

# CAMPUS LANDSCAPE SPACE PLANNING AND DESIGN USING QFD

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## Abstract

Millions of people live and work on college campuses everyday. The environment they dwell and interact with is essential to their quality of life and health. There is no doubt that the campus landscape is of great importance to millions of students, faculty, and staff on campus. Surrounding communities are also significantly affected by college campuses as colleges often provide education and social events, as well as economic activities. However, in the past, the design of campus landscape spaces have been overlooked or treated as a leftover of buildings, even though campus landscape spaces are more than the “faces” of colleges.

With more and more colleges and universities expanding and redesigning their landscape spaces, the design of campus landscape space has gained more recognition in the recent twenty years. One of the significant changes in the design process is the taking of users’ needs/concerns into account. This change is influenced by a community-based design concept found in Active Living and Public Spaces design. While Active Living and Public Spaces design emphasizes the importance of user involvement and different techniques in soliciting user input, there is a missing link between user input and the design program elements.

In this thesis, I examine the past practice of campus landscape space design and propose using Quality Function Deployment (QFD) to fill in this missing link. QFD has been used in various industries, including service and manufacturing, for years. It emphasizes the importance of taking users’ needs, called Voice of Customers (VOC), into the design process. The employment of different matrices to capture the relationship between VOC and subsequent design and quality characteristics makes QFD a unique framework suitable to fill the gap in the current design process.

A case study of campus landscape space design is conducted to examine the applicability of QFD in campus landscape space design, including the advantages, the obstacles, and the unique condition of using QFD in landscape design. The study yields several insights on the application of QFD in campus landscape space design, which are applicable in other landscape design projects.

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# Chapter 1

## Introduction

*“It is often said that if Central Park is so unfailingly popular with New Yorkers, it is because it was not planned by a landscape architect interested only in the formal beauty of the design, but by someone who actually cared about the wants and needs of the people who would be using the park every day.”*

*<Gardens of the World>*  
(Pigeat 2003)

There are 3,587 accredited colleges and universities in the United States (a total of 4,386 post-secondary institutions, according to the Carnegie Foundation for the Advancement of Teaching's Respected Classifications). They enroll over 12 million people annually, and the number has quickly increased in recent years. Now, there are around 2 million faculty and staff. 40% American population has been involved with these institutions as students (Dober 1992). The experiences of people in colleges and universities are an important part of their lives. Colleges and universities become significant resources, like health care, science and technology, etc. for surrounding communities; they affect people's lives by providing diverse social, economic, and cultural activities. It is easy to see the importance of campus landscape and its impact on how people use such spaces.

As a public space, campus landscape space is vital to students, faculty and staff, and community members who utilize the space. The design of campus landscape space has been overlooked in the past because of the focus on buildings. In the history of American campus design, “Whatever the model selected and whatever the site, location, or region, a campus plan will almost always be some arrangement of buildings, with spaces created between them” (Marcus and Francis 1998). Campus planning also focuses on fiscal issues, educational policy, and large-scale planning. In the recent 20 years, many colleges and universities redesigned or enlarged their campus open spaces. People have started to

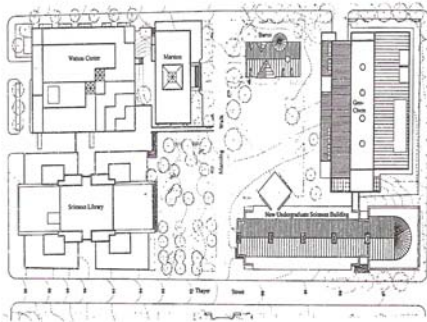
recognize the importance of campus landscape spaces; it is no longer the leftover of buildings.

With the recognition of campus landscape space, its design has drawn more attention. To make these places better serve the needs of students, faculty and staff, and bring the life to campus, how to design campus landscape spaces becomes an issue. With new design ideas and trends in active living and public spaces, campus landscape spaces are given special attention and specific designs. Research and studies discuss how students, faculty, staff, and members in community use campus landscape spaces based on the areas of environmental behavior and environmental perception.

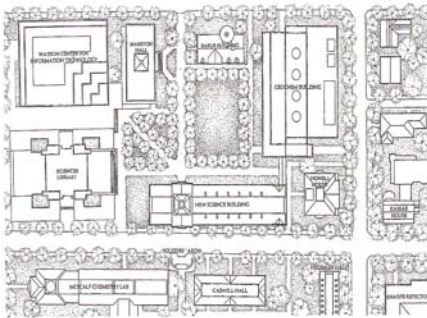
The design focus is switched from traditional emphasis on the landscape spaces' forms and function to their real human use.

However, to date, there is limited literature and research on how to design campus landscape spaces, especially, campus landscape spaces that fit students/faculty/staff's needs. To design a place that matches user needs, the Active Living and Public Open Space designs advocate a community-based design process that involves users, managers, and design professionals in the design process. Nevertheless, how to make the collected users' opinion accountable, how to systematically utilize the users' input, and how to connect the users' needs to the design attributes remains a challenge. The community-based process does not provide a framework to effectively organize users' concerns or associate users' needs to the actual design attributes.

Given the importance of the campus open spaces design and users' involvement in the design process, this research focuses on the design process that would involves the users' input and provides a framework that can link those inputs to design attributes. Quality Function Deployment (QFD) is a framework widely used in



OPPORTUNITY LOST / Brown University



**Picture 1 Before and after landscape treatment on outdoor spaces - Brown University (Dober 2000)**

industries (including manufacture and service). Its use as a tool in Landscape Architecture is studied less. This research addresses the applicability of QFD, and its benefits and limitations in campus open space design and in landscape architecture design. A case study is provided to demonstrate the use of QFD in campus landscape space design. A discussion section follows the case study to address the pros and cons of using QFD in the design of campus landscape spaces as well as special consideration when it is applied to landscape architecture.

This thesis is organized into six chapters. This section presents the overview of the research. Chapter 2 shows the background of the research – why it is important to address the design of campus landscape space, current design considerations, and the need for a new design paradigm. It also shows the questions and challenges addressed in this research. Chapter 3 illustrates previous work found in literature. Multiple subject areas are covered in the review because the design process relates to many contemporary concepts and methods. A case study is presented in Chapter 4 to demonstrate the use of QFD in the campus landscape space design. Chapter 5 contains an analysis and discussion of the applicability of QFD in landscape design based on the case study. All the findings are summed up in the final chapter.

## Chapter 2

### Background

*It is difficult to design a space that will not attract people. What is remarkable is how often this has been accomplished.”*

*-William H. Whyte*

#### **2.1 Campus Landscape Spaces**

The campus is the total physical environment, including all buildings and landscape space. This combination of buildings and landscape space between buildings functions as an organized whole, and has a distinctive identity. The landscape and buildings hold a key place in the collective memory of the institution. Campuses in the United States have existed over 200 years and adopt three basic architectural prototypes: the Roman forum, the ecclesiastical quadrangle, and the village green. “The Roman forum is a formal, rectangular, and symmetrical space surrounded by colonnades on two or three sides. It usually has a dominant building or temple on the fourth side (Jefferson's “lawn” at the University of Virginia, Charlottesville, is a prime example). The ecclesiastical quadrangle, derived from medieval monasteries, is a green space completely enclosed by buildings, for example, the Oxford colleges. The village green is a public open space informally surrounded by important buildings such as churches, the town hall, or the library (The Harvard Yard is the quintessential village green example)” (Gisolfi 2004).

##### **2.1.1 The importance of Campus Landscape Spaces**

The quality of a school is judged by its sense of place and by the activities going on across the campus. Prospective students, their parents, and faculty count the overall feel of a campus as part of their decision when selecting a school. It also contributes significantly to a university’s ongoing efforts to attract and sustain the best students, faculty and staff, and to reflect its social purpose in a positive way. Few people are happy attending a campus that

seems placeless or dull, or whose surrounding context is hard to enjoy. Landscape spaces help unify the campus through a connecting fabric of buildings and landscape, and are a necessary balance to the construction of roads, parking lots, and buildings. As the campus continues to grow, it will be increasingly important to provide the relief and contrast of a well thought out campus landscape.

Campus landscape space serves several important functions to the whole campus:

- Landscape open spaces give identity to campuses

Without great landscape spaces, there would be no great campuses. These are spaces shared by students, staff, and faculty as they move around campus, socialize, recreate, and study. These spaces connect buildings and establish the image of the university. It is the treatment of this campus landscape that forms the opinions, impressions, and attitudes of the institution.

- Provide settings for all kinds of campus activities

Activities on campuses vary from sunbathing and relaxing to formal/informal events (university wide, group, class, sports, commencement, etc.), including quiet study, people watching, enjoying nature, meditation, chatting with friends, picnic, games, bird feeding, playing Frisbee, and so on. The landscape spaces “encourage the maximum number of impromptu encounters with other students, with other faculty members, with visitors, with works of art, with books, and with activities with which one is not himself a regular part...will stimulate curiosity, prompt casual encounter and conversation,,, the atmosphere which it produces be truly educational in the broadest sense” (Keast 1967). Landscape spaces are essential to alleviate stress among students and



**Picture 2 Outdoor sittings provide places for studying, chatting with friends, eating and people watching, etc. (Penn State University 2007)**

university employees, making the intensity or boredom of classes, and office work more tolerable.

- Protect nature environment

Landscape nature spaces can help the restoration and protection of wildlife habitat. This acknowledges ecological concern that is growing both within the university and in the surrounding communities.

- Aesthetic pleasure

The visual quality of the campus has a profound influence on the quality of people's experiences on campuses. It puts colleges and universities in a better position to attract and retain faculty and students, advance educational and research programs, energize fund-raising appeals to alumni and friends, demonstrate environmental design concepts and ethics, enlarge the presence of art, and strengthen the campus as a community design asset.



**Picture 3 College campus provides aesthetic pleasure (Bradley 2006)**

### **2.1.2 What Makes Campus Landscape Space Great**

There are three major components of open space that generally support campus environmental quality. (Abu-Ghazze 1999):

- Physical and ecological quality—this supports natural environment characteristics.
- Behavioral and functional quality—this supports interactions between human behavior and physical setting. It comprises the density or sense of comfort of a sitting space, the availability of amenities such as food and drinks, and the degree of interaction with adjacent buildings and/or spaces.

- Aesthetic and visual quality—visual preference based on visual sensation. This is the most important aspect of aesthetic - visual quality of landscape spaces.

The most important factor to make a place outstanding is how a user perceives the physical environment decides the quality and effectiveness of landscape space. People prefer environmental settings that offer them the opportunity to acquire additional information and to help them to make sense of the environment (Garling, Book et al. 1986; Abu-Ghazze 1999), which helps campus users manage their communication and social interaction with each other, identify important features of their everyday environment, and enjoy the aesthetics. The users' perception of the campus landscape space is closely tied to human activities as well (Manning and Coleman-Boatwright 1991).



**Picture 4 “The University of Maryland College Park has a lively campus” (University of Maryland 2006)**

This Project for Public Spaces (PPS 2000) advocates that there should be at least ten dynamic, well used spaces on campus to attract all kinds of people. PPS calls it the “The Power of Ten.” Within each place, there should be at least ten things to do, such as eating, drinking, reading, browsing, playing a game, looking at art, and so on. Such places bridge the gap between the distinct and diverse communities within the campus; they are the settings for civic gatherings, residential life, and academic discussions, and they possess a variety of public, private, academic, retail, and cultural amenities. It is clear that these activities occur at campus landscape spaces.

Research also indicates that, in a setting such as a university campus with a wide range of users from young freshmen to faculty and staff and active retiree, landscape spaces need to span from active/urban to passive/natural and large open lawns or hillsides to secluded spaces (Abu-Ghazze 1999).

*Campus outdoor spaces not only were treated as leftover in the past, but also designed not in terms of their real human use.*

## **2.2 The Problems of Campus Landscape Space**

In many campuses, exterior places are empty much of the time. The campuses are neat, clean, but devoid of activity except the class changes. These spaces were not designed for students to use, but to be looked at nor are they part of the “learning environment”. The following are some design problems:

### **2.2.1 Campus Landscape Space not Considered Important in the Past**

Landscape spaces were treated as a leftover in campus design history. Early campus planners were architects by profession and focused their “planning” on the design and placement of new buildings, with limited attention to the surrounding grounds (Turner 1984). According to Marcus and Wischemann: “Over many centuries, different campus plans have emerged in the Western world, from the urbane enclosed courtyards of Oxford and Cambridge, to the formal ‘academic village’ of Jefferson’s University of Virginia, to the mix of formal planning and ad hoc building on the Berkeley campus, to single mega-structures at several Canadian locations, to the University of California at Santa Cruz plan where topography and ecology are the principal determinants of building locations. Whatever the model selected and whatever the site, location, or region, a campus plan will almost always be some arrangement of buildings, with spaces created between them.” (Marcus and Wischemann 1987) These “leftover” places were decorated for appearance, but it was not considered how university community members use them. Few places provide the needs of members from the university community.

## 2.2.2 Lack of Consideration on How People Use Campus Landscape Spaces

**Picture 5** The ecclesiastical quadrangle, derived from medieval monasteries, is a green space completely enclosed by buildings, Oxford College, 1861 (Higginbotham 2007)



Traditionally campus landscape is seen as a green carpet upon which buildings are placed. Buildings and grounds are integrated into a green precinct that is pleasant to see. Landscape materials were selected, arranged, and installed especially for the campus' beauty, with the ensemble textured and colored by the changing seasons and nature's rhythms. Landscape space design emphasizes the campus image, not for active use.

## 2.2.3 Users' Voice not Heard in Traditional Design Process

The campus community is not traditionally a part of campus open space design. The traditional approach is "project-driven". Professionals develop the plan for building projects, gain approval from administration and implement construction.

Occasionally, alternative design schemes are presented, and "the community" gives input as to which scheme should be selected. The problem with this approach is: it leaves the users with no opportunity to bring up issues they are concerned about. The ideas have already been developed, and the community is added to react

to ideas, rather than talk about what their concerns/suggestions are. Since projects take a long time to come to fruition, the initial steps are critical to the outcome. The users are asked to review a plan instead of give their unique insights in the program.

