in risk management of other similar sites), and even other project personnel cooperate in identifying the risks. *It is recommended to arrange a risk management committee in ICOMOS to share the risk management experiences between cultural sites and provide technical supports to them.* Accordingly the characteristics of the risks shall be investigated and a **Risk Register** will be initiated. Based on previous organizational or international experiences and documents for similar sites or sites conditions, the risk register may contains **List of identified risks, List of potential responses, Root causes of risk, and a risk breakdown structure (RBS).**

7. Qualitative Risk Analysis

At this stage, the risk management team will determine rapidly which risk has priority for quantitative risk analysis and planning the relative risk response. This shall be done by considering the probability of occurrence and the corresponding impact (using definitions of risk impact on objectives probability and impact matrix or risk importance factor as described in Figures 4 and 5). Accordingly the responsible organization shall focus on high-priority risks. This analysis may be updated during the project life. A summary report is proposed for the outcome in Figure 6. Through calculating the biggest Risk Importance Factor (RIF-probability multiplied by biggest impact), we may find the risks to have high and moderate importance for necessary further actions:

Figure 6: Summary Outcome of Qualitative Risk Analysis

SI	Risk Category	Risk	Occurring Probability	Possible Impact on objectives				Biggest RIF	Result
				Cost	Time	Quality	Scope		
1-1	Natural Risks	Earthquake	0.3	0.9	0.9	0.9	0.9	0.27	High Importance
1-2		Storm, Flood	0.3	0.1	0.1	0.1	0.1	0.03	Low Importance
1-3		Volcanoe	0.0	-	-	-	-	0.0	Low Importance
1-5		Weathering (Pollution,)	0.9	0.5	0.5	0.8	0.3	0.72	High Importance
2-1	Technical Risks	ICOMOS requirements	0.3	0.3	0.5	0.1	0.1	0.15	Moderate Importance
2-2		Available technology	0.3	0.5	0.7	0.3	0.1	0.21	High Importance
2-4		Obtaining Required Quality	0.1	0.7	0.3	0.5	0.1	0.07	Moderate Importance

By this analysis, the risk register may be updated and include:

- **Relative ranking or priority list of project risks:** probability and impact matrix is used to classify the risks according to their significance, and prepare a list of prioritized risks to focus on.
- **Risks grouped by categories:** Risk categorization can reveal common root causes of risk.
- **List of risk requiring short term response:** Those risks that require an urgent response and those that can be handled at a later date may be put into different groups.

- **List of risks for additional analysis and response:** Some risks might warrant more analysis, including Quantitative Risk Analysis, as well as response action.
- **Watch-lists of low priority risks:** Risks that are not assessed as important in the Qualitative Risk Analysis process can be placed on a watch-list for continued monitoring.
- **Trends in qualitative risk analysis results:** As the analysis is repeated, a trend for particular risks may become apparent, and make risk response or further analysis more or less urgent/important.

8. Quantitative Risk Analysis

After prioritizing the high importance risks, the time and cost consuming methods of quantitative risk analysis may be performed for analyzing the effect of those risks on the site that have been determined as high risks, and the second stage the moderate risks shall be analyzed. Techniques such as such as Monte Carlo simulation and decision tree analysis to:

- Quantify the possible outcomes of risks and their probabilities
- Assess the probability of achieving specific objectives
- Identify risks requiring the most attention by quantifying their relative contribution to overall risk
- Identify realistic and achievable cost, schedule, or scope targets, given the risks
- Determine the best management decision when some conditions or outcomes are uncertain.

Quantitative Risk analysis, may updated the risk register by:

- **Probabilistic analysis of the project:** Estimating potential schedule and cost outcomes, listing the possible completion dates and costs with their associated confidence levels, quantifying the cost and time contingency reserves that are needed to bring the risk of overrunning stated project objectives to a level acceptable to the organization.
- **Probability of achieving cost and time objectives:** With the facing risks, the probability of achieving objectives under the current plan can be estimated.
- **Prioritized list of quantified risks:** This list of risks includes those that pose the greatest threat or present the greatest opportunity

9. Risk Response Planning

After qualitative and quantitative risk analysis, possible responses to each risk shall be planned, in order to enhance opportunities and reduce the threats. For example if there is a risk of fund shortage, which activities shall be done or which shall be pended to minimize the unwanted outcomes.

On the other hand if we have an opportunity of receiving more fund, do we have any plan to utilize it in the best optimum way? At this stage for any of the agreed risks, a responsible person shall be determined for necessary actions. Appropriate responses are chosen, agreed, and included. Often, the high and moderate risks are addressed in detail. Low priority Risks are included in a “watch-list” for periodic monitoring. Also for any risks a strategy shall be determined:

9.1. Strategies for Negative Risks or Threats

- **Avoid:** Risk avoidance is eliminating the threat posed by an adverse risk, to isolate the objectives from the risk’s impact, or to relax the objective that is in jeopardy, such as extending the schedule or reducing scope. Some risks that arise early in the can be avoided by clarifying requirements, obtaining information, improving communication, or acquiring expertise.
- **Transfer:** Risk transference requires shifting the negative impact of a threat and ownership of the response to a third party and does not eliminate it. Transferring liability is effective in dealing with financial risk exposure. Risk transference nearly always involves payment of a risk premium to the party taking on the risk (insurance, performance bonds, warranties, guarantees, etc).
- **Mitigate:** Risk mitigation implies a reduction in the probability and/or impact of an adverse risk event to an acceptable threshold. Taking early action to reduce the probability and/or impact of a risk occurring is often more effective than trying to repair the damage after the risk has occurred.

