

CHAPTER SEVEN

CONCLUSION AND DISCUSSION

This conclusion part discusses the results presented in previous chapters, summarizes general concepts and guidelines for a comprehensive site analysis framework, and states the contributions of this research. It also suggests future research that may extend the concept and implementation of the integrated site analysis framework.

7.1 Research Summary

Today's architectural design process involves many participants, increasingly complex information and knowledge. Design consists of five important components: aesthetics, culture, environment, structure and materials, and economics and social influence. It is also a "participatory" process, encouraging interdisciplinary knowledge and collaborative community participation. This research views site analysis as a sub-system within the design process, and the major factors in the design process also form the essence of site analysis and selection. In site analysis, several major environmental factors are identified based on the comparison between feng shui and contemporary environmental design principles.

In order to develop an integrated framework for site analysis and selection, this research has completed the following tasks:

1. Development of an integrated site analysis framework on the basis of a comprehensive study of design methods and processes, and a review of principles and theories related to environmental design;

2. Implementation of the framework through the use of a computer simulation program, SiteOne, using techniques, tools, and methods that have developed from existing disciplines;
3. Demonstration of the framework through data collection and analysis for Reston, Virginia;
4. Interviews with different professionals to demonstrate site analysis processes;
5. A discussion of results generated from the computer program and on the comparison of interview results with the results from SiteOne.

Each chapter gives detailed descriptions of these tasks. Chapter two reviews the basic concepts of design problems, methods, and processes. It also presents the available research on site analysis, and discusses its position in the design process. The literature review suggests an extended design process that begins with site analysis. Traditional practical steps include selecting a site, locating buildings, and placing utilities. In an extended design process, site analysis includes site selection, inventory, analysis, concept development, and design implementation. Most definitions divide the site analysis process into various steps within a structured and integrated system. Therefore, site analysis is a sub-system within the design process.

Chapter three reviews feng shui and contemporary environmental design principles. It also compares feng shui with two contemporary environmental design models: the bioclimatic and environmentally conscious models. The analysis suggests an integrated approach, using a scientific research method and organic system, which has a hierarchical order in its main structure and incorporates both sequential and parallel structures in its sub-structure.

In chapter three, the analysis also notes the similarities among the environmental issues considered in the three models. This chapter sheds light on important environmental factors that are considered in the framework and SiteOne. These environmental factors include temperature, wind speed and direction, relative humidity, solar radiation, relation to bodies of water, the shape of these bodies, flood area, soil type and quality, slope, aspect, and vegetation. They fall into five categories in the proposed framework as presented in the fourth chapter.

Chapter four discusses the concept, components, and structures involved in an integrated site analysis framework. The framework starts with the idea that the site analysis process can be segmented into steps, and that each step represents a snapshot of an analysis action. As an integrated approach, the framework then incorporates each step and considers the interaction between them. This research uses different types of categories to represent these steps. This chapter also gives detailed descriptions of different categories, highlights the environmental factors in the framework, and describes implementation strategies.

Reviews of literature, application methods and tools provide useful information to implement the framework into a computer simulation program. The methods and items proposed by McHarg and HOK further confirm these factors, identify the interactions between factors, and group them into several categories. Additionally, ArcView and its extensions provide a large number of spatial modeling and analysis functions, which act as pre-processors to SiteOne. Moreover, SiteOne and other GIS tools have a complementary relationship. SiteOne can use the analysis results from other tools in the infrastructure or economic models. SiteOne can also perform site-specific analyses based on results from other tools and provide feedbacks for these tools to revise their analysis and redefine the boundary.

The last part of chapter four introduces the implementation of a computer simulation tool, SiteOne. The SiteOne prototype system, developed to demonstrate the concepts and ideas presented in this research, analyzes a range of alternatives and then derives solutions from the suggested site conditions. There are various modules that make up the prototype system: an analysis module, a database module, and a result generation module. Each module also has a GUI.

Chapter Five presents a case study using the town of Reston, Virginia to validate the proposed analysis framework, test implementation of the framework using the SiteOne program, and demonstrate the results for further application in a design process. It also introduces the different collection and analysis methods for climatic, topographical, hydrological, and vegetation data. This chapter presents the analysis results from single categories, as well as the overall outcome. Finally, it describes the analysis procedure and presents the result maps from SiteOne.

