



ISTANBUL TECHNICAL UNIVERSITY

**GRADUATE SCHOOL OF SCIENCE
ENGINEERING AND TECHNOLOGY**

Department of Architecture

Architectural Design Program



POLITECNICO DI TORINO

SCUOLA DI DOTTORATO

Department of Architecture and Design

**Architecture, History and Project Design
Program**

**THE MORPHOLOGICAL SIDE OF ACADEMIC SPACE:
A SUSTAINABILITY AND LIVEABILITY MULTI-CRITERIA
EVALUATION OF UNIVERSITY-CITY INTERACTION**

Ph.D. THESIS

Haniye RAZAVIVAND FARD

SEPTEMBER 2019



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**IL LATO MORFOLOGICO DELLO SPAZIO ACCADEMICO: UNA
SOSTENIBILITÀ E VIVIBILITÀ ANALISI MULTI-CRITERIA DI
INTERAZIONE UNIVERSITÀ-CITTÀ**

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*To My Parents,
for their love and support*

FOREWORD

This dissertation has been co-tutored grounded on a Joint Ph.D. agreement between Istanbul Technical University, Architectural Design Program and Politecnico di Torino, Architecture. History and Project Program.

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ABBREVIATIONS

EPFL	: École Polytechnique Fédérale de Lausanne
ETH	: Eidgenössische Technische Hochschule
NGO	: Non-Governmental Organization

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THE MORPHOLOGICAL SIDE OF ACADEMIC SPACE: A SUSTAINABILITY AND LIVEABILITY MULTI-CRITERIA EVALUATION OF UNIVERSITY-CITY INTERACTION

SUMMARY

The emergence of the global knowledge-based world has influenced the reality of higher education institutions. Currently, universities are major sources of knowledge generation and dissemination, innovation and technology transfer, initiators of new visions, supporters of socio-cultural progress, and economic growth engines in the societies. Contemporary universities are not isolated and mono-functional entities anymore, instead they are active urban transformation agencies. In this regard, the mission of universities has altered profoundly from education and research towards the “third mission” i.e. public service and urban outreach activities. Many contemporary universities are engaged in urban dynamics, fostering synergies and functioning as engines of sustainable urban development.

This fact has been also represented in the universities’ aspiration to be an integral part of the city in which they are located. They are place-based large institutions which create a direct interaction with their surrounding urban setting. Universities are shaped and are shaped by their urban context. They are influential actors in urban dynamics of their territories. Considering universities’ third mission, they are key urban development agents in terms of social, cultural, economic, environmental, and physical aspects. In this respect, the physical setting of universities has a significant role in addressing their mission. To do so, they revise their urban physical setting to make a mutually beneficial relationship with their hosting urban context. They have a great potential to enhance liveability, promote the quality of urban space and academic space, and enhance the sustainability of the urban space. Universities’ mission and vision are materialized in their campus space. Campus physical setting is not just a mean to facilitate learning but it has a larger influence on the educational, social, cultural, economic life of the academic community and the broader society. A university campus with a high-quality urban space can reinforce a higher quality research and education, attract and nurture high-quality human capital, assure the presence of people, support diversified activities, stimulate the flow of synergy, foster social and economic well-being, and consequently contribute to vibrancy, liveability and sustainability of campus space, and promote prosperity of the hosting neighborhood, city, and region. Moreover, it is claimed that the campus location within the residing urban context has an important role in universities’ performance and diffusing required synergies in the urban context. The spatial organization and morphological characteristics of universities demonstrate the extent and type of their interaction. The extent of this influence can vary depending on the type of interaction that is formed between two domains and the physical features and morphological characteristics of the university campuses.

In this sense, this research argues that the physical features and morphological characteristics of the university campus and its urban outreach activities influence the

sustainability and liveability of the campus space and surrounding urban space.

For this purpose, this research provides a theoretical framework to evaluate the impact of physical attributes and morphological characteristics of campus form and the university's outreach activities on sustainability and liveability dimensions.

In this respect, a methodological framework is proposed which encompasses two cycles: hypothesizing cycle and theorizing cycle. Hypothesizing cycle follows a qualitative approach for hypothesis making and conceptualizing the research object. Considering universities' insertion within surrounding urban context and their morphological attributes, **six typologies of university campuses** are identified. Following a comprehensive literature review, the theorizing cycle encompasses a content analysis of forty university campus masterplans and investigating the university campus design principles. This approach makes it possible to understand and incorporate the perspectives of both campus design practitioners and academic scholars about the most important campus planning strategies and principles.