Adopting less complex processes, conducting more tests, or choosing a more stable supplier are examples of mitigation actions.

9.2. Strategies for Positive Risks or Opportunities

- **Exploit:** This strategy may be applied where the organization wishes to ensure that the opportunity is realized. It eliminate the uncertainty associated with a particular upside risk by making the opportunity definitely happen. Directly exploiting responses include assigning more talented resources to the project to reduce the time to completion, or to provide better quality than originally planned.
- **Share:** Sharing a positive risk involves allocating ownership to a third party who is best able to capture the opportunity for the benefit of the project. Examples of sharing actions include forming risk-sharing partnerships, teams, or joint ventures, which can be established with the express purpose of managing opportunities.
- **Enhance:** This strategy modifies the “size” of an opportunity by increasing probability and/or positive impacts, and by identifying and maximizing key drivers of these positive-impact risks. Seeking to facilitate or strengthen the cause of the opportunity, and targeting its trigger conditions, might increase probability. Impact drivers can also be targeted, seeking to increase the project’s susceptibility to the opportunity.

9.3. Strategy for Both Threats and Opportunities

- **Acceptance:** It is not possible to eliminate all risk from a project. So the project team decides not to change the management plan to deal with a risk, or is unable to identify any response strategy (either for threats or opportunities). This strategy can be either passive (no action) or active (establish a contingency reserve, including amounts of time, money, or resources to handle known or unknown threats or opportunities).

9.4. Contingent Response Strategy

Some responses are used only if certain events occur. For some risks, it is better to make a response plan that will only be executed under certain predefined conditions. Events that trigger the contingency response, such as missing intermediate milestones or gaining higher priority with a supplier, should be defined and tracked.

9.5. Updating Risk Register

The risk register at this point can include:

- Risks descriptions, areas of the project affected and how they may affect them.
- Risk owners and assigned responsibilities
- Outputs of risk analysis processes (I/c prioritized lists of risks, probabilistic analysis of the project)
- Agreed-upon response strategies, Specific actions to implement the chosen response strategy
- Symptoms and warning signs of risks’ occurrence
- Budget and schedule activities required to implement the chosen responses
- Contingency reserves of time and cost designed to provide for stakeholders’ risk tolerances, or calculated based on the quantitative analysis of the project and the organization’s risk thresholds.
- Contingency plans and triggers that call for their execution
- Fallback plans for use as a reaction to a risk that the primary response proves to be inadequate
- Secondary risks that arise as a direct outcome of implementing a risk response
- Residual risks that remain after planned responses been taken, and those deliberately accepted

10. Risk Monitoring and Control

It is the process of identifying, analyzing, and planning for newly arising risks, keeping track of the identified risks and those on the watch-list, reanalyzing existing risks, monitoring trigger conditions

for contingency plans, monitoring residual risks, and reviewing the execution of risk responses while evaluating their effectiveness. it determines if:

- Project assumptions are still valid
- Risk, as assessed, has changed from its prior state, with analysis of trends
- Proper risk management policies and procedures are being followed
- Contingency reserves of cost or schedule should be modified in line with the

During and after an updated risk register may also contain:

- Outcomes of risk reassessments, audits, and periodic risk reviews, such as updates to probability, impact, priority, response plans, ownership, and other elements of the risk register. Outcomes can also include closing risks that are no longer applicable.
- The actual outcomes of the project's risks, and risk responses that can help project managers plan for risk throughout the organization, as well as on future projects.

11. Conclusion

- PMBOK introduces a systematic approach for risk management which is also possible to be used in heritage risk management.
- Due to large amount of projects' turnover around the work and the importance of risk management for projects, several softwares have been developed for project risk management. Therefore by adopting the project risk management, they me be useful for site risk management also.
- Accordingly site risk management may include risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning and risk monitoring and control. It was tried to adapt this approach for risk management of heritage sites.
- A risk register shall be created to include all the data and processes for risk management. A preliminary risk register is made at the start of the risk planning and will be updated and completed during the risk management
- It is recommended to arrange a risk management committee in ICOMOS to share the risk management experiences between cultural sites and provide technical supports to them

12. References

- 1- Project Management Institute, "**A guide to the project management body of knowledge (PMBOK)**", Project Management Institute, 2004
- 2- Project Management Institute, "**Construction extension to a guide to the project management body of knowledge (PMBOK -Guide)- 2000 Edition**", Project Management Institute, 2003
- 3- Hajjalikhani M.R., "1st International Conference on:"Sustainable Local Heritage Conservation, The Transdisciplinary Approach", 17-19 November 2006, Udonthani, Thailand