Chapter Six introduces a set of procedures to validate the results from SiteOne. The procedures begin with the design of a scenario for the different parties involved in the site analysis process. The second step is to collect related maps and census data sets. The next step is to interview three professionals who represent different roles in site analysis. Finally, chapter six summarizes the differences between the interview results and the SiteOne results and analyzes the possible causes of this variance.

7.2 Contribution

7.2.1 Proposed a Site Analysis Framework

Throughout the study, the primary goal has been to develop a site analysis framework for use by professionals, because an integrated framework for site analysis and selection does not currently exist. Today's architectural design process involves many participants. The information and knowledge involved in this process have become increasingly complicated, and have a wider spectrum. The comprehensive connection between different design stages is also hard to derive, particularly regarding the integration of various computer tools. Such a method should be comprehensive, able to provide useable data, adaptable, and user-friendly.

This work introduces a new site analysis methodology in the form of an integrated framework. It is the first step of an extended design process. The site selection and analysis process is also a sub-system that considers the major factors required in other parts of the design process. In addition, the framework separates the site analysis process into different models, incorporates each model, and considers the interaction between them. The most obvious models are environmental models (climate, geology, hydrology, topography, and vegetation models), social-cultural models, economic models, and infrastructure models. Each model also contains several important factors.

The other important characteristic of the site analysis framework is that it is adaptable to various users for possible future feedback. This framework attempts to include most physical and biological parameters relevant to site analysis. It also incorporates other critical site resource requirements, including social-cultural models, economic models, and infrastructure models, into the evaluation process. Although detailed analyses for these

models are not included in this research, the module structure of the framework allows users to easily add data and criteria.

In addition, the framework is adaptable at several levels. For example, the site level evaluation enables users to consider the smallest units in a broad range of landscape spatial scales. However, because the criteria and data sets identified in the process are valid for a larger scale, designers can perform land evaluation in either the large-scale project development level or in the site planning level, by using the concept and module design of the proposed framework. If alternative sites are located within a county or several counties instead of a particular town, users can utilize the same analysis processes demonstrated in this research. Thus, a re-evaluation process is not needed to adapt to increasing demands for new development.

7.2.2 Incorporated Feng Shui and Contemporary Environmental Design Principles

The other contribution of this research is its ability to identify and organize environmental factors that influence site analysis and design. Current principles and methods ambiguously define environmental aspects in the complex site analysis and selection process. On the one hand, conventional design approaches emphasize basic aspects of the natural environment. On the other hand, feng shui offers both an alternative and complement to contemporary methods. However, the comparison and possible incorporation of contemporary and traditional environmental principles has received less attention.

The study compares feng shui and contemporary models, and summarizes environmental factors essential to all models. The basic feng shui theories cannot be evaluated as thoroughly as a single element, such as air movement or landform, as feng shui embraces many fields of knowledge and integrates all related factors. These factors are also largely abstract. Therefore, this work focuses on the applicability of feng shui and interprets its principles into measurable factors, including wind, relation to bodies of water, the shape of these bodies, soil type, slope, orientation, and vegetation.

The analysis of the feng shui and contemporary models also suggests the similar environmental issues that these models consider. Therefore, it is possible to identify these factors in a non-biased manner. The emphasis on environmental factors from all models may

lead to a better understanding of the relationships between humankind and the natural environment.

7.2.3 *Implemented SiteOne*

The third contribution is the adaptation of the framework to a computer program, SiteOne, to demonstrate the concepts and ideas of the proposed framework with an emphasis on environmental factors. SiteOne offers several valuable features. It helps professionals collect a wide range of information and select corresponding criteria in the early stages of the design. It can also act as an educational knowledge component for professionals, as well as the general public. For example, the tool can assist residents in improving community livability and encouraging public participation. The results can also support potential adjustment for policies and regulations.

Additionally, SiteOne can help governments protect public health, safety, general welfare, and aesthetics by providing valuable information and decision support. Thus, it is important to define design goals at the beginning and test them with real cases. Moreover, it is useful to compare SiteOne's results with those derived from existing tools. The decision support tool is very useful in reviewing procedures for both local officials and developers; as such, it can prove invaluable for the implementation of complicated regulations. Thus, the benefits of using this tool include encouraging public participation, fulfilling general interests, and providing feedback for improving regulatory systems.

Furthermore, the implementation and data analyses in SiteOne clarify the decision making process. It explains the logic behind its recommendations, so that each step in the decision-support process can be easily understood and modified. This study also adjusts the decision process and weighting factors in SiteOne based on interview results with professionals. This helps improve the credibility and usability of SiteOne.