Design professionals assigned to the project tasks decide issues alone, they tend to “impose their own judgment instead of considering the preferences of the expected users; in other words, they base their decisions on an a prior expert-judgment basis and may make naive assumptions about user preferences with questionable relevance” (Abu-Ghazzeh 1999). The following are some examples of problems with landscape design spaces:



**Picture 6** A lack of formal seating requiring students to use steps and curbs.

(NC State University News Services 2007)



(El Camino College 2007)

**Picture 7** Lack elements appropriate for having discussion or reflection.



(Silberman 2007)

**Picture 8** Students don't like to go to a place that lacks the chances to meet other people or activities. Spaces need to provide for user needs and scale with ergonomic elements to support use and a sense of belonging



(Photograph by the Author)

**Picture 9** Lack of activity centers for occasional or planned activity.



(Virginia Tech Imagebase 2007)



**Picture 10** Space not located convenient for student use (Virginia Tech Imagebase 2007).

**Bounded by traffic  
conflicts.**



**Picture 11 Difficult to access (Virginia Tech Imagebase 2007)**

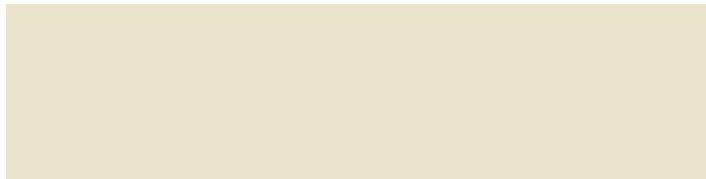
**Picture 12 Questionable safety uses (photograph by the author).**



Successful campuses create an inherent sense of community by offering many ways for people to interact with each other in the spaces between buildings. The idea of a self-contained community for learning, with places to exchange ideas in a tailor-made setting, was one of the great inventions of a young American republic. To create this interaction, campuses need a large variety of activities that are not specifically academic. It is not enough to build a university around the specialized needs of its academic programs; it also needs a collection of distinct gathering places that catalyze interaction. (PPS 2000)

The following are some examples of successful campus landscape spaces:

**Picture 13 SDSU provides many outdoor areas to study, relax and enjoy San Diego's climate (San Diego State University 2007)**



**Picture 14 Sitting and gathering spaces for groups or individuals (Hofstra University 2007).**



**Picture 15** Academics street and paths for students.



(University of Arkansas 2007)

**Picture 16** Paths that not only connect critical buildings but provide for “down time” between appointments.



College of Charleston, SC (College of Charleston 2005)

**Picture 17 Structural and nonstructural recreational spaces: Lack of traffic conflict. Multi-function recreation spaces.**



(The University of Sydney 2007)

**Picture 18 Space not restricted for specific recreational use.**

Space appropriate for different “pick up” activity for large or small groups.



(Penn State Lehigh Valley 2006)

## ***2.3 An new design approach for campus open space***

### **2.3.1 Users should participate in the design process:**

Armstrong (1993) observed that the individual has a natural claim to participate in decision making related to his/her situation with both psychological and social needs to feel control over his or her own life-conditions. He explains that decisions become better when the persons who are affected become a part of the decision-making process. Kjaersdam (1988) suggests, based on the Danish experience of involving the ordinary citizens in making decisions that are related to planning the physical environment, the inclusion of the public has a considerable effect on identifying issues and needs, as well as on the solutions and choices that are included in the plans. This is obtained and affected by arguments that were expressed in public debates, therefore a collective awareness of and expectations from the plans were created, which made plans more stable and effective (Abu-Ghazze 1999). Also, if design professionals are not familiar with studies in environmental psychology, they may miss important information regarding user behavior and preference. Users' input often fills this gap.



**Picture 19 Franklin Boulevard Urban Design Master Plan community meeting (Franklin Boulevard Projects 2002)**

### **2.3.2 Community-based design process:**

In recent twenty years, with the emphasis of active living and public spaces, campus landscape space has garnered more attention in the effect on its everyday users. Many universities redesign or enlarge their campus landscape spaces, and realized the importance of community involvement. In landscape design, the concept of Active Living and public spaces design started the community-based design process, which is an alternative way from traditional

design. The comparison between these two is listed in Table 1: The project-driven approach defines the project first before asking any input from the community. It is adopted by most of authority in planning public open spaces. On the other hand, community-based approach is driven by the input from residents before the project is defined.

**Table 1 Traditional and Community-based planning approaches. (PPS)**

Traditional approach	Community-based approach
Project-driven	Place-driven
Discipline-based	Community-based
User adopted	User define

Figure 1 shows the relationship between users, design professionals and their input on site planning in a traditional approach. It does not involve users' opinions in the initial design process.

**Figure 1 Traditional Design Approach.**

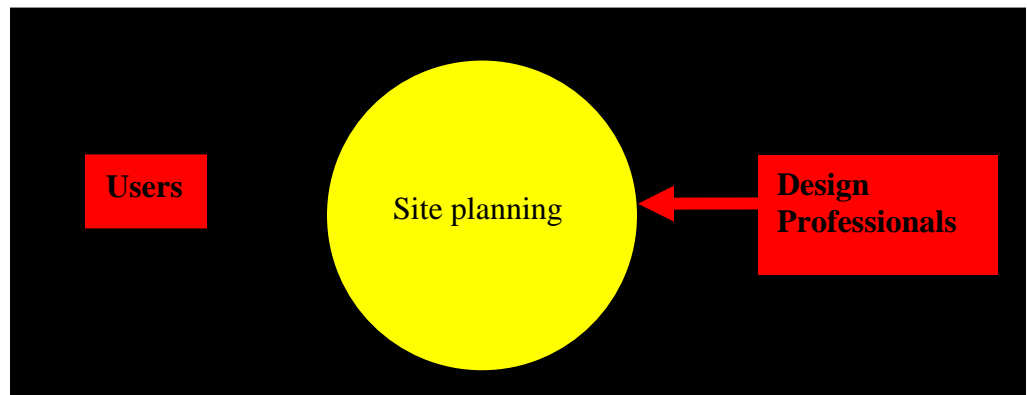


Figure 2 shows the community-based design approach. It involves the users (community members) as well as the design professionals in the design process.

**Figure 2 Community-based Design Approach.**

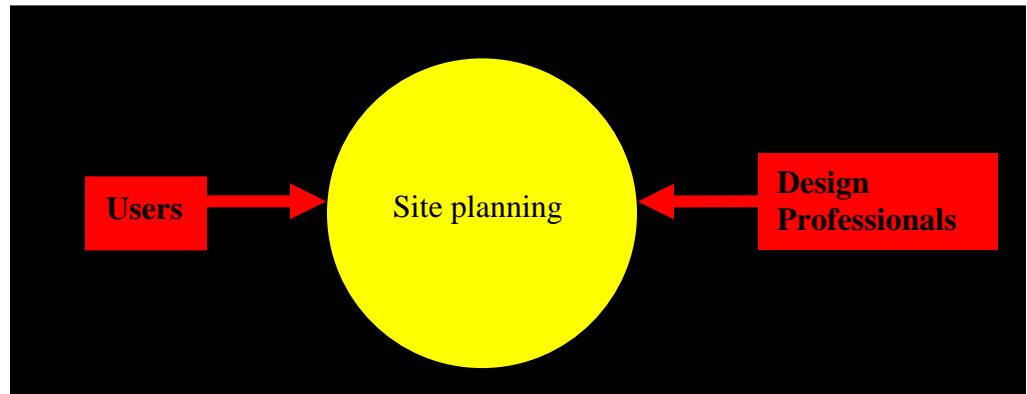
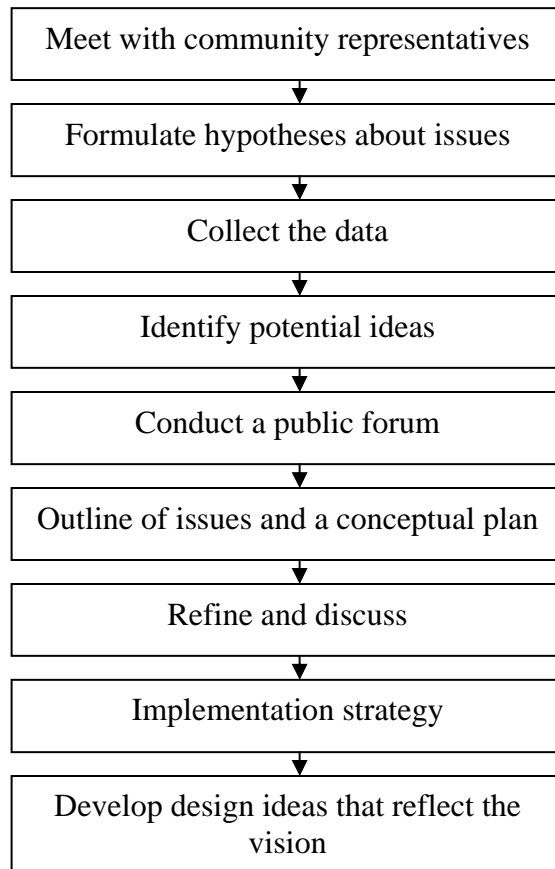
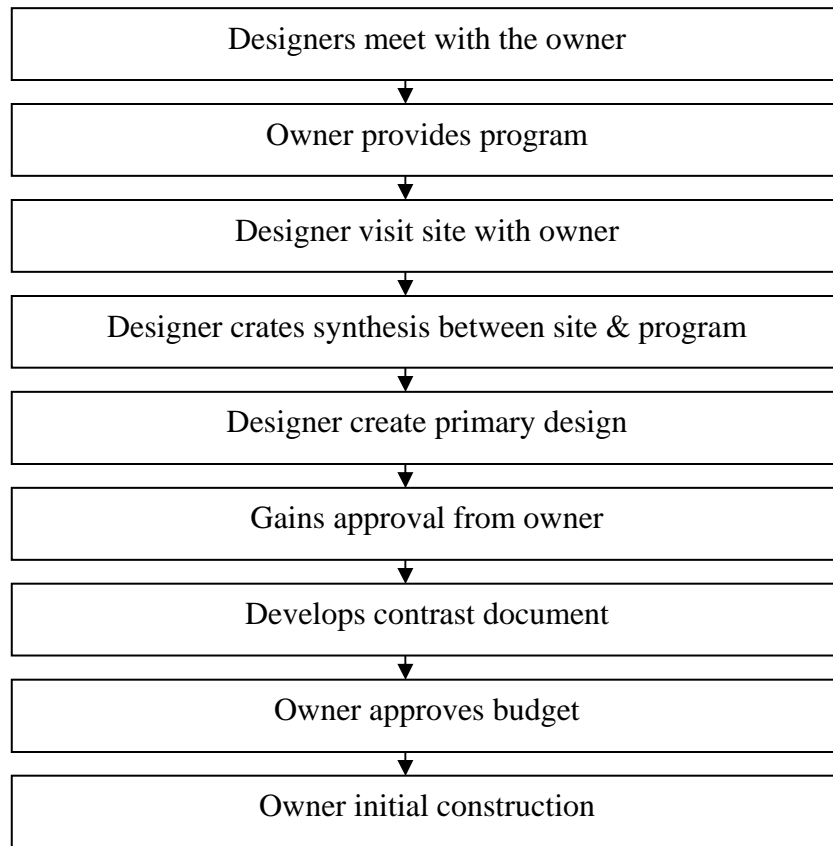


Figure 3 illustrates the steps in the process. Basically, it is a “linear” process that may involve many different groups in the community. Figure 4 exhibits traditional process that is project-driven.

**Figure 3 Community-Based Planning Steps.**



**Figure 4 Traditional Planning Steps.**



### **2.3.3 The need for the new design paradigm**

It is important to introduce new development processes in architectural design. Quality assurance and benefits to the customer are key factors driving these types of changes in the industry. QFD, concurrent engineering and system engineering are important customer quality solutions that need to be integrated in the architecture and building industries for lasting customer satisfaction (Conradie and Küsel 1999).

Besides the importance of knowing user's opinion and concerns, the integration of design and engineering is also essential in architecture design. Benefits of this integration include: (Buchanan 2005)

- More innovation, technological advances
- Cutting cost
- Better quality and customer satisfaction

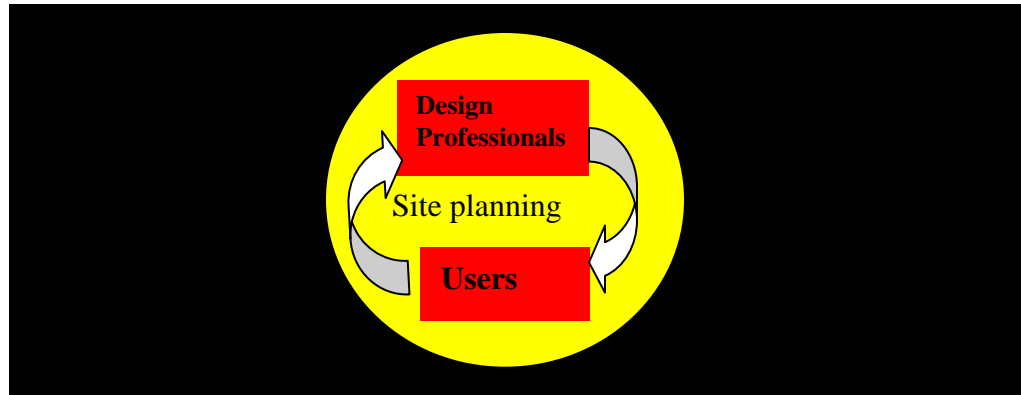
It is essential to have cohesive framework in the design process that can integrate all these – user’s need, design professional’s creativities, engineer’s innovations – together.

#### **2.3.4 New approach – Quality Function Deployment**

Quality Function Deployment (QFD), which originated in Japan in the 70’s and was introduced in the United States in the 80’s, is widely applied in the business world. Today, it is one of the most appropriate methods in use that can enable design professionals to translate end-user needs into product requirements, because it focuses on quality as going beyond an “us-versus-them” mentality (Erder and Pureur 2003). QFD can be used in the design process for the collected views and ideas of users, on their design ideas, level of interest, needs and preferences related to design landscape spaces. In this method, the users are seen as design professionals or members of the design team, and they are cooperating in the design process. This method fits the abilities and circumstances of all the people involved, asking them to help in the design of the research itself as well as contributing to its results.

Figure 5 shows the relationship between design professionals and users within the design process.

**Figure 5 QFD approach in design process.**



QFD is widely used in the industry for product design to match user's needs. It not only integrates users' needs into design, but also puts multidiscipline team into the design process. It has been used in many areas other than manufacture industry, like architecture, education, aerospace, etc.

### **2.3.5 Compare QFD and community-based process**

Community-based approach in planning public spaces is based on certain principles. The heart of these principles is community-centric: the community is the expert. In other words, the users are the most important driving force in the design of public spaces. This concept is in accordance with the QFD's emphasis of satisfying users' need.

The first five steps in the community-based process involve collecting data from representatives of different groups. These steps correspond to the collection of users' need in QFD framework. Unlike community-based process, QFD does not specify methodology in collecting users' need data since QFD can be used in many diverse areas. On the other hand, QFD provides a

methodology in prioritizing and organizing the users' need, which can be linked to various design attributes.

Community-based process does not provide any specific methodology on how to “translate data into a conceptual plan” nor on how to relate the collected data to the design attributes. This is the area that QFD outshines the community-based process.

Figure 6 shows the steps both approaches use and the participation of design professionals and users. Highlighted yellow in Figure 6, the community-base process suggests methodology in defining users, collecting user's requirements, and generating conceptual design. Both design professionals and users are involved during the process. Shown with red text in Figure 6, QFD provides framework in all the steps.