Based on the developed methodological approach, a set of criteria has been developed that assess the sustainability and liveability of university campuses. **The multi-criteria set** comprises nine main criteria and twenty-eight sub-criteria. The criteria include **liveability, legibility, cohesion, compactness, walkability, accessibility, connectivity, integration, and sustainability**. The defined set of criteria addresses spatial and morphological attributes of a campus setting such as campus spatial organization, greenness, compactness, density, legibility, whereas including the dimensions regarding the urban outreach activities of the university which is related to campus physical space such as shared facilities, provided services, and sustainability incentives.

The developed set of criteria can be used to assess the performance of different types of university campuses. It can be utilized for the existing university campuses and the campus redevelopment projects as well as newly constructed campuses. To assess the performance of campus regarding each sub-criterion, a "**Histology Atlas of Campus Form**" has been developed which makes it possible to evaluate the campus spatial maps and score them for each criterion in a base of three-point Likert scale. Acquiring these criteria facilitates the comparisons between campus spatial organizations and makes it possible to generalize the findings. In this research, a multiple case study analysis has been conducted and the set of criteria has been applied to fifteen university campuses which have been selected among the best representatives of their typologies as case studies for the defined six university campus typologies. To do so, a morphological approach has been obtained and an in-depth study has been implemented through which the university campus history, development processes, and third-mission activities have been analyzed. Then, a spatial analysis has been applied to each university campus and analytical maps have been produced. Then, the analytical maps have been assessed according the set of criteria and the Histology Atlas of Campus Form.

The case study analysis makes it possible to have a better understanding of how each campus typology performs regarding the defined set of criteria in terms of sustainability and liveability aspects. Based on the produced campus analytical maps, "**A Campus Form Morphological Atlas**" has been developed. The Campus Form Morphological Atlas is a model to illustrate the performance of various morphological dimensions of the university setting, concerning the campus typology.

Indeed, the developed set of criteria and the proposed campus typologies make it

possible to propose a well-performing university campus model. This university campus model can assist university campus designers, decision-makers, and university authorities to better understand the relationship between the campus typology and campus form with the associated sustainability and liveability outcomes. It also provides an opportunity to explore the relationship between campus form and the mission and vision of the university.

Keywords: University-City Interaction, Multi-Criteria Analysis, Morphological Characteristics, Liveability, Sustainability.

AKADEMİK MEKANIN MORFOLOJİK YÜZÜ: ÜNİVERSİTE-ŞEHİR ETKİLEŞİMİNİN SÜRDÜRÜLEBİLİRLİK VE YAŞANABİLİRLİK AÇILARINDAN ÇOK- KRİTERLİ DEĞERLENDİRMESİ

ÖZET

Günümüzde üniversiteler, bilgi üretme ve yayma, inovasyon ve teknoloji transferi, yeni vizyonların ve sosyo-kültürel ilerlemenin destekleyicileri ve toplumdaki ekonomik büyüme motorlarının başlıca kaynaklarıdır. Çağdaş üniversiteler artık izole edilmiş ve tek fonksiyonlu işletmeler değil, aktif kentsel dönüşüm aktörleridir. Bu bağlamda, üniversitelerin misyonu eğitim ve araştırmadan üçüncü misyona, yani kamu hizmeti ve kentsel sosyal faaliyetlere doğru değişmiştir. Pek çok çağdaş üniversite, kentsel dinamiklerle uğraşmakta, sinerjiyi desteklemekte ve sürdürülebilir kentsel gelişim motorları olarak işlev görmektedir.

