Title

GIS Analysis for Sustainable Heritage Management in Luang Prabang

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1. Introduction/Background

Since the establishment of the UNESCO World Heritage Convention in 1972, both public and private sectors around the world have attached growing importance to the safeguarding and conservation of the cultural and natural heritage. The inscription of the World Heritage comes with positive and negative implications. World Heritage Sites receive major publicity and attention, resulting in increasing number of tourists. At the same time, in spite of its economic benefits and political prestige, the local governments and communities with little experience often face the dilemma to cope with the sudden increase of tourists as well as rapid development.

Luang Prabang of Lao PDR, inscribed as the World Heritage Site in 1995, is an outstanding example of the fusion of traditional architecture and Lao urban structures with those built with European influences in the 19th and 20th centuries. It has unique and remarkably well-preserved townscape which illustrates the blending of Asian and European distinct cultural traditions. In this small town, the number of tourists grew five times between 1995 and 2006, giving opportunities and challenges to local authorities and communities.

Through collaborative works of Tokyo Institute of Technology (Tokyo Tech), UNESCO, and the Department of World Heritage, Luang Prabang (DPL) of Lao Government, the study found a strong need for strategic management of the heritage site by introducing applicable information technology. As International Telecommunication Union indicates, information communication technology (ICT) itself is not a direct element which contributes to development. It rather accelerates development for local population by facilitating access to information and communication, thus, complementing different development activities in education, culture, health and tourism. During the first phase of last four years, the joint ICT team worked on the different components, ranging from establishment
of database of heritage information and building authorization to development and management of ICT center, as well as local human resources development.

Information management and dissemination is a vital element for a community to create instruments that can guide its development towards a model that is sensitive to its natural and cultural environment, and, hence, is socially and economically sustainable. Sustainability is a universal concept, but not all territories face concurrent developmental issues. Specific dilemmas suggest that actions for sustainable development have to be contemplated through the lenses of local priorities. This joint project consists on the introduction of a system comprising a database of architectural heritage, environmental assets and cultural intangibles. The database will both consolidate and systematise information available and provide a framework for the insertion of further multidisciplinary and multidimensional data. The system will raise awareness with regards to the importance of preserving what makes Luang Prabang a special place, such as its urban fabric, which blends sacred and civil, colonial and vernacular, natural and man-made, in a harmonious, human-scale microcosm. It also provides a cross-cutting linkage between local government departments and administration bodies involved in land development, heritage, urban management and technology. And, importantly, the introduction of information technology will broaden experiences for individuals, particularly for young generation at community level.

During the second phase of the activities, the project team have worked on introducing GIS (Geographic Information System), considering basic important aspects such as data collection method, development of basic map and developing local human resources. Localized GIS prototype was developed to study the changes occurred in core part of heritage town of Luang Prabang between 1999 and 2009. This paper intends to illustrate analysis on such changes from selected building attributes, namely, building usage, types of architecture, building materials used, and the building conditions. Feedback from local residents is also used to support explanation on such changes.

2. Methodology

The pilot study area of 6 villages is situated in the core of heritage site, where tourism and restaurant business as well as cultural activities are concentrated. It is one of the most animated areas for visitors. First, two base maps were created for 1999 and 2009 for comparative purposes. 1999 map include 701 buildings,
including 206 inventory buildings, while 2009 map has 745 buildings with 205 inventory building. The sample size of 700 buildings in 1999 and 745 buildings in 2009 was used for special analysis. Second, building data of 1999 was retrieved from authorization data file from the archives of DPL. Recent building information data was collected filling out data sheet developed by DPL architectures section, covering 14 feature attributes of the buildings. Field survey was conducted in 2009 and 2010. Third, for the spatial analysis, ArcGIS software 9.3.1 was utilized to analyse and trace the trend of changes in each building attribute. The building attributes of 1999 and that of 2009 are compared through geo-visualization and statistical analysis. In geo-visualization, building attribute is overlaid using thematic mapping to observe the difference in geographical distribution of buildings. In statistical analysis, the building attributes are queried and summarized using analysis toolbox, join-table and selection tools. The final analysis of changes was supplemented by the qualitative questionnaire conducted with the residents in 2011.

3. Data analysis on changing trend

This section covers summary of GIS data analysis on changing trend from five selected aspects, including 1) building usage, 2) types of architecture, 3) building materials and 4) conditions of the buildings.

1) Building usage

Building usage is divided in six major types, as residence, touristic use (hotels and accommodations), religious use, commercial use, government offices, and mixed use of residence and business. The visual comparison of 1999 and 2009 GIS maps shows that touristic use of the building increased in every village (Fig.1). Particularly, an increase of building with touristic use along the road facing Mekong River is evident.