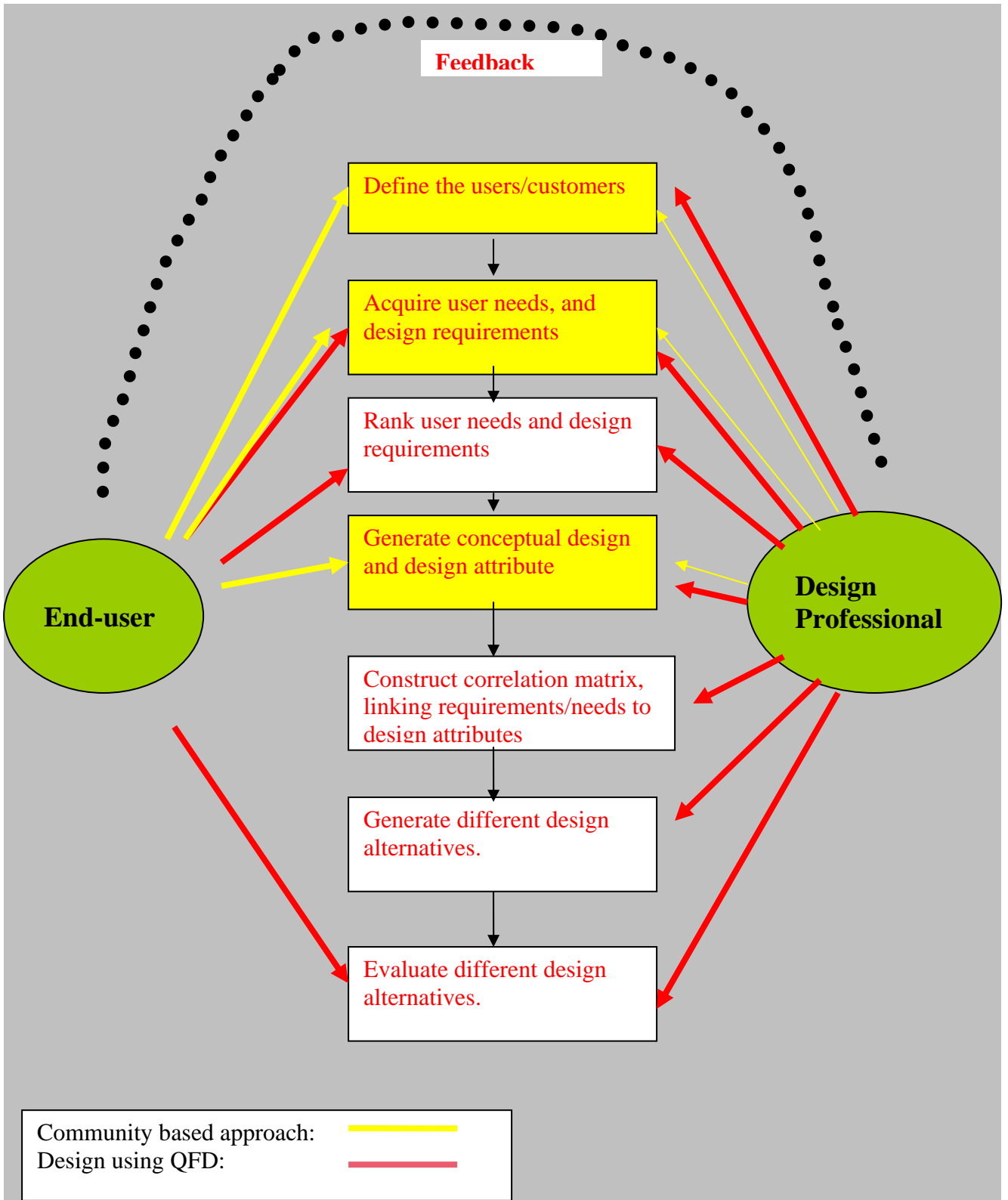


Figure 6 Interaction between Users and Design Professionals in Community-Based Approach and QFD

## **2.4. Thesis intent and focus**

Given the importance of the campus open space design and involving users in the design process, this research focus on studying the design process that would involve the users' input and provides a framework that can link those inputs to design attributes. Quality Function Deployment (QFD) is a framework widely used in industries (including manufacture and service) to help develop products that match users' needs. It has been used in education, administration, and construction as well. Its use in Landscape Architecture design is less studied. In this thesis, I examine QFD as a framework to integrate users' needs/requirements into design process of campus landscape space. The research is to explore the following questions:

- QFD was created especially for industrial product design process. Can QFD help campus landscape space design process by providing a framework that links users' needs to design attributes? If so, can QFD be used in other landscape design? Can we involve users into the landscape design process using QFD? How can we use it for landscape design? What kind of modifications is needed?
- One of the QFD strengths is its use for benchmarking. Can QFD also be used to evaluate landscape design?
- What benefits QFD can provide in the design process of campus landscape space design? What are the potential benefits of adopting QFD in landscape design in general? What are the limitations of QFD applying to landscape design?

In short, this research addresses the applicability of QFD, its benefits and limitations in campus landscape space design and landscape architecture design in general. A case study is provided

to demonstrate the use of QFD in a project of campus landscape space design.

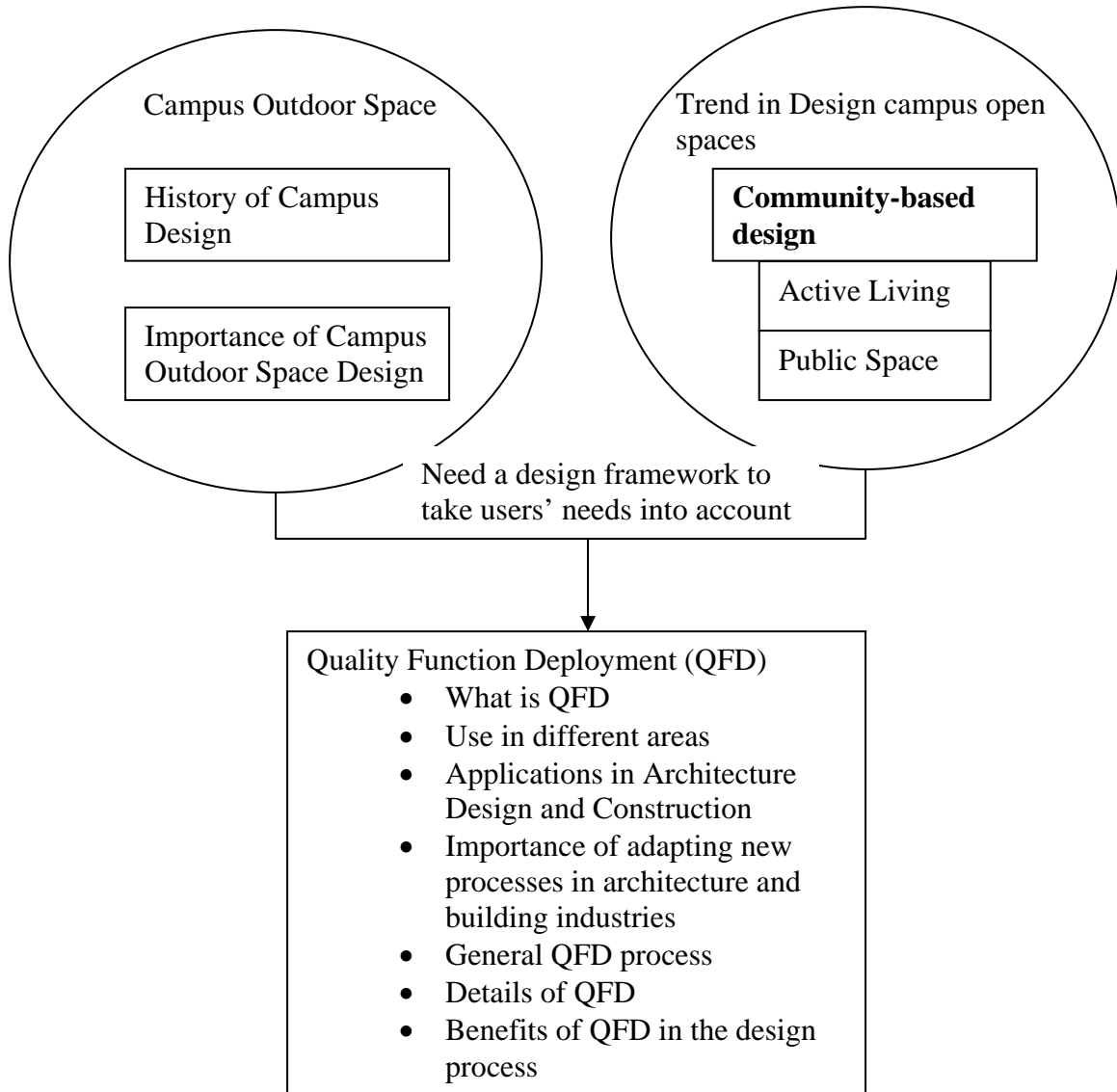
## Chapter 3

### Literature Review

*“No community on the face of the earth has ever been built except on the skills and resources and contributions of the gifts of the people who live there.”*

*-Jody Ketzmann, VBCD  
I n s t i t u t e*

Several areas are related to this research topic. In the immediate context area, campus landscape space design is the focus, with the background and history in the campus design in general. Given the similarity in the design consideration between the design of campus landscape space and the design of public open space, a review of issues faced by public open space design is important and applicable in this research. As indicated in previous section, the problem in the traditional design approach has to do with the negligence of user's needs in the beginning of design process. Current design approaches, like Active Living and Community-based approach, call for a process that includes hearing user's voice, and their involvement in the design process. Yet a cohesive framework is not there to ensure the user's demands or concerns will trickle down to the design consideration and its features. In this research, I examine the use of QFD in filling out this deficiency. Figure 7 shows the relationship between all these different areas, and how they are all tied together. In this section, each subject area is reviewed in details.



**Figure 7 Related Subject Areas – Map of Literature Review**

## 3.1 Campus Design

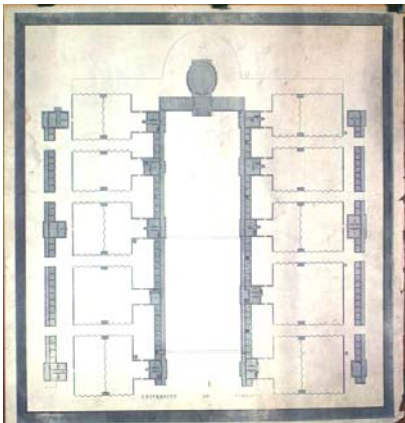
### 3.1.1 Campus Design history:

American campus planning and design has a history of more than 200 years. In the beginning, many campus designs followed the British tradition that has three main components: classrooms, resident halls, recreational facilities (Turner 1984). Early campus planners were architects by profession and focused their “planning” on the design and placement of new buildings, with limited attention to the importance of surrounding open space.

Beginning in the 1820s, the picturesque style originated in England, where the gently rolling agrarian ideals of Lancelot "Capability" Brown evolved with the more dramatic picturesque vision of Uvedale Price and Richard Payne Knight with gnarled trees, chasms, and precipices. Andrew Jackson Downing, who later successfully combined both of these styles as options for appropriate natural rolling topography, popularized the two in a style that has become known solely as the picturesque or the romantic style of landscape design.

In early 1800, Thomas Jefferson advocated the idea of an “academic village,” which influenced the evolution of American college campus. As expressed at the University of Virginia, rather than to European prototypes of universities, Jefferson's ideas were borrowed from European models for hospitals and industrial villages (Jefferson 1805). Likewise, most campus planning made use of axial organization, straight roads, and buildings aligned within or bordering park-like landscapes reminiscent of village greens.

In 1862, universities evolved with the adoption of the Land Grant College Act (or Morrill Act), which promoted education in



Picture 20 Academical Village (1825) (University of Virginia)

agriculture, science, and engineering (Turner 1984). Also, the Act endorsed a more democratic approach to higher education, with schooling for all social classes and the right to choose a course of study. This approach sparked the interest of the prominent landscape architect Frederick Law Olmsted. Olmsted shifted the focus from buildings located in isolated locations to educational neighborhoods integrated into the larger community, in which reflected the more open nature of education. This concept had been used in the design of University of California at Berkeley that was built on farmland adjoined the San Francisco Bay in 1865. Olmsted's design envisioned a more natural, park-like campus with many smaller buildings located along meandering roads. Campuses started to be designed for the entire community and not just the location of future buildings.

Another major turning point for campus design was the "City Beautiful" movement that came out of the Chicago World Fair (Columbian Exposition in 1893). Some of the principles of City Beautiful movement, such as monumental design centered on a unifying theme, were incorporated into college campuses (Hamlin 1903). There was even a general scheme developed for an appropriate campus design consisting of an open space with structures placed around it (in squares or rectangles) along a long axis which might open onto a view or a community (Turner 1984). We still see campus today with an open space surrounded by buildings.

In the late 1940s, the population of students increased greatly, a more diverse student body with middle class and co-ed students. Massive growth caused city-like problems on campus such as vehicle traffic congestion and increased conflicts over land-use as once rural campuses became increasingly surrounded by towns and cities. The post WWII time period saw campus master planning

evolve from the more formal “classical” designs of the City Beautiful movement to an approach for managing future growth. This change came from the general uncertainty of the future (thus limiting the time-line for planning) and the realization that many of the magnificent master plans of the past several decades had never been implemented (Turner 1984).

The evolution of campus planning in the 1940s and 50s was captured in the first modern text on the subject: Richard Dober’s Campus Planning, written in 1963. This book was a significant departure from past discussions because of its focus on the planning process and not on architectural style. In many ways the Dober text promoted the transition of campus master planning from the realm of architects to planners.

Other modern campus plans of this era include Ludwig Mies van der Rohe's work at the Illinois Institute of Technology in Chicago in 1938 to 1940; Dan Kiley and Skidmore Owings and Merrill's plan for the Air Force Academy in Colorado Springs from 1954 to 1962; Foothill Community College by Sasaki Walker Associates with architects Ernest J. Kump and Master & Hurd in 1959; and Church's design (with Warnecke and Associates) for the UC campus at Santa Cruz from 1963 to 1965.

The amount of current literature dedicated to campus master planning remains scarce. Articles where some aspect of master plans is discussed occasionally get published in professional journals, such as *Planning for Higher Education*. A lot of the campus planning field is dominated by private consultants, with little interest shown by academics. Some of this may be the lingering result of a historical divergence of professional disciplines in this small field. Certainly, there are a lot of different concerns in the design and planning on campus landscape, such as resource

constraints, politics, historical heritage, and cost. Compounding these factors, there are several different types of campuses – urban, commuter, rural and also those that include housing for students and/or faculty. They may have different priorities, constraints and functions.

### **3.1.2 Campus Landscape Spaces Planning and Design in Recent Twenty Years**

During the past twenty years, more and more colleges and universities realized the importance of campus landscape spaces for improving the whole school's image, the quality of campus life, attracting and retaining students and factually community members, protecting nature environment, etc. Many of them redesigned and/or increased their campus landscape space. Most notably Princeton University, University of North Carolina--Chapel Hill, University of Texas at San Antonio University of California-Berkeley, The University of Texas at Huston, University of Arizona, Brock University.