Bu gerçek, üniversitelerin içinde buldukları şehirlerin ayrılmaz bir parçası olma isteklerinde de görülmektedir. Üniversiteler, çevresindeki kentsel ortamla doğrudan etkileşime giren yer bazlı büyük kurumlardır. Üniversiteler kentsel bağamlarına göre şekillenmekte ve onları şekillendirmektedir. Ayrıca, bölgelerinin kentsel dinamiklerini etkileyen aktörler olduğu söylenebilir. Üniversitelerin üçüncü misyonu göz önünde bulundurulduğunda, sosyal, kültürel, ekonomik, çevresel ve fiziksel yönleri açısından temel kentsel gelişim aktörleri olarak algılanmaktadır. Bu bakımdan, üniversitelerin fiziksel yerleşimleri görevlerini yerine getirme hususunda önemli bir rol sahibidir. Bu nedenle, ev sahipliği yapan kentsel bağamları ile karşılıklı fayda sağlayan bir ilişki kurmak için, kentsel fiziksel ortamlarını gözden geçirmektedirler. Üniversiteler kentsel mekanın yaşanabilirlik ve sürdürülebilirliğini artırmak ve kentsel ve akademik mekanın kalitesini yükseltmek için büyük bir potansiyele sahiplerdir. Üniversitelerin misyon ve vizyonu kampüs alanlarında hayat bulmaktadır. Kampüsün fiziksel ortamı sadece öğrenmeyi kolaylaştırmak için bir araç değil, aynı zamanda akademinin ve toplumun eğitimsel, sosyal, kültürel, ekonomik yaşamı üzerinde daha büyük bir etkiye sahiptir. Kaliteli fiziksel alana sahip bir üniversite kampüsü, kaliteli araştırma ve eğitimi güçlendirmekte, nitelikli insan sermayesini çekmekte ve bunları muhafaza edebilmekte, insanların mekanda vakit geçirebilmelerini sağlamakta, çeşitli faaliyetleri desteklemekte, sinerji akışını geliştirmekte, sosyal ve ekonomik refahı desteklemektedir. Sonuç olarak, kampus alanının canlılığına, yaşanabilirliğine ve sürdürülebilirliğine katkıda bulunmakta ve içinde bulunduğu mahalle, şehir ve bölgenin refahını arttırmaktadır. Bunlara ek olarak, kentsel bağlamdaki kampüs konumunun, üniversitelerin performansında ve gerekli sinerjilerin kentsel bağlamda yayılmasında önemli bir rol oynadığı iddia edilmektedir. Üniversitelerin mekânsal organizasyonu ve morfolojik özellikleri, etkileşimlerinin kapsamını ve türünü göstermektedir. Bu etkinin kapsamı, iki alan arasında oluşan etkileşimin türüne ve üniversite kampüslerinin fiziksel özellikleri ve morfolojik özelliklerine bağlı olarak değişebilmektedir.

Bu anlamda, bu tez, üniversite kampüsünün fiziki özellikleri ve morfolojik özellikleri ile üniversitenin kentsel erişim faaliyetlerinin kampüs alanının ve çevresindeki kentsel alanın sürdürülebilirliğini ve yaşanabilirliğini nasıl etkilediğini araştırmaktadır.

Üniversitenin fiziksel kalitesi ile akademik ve kentsel yaşam kalitesi arasında bir korelasyon olduğu kabul edilmektedir. Bir kampüs ortamının fiziksel özellikleri, kapsamlı bir kampüs planı tarafından iyi bir şekilde gösterilebilir. Kampüs yerleşimi, öğrencilerin ve akademisyenlerin ilgisini çekmek, yaşam kalitesini yükseltmek, akademik atmosferi geliştirmek, sürdürülebilirlik hedeflerine katkıda bulunmak ve yakın kentsel alanın kalitesini artırmak dahil olmak üzere üniversitenin kurumsal hedeflerini ana hatlarıyla belirtmektedir.

Bu çerçevede değerlendirildiğinde, bu araştırma, üniversiteler ve faaliyet gösterdikleri kentsel bağlam arasındaki ilişkiyi araştırmak amacıyla başlatılmıştır. Araştırmanın temel sorusu aşağıdaki gibi ifade edilmiştir:

- Üniversitelerin fiziksel ve morfolojik özellikleri ve kentsel erişim faaliyetleri ve üçüncü görevi olan toplumsal misyonu, üniversite kampüsünün kentsel alanı ve çevresindeki kentsel alanının sürdürülebilirliğini ve yaşanabilirliğini nasıl etkilemektedir?

Araştırmanın alt soruları ise aşağıdaki gibidir:

- Üniversite kampüs alanı ve çevresindeki kentsel alanın sürdürülebilirliğini ve yaşanabilirliğini etkileyen ana ölçütler nelerdir?
- Bu ölçütlerin etkisi üniversite kampüslerinin farklı tipolojilerinde ne ölçüde değişiklik göstermektedir?