Finally, SiteOne provides visual analysis results based on selected criteria and models. Graphic output not only provides visual assistance to explore hidden information and recognize potentially problematic areas, but also enhances work quality, particularly in the investigation of crucial sites. Traditionally, only landscape architects and architects would pay attention to the graphic results. Today, graphic interface becomes an important feature in computer-based tool development. Whether presenting the analysis results to the

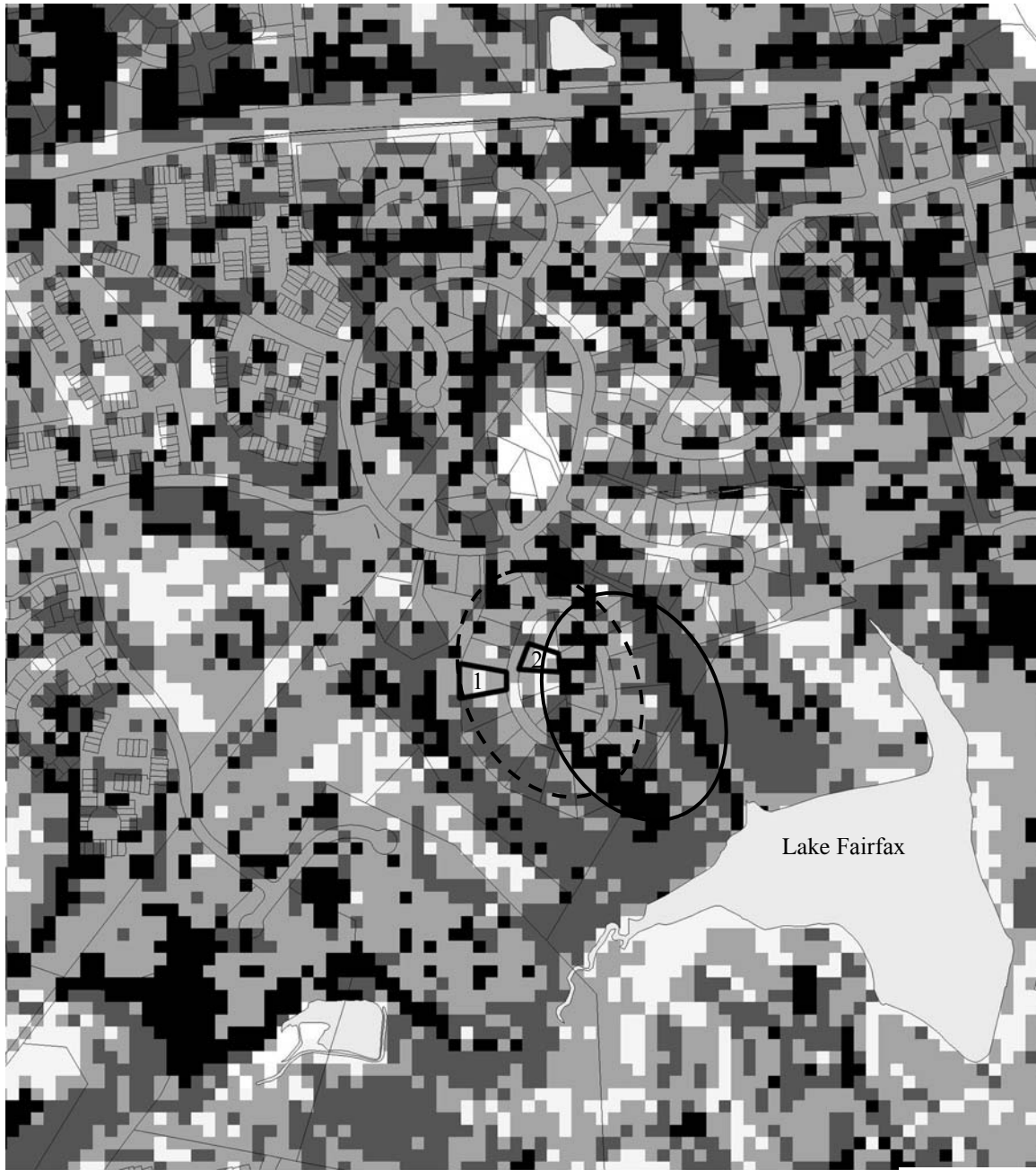
public or communicating concepts and ideas with colleagues, each party in the development process benefits from graphically attractive and user-friendly tools. In some cases, the participants' education level is "not higher than elementary school." In these cases, computer simulation and visual output are especially important for improving and encouraging public participation.