Although campus design history has over 200 years in the United States, how to design campus landscape spaces is still a relatively new concept to the design community. Among the above universities, each school used different guidelines to design their landscape space and even categorized these spaces differently. The following are some examples:

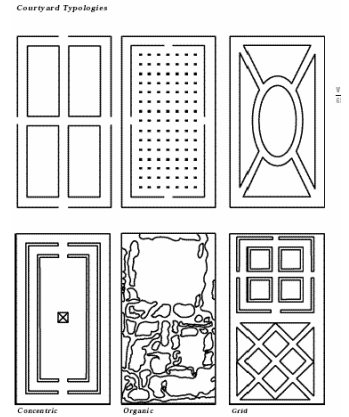
**The University of Texas at Austin** (Cesar Pelli & Associates and Balmori Associates Inc. 1999)

*Five types of landscape open spaces: Courtyards, Plazas, Malls, Walking*

Courtyards have different types. They are all enclosed by buildings, with functions as recreation, social activities, formal/informal outdoor classrooms.



Picture 21 Courtyard 1

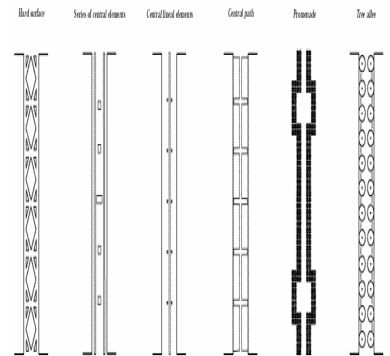


Picture 22 Courtyard 2

Various treatments for malls can be used, like using planting, paving and sculptural elements; function as formal and informal gathering.



Picture 23 Mall 1



Picture 24 Mall 2

Plazas are formal spaces for outdoor social activities: They are larger and more formal than green courtyards and parks, less formal than malls and may not have trees. Most plazas are paved, and covered porticos may sometimes be used. They are closer in character to the malls..



Picture 25. Plaza

Walking streets are similar as malls and plazas, but are not that formal (are less singular).



Picture 26. Walking Street

Parks are usually designed from the largest and greenest of the open spaces on campus. These areas will be planted with additional trees. The planting of trees will provide shade, visual screening and additional stability for the soil in case of heavy rain or flooding. The intent of these parks is to provide green, restful recreational space, as a park does in a small town.



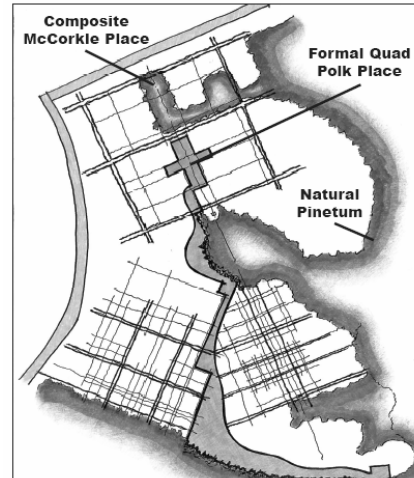
Picture 27. Park

**UNC-Chapel Hill: (UNC - Chapel Hill 2001)**

Three types of landscape open space found on the Chapel Hill campus: **Formal, Natural and A Composite of the two.**

Three types of open space found on the Chapel Hill campus:

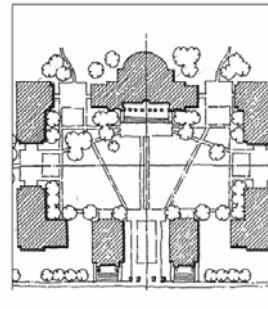
- **Formal,**
- **Natural**
- **A Composite of the two.**



Picture 28. UNC Outdoor Open Space

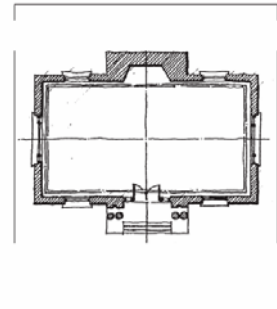
**Formal**

- **Tree-lined, well-defined, rectangular spaces**
- **Symbolic core of campus**
- **Social gathering place**
- **Passive recreational activities**
- **Classical**
- **Relatively flat or controlled topography**
- **Well-defined exterior spaces similar to interior rooms**



Prototypical Quadrangle

Picture 29. Prototypical Quadrangle

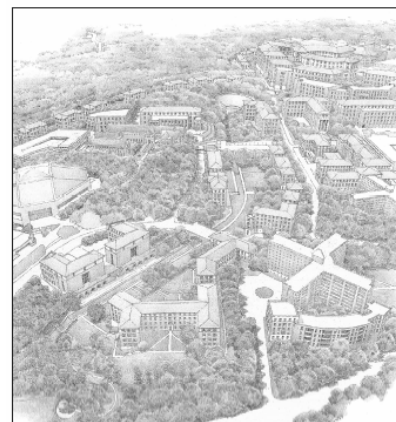


Prototypical Room

Picture 30. Prototypical Room

Composite of the two:  
Park-like settings are defined by edges.

- **Trees are informally placed.**
- **Elements are more rustic (for examples, walls and seating).**
- **Passive recreational activities take place.**
- **Settings are romantic.**
- **Topography ranges from flat to steep.**



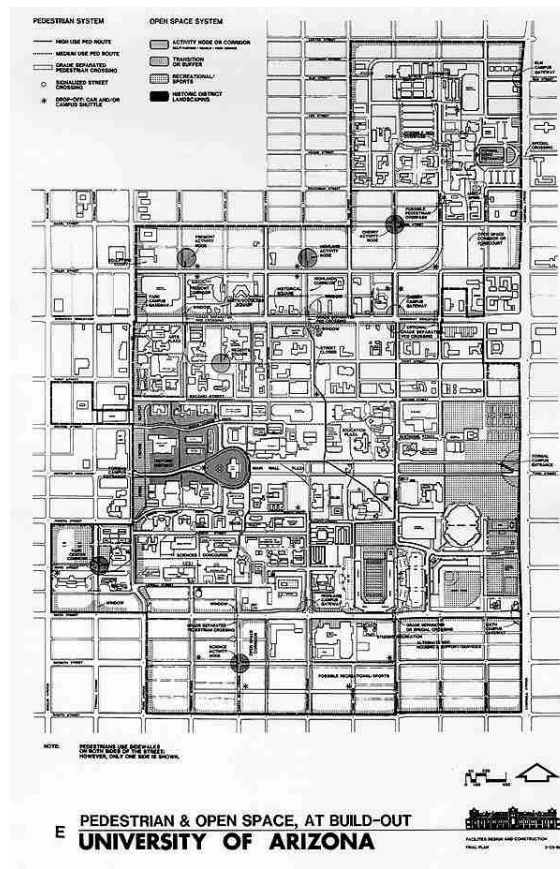
Proposed View of South Campus, UNC-Chapel Hill

Picture 31. South Campus

## University of Arizona (University of Arizona 1988):

Three types:

- Malls and corridor-type open spaces (usually involving street closures), as well as formal campus entrances
- Transition zones and campus gateways
- Intensively used plaza areas



Picture 32

## The University of Texas at San Antonio (The University of Texas at San Antonio 2004):

Types: general open spaces, recreation and athletic fields, and paseo systems (including building courtyards) The general open spaces can be further subdivided into three general groups: manicured lawns and planting areas, meadowlands, and areas of native preserve.



Picture 32 Open Space of UTSA

Picture 33

**AGRARIAN ZONES**

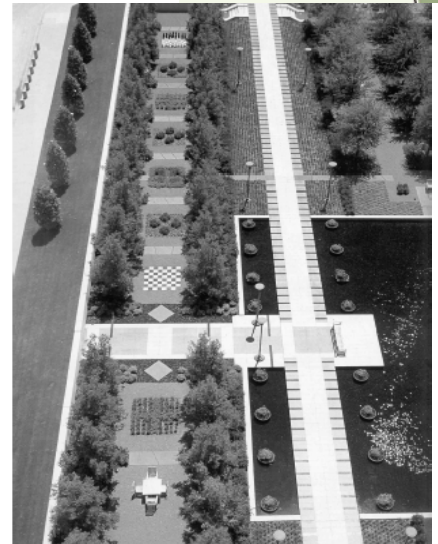


Rows of trees are a predominant characteristic of the agrarian landscape.



Picture 34

**MODERN ZONES**



The one defining characteristic of the modern landscape for the campus is that it stands in contrast to the more natural plantings and design of the other zones.

Picture 35

**TOWN & COUNTRY ZONES**



Water features may be added to the campus to recall the adjacent Lake Moodie.

Picture 36

**ENVIRONMENTAL ZONES**



The Environmental Zone emphasizes natural places, forms and plant materials.

## Princeton University (Princeton University 2006)



Picture 37 Outdoor Open Space of Princeton University

## UC Berkeley (UC Berkeley 2003)



Picture 38 Outdoor Space of UC Berkeley

### ***3.2 Research Related to Campus Landscape Space Design***

There were few researches related to campus landscape spaces designing in the past several decades. The best overview on campus development is Paul V. Turner's "Campus – an American Planning Tradition" (Turner 1984), and Ira Fink's bibliography published by the Society for College and University Planning (1999) includes significant material on facility planning and campus design. The bibliography Contemporary Landscape Inquiry Project, organized by the University of Toronto, is a good source for citations about landscape design history and modern trends and ideas, but with little indexed to campuses (Dober 2000).

Richard P. Dober wrote the book "Campus Landscape: Functions, Forms, Features" (Dober 2000) provide a comprehensive information about campus landscape. In this book, he gives great various campus landscape examples of colleges and universities both in the United States and overseas with their purposes, sizes, locales, histories, etc. with text and photographs and drawings. Clare Cooper Marcus and Trudy Wischemann are the first modern individual to focus on the social and psychological factors in campus landscape spaces design in the book People Places (Marcus and Wischemann 1990). Based on their survey and researches on dozens of colleges and universities, they purposed a "home-based" concept to create people-friendly campus landscape spaces. They also list design recommendations on variety of landscape spaces. Project of Public Spaces is the leading organization to create community public spaces in the United States. It said, there should be at least ten dynamic activities experiences to attract all kinds of people on campus public space, such as eating, drinking, reading, browsing, playing a game, looking at art, etc. The followings are

details of these prior works related to campus landscape space design.

### **3.2.1 Campus Landscape: Functions, Forms, Features**

**“Campuses will be centerpieces in twenty-first-century culture.”  
-Richard P. Dober**

Dober in his book, “Campus Landscape”, provides information, instruction, and ideas on planning and designing every aspect of the campus landscape, using real-world examples of classic and contemporary campus landscapes. It used more than 175 photographs and drawings, including landscape master plans, elevation views, and landscape symbols, makes this book a valuable reference. The text discusses campus landscapes by providing a historical overview of many aspects related to their development. The text also provides insight on how these landscapes will be influenced in the future by social, economic, and environmental issues.

In this book, he discussed a variety of ways a campus landscape is divided into spaces and how these different spaces have unique uses or purposes. He also discusses how spaces throughout a campus are developed to serve educational purposes (horticultural gardens or arboreta), entertainment purposes (playing fields, amphitheaters) and to enlighten users of the landscape by incorporating sculpture and other forms of art into the design. Discussion also includes how different fixtures, like lightening, seating, and other types of landscape furniture are incorporated into the campus landscape to make the space usable by students, staff, faculty, and campus visitors (Dober 2000).

Dober’s main idea is to design the campus landscape into a green environment that situates, serves, and symbolizes higher education. Although this book provides comprehensive coverage of campus

landscape design, its focus is on the functions, forms and features (as suggested in its title). The context is “static”, i.e. very little coverage on the design process, the transformation of campus landscape, or the dynamic of changes.

*“Places can and should, be responsive to our pragmatic needs...Places also can and should allow us to express who we are...and places can and must express and affirm the value of each individual and our collective place in balance with the natural forces and other living species of the planet.”*  
- Francis, Carolyn

### **3.2.2 People Places**

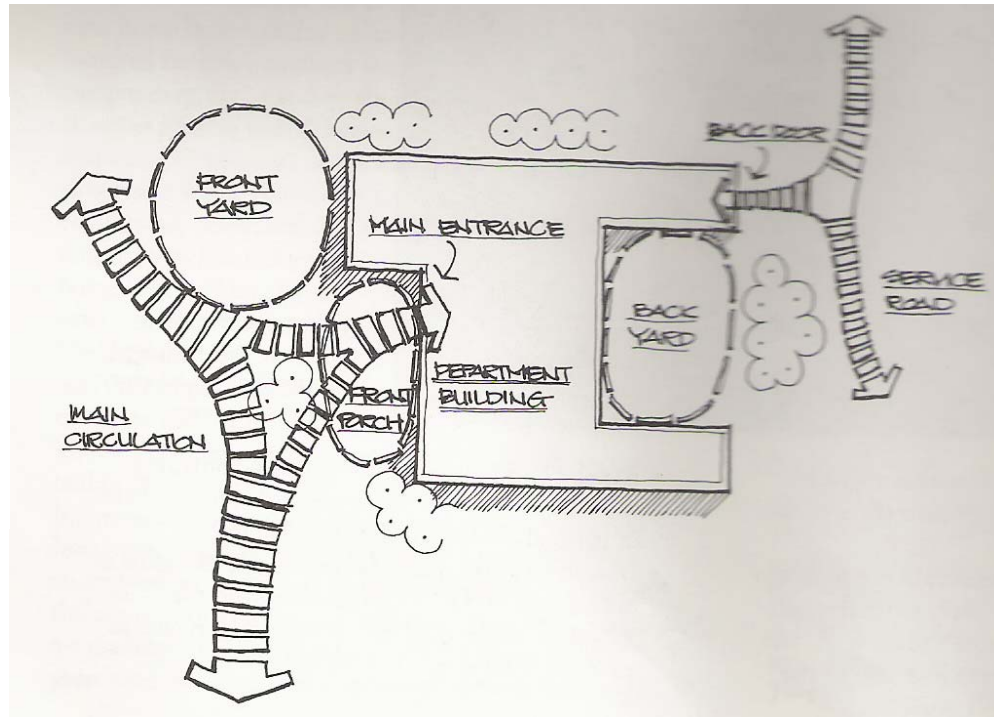
Marcus and Francis compiled and edited the book, “People Places” that won the Merit Award in Communication from the American Society of Landscape Architects. They analyze and summarize existing research on how urban open spaces are actually used. It offers research-based guidelines and recommendations for creating more usable and enjoyable people-friendly spaces. Seven types of urban open space are discussed: urban plazas, neighborhood parks, miniparks and vest-pocket parks, campus landscape spaces, outdoor spaces in housing for the elderly, child-care outdoor spaces, and hospital outdoor spaces. It contains a chapter-by-chapter review of the literature, illustrative case studies, and Performance-based design recommendations that specify key relationships between design and use to each type of space.

Marcus and Wischemann (Marcus and Wischemann 1990) made major contribution to campus landscape spaces design in terms of how people use the places and the interaction between the spaces and users. They studied the design of landscape spaces in a number of campuses in the United States and made observations about how people use such spaces. Their observations were related to the location and design of some areas that were present adjacent to specific buildings and how this affected one’s use of campus landscape spaces. They proposed “home base” concept for design, which is that each student, faculty member and employee has a work or home base around his or her daily campus activities

circulate. To students, the home base is usually the students' major department. Each building can be viewed as a house, and the adjacent landscape places as "front porches" and "front and back yards."