Bu amaçla, bu araştırma, kampüs formunun fiziksel özellikleri, morfolojik özellikleri ve üniversite sosyal yardım faaliyetlerinin sürdürülebilirlik ve yaşanabilirlik boyutları üzerindeki etkisini değerlendirmek için teorik bir çerçeve sunmaktadır.

Bu bağlamda, iki aşamayı kapsayan bir metodolojik çerçeve önerilmektedir: Hipotez kurma aşaması ve teorileştirme aşaması. Hipotez kurma aşaması, hipotez geliştirme ve araştırma nesnesini kavramsallaştırma için nitel bir yaklaşım izler. Üniversitelerin ilişkili olduğu kentsel bağlam ve morfolojik özellikleri dikkate alındığında, kampüs-şehir ilişkisi açısından altı üniversite kampüsü tipolojisi tanımlanmıştır. Kapsamlı bir literatür taramasının ardından, belirlenen ölçütlere göre seçilen kırk adet üniversite kampüsü master planı içerik analizine tabi tutulmuş ve üniversite kampüs tasarım ilkeleri araştırılmıştır. Bu yaklaşım, hem kampüs tasarımcıların, hem de akademisyenlerin, en önemli kampüs planlama stratejileri ve ilkeleri konusundaki bakış açılarını anlamayı ve birleştirmeyi mümkün kılmaktadır.

İlgili literatüre ve geliştirilen metodolojik yaklaşıma dayanarak, üniversite kampüslerinin sürdürülebilirliğini ve yaşanabilirliğini değerlendiren bir dizi ölçüt geliştirilmiştir. Çoklu ölçüt seti, dokuz ana ölçüt ve yirmi sekiz alt ölçüt içermektedir. Ölçütler, **yaşanabilirlik**, **okunaklılık**, **uyum**, **kompaktlık**, **yürünebilirlik**, **erişilebilirlik**, **bağlantısallık**, **entegrasyon** ve **sürdürülebilirliği** içermektedir. Tanımlanan ölçüt seti, kampüs mekânsal organizasyonu, yeşillik, kompaktlık, yoğunluk, okunaklılık gibi bir kampüs ortamının mekânsal ve morfolojik niteliklerini ele alırken, üniversitenin, ortak tesisler, sağlanan hizmetler ve sürdürülebilirlik teşvikleri gibi kampüs fiziki alanıyla ilgili kentsel erişim faaliyetlerine ilişkin boyutları dahil etmektedir.

Geliştirilen ölçütler farklı üniversite kampüslerinin performansını değerlendirmek için ve mevcut üniversite kampüsleri ve kampüs iyileştirme projeleri ile yeni inşa edilen kampüsler için kullanılabilir. Her bir alt ölçüte ilişkin kampüsün performansını belirlemek için, kampüs mekânsal haritalarını değerlendirmeyi ve her ölçüt için bunları üç puanlık Likert ölçeği temelinde puanlandırmayı mümkün kılan “**Kampüs Histolojisi Atlas Formu**” geliştirilmiştir. Bu ölçütlerin alınması kampüs mekânsal organizasyonları arasındaki karşılaştırmaları kolaylaştırmakta ve bulguların genelleştirilmesini mümkün kılmaktadır. Bu araştırmada, çoklu bir vaka çalışması analizi gerçekleştirilmiş ve belirlenmiş altı üniversite kampüsü tipolojisi için vaka çalışmaları olarak tipolojilerinin en iyi temsilcileri arasından seçilen on beş üniversite kampüsüne bir dizi ölçüt uygulanmıştır. Bu aşamada, morfolojik bir yaklaşım kullanılarak üniversite kampüsü tarihi, gelişim süreçleri, üçüncü görev faaliyetleri derinlemesine analiz edilmiştir. Daha sonra her üniversite kampüsü için mekânsal bir analiz uygulanmış ve analitik haritalar üretilmiştir.

Vaka çalışması analizi, her bir kampüs tipolojisinin, sürdürülebilirlik ve yaşanabilirlik açısından tanımlanmış ölçütlere göre nasıl bir performans gösterdiğinin daha iyi anlaşılmasını mümkün kılmaktadır. Üretilen kampüs analitik haritalarına dayanarak bir “**Kampüs Formu Morfolojik Atlası**” geliştirilmiştir. Kampüs Formu Morfolojik Atlası, kampüs tipolojisine ilişkin morfolojik boyutların performansını göstermek için bir modeldir.