7.3 Discussion on Future Research

This research is only the first step towards the development of a complete computational decision support program for site analysis. There are several major directions that future research could strengthen the proposed framework.

First of all, the study proposes a systematic approach with a flexible and adaptable model structure in site analysis. This allows the framework to easily improve and complete in the future. With the consideration of the environmental factors, the application of SiteOne can also be further explored. One example is to use the analysis results presented in the fifth chapter to evaluate parcel designs in a sub-division. Figure 7-1 shows the current parcel layout with the feng shui analysis result. It is a sub-division near Lake Fairfax Park in Reston. The suitability of development in lots 1 and 2 is less than 70%. If the location of this sub-division (in dashed ellipse) moves about 400 ft. eastward (in solid ellipse), the suitability in every lot is greater than 70%.

The only models that SiteOne has fully developed are those dealing with the environment. Other models need to be updated and presented in a more detailed fashion. Some existing models have already shown their ability to perform infrastructure analysis or economic analysis. These models and SiteOne can be used complementarily. The implementation strategies of these models may be different from the environmental models, especially for those not presented in a graphical format. In addition, models that are not identified in this research may be established and added to the framework in the future. For example, the aesthetic model, which addresses visibility, cultural identity, and artistic value, may be made independent from the social-cultural model. Furthermore, the interactions between models need to be studied when more models are added to the framework. Chapter



Reston, VA

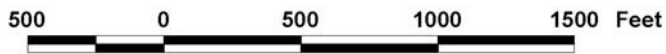
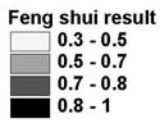


Figure 7-1 Parcel layout with feng shui analysis result

five shows this in its discussion of the interactions between different environmental models. One example is the hydrologic analysis. When using feng shui, it considers slope and aspect in addition to its relationship with bodies of water.

Secondly, the environmental factors considered in the framework are the result of an incorporation between feng shui and contemporary principles. This incorporation is based on an understanding of existing studies and research in these areas. The actual knowledge presented in this dissertation is only an example of the kind of knowledge that this framework could define. Therefore, an extension of such knowledge is a potential future research direction.

One important area for future development is the incorporation of more existing site information. For example, TMY data sets include twice as many climatic factors as SiteOne. These data sets are also available across the United States. It is useful to extend the climatic analysis presented here by adding these factors directly from TMY. Technically, this task requires the development of a conversion function to present TMY in a graphic format, which would match other data sets in SiteOne. Other information mentioned in the interviews with professionals, such as radar images and aerial photos, also need to be considered.

Another possible area for future development largely relies on the development of environmental research, integrated with a deeper understanding of feng shui. The most important concept in feng shui, Chi, is still under investigation, although it is manifested to the process of water evaporation and air circulation. Other basic feng shui theories also need further scientific analysis. If the applications and theories of feng shui can be effectively analyzed using contemporary environmental theory, this could extend the domain knowledge presented here by applying more constraints and criteria to the variables.

The third direction is to evaluate the SiteOne results in other cases. Chapter six discusses the interview results and the SiteOne results. It shows one way to evaluate the proposed framework and its implementation. Other verifications need to be done in the same study area. One possible way is to analyze the historical building sites in Reston, because it takes decades and centuries to decide if a site is suitable for constructing buildings. The evaluation can compare the locations of these buildings with the favorable areas identified in SiteOne. Site surveys will also provide important improvement and adjustment directions for

SiteOne. There are three major categories used to conduct post-occupancy evaluations: the condition of a site, the information about the people who live and use the building, and the performance of the building.

Other suburban areas of metropolitan regions need to be analyzed, using the methodology developed here. This can further test and verify the inventory system and the criteria. Additional research is needed to define the site analysis framework for various purposes and densities of buildings, including the function of the buildings, size and space standards, and typical outdoor activities.

As a concluding remark, every step in the design process is hard to define thoroughly, especially when transforming the process in a computer program. Similar to feng shui being seen as a connection between “art” and “science,” Sir Eric Ashby (1971) notices the increasing need to combine science and common sense “in the different art of decision making.” Therefore, it is hoped that this work will contribute to the site analysis methods in identifying suitable housing sites in suburban areas. The concept and some elements of the methodology developed here may be useful in other geographic contexts.