Picture 39 Each campus building should ideally have a front porch, front yard, back yard, and back door.

-Campus outdoor spaces from People Place



- **Front porch:** The front porch of a campus building at the university offered an important physical and psychological transition from the campus as a whole to a specific department or college. It can be a significant social/study/meeting/eating place.
- **Front yard:** Some campus buildings have "front yards" - significant green spaces where building residences can relax in a different way from on the front porch. One can go with a friend to talk in private, to sunbathe or sleep, to eat, to study, or to hold a class meeting close to home base.
- **Backyard:** Spaces attached to or partially enclosed by buildings, where "residents" feel a greater sense of territory than in

the front yard and where semiprivate department or college events can be held.

- **Backdoor**: campus building should have a backdoor or service entrance where (1) delivery trucks park and unload, (2) noxious materials are stored, and (3) garbage is picked up. If the front door and backdoor are the one and the same, it can be very irritating for people wishing to socialize, eat lunch, or study when at the same place and time trucks deliver products to the vending machines.

- **Common Turf**: Common Turfs that are not the territory of specific buildings or departments. They are viewed as the streets and parks of the campus “town”. (Marcus and Wischemann 1990)

In this book, it described how users would use these places, what kind of activities likely to happen there, and also gave design recommendations for these places. For the survey, they concluded several main reasons for students to choose landscape spaces: Naturalness, tress, and greenery, peace and quiet, shade and sun, people and people watching, proximity to water, grass and open space, feeling free and comfortable. This observation and analysis of user behavior and preference complement to Dober’s book. It even has a design review checklist for design professionals. Though it is one step further counting on user’s needs, it still does not review the design process.

### **3.2.3. Active Living & Public Spaces:**

In the United States, many community environments are “unhealthy” to people. For examples:

- “Community design often favors automobiles. Shopping areas, schools, and offices are often located far from people’s homes.

The low-density, single-use, large-area zoning commonly found in suburban landscapes further limits people's ability to walk or bicycle for daily transportation. Cul-de-sacs, curvilinear streets, and limited access between neighboring communities create circuitous routes for pedestrians.

- Safety concerns limit active choices.
- Infrastructure is lacking. Many communities don't have sidewalks and bike lanes, and limited safe storage or parking for bicycles.

Recreation facilities may not be accessible. The location of many regional recreation facilities and parks precludes their use for routine or spontaneous recreation. Some parks limit activity to organized sports and scheduled events, thus limiting the audience who can take advantage of park amenities. Some schools with modern sports facilities do not permit community use of them during non-school hours. Those that do may be located beyond walking distance. Private facilities may be cost-prohibitive to many potential users.” (Mishkovsky 2004)

Physical inactivity causes numerous physical and mental health problems, is responsible for an estimated 200,000 deaths per year, and contributes to the obesity epidemic. Among preschool children and adolescents, obesity has doubled since the 1970s. The percentage of obese children 6 to 11 years old has tripled (Active Living Research 2006).

Health researchers have studied a broad array of environmental factors that might influence physical activity. Although which factors are more important are not sure yet, enough evidence has shown that activity-friendly environments can help more people engage in active living. Active living means a way of life in which physical activity is valued and integrated into daily living. It

focuses on how the built environment - including neighborhoods, transportation systems, buildings, parks and outdoor space - can promote more active lives. It is recommended that 30 minutes each day for people to do moderately intense physical activity (60 minutes for youth).

According to researches, providing a convenient and inviting environment for physical activities is essential to increasing people physical activities. “People with the best access to a variety of built and natural facilities were 43 percent more likely to exercise 30 minutes most days than those with poor access. 43 percent of people with safe places to walk within 10 minutes of home met recommended activity levels, while just 27 percent of those without safe places to walk were active enough....” (Active Living Research 2006) For children’s obesity problems, much research has focused on educating children and changing their physical activity and eating behavior, but these approaches have had limited success (CDC 2005). Changing the environments in which children eat and play is now seen as an essential strategy in fighting the obesity epidemic (Koplan, Liverman et al. 2005).

Now, colleges and universities also emphasize the importance of active living on campus. Some colleges and universities redesign their campus adopting some active living principles, such as:



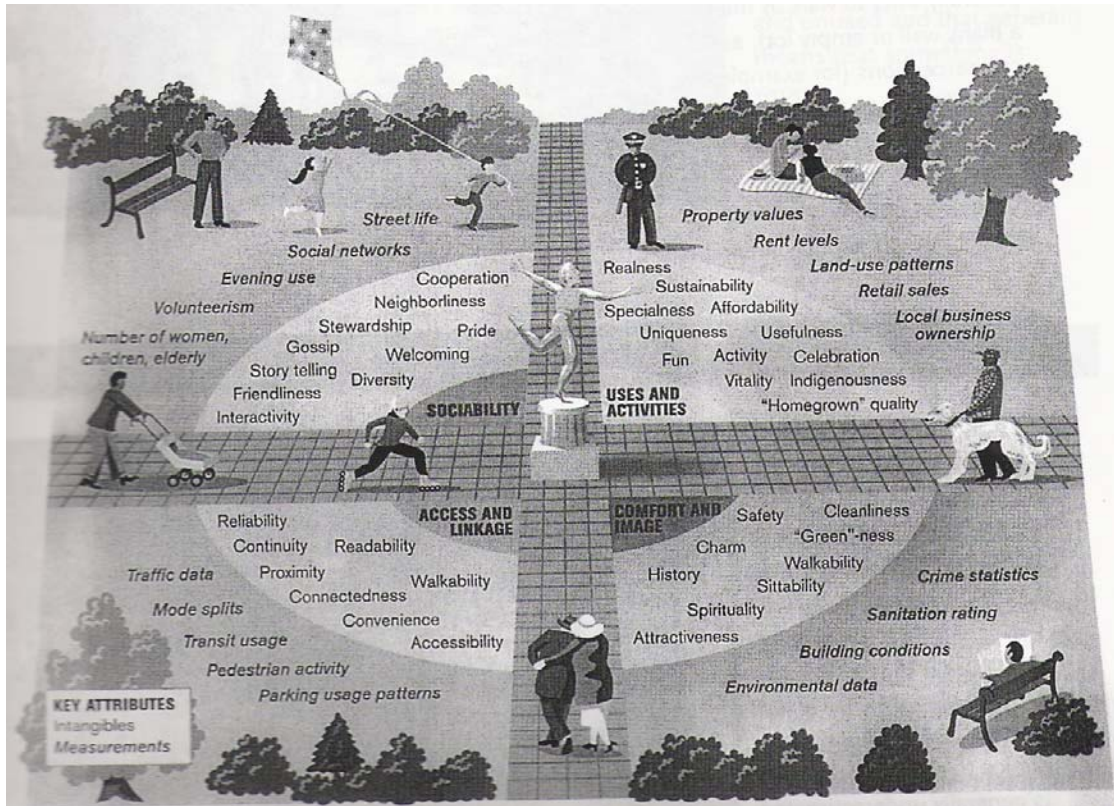
**Picture 40 Active Campus  
-U of Minnesota (The  
University of Minnesota 2006)**

- “Keeping the campus ‘walkable’ with comfortable pedestrian and open space corridors
- Vehicular traffic will be allowed to remain where needed, but only calm traffic on pavements that complement the pedestrian environment and scale.
- Pedestrian corridors should have continuity of comfortable elements
- Continuity of pavement types
- Concrete pavements with finish and texture that can be easily repaired and replicated. Special brick or other unit pavers should be used in limited special areas only. Concrete paving is more feasible and affordable to maintain and replace. Unit pavers in disrepair are unsightly and can be dangerous. Concrete pavement can be given more human scale and texture by using closely spaced saw joints and similar techniques.
- More emphasis on comfortable, clean, safe usable grass open spaces.
- Comfortable benches and furniture for outdoor study and informal gatherings in shaded and protected locations.
- Meeting areas in appropriate quiet settings.
- Avoid unnecessary obstacles such as raised planters where not providing direction or space definition.
- Provide a tree lined green strip between the sidewalk and curb, especially on campus edge streets.” (University Of North Texas 2002)

How to design landscape spaces are critical for improving active living on campuses. Although active living guideline and concept exist, many landscape spaces on campuses are still empty most of time; the design of these spaces are not inviting for people to do activities there. On the other hand, people complain that there are few places for them to do outside activities.

### **3.2.4 Public Spaces:**

Creating public spaces for community activities is also emphasized in the recent twenty years. Project of Public Spaces is the leading organization for this trend. PPS found that a successful public space has four key qualities after evaluating thousands of public spaces around the world: They are **accessible**; people are engaged in **activities** there; the space is **comfortable** and has a good image; and finally, it is a **sociable** place: one where people meet each other and take people when they come to visit. PPS developed **The Place Diagram** as a tool:



Picture 41. The Place Diagram. (PPS 2000)

For public spaces on campus, Project for Public Spaces (PPS) developed the concept of “The Power of Ten.” Within any campus, there should be at least ten dynamics to attract all kinds of people, such as eating, drinking, reading, browsing, playing a game, looking at art, and so on. Such places bridge the gap between the distinct and diverse communities within the campus; they are the settings for civic gatherings, residential life, and academic discussions, and they possess a variety of public, private, academic, retail and cultural amenities. The recent campus public spaces they did include, Harvard University Allston Campus, Duke University West Campus Plaza: Creating a Central Square, Yale University: College/Chapel District, Harvard University North Campus Placemaking Study, Northwest Community Hospital: East Campus Public Space Renaissance Project, etc.

To design successful public spaces, PPS thinks it is crucial to involve community members in the design process. The community member can provide perspective and valuable insights into how an area functions; they have a unique understanding of the issues that are important. However, in traditional design process, community members are rarely asked to contribute their ideas or concerns in the planning process. So, PPS thinks community-based approach is an alternative way from traditional design for making a great public space.

### ***3.3 Community-Based Approach***

The goal of community-based approach is to create a successful public space for the community members. The whole community will come together to develop the community envision for this space and make a concept plan together. The professionals' role is to help and support community in the process, implement the vision of the community. This is a place-oriented approach, which starts with the professionals eliciting the community's ideas - their concerns about how to change their local public spaces. Usually, people were brought together in meetings or in a workshop where they evaluate their local spaces and discuss the issues and form their vision. Generally the process involves: consulting with the community at the outset; making observations and collecting data at the place in order to discover and substantiate its critical issues; presenting those issues to the community for additional input; and finally, implementing the community's vision. The following are some of the typical steps (PPS 2000):

- Meet with community representatives: from both public and private sectors to identify the range of issues that the various groups face regarding a particular place.

- Formulate hypotheses about issues that merit further data collection and develop a workplan for how to collect this information.
- Collect the data that you need to better understand the situation.
- Analyze data, review community input, and identify potential ideas for implementation.
- Conduct a public forum for community representatives and interested members of the larger community at which you present issues, get feedback and develop, with the community, a vision for the space.
- Translate the results of the meetings and the observations into an outline of issues and a conceptual plan that reflects the community's vision.
- Refine and discuss these recommendations with the community.
- Develop an implementation strategy.
- Develop design ideas that reflect the vision and the implementation strategy.

**The problems of this approach are:**

Usually, the voices that can be heard are only those persons who were active in the discussion or dominated a discussion. These people's ideas may not represent most people's needs. The dynamic of a discussion influence the discussion results greatly. Like who is the group leader, what are the relationships among the group members. Even though they may have different idea, but they may not say it; or people may argue with one topic for most of the time and ignored other important issues. With different people, the summary of each meeting/discussion also differs. There are so many details and practice issues involved in the process that are based on

personal choices. Even it is the same community and same public space, with different group meetings/discussions/group leaders as well as how the professionals help and support the whole process, the vision of community and the concept plan may varies.

### **3.4 Quality Function Deployment (QFD)**

#### **3.4.1 What is QFD**

Original from in Japan in the late 1960s by Professors Shigeru Mizuno and Yoji Akao, the introduction of QFD to America and Europe began in 1983 when the American Society for Quality Control published Akao's work in *Quality Progress* and Cambridge Research (today Kaizen Institute) invited Akao to give a QFD seminar in Chicago. Since then, QFD has been applied in industry and business, from aerospace, manufacturing, software, communication, IT, chemical and pharmaceutical, transportation, defense, government, R&D, food to service industry.

Organizations that have in the past presented at the Symposium on QFD include 3M, AT&T, Accenture, Boeing, Continental Rehabilitation Hospital, DaimlerChrysler, EDS, Ford, GM, Hayes Brake, Hewlett-Packard, Hughes Aircraft, IBM, Jet Propulsion Laboratory, Kawasaki Heavy Industry, Kodak, Lockheed-Martin, Pratt & Whitney, Motorola, NASA, Nokia, Raytheon, Texas Instrument, Toshiba, United Technologies, U.S. Dept. of Defense, United Technologies, Visteon, Xerox and many other Fortune 500 companies (QFD Institute 2006).

QFD is a structured and disciplined process that provides a means to identify and carry the voice of the customer through each stage of product or service development and implementation. QFD provides a structure for ensuring that customers' needs and wants are successfully captured and then translated into specific product

requirements, design specifications, product attributes, and process parameters.

QFD provides a system of comprehensive development process for:

- Understanding customer needs
- What 'value' means to the customer
- Understanding how customers or end users become interested, choose, and are satisfied
- Analyzing how do we know the needs of the customer
- Deciding what features to include
- Determining what level of performance to deliver
- Intelligently linking the needs of the customer with design, development, engineering, manufacturing, and service functions

The expected outcome of using QFD is a successful, high quality product that creates customer satisfaction and loyalty. QFD is frequently associated with providing the following significant benefits (Akao 1990; Day 1993; Moore and Pessemier 1993; Olbon 1995).

- 30-50% reductions in engineering changes (*reduced product cost*).
- 30-50% shorter design cycles (*reduced time to market*).
- 20-60% lower start-up costs (*reduce product cost*).
- 20-50% fewer warranty claims (*increased product performance*).
- Increased customer satisfaction (*increased product performance*).

Figure 8 shows the decline in terms of problems in production, time, and cost after adopting QFD.