Nihayetinde, geliştirilen ölçütler kümesi ve önerilen kampüs tipolojileri, iyi performans gösteren bir üniversite kampüs modeli önerilmesini mümkün kılmaktadır. Bu üniversite kampüs modeli, üniversite kampüs tasarımcılarına, karar vericilere ve üniversite yetkililerine, kampüs tipolojisi ile kampüs formu arasındaki ilişkiyi, sürdürülebilirlik ve yaşanabilirlik sonuçları ile ilişkilendirerek daha iyi anlamalarına yardımcı olabilir. Ayrıca, kampüs formu ile üniversitenin misyonu ve vizyonu arasındaki ilişkiyi keşfetme fırsatı da sunar.

Anahtar Sözcükler: Üniversite-şehir etkileşimi, Çok-Kriterli Analiz, Morfolojik Özellikler, Yaşanabilirlik, Sürdürülebilirlik.

IL LATO MORFOLOGICO DELLO SPAZIO ACCADEMICO: UNA SOSTENIBILITÀ E VIVIBILITÀ ANALISI MULTI-CRITERIA DI INTERAZIONE UNIVERSITÀ-CITTÀ

SOMMARIO

L'emergere del mondo globale basato sulla conoscenza ha influenzato la realtà degli istituti di istruzione superiore. Le università sono le principali fonti di generazione e diffusione della conoscenza, innovazione e trasferimento tecnologico, promotori di nuove visioni e sostenitori del progresso socioculturale e motori di crescita economica nelle società. Le università contemporanee non sono più entità isolate e mono-funzionali, ma sono agenzie pro-attive di trasformazione urbana. A questo proposito, la missione delle università è cambiata profondamente: dalla funzione esclusiva di ente preposto all'istruzione e alla ricerca, gli istituti universitari si sono mossi verso la terza missione, vale a dire il servizio pubblico e, tra queste, anche attività di ridisegno urbano. Molte università contemporanee sono impegnate nelle dinamiche di trasformazione delle città, promuovendo sinergie e funzionando come motori di sviluppo urbano sostenibile.

Questo fatto è stato anche rappresentato nell'aspirazione delle università a essere parte integrante della città sulla quale insisitono. Sono grandi istituzioni basate sul luogo che creano un'interazione diretta con l'ambiente urbano circostante. Le università stanno modellando e plasmando il loro contesto urbano e sono attori influenti nelle dinamiche urbane dei loro territori. Considerando la terza missione delle università, sono agenti chiave dello sviluppo urbano in termini di socialità, cultura, economia, ambiente e forma insediativa. A questo proposito, la posizione fisica delle università ha un ruolo significativo nel delineare la loro missione. Per fare ciò, stanno rivedendo il loro ambiente fisico urbano per stabilire una relazione reciprocamente vantaggiosa con il contesto urbano in cui si collocano. Hanno un grande potenziale per migliorare la vivibilità, promuovere la qualità dello spazio urbano e dello spazio accademico e migliorare la sostenibilità dello spazio urbano. La missione e la visione delle università si materializzano nello spazio attraverso il campus. Lo spazio fisico del campus non è solo il mezzo per facilitare l'apprendimento, ma ha un'influenza sulla vita educativa, sociale, culturale, economica della comunità accademica e della società in generale. Un campus universitario con uno spazio urbano di alta qualità può in qualche modo rafforzare l'attività di ricerca e elevare il livello dell'istruzione, attrarre e alimentare capitale umano di alta qualità, assicurare la presenza di persone con diversi ruoli, sostenere attività diversificate, stimolare flussi di sinergie, favorire il benessere sociale ed economico, di conseguenza contribuiscono alla vivacità, alla vivibilità e alla sostenibilità dello spazio del campus e promuovono la prosperità del quartiere, della città e della regione che lo ospitano. Inoltre, la posizione del campus all'interno del contesto urbano ha un ruolo importante nelle prestazioni delle università e nella diffusione delle sinergie richieste dal contesto urbano stesso. L'organizzazione spaziale e le caratteristiche morfologiche delle università dimostrano l'estensione e il tipo della loro interazione. L'entità di questa influenza può variare a seconda del tipo di interazione che si forma tra i due domini delle caratteristiche fisiche e caratteristiche

morfologiche dei campus universitari.

In questo senso, questa ricerca sostiene che le caratteristiche fisiche e morfologiche del campus universitario e le attività “urbane” dell'università influenzano la sostenibilità e la vivibilità dello spazio del campus e dello spazio urbano circostante.