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1 PSMV identifies 14 feature attributes of the buildings covering 1) building usage, 2) building architecture, 3) building materials, 4) building roof materials, 5) building conditions, 6) number of floors, 7) soil occupation coefficient, 8) built land and free land area, 9) authorization construction, 10) unauthorized construction, 11) year of construction, 12) heritage protection zone, 13) village name and 14) X,Y coordinates.
As the statistical analysis indicates, the number of buildings used as residence decreased from 427 to 268, as the most evident decrease. 33% of the residence in 1999 changed to buildings with touristic use in 2009. In total, buildings with touristic use increased from 66 to 250, supporting visual observation on changes. No significant change was observed in religious use, government offices, mixed residence and small business, and commercial buildings. Among newly constructed buildings during 10 years (N=89), 50% were built for touristic use.

2) Types of building architecture

Types of building architecture are categorised into six types as traditional, colonial, commercial, temples, others, and unknown. Commercial type of building
architecture is defined as shops with Chinese-Vietnamese influences. “Others” architecture is defined as buildings with imported or foreign influences such as Thai style of architecture. Observation of building architecture during ten years illustrates interesting change. As seen in visual comparison, the number of traditional building architecture increased. Such increase can be seen in all six villages, with particular concentration in two villages (Phone Heuang, Khill) located in Mekong River and Nam Khan River.

Fig 3. Visual Comparison: Building Architecture (1999 and 2009)

Figure 4 summarizes the change in types of building architecture. Traditional buildings increased from 197 to 278, showing major change in the pilot sites. “Others” types of architecture referring to foreign and imported building architecture decreased during the ten-year period, possibly “replaced” by traditional types of architecture. Further analysis is expected to identify relationship between use of building and types of architecture, particularly for touristic use and touristic use and

Fig 4. Change in Building Architecture (1999 and 2009)

Source: Data analysis from Luang Prabang, 2010
traditional architecture. Interviews with local residents suggest that motivation to restore/construct traditional architecture comes from the fact that nice traditional architecture attracts tourists.

3) Building materials

PSMV divides building materials as traditional and non-traditional materials. Traditional materials include bamboo, timber, bricks and mixture of those materials, while non-traditional materials are represented by cements, zinc and those mixtures with other materials. Visual comparison between 1999 and 2009 data in Figure 6 illustrates that the building using cement and timber are prevailed through the pilot site, especially in three villages of Xieng Mouane, Phone Heuang and Vatsene. The analysis on types of building usage found that in both Xieng Mouane and Phone Heuang villages, buildings with touristic usage increased. The relationship between building usage and materials used for buildings need to be carefully analyzed.

Fig 5. Visual Comparison: Building Material (1999 and 2009)

Source: Geo-Analysis, Luang Prabang, 2010
From the statistical data analysis, it is evident that buildings using timber and bamboo, and mixed traditional materials has decreased to two-thirds of the original buildings of 1999. Traditional materials used together with bricks and plaster tend to be kept its original forms. UNESCO Tourist Impact Report (2004) on Luang Prabang identified six factors on choosing building materials: 1) affordability, 2) availability, 3) durability, 4) cooling effect of material, 5) flexibility of design, and 6) restoration technique. In addition, the non-traditional material is permitted for general buildings under PSMV regulations as long as the material is finished with coating.

4) Building conditions

The building condition were categorized into good, moderate and bad condition and assessed during field survey. 656 buildings out of original 700 of 1999 remained until 2009. 44 buildings were demolished, and 89 new buildings were built between 1999 and 2009. The visual comparison between 1999 and 2009 GIS data shows building with good condition had increased through the 6 villages (Figure 7).
As Figure 8 indicates, during 10 years, among 360 good conditioned buildings of 1999, the two-third maintained similar condition while one-fourth of the buildings became moderate condition and five regarded as bad condition (1.4%). As for buildings with moderate condition, nearly half of the buildings improved to good condition and about 40% remained the same whereas 10% deteriorated to bad condition. For bad conditioned buildings, more than 60% improved to good condition (40.9%) and to moderate condition (21.2%), while 22 remained the same (16.7%). 28 buildings were demolished (21.2%). Most of the newly constructed buildings are in good condition (N=61) while 17 are in moderate condition and 11 are found in bad condition. Overall, buildings with good condition increased significantly while buildings with bad condition decreased. The survey analysis also found that increase of buildings with good condition is particularly seen buildings with touristic use. The buildings with good condition used for touristic purpose increased from 55 to 214 of which 24 are newly constructed.
buildings. The reasons to motivate residents to improve building conditions need to be investigated. Also the relationship with the policy to support tourism is to be further analyzed.

4. Conclusions

In introducing applicable ICT in World Heritage Town of Luang Prabang, GIS was used to study the changes in the townscape during ten years of 1999 and 2009. The geo-analysis and statistical analysis of the six villages present four major findings. First, the building of touristic use increased while the residential buildings had a sharp decrease. Second, the buildings with traditional architecture increased the most, particularly replacing buildings with Vietnamese and Chinese influences. Third, non-traditional building materials such as cement and zins have replaced traditional building materials of timbers and bamboo. Forth, building conditions are improving over the last ten years and buildings with touristic use contribute to increase in good conditioned buildings. Further investigation should be focused on the relationship between different building attributes, together with feedback from the local residents.