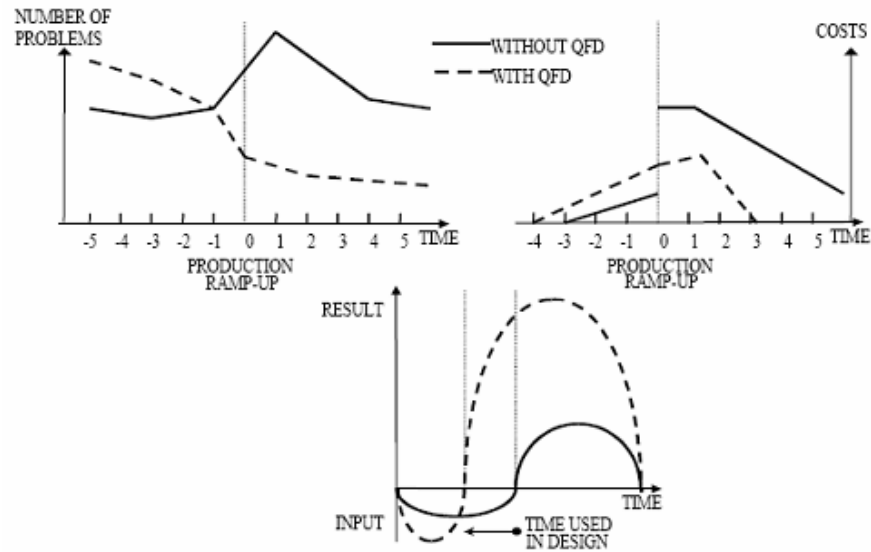


Figure 8 Decline in problems of production, cost and time when using QFD (Ekdahl 1997)

### 3.4.2 House of Quality (HoQ)

The engine that drives the QFD process is the product-planning matrix commonly referred to as the House of Quality (HoQ). The HoQ serves as a conceptual map that provides the means for cross-functional planning and communications. During this phase of QFD customer requirements are translated into specific design requirements. The HoQ is composed of seven key elements:

**1. Voice of the Customer (VOC): What's** – This element involves explicitly stating customers' needs and wants as a finite set of well-defined product requirements. This is the list of what customer needs/wants (the voice of the customer). And also customer ranks their importance.

**2. Product Features (design attributes): how's** – It is the voice of the design professionals. This element involves determining design attributes that will satisfy the identified customer requirements. In traditional QFD, this element usually involves technical or functional performance with measurable unit. For example, to

satisfy customer's need for quiet machine, a design feature may be the noise produced by the engine, measurable in terms of decibel (dB).

**3. Importance of Customer Needs** - This element involves *prioritizing* the identified customer requirements to indicate which requirements are the most critical.

**4. Relationship Between Customer Needs (what's) and design attributes (how's)** – This element involves determining the relative strength of the relationships between customer requirements and product features. These cells indicate the strength of the interrelation between the What's and the How's. It can have the degrees like:

- H: Strong
- M: Medium
- L: Weak
- Empty: no relationship

Or it can have a scale from 1 to 5. Traditional QFD uses 9, 3, 1, and 0 to represent Strong, Medium, Weak and no relationships.

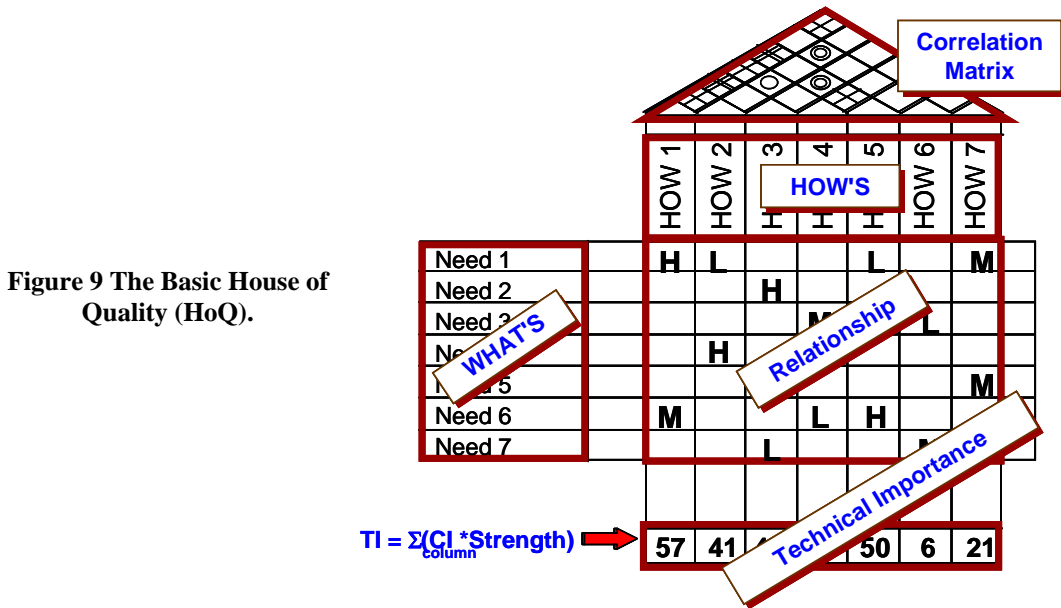
**5. Prioritized design attributes (how's)** - This element involves prioritizing and setting target measures for product features.

**6. Feature-to-Feature Correlation (Impact Of The How's On Each Other)** – This element involves determining the relative strength of the relationships between product features. It can be represented using symbols like:

- ◎ Strong Positive
- Positive
- × Negative
- ⊗ Strong Negative

This element is useful for design professionals to see the dynamic between design features and possible tradeoff they have to make in the design.

**7. Planning Matrix** - This element involves benchmarking a company's product with major competitors' products in regard to identified customer requirements. This can also be used to compare different products within the same company. In essence, this element is used for comparing different designs.



The HoQ is not QFD. In some cases, the HoQ is not even constructed or necessary in the process of implementing QFD. However, in most cases, HoQ remains an essential tool for linking Voice of the Customer to Voice of the Engineer/Designer (QFD Institute 2006).

Although many books and articles on "how to do QFD" are available, there is a relative small number of example matrices available. QFD matrices are highly proprietary because there are many product or service information within them. Companies will not show/share their company secrets or product development plan. QFD is a systematic means of ensuring that customer requirements are accurately translated into relevant technical descriptors

throughout each stage of product development. Meeting or exceeding customer demands means more than just maintaining or improving product performance. It means building products that delight customers and fulfill their unarticulated desires. To ensure customer's needs are matched in every aspect of the process, a series of matrixes or phases are conducted. Typical QFD process in manufacture industry involves four phases; each phase, or matrix, represents a more specific aspect of the product's requirements, where binary relationships between elements are evaluated for each phase.

The four-phase multiple matrix processes are (Day 1993):

**I. *Product Planning (House of Quality)*** – Focus on translating customer requirements into engineering or design requirements.

**II. *Part Deployment*** – Focus on translating engineering or design requirements into product or part characteristics.

**III. *Process Planning*** – Focus on translating product or part characteristics into manufacturing operations and controls.

**IV. *Production Planning*** - Focus on translating manufacturing operations into specific operations and process parameters.

Customer's needs are mapped (connected) to every aspect of the system life cycle through a series of matrixes, including design, engineering, manufacturing, operations, etc. This “trickle-down” of customers' needs is accomplished by converting the How's at the upper level to the What's in the next level. Figure 10 shows an example of the How's at one level become the what's at the next level.

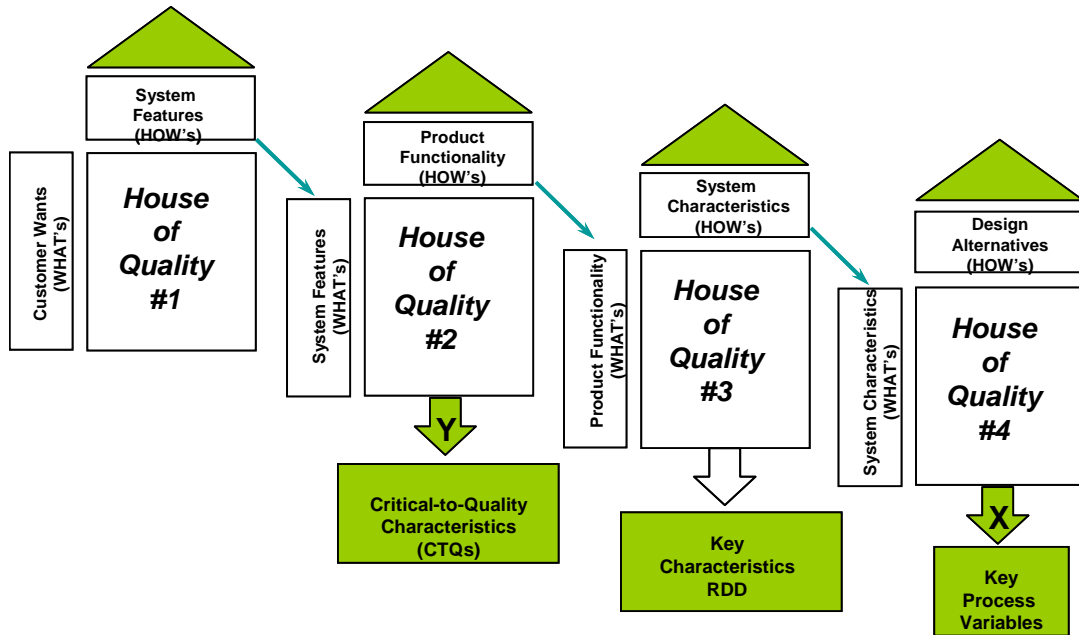


Figure 10 Series of HoQs in QFD process

### 3.4.3 Application of QFD in architecture:

There are limited numbers of literature available regarding the use of QFD in architecture design (not counting those in the construction industry). Figure 11 shows an example of a series of HoQs applied in the architecture and construction. This is an ideal example that imitates those QFD in manufacture industry. In practice, QFD has been used to set the priority of design properties in a pilot building project, Villa 2000, in Finland (Nieminen, Huovila et al. 1998).

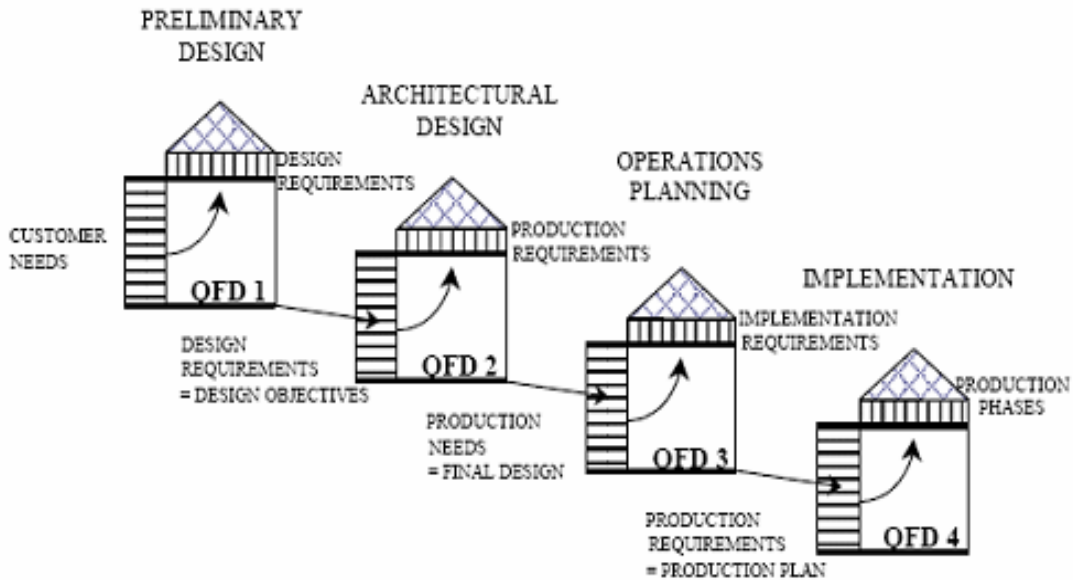


Figure 11 Applying QFD to architectural design and construction project (Haapasalo 2000)

Based on few literatures available, including the survey from the architects' feedback in Singapore in 2001 and Finnish Association of Architects (SAFA) in 1996, QFD has certain benefits and problems applying to architecture.

### 3.4.3.1 Benefits of using QFD in architecture

- **QFD offers a rationalized approach to customer satisfaction**

Architects need to put client satisfaction as their core objective, and they also have the responsibilities to environment and the neighborhood. QFD offers a rationalized approach to meet customer's needs.

- **Adding value to design**

Innovation is one of the main considerations for many architects

to add value to their projects. QFD is able to play a pivotal role to support effective innovation and strategy.

- **Value in quality**

The judgment on quality in design has always been contentious in architecture. Architects often complain that clients and public don't understand or appreciate their design. QFD provides a platform for customers to be "educated" by architects into the "possibilities of the unknown" instead of fervently holding on to their "popular taste".

- **Integration of design and engineering**

The integration of design and engineering is essential to architecture. Benefits include (Buchanan 2005):

- More innovation, technological advances
- Cutting cost
- Better quality and customer satisfaction

#### **3.4.3.2 Problems of using QFD in architecture:**

- **It's not easy to learn.** It seems complex and mathematical with too many data.
- **It requires team work, which is time consuming.** The team leader should be formally trained in the technique to guide and direct the process.
- **It is difficulty to handle the differentiate needs and features.** For some architecture design, it's not easy to define the average customer, and also customers may not know all possibilities.

### 3.4.3.3 Misconceptions

Other than the benefits and problems observed by architects, there are some misconceptions exist among people who do not have in depth knowledge about the method. Followings are few typical misconceptions:

- **QFD will kill the creativity.** “Systematizing the design process is not going to work, because design is a creative process. Having a system will actually kill it!” “This method is leveling all the designers’ skills to a common denominator, instead of raising it to a higher level and highlighting the differences in the skills of various designers.”

**Correction: QFD is not a design technique. It is to guide the design process to ends that best reflect customer needs/wants. It is applied to evaluate design solutions or outputs from the iterative/creative process of design.** “QFD has nothing to do with the ‘production part’ (i.e. design creation) but rather the subsequent reproduction and re-reproduction parts. (i.e. design iterations)”

- **A good design professional don’t need QFD.** “Any good designer would have gone through this (i.e. the matrices) in the mind in a more optimal and efficient fashion rather than doing it in a linear, quantitative fashion.”

**Comments: A design in the mind of architects must be tested with realization. A translation of the “what’s” (i.e. customer requirements) into the “how’s” (i.e. technical characteristics) in the House of Quality matrix forces the design professional to consciously explore technological and engineering options to fulfill those needs. The relationship matrix determines how much each proposed design feature meets the requirements.** “Everybody should adopt this kind of

approach to have a clear understanding of what is expected and to ensure that resources are commensurate with their objectives.”

## Chapter 4

# Campus Landscape Space Design Using QFD

*What we really need is a new national training program in creating good places.*

*-Project for Public Spaces*

In this research, the application of QFD process in landscape architecture design is examined by following the process in a case study on the campus open space design. This is to demonstrate the value of adopting QFD in design process that will enable design architects to better understand the users' need and provide a prioritized design attributes that would help architect in the design.

Recall the design process using QFD:

1. Define the users/customers.
2. Acquire user needs, and design requirements.
3. Rank user needs and design requirements.
4. Generate conceptual design and design attribute
5. Construct correlation matrix, linking requirements/needs to design attributes
6. Generate different design alternatives.
7. Evaluate different design alternatives.

This process is not necessarily linear. In fact, it is often iterative and continuous in practice. Following is the case study of campus garden design using QFD.