A tale scopo, questa ricerca fornisce un quadro metodologico per valutare l'impatto degli aspetti fisici e delle caratteristiche morfologiche della forma del campus e delle attività di sensibilizzazione dell'università sulle dimensioni della sostenibilità e della sua vivibilità. Sulla base dell'approccio metodologico sviluppato, è stata prefigurata un'analisi fondata su una serie di criteri tra cui nove criteri principali e ventotto sottocriteri. Questa serie di multi-criteri comprende **vivibilità, leggibilità, coesione, compattezza, pedonabilità, accessibilità, connettività, integrazione, e sostenibilità**. L'insieme definito dei criteri comprende gli aspetti spaziali e morfologici di ambientazione del campus come: l'organizzazione spaziale del campus, il verde, la compattezza, la densità, la leggibilità, mentre include le dimensioni relative alle attività “urbana” dell'università che sono correlate allo spazio fisico del campus come condiviso strutture, servizi forniti e incentivi alla sostenibilità.

L'insieme di criteri delineati può essere utilizzato per valutare le prestazioni di diversi tipi di campus universitari. Può essere utilizzato per i campus universitari esistenti e i loro progetti di riqualificazione, nonché per i campus di nuova costruzione. Per valutare le prestazioni del campus relativamente a ciascun sottocriterio, è stato sviluppato quello che abbiamo definito “**l'atlante istologico**” del modulo campus, che consente di valutare le mappe spaziali del campus e di assegnarle a ciascun criterio in base a una scala Likert a tre punti.

L'acquisizione di questi criteri facilita i confronti tra le organizzazioni spaziali del campus e rende possibile generalizzare i risultati. In questa ricerca, l'insieme di criteri è stato applicato a quindici campus universitari che sono stati selezionati come casi di studio per le sei tipologie di campus universitari definite. L'analisi di ogni caso studio consente di comprendere meglio le prestazioni di ciascuna tipologia di campus in relazione all'insieme definito di criteri in termini di sostenibilità e aspetti di vivibilità.

Parole chiave: Interazione Università-Città, Analisi Multi-Criteri, Caratteristiche Morfologiche, Vivibilità, Sostenibilità.

1. INTRODUCTION

1.1 Research Background

Universities are among the main institutions that shape the urban space in which they are located and meanwhile are get shaped by their urban context. They are major sources of knowledge generation and dissemination, innovation and technology transfer, initiators of new visions and enhancers of socio-cultural status, and, economic engines in the society. Contemporary universities are not isolated and mono-functional entities anymore, instead they are active urban agencies. In this regard, the mission of universities has altered profoundly towards urban outreach activities. Many contemporary universities are engaged in urban dynamics, fostering synergies and functioning as engines of sustainable urban development. Being large urban institutions, they revise their urban physical setting to make a mutually beneficial relationship with their hosting urban context.

Currently, many universities are revise their relationship with their hosting urban context and attempt to be more integrated into their hosting cities. This fact has been well represented in the universities' ambition to be an integral part of their residing city and has changed the recent urban reality. They act as one of the main actors of the transformation of their adjacent neighborhood specifically in deteriorated urban environments. In this respect, university campuses, as large-scale institutions, have a significant local impact in terms of social, cultural, economic, environmental and spatial aspects. They have the potential to enhance urban vitality and promote the quality of urban and academic life. This reciprocal dialogue has a positive impact on both domains where urban space can benefit from university services and the university space would have the opportunity of using urban facilities.

In this context, the university campus urban space and its position within the hosting urban context have an important role in universities' function and diffusing required synergies in the urban context. The extent of this influence can vary depending on the type of relationship that is formed between two domains. It is largely related to the physical features and morphological characteristics of the university campuses.

Considering the prominent role of universities in generating synergies and affecting urban dynamics, it can be argued that the physical and morphological characteristics of the university campus and the relationship between the university campus and its surrounding urban space affects the sustainability and the liveability of both domains. This research focuses on universities' urban outreach activities and the physical features and morphological characteristics of university campuses in creating an interaction with their surrounding urban context. Through defining different typologies of universities campuses, it explores the impact of outreach activities and physical features and morphological attributes of each campus typology on sustainability and liveability of university campus urban space and surrounding urban space.

1.2 Research Questions

Considering the above-mentioned background, this research has been initiated with the primary aim of exploring the relationship between universities and their residing urban context and has followed to understand the spatial and morphological dimensions that influence the sustainability and liveability of campus space and adjacent urban space. In this respect, it aims to explore the following:

- How do physical features and morphological characteristics of universities, and their third mission objectives in terms of urban outreach activities influence the sustainability and livability of university campus urban space and the surrounding urban space?

And it follows by the sub-questions as:

- What are the main criteria that influence the sustainability and liveability of university campus space and surrounding urban space?
- To what extent does the impact of these criteria vary in different typologies of university campuses?

1.3 Research Objectives

“Campus” or universities' physical setting is a space that universities' core functions as teaching, research, and urban outreach are taking place. Thus, the spatial layout and physical configuration of a university campus portray the university's main attributes which are form and function. In this study, it is argued that the function of universities

is so complex and that examining the physical form of universities can be a way in simplifying this issue.

Considering the prominent role of university campuses in relation to their hosting urban spaces, this research intends to explore how physical features and morphological characteristics of university campuses and their urban outreach activities influence the sustainability and liveability of university campus space and the surrounding urban space. The lens through which to observe the university-city relationship focuses on the concepts of the campus form, sustainability, and liveability. Thus, it aims to propose a methodological framework to assess and better understand how different typologies of university campuses perform in terms of sustainability and liveability factors.

1.4 Scope of Research

This study mainly addresses the influence of the morphological characteristics and physical features of university campuses and their urban outreach initiatives on sustainability and livability of university campus urban space and surrounding urban space.

- In this research, the terms “campus” and “campus urban space” mainly refers the physical setting of campus without considering the interior space of buildings in detail.
- The relationship between universities and their residing cities is a mutual interaction where both domains have an impact on each other in several aspects including social, cultural, economic, environmental, and spatial aspects which is a broad issue. To narrow down the concept and make it more practical, through reviewing the vast literature on the issue, it is decided that the impact of the university on its surrounding urban context be examined considering sustainability and livability factors.
- In order to design an excellent university, it is important to consider the physical presence of universities. Thus, a detailed analysis of the universities’ spatial existence can be conveyed in four scales: (1) the university-city relation (2) the precincts or university campuses (3) architectural components as independent buildings (4) classrooms as the smallest educational cells

(Campos Calvo-Sotelo, 2014). Thus, the scale considered in this research lies on the interface of the first and second scales.

- In this respect, it is important to notify that many universities have several campuses. However, within the scope of this study, universities have not been evaluated as a whole institution but in each case study the main campus or the campus which is relevant to the analyzed campus typology has been considered.
- Another significant issue to be considered is that universities have been developed in several phases within a period of time. In this research, after studying the historical background and development process of the university campus, the current university campus configuration has been considered for spatial analysis.
- Sustainability is an extensive and complicated concept and encompasses several aspects. In this research after analyzing various university campus sustainability assessment frameworks and literature on sustainability in higher education and urban sustainability, sustainability criteria regarding the urban form and urban outreach activities of universities were considered.
- Morphology is a broad concept and covers several aspects including physical form, social form, natural context, and etc. However, within the scope of this research, only the issues related to the physical form have been considered.

1.5 Research Methodology

The methodology for this research is twofold: hypothesizing cycle and theorizing cycle.

Hypothesizing cycle follows a qualitative approach for hypothesis making resulting in:

- Exploration of the subjects of university-city relationship, university's third mission, university campus form features, liveability, and sustainability and conceptualization of the research object.
- Studying the morphological attributes of university campuses and their surrounding urban context.

Applying a synchronic-morphological approach to define and characterize the six typologies of university campuses.

- Literature review on the concepts of sustainability and liveability in relation to urban form and campus form.
- Interpretive study on the university campus design principles and campus master-planning strategies.

The second stage includes the theorizing cycle. Based on the studied concepts in hypothesizing cycle, it intends to provide a theoretical model.

- A content analysis of campus masterplans to identify common goals, strategies and actions which were identified by campus planners.
- A multi-criteria evaluation to define the main criteria related to campus form sustainability and liveability and developing a set of criteria.
- Developing a “Histology Atlas of Campus Form” to assess the performance of campus regarding each sub-criterion.
- A multiple case study analysis to assess the performance of selected case studies from the identified six campus typologies according to the set of criteria.
- Developing a “Morphological Atlas of Campus Form” as a model for a critical reading on various campus morphological attributes.