### **4.1 Define the users/customers**

The first step is to identify the users. This may look obvious in some cases, but can be complicated since many designs not only

concern the direct users or clients; many different stakeholders may be involved. For university campus, it is easy to identify the majority end-users of campus landscape spaces are students. Faculty, staffs, parents, visitors and surrounding community members are also important users. Since the focus of this research is not on the results, but the applicability of QFD in campus landscape design, only the major end-users (college students) were chosen to simplify the process.

Among college students, I chose 80 with half of them from different genders. Among the sample users, more than half of them are undergraduate to reflect certain proportion of the population.

Table 2 shows the composition of the user sample.

**Table 2 Sample Users in the Study.**

Total Number	80	Percentage
Female	40	50%
Male	40	50%
Undergraduate	49	61%
Graduate	31	39%

## ***4.2 Acquire User Needs***

This is the most crucial step of the QFD process. It involves the identification of what end-users needs. Several methods can be used to establish customers' expectations: survey, interviews; questionnaires; observation, community meetings, etc.

A pilot questionnaire survey was made based on literature review and observation, and it was given to 10 college students at Virginia Tech with interviews. The final survey questionnaire was modified based on the pilot study. (See Appendix)

From the survey, the major findings include what are the most (and the least) needed features or functions, as well as some special needs:

The needs considered most important by most users:

- Naturalness
- Sitting places
- Activities
- Safety

The least considered needs:

- Boundaries: Hedges/living walls
- Detailed Aesthnic view:
  - lawns: Surface texture
  - Flowers colors
  - Art/sculpture
  - Garden styles

Some special needs:

- Education: plants, biology, civil engineer and art classes
- Graduate reception
- Personal: Wedding, etc.

Based on the survey results, most college students' needs for campus garden include the followings:

- Sitting Places
- Naturalness, trees & greenery

- Grass & open space
- Peace & Quiet
- Feeling Free & Comfortable
- Fresh Air
- Shade/Sun
- Safety
- Clear
- Activities:
  - Studying/reading
  - Recreation
  - Social
  - Conversation
  - Eating
  - Family gathering
  - Meditation
  - Watching people
  - Sun bath

Those least considered and special needs are excluded from the case study to simplify the construction of the House of Quality. In reality, some of them may have to be included because of special concern. For example, the teaching function of the horticulture garden may not be important to most of the students, but it serves the major reason to have such a garden.

### 4.3 Rank user needs

Based on the survey, students' needs can be ranked. Table 3 shows the ranking of those features or needs considered important to users. The ranking scores are derived from the survey based on average user ranking. In practice, the ranking may be conducted by further marketing study (for examples, large sample phone survey, online survey, interview, interest group meetings.)

Students' Needs		Importance Ranking
Activities	Studying/reading	9
	Recreation	5
	Social	8
	Other/conversation/eating	8
Sittings	Group	7
	Individual	10
Beautiful, aesthetic looking		6
Peace & quiet		8
Naturalness & greenery		10
Clean/not dirty		6
Fresh air		8
Shade/Sun		8
Safety		10
Grass & Open space		7
Feeling free and comfortable		9

Table 3 Ranking of User's Needs.

It is often the case that many needs or requirements are interrelated with each other. For examples, the individual sittings may be needed for individual activities like reading and studying; the

naturalness and greenery will create the feeling of aesthetic pleasure; a dirty place won't look beautiful. Some needs may conflict with others, like the need to have group activities and peace & quiet. In ranking these needs, we need to consider not to have duplicated items, items included by the other one, or items defined too broadly or too narrowly. It is often necessary to go back to previous step and iterate with this step. For the design of community open space, this ranking process and the previous step (identifying user needs) can be conducted on the meetings with the community. The consensus reached in the meeting would be invaluable to the design.

#### ***4.4 Identify design attributes***

This phase addresses the “how” question by identifying the measurable and definable design features of the campus garden. As reviewed in the previous section, QFD usually consist a series of HoQ. The first HoQ tracks user needs to quality functions; the second HoQ will “translate” the quality functions to design features; then the design features to construction (manufacture). This usual approach is difficult to adopt in landscape design field. In landscape design, user's needs are usually mixed with the quality functions. For example, users want to have the pleasure coming from aesthetic view. The need (pleasure) is difficult to separate from the quality function (aesthetic view), since the need is specifically tied to the function (i.e. the pleasure is not coming from viewing something else.)

This coupling of needs and quality functions is the most challenging aspect in adopting QFD into landscape design. Because of this unique characteristic in landscape design, I combine the user needs with quality functions as the “what” elements, and the “how” elements are design features.

Garden design involves many items and factors. To meet the student's needs, I chose those of the closest relationship with college students' needs based on the literature review & People Places (Marcus and Wischemann 1990). These include the following items:

- **Landscape Features**
  - Tree/Shrubs
  - Lawns/Grass
  - Water (Creek/Pond)
  - Path
- **Landscape furniture/Facilities**
  - Benches
  - Tables
  - Recreational facilities
  - Group/Social facilities
  - Safety Lightings
- **Surroundings**
  - Buildings
  - Open space (enough distance from any department)
- **Accessible/convenience**
- **Noise control**
- **Spaces**

#### ***4.5 Development of correlation matrix, linking requirements/needs to design attributes***

An important step in the QFD process is the development of the correlation matrix. This correlation matrix shows the relationship between the “what” list and the “how to” list. For example,

students need “sitting places” in the “what” list, is strongly correlated with the following design attributes: benches, chairs. The correlation matrix was developed by matching the stated needs of the students with the specific design attribute that aims at meeting those needs. The strength of the correlation could also be described as strong, medium or weak. The correlation strength can be quantified as 5, 3 and 1. (Some tradition HoQ use 9, 3 and 1.)

After the construction of the correlation matrix, it is necessary to check it for errors or omissions. A blank row in the matrix would suggest that there is a student’s need not met by any of the design attribute. This should prompt for the design professionals to come up with features to meet the need. On the other hand, a blank column implies a design attribute not addressing any of the students’ needs. This implies the redundancy of the design feature, or missing of certain user’s need on the list.

Owing to the inherent characteristics of landscape design, the correlation matrix is likely to be large and difficult to work with. To avoid this, it is possible to draw up a preliminary matrix initially and then refine this using a rough-and-ready approach. This approach involves breaking down the original matrix into several smaller matrices during the deployment phase.

Table 4 shows part of the HoQ with correlation matrix in the case study. The second column indicates the rate of importance, derived from the survey; while the third column is the normalized percentage weight users placed on the needs. The other numbers in the matrix indicates the correlation between the needs and design features. I use 5, 3, and 1 to indicate strong, medium and weak relation.

HoQ Campus Garden Design		Rate of Importance	Demanded Quality Weight (Percentage Weight)	Landscape Features				Landscape Furnitures/Facilities					Surroundings	Accessible, Convenience	Noise Control	Spaces
				Trees, shrubs	Lawns	Path	Water (creek, pond)	Benches	Tables	Safety Lightings	Recreational	Group, Soical				
Activities	Studying, Reading	9	8	3	1	1	1	5	1		1	3	5	5	5	5
	Recreation	5	4	1	5	5	3	1	5		5	1	5	5	1	5
	Social	8	7	3	3	3	5	5	5		3	5	3	5	1	5
	Other - Conversation, Eating	8	7	3	3	1	3	5	3		1	3	1	5	3	3
Sittings	Group	7	6	3	5	1		5	1	1	1	3	1		1	1
	Individual	10	8	3	1	1	1	5	1	1	1	1	1		1	1
Beautiful, Aesthetic Looking		6	5	5	5	5	1	1		1	1	1	5		5	3
Peace & Quiet		8	7	5	5	1	5	1		5	1	1	1		1	5
Naturalness		10	8	5	3	1	5	1		1	1	1	5		1	3
Clean		6	5	1	5	5	5	1	1	1	1	1	1		3	1
Fresh Air		8	7	5	1	1	1	1	1	1	1	1	1		1	1
Shade/Sun		8	7	5	5	5	1	1	1	5	1	1	1		1	5
Feeling free and comfortable		9	8	5	5	5	1	3	3	5	3	3	5		1	5
Grass & Open space		7	6	1	5	3										
Safety		10	8	1	5	5	5	1	1	5	1	1	5	5	5	5
Sum		119	100	335	366	273	251	250	146	187	139	176	272	168	202	326

Table 4 Correlations between User's Needs and Design Features.

In this research, I use the computation model similar to that described in “Better Design in Half the Time” by Bob King. The rating of importance in voice of customer (VOC) is normalized to a percentage of importance. The weighting of relationship between VOC and Quality Characteristics (design features) is calculated by multiplying correlation number and the normalized weight of customer need. This is probably the most adapted computation method in HoQ. For practical usage, many software packages are available in facilitating the construction and computing of HoQ.

As shown in Table 4, it is easy to see that the most influential design attributes are lawns, trees/shrubs, space, path, surroundings, water features and benches. These design attributes have the highest summary score from computation, and are close related to most of the user’s needs. Design professionals should pay more attention on these attributes.

The results of the summary scores may or may not correspond to design professionals’ expectation. If it does not match designers’ expectation, they can trace the score back to the correlation table, the elements of user’s needs and design attributes. This exercise alone may give design professionals some insight in users’ needs/concerns, the choice of design attributes and other related design issues. This is one of the advantages provided through QFD – it is dynamic and iterative, yet systematic and logical. It is especially useful when a design teams is involved, since it can provide a guided and focus discussion, instead of aimless argument as often the case in the conceptual design phase.

#### ***4.6 Generate different design alternatives***

One of the advantages of QFD is its ability to provide comparison between different design alternatives. With carefully constructed

HoQ, it is easier to know what would be the more influential design attributes. The design professionals can generate different design alternatives for comparison. As stated earlier, QFD is not a design technique; it does not replace design professionals' creative work.

In this case study, I use a the horticulture garden at Virginia Tech as Garden A; and the garden in Sichuan University in China as the other design – Garden B. As this is for demonstration purpose, the differences between the settings and environment (like the area, grading, climate, etc.) are not considered.



**Various plants and flowers**



**Few sitting places**

**A gazebo and a deck  
with several benches**



**Garden A**



Picture 42 Garden A



**A landmark in the center of the garden with many sitting places.**



**Sidewalks are around the garden**

**Many sitting places in the garden**



**Various sitting places**



**GardenB**



Picture 43 Garden B

#### ***4.7 Evaluate different design alternatives***

QFD provides a way to compare different design alternatives. The computation is based on users' assessment of each design on all items of VOC (voice of customers). The total "score" is calculated by summing up each item's product of normalized weight and the evaluation score. This calculation is the same as calculating the total score of each design attribute. Table 5 shows the matrix of the two designs. The score of each item is based the survey by showing people the pictures of both gardens, and observation of both gardens. This type of comparison is identical to traditional method used in decision science with multiple criteria.

In practice, design professionals may be able to evaluate different conceptual designs based on experience and design features. Users may also be able to give some feedback as well if the designs can be rendered on computer with 3D graphic. The important thing here is that each evaluation can be traced to original user-defined needs or requirements.

HoQ Campus Garden Design		Rate of Importance	Demanded Quality Weight (Percentage Weight)	Garden A	Garden B
Activities	Studying, Reading	9	8	5	9
	Recreation	5	4	5	3
	Social	8	7	3	8
	Other - Conversation, Eating	8	7	7	9
Sittings	Group	7	6	5	9
	Individual	10	8	9	5
Beautiful, Aesthetic Looking		6	5	9	9
Peace & Quiet		8	7	9	8
Naturalness		10	8	9	8
Clean		6	5	9	7
Fresh Air		8	7	9	9
Shade/Sun		8	7	9	9
Feeling free and comfortable		9	8	8	9
Grass & Open space		7	6		
Safety		10	8	6	9
Sum		119	100	690	756

Table 5 Evaluation of Different Design Alternatives

Other than evaluating the designs based on user’s needs and requirements, HoQ can also be constructed to look at each design attributes of different designs. As depicted in Table 6, each garden design can be listed in a row, with its corresponding measures in the matrix. Here it has the difference especially in landscape design compared to tradition HoQ used in industries. Since it has the design attributes as the “how”, instead of measurable (quantifiable) functions, it is difficult to come up with only a “number” to represent the evaluation of each design’s attribute on each design alternative. Instead, it needs a qualitative (and quantitative if possible) assessment of each design attribute. For example, though the design attributes like trees/shrubs, lawns and path can be quantified (with covered square footage or percentage), the numbers are not meaningful without looking at the whole design.

HoQ Campus Garden Design	Rate of Importance	Demanded Quality Weight (Percentage Weight)	Landscape Features				Landscape Furnitures/Facilities			Surroundings	Accessible, Convenience	Noise Control	Spaces
			Trees, shrubs	Lawns	Path	Water (creek, pond)	Benches	Tables	Safety Lightings				
Garden A			Qualitative and Quantitative Measures of Garden A										
Garden B			Qualitative and Quantitative Measures of Garden B										

**Table 6 Evaluation of Different Design Alternatives Based on Each Design Attribute.**

After going through all the steps, design professionals should have a HoQ similar to Table 7. As mentioned above, the construction of HoQ is not a one-time job. Rather, design professionals should go through the process in an iterative fashion, adjusting and modifying

as the design changed and refined. Table 7 shows the HoQ for the case study of campus garden design.

HoQ Campus Garden Design		Rate of Importance	Demanded Quality Weight (Percentage Weight)	Landscape Features				Landscape Furnitures/Facilities					Surroundings	Accessible, Convenience	Noise Control	Spaces	Garden A	Garden B
				Trees, shrubs	Lawns	Path	Water (creek, pond)	Benches	Tables	Safety Lightings	Recreational	Group, Soical						
Activities	Studying, Reading	9	8	3	1	1	1	5	1		1	3	5	5	5	5	5	9
	Recreation	5	4	1	5	5	3	1	5		5	1	5	5	1	5	5	3
	Social	8	7	3	3	3	5	5	5		3	5	3	5	1	5	3	8
	Other - Conversation, Eating	8	7	3	3	1	3	5	3		1	3	1	5	3	3	7	9
Sittings	Group	7	6	3	5	1		5	1	1	1	3	1		1	1	5	9
	Individual	10	8	3	1	1	1	5	1	1	1	1	1		1	1	9	5
Beautiful, Aesthetic Looking		6	5	5	5	5	1	1		1	1	1	5		5	3	9	9
Peace & Quiet		8	7	5	5	1	5	1		5	1	1	1		1	5	9	8
Naturalness		10	8	5	3	1	5	1		1	1	1	5		1	3	9	8
Clean		6	5	1	5	5	5	1	1	1	1	1	1		3	1	9	7
Fresh Air		8	7	5	1	1	1	1	1	1	1	1	1		1	1	9	9
Shade/Sun		8	7	5	5	5	1	1	1	5	1	1	1		1	5	9	9
Feeling free and comfortable		9	8	5	5	5	1	3	3	5	3	3	5		1	5	8	9
Grass & Open space		7	6	1	5	3												
Safety		10	8	1	5	5	5	1	1	5	1	1	5	5	5	5	6	9
Sum		119	100	335	366	273	251	250	146	187	139	176	272	168	202	326	690	756
Garden A				Qualitative and Quantitative Measures of Garden A														
Garden B				Qualitative and Quantitative Measures of Garden B														

Table 7 House of Quality for Campus Garden Design

## Chapter 5 Discussion

“An important criterion for evaluating campus plans would be to ask whether the campus plan encourages the maximum number of impromptu encounters with other students, with other faculty members, with visitors, with works of art, with books, and with activities with which one is not himself a regular part...and only if the plan has the kinds of qualities which will stimulate curiosity, prompt casual encounters and conversation...will the atmosphere which it produces be truly educational in the broadest sense.”

-William R. Keast

Campus landscape space design has been overlooked for years.

With many institutions expand and renew their campus, the importance of campus landscape space has gained its rightful due.

The current trend in the design of public open space and the healthy active living all indicate the importance of the users' involvement in the design process. How to integrate users' voices into the design becomes an important task for design professionals.

The focus of this research is to investigate the applicability of Quality Function Deployment (QFD) in landscape design, especially on campus landscape space. QFD provides a framework that takes user's needs and requirements into account, and the traceability of these needs to design attributes. It also provides other advantages; yet it is not without some tradeoff and limitation. In this section, those characteristics is presented and discussed based on the finding of the campus garden design case study.

### ***5.1 Benefits provided by QFD***

Based on the case study and review of literature, QFD has the following advantages:

1. The design process forces design professionals to take users' needs into account:

It is obvious that the whole QFD process is driven by the Voice of Customers. All design attributes and consideration are linked to the VOC. This forces design professionals to take users' opinions into account in their designs and avoid certain pitfalls, like fancy design with deviation from users' needs.

QFD takes the consideration of users' input further than what

community-base approach does in the design process. Although it does not specify what kind of methods or activities to use in collecting users' input, it forces design professionals to take the input seriously by linking design decision to the user input.

2. QFD provides a framework in building consensus:

With the current trend in Active Living and Community-Based Design, more and more emphasis is on the users' involvement in the design process. QFD provides an organized framework with objective measurement, and supports the communication between design professionals, engineers and users with a focus and cohesive platform. In essence, QFD provides the "interface" that bridges among people with different disciplines and point of views.

3. The design attributes can be prioritized based on more objective method:

As demonstrated in the case study, the design attributes can be prioritized based on users' preference and its relationship with the design attributes. This evaluation method is more objective compared to using design professionals' own preference. It creates a feedback mechanism for designers regarding to what is important and what they might miss. In constructing the HoQ, design professionals can often gain insights in their designs and what users really need.

4. Different design alternatives can be compared with an objective and traceable methodology:

QFD also provides an objective method for comparing different design alternatives. The comparison can be based on the synthesis of design professionals' assessment and users' feedback on each item in VOC. The comparison can also be drawn from a detail analysis on the design's characteristic on

each design attribute. Both comparisons are traceable to the original VOC, making analysis of design easier to do.

## **5.2 Obstacles in using QFD**

While using QFD in the design of campus garden, I also found some obstacles. These may prevent wider adoption of QFD in landscape architecture.

1. It is time consuming in gathering user needs and requirements:  
It is difficult to gather user's needs from a wide range of users. The process is often long, tedious, and intricate. How to synthesize and prioritize conflicting requirements from different groups of users is also a challenge. Nevertheless, this is not the obstacle only to QFD; every design process that wants to take users' need into account (like active living, community-based approach) has the same challenge. The challenge unique to using QFD is on the prioritization of user needs.
2. Implementation of QFD requires understanding and knowledge that will require additional training for the design professionals:  
Using QFD requires design professionals to have working knowledge of the concepts related to the following subject areas: system engineering concept, experimental design and development, and decision science. It is often the case that people dismiss the use of QFD either based on their misconception or lack of in depth knowledge on how to adopt and adjust using QFD. QFD is a framework that can be adopted with many other methodology and techniques in system design, evaluation and development. As addressed in the review section, many techniques have been used to overcome certain shortcoming of the original QFD. However, the use of those techniques requires in depth knowledge in those areas. In

practice, it is difficult to require all members involved in the design process to possess the required knowledge, especially in the case of rapid changing environment and requirement.

3. Overcome misconceptions about QFD:

As addressed on the review section, many people have the misconception about QFD. These misconceptions will create skeptic and prevent people from adopting QFD.

4. Managing the complexity is difficult:

As in most real cases, the implementation of QFD is a complex process. The House of Quality (HoQ) will grow more complex with the scope of the project as well as the depth and detail with the project progress. From available literature, I found people often use QFD in an “isolated” or break-down mode; i.e. they use QFD to target a certain component or sub-system as the project or system become large. It is difficult to find any document or literature that contains a detail QFD implementation on a complex system from conceptual design to detail design. This may be due to the company secret involved or limitation of publication. But from the case study, I found the complexity of constructing HoQ can be overwhelming, especially without a proper software to track all the changes. There are software available to ease the difficulty, yet it limits the robustness because of predefined framework of the software.

5. Unique characteristic in landscape planning and design may require special adjustment:

As indicated in the case study, the function and the design requirement are often mixed and difficult to separate in landscape design. Also, many design attributes or features are not quantifiable. This creates difficulty in assigning target values for design attributes or design requirement.

Subsequently, the numbers within HoQ may not be reflective to reality. This can be adjusted using qualitative description and other methods – a topic for further research. This is the unique challenge in using QFD in landscape design.

While QFD presents many advantages in the design process of campus landscape space, the obstacles remain. Nevertheless, the essential concept spawns out from QFD is particularly valuable in landscape design. This essential concept is the building of relationship using matrix. It can be the relationship between user's needs and design attributes; or it can be the physical properties of the design and the requirements (as in the Villa 2000 project in Finland.) It can be extended and expanded like a web that encompass many factors in design, like engineering, construction, which may not be included in the traditional architecture design process. This inclusion and integration can result in better design and more innovation. The challenge for landscape architect is how to adopt this concept and make it especially suitable for landscape design.

## Chapter 6

### Conclusion

*The American campus is a world in itself, a temporary paradise, a gracious stage of life.'*  
-Le Corbusier

Joseph Juran, one of the most famous quality masterminds in the 20<sup>th</sup> century, used to define quality as “fitness for use” (Juran 1999). (His teaching and concepts in quality and management, along with Deming’s, revolutionized Japan’s industry in the last century.) Although it is an over-simplified catch phrase for quality, the concept it implies is a paradigm shift from producer’s view to user’s view in terms of quality. This shift from “fitness for standard” to “fitness for use” captures the essence of how “quality” is no longer defined by the producer or design professional.

In landscape planning and design, little attention was given to listening to user’s needs or concerns in the past. It is not unusual to see design professionals formulate their design ideas solely based on their experience, “insight”, creativity and artistic training. Although with this approach, design professional may create great designs, however, faced with a set of complex and occasionally conflicting individual and community issues, resolution of the community and project needs may be limited and incomplete.

As an important landscape design, the design of campus landscape spaces affects millions of people. However, it was overlooked historically. With the current trend in the concept of Active Living and Community-based approach, the design of campus open spaces should take on meeting user’s need by bringing them into the design process. One of the promising approaches is QFD. It provides the “missing links” between user’s needs and design attributes.

In this thesis, an approach of using QFD in campus landscape space design is proposed and demonstrated through a case study. It shows promising results in terms of its ability in tracking the relationship between user needs and design features, the prioritizing of user demands, the advantage of comparing different design alternatives, and as a platform to build consensus. On the other hand, there are obstacles to overcome – the unique characteristics of landscape planning and design require adjustment to the method, the challenge of complexity involved, and the time to solicit the broad range user's input.

With the spreading of concept and knowledge in modern design process, more landscape architecture designs will adopt QFD as part of design framework (such as Villa 2000 project). This merits further studies on QFD's effectiveness, the kind of modification needed, and how it measures up to other design paradigms.

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## **Appendix Pilot Study**

**Pre study on student's perception and needs on using campus landscape spaces (using Duck Pond on the campus of VA Tech as an example).**

### **Duck Pond**

## Research Questions

- **What are students' perception about duck pond?**
- **What factors attract students coming to duck pond?**
- **What do they do at duck pond?**
- **What factors affect them to choose/not to choose other outdoor spaces on campus?**

## Methodology

**Observations** were made both at weekdays and weekends from morning to afternoon.

**Interviews and survey** made on the people who were at duck pond.

The number of participants is 10. (Pretest)

Gender. 5 males and 5 females.

Age is from 20 – 45.

# **Observations**



**Landscape features:**

Facing water, good view on golf court. A woods hill is at the back. There are many kinds of trees and grasses. Along a walking trail.

**Facilities:**

- Benches and Chairs: 13
- Tables: 6
- Barbecue stoves: 3
- Gazebo: 1
- Deck: 1
- Walking path: 1
- Water fountain: 1
- Information board: 1
- A tree can be sited and climbing



**Activities:**

Studying/ reading/ meeting friends/family & social activities/ barbecues/ feeding ducks & Canadian geese/ meditation/ fishing/enjoy nature/ jogging/walking/taking pictures/visiting/ having classes

**Landscape features:**

Woods hill area with various trees. Partial view on water pond, and partial view on campus

**Facilities:**

- Restrooms



**Activities:**

Walking/ taking class (plants class)/sunbath/recreation (playing football)

**Landscape**

**features:**

This area is between water pond and main campus traffics.  
Most grasses with some trees.  
View on golf court on north side.

**Facilities:**

- Chairs: 6
- Walking path: 1



**Activities:**

Taking classes/ fishing/ conversation/ walking/ watching/ reading

**Landscape**

**features:**

Water comes from a stream to duck pond across a small wood bridge. Most are grasses with few trees

**Facilities:**

- A Bridge
- Walking paths



**Activates:**

Walking/feeding ducks/playing water/reading/group activities/ taking classes



**The most active area**



**The medium active area**



**The least active area**

# **Interviews and Survey**

## Major Questions in Interviews and Survey

- What are the factors that attract you here?
- What do you do here?
- How often do you do this activity?
- How long does it take in average?
- What are the landscape features you like most or least in this space?
- Why do you come to duck pond, but not the other open places on campus?

### **Several main reasons attract students:**

1. Nature feelings & water & beautiful view (7)
2. Quiet (1)
3. Close to campus (1)

### **Activities:**

- Studying/reading: 7 (4d/w-1/sem, most a weekly) average: 1:45 hrs/per
- Exercise/jogging: 6 (1/w-1/month) average: 1hr.
- Walking through it: 4 (every day-1/month)
- Social activities with family/friends/group: 5 (1/w-1/sem)
- Sitting /thinking: 3 (1/w-1/sem) (.5/hr-1/hr)
- Feeding ducks & Canadian geese: 10 (1/w-1/sem)
- Showing this place to visitors.

**Negative impression: too muddy and dirty.**

**Compare duck pond to  
other open spaces on campus**

<b>Open spaces on campus</b>	<b>Functions</b>	<b>Features</b>
<b>Nature feeling spaces</b>	Enjoy a nature environment Visiting, Relax, sitting, thinking, studying, etc. Education	Beautiful environment: flowers, various plants, water, green lawns, sitting places, gazebo, deck, etc.
<b>Open spaces with special meanings</b>	Symbolic space	Open space Sculptures
<b>Open spaces between buildings</b>	1. Pathways 2. Connection between buildings	Pathways Trees and flowers Some provide sitting places and, Some have green lawns
<b>Courtyards surrounded by buildings</b>	1. Pathways 2. Recreation 3. Place for group activities	Large green lawn Few trees, bushes Some recreation facilities Buildings around the space Pathways
<b>Edge spaces along circulation routes</b>	Transition Decoration	Grasses and trees Some have flowers



Pictures from Virginia Tech ImageBase.

## **Nature feeling spaces**



### **Landscape features and facilities:**

A garden with various plants and flowers, a open green lawn, man-made stream and a bridge, a gazebo, a small fish pond, few sitting places, a deck and short walking paths.

### **Students' perception and activities:**

Beautiful and peaceful

Walk through

Classes

Meet friends

### **Reasons that choose duck pond, but not here:**

1. Location is important. (Far or close to where the students were)
2. "home base" theory: People feel it is a place mainly for people in the horticulture department, for those taking class related to plants.  
Duck pond doesn't close to any building/department. It's for everyone.
3. Duck pond has a big water pond.

## **Open spaces with special meanings**



### **Landscape features and facilities:**

Concrete floor open space with good view on drill field. Four pylons on each sides. Located in the center of campus.

### **Students' perception and activities:**

1. Pass by quite often. (center on campus)
2. Meet friends. (Everyone knows it)
3. Good view
4. Take pictures/visit
5. Study (enjoy sun in winter times because it's warmer than duck pond.)

### **Negative factors:**

- It doesn't have many places to sit.
- Kind of crowd/not quiet/no privacy.
- Doesn't have the nature feelings, Man-made open space.
- Not much to do

### **Courtyards surrounded by buildings**



#### **Landscape features and facilities:**

Large green open spaces with several paths, surrounded by buildings. Few trees. A sand court for playing balls.

#### **Students' perception and activities:**

- Walk through
- Sitting outside
- Meet friends/talk
- Recreation (playing beach ball)
- No sitting places.
- Not quiet/no privacy
- Not much facilities for recreation and social activities
- Duck pond is quieter and is more private with nature feelings, plus more sitting places.

### **Open spaces between buildings**



(1)

#### **Landscape features and facilities:**

1. A road connects library & book store to a parking lots. Lawn area before graduate school. Many sitting places with shade just outside squire cafeteria. There are also some stone benches along the road.
2. Walking road with stairs. Some trees and bushes and lightings.
3. Concrete road with tree beds and flower beds. Some stone benches. It's a narrow area.

#### **Students' perception and activities:**

1. Meet friends. (More friends around here often)/ Walk through (Having classes/actives, parking)/ Sitting (close to campus) eating/ enjoy sun

Here are many people come and go. Not quiet/no privacy.

It's quieter/fewer people with water/nature feelings at Duck pond.

2 & 3. Just walking through. There is no good place for sitting/do not feel comfortable.



(2)



(3)

### **Edge open spaces along circulation routes**



Student service building

#### **Landscape features and facilities:**

Grasses with few trees. It's the space between a building and road. There is no chair/bench, but has a side walk.

#### **Students' perception and activities:**

Not much to do there except walk through.  
Here are many people and traffic.

#### **Duck pond:**

1. less crowded/quieter
2. Water/more nature feelings
3. More things to do there.

## Summary-Duck Pond

### **Duck Pond:**

1. Nature feelings/ water
2. Quiet/fewer people
3. Close to campus

### **Three important factors that affect students to choose the open spaces on campus:**

- **Functions:** What kind of functions the open space can provide.  
Whether it provides comfortable place and facilities for what they want to do there. E.g. Sitting places for reading/studying, facilities for social activities and recreation, etc.
- **Location:** 1. If there are two similar open spaces, students always choose the closer one. 2. Close to their "home base". Like department or dormitory or the building that they have classes/activities.
- **Landscape:**
  1. nature feelings/surrounded by buildings/close to traffic
  2. Quiet/crowd
  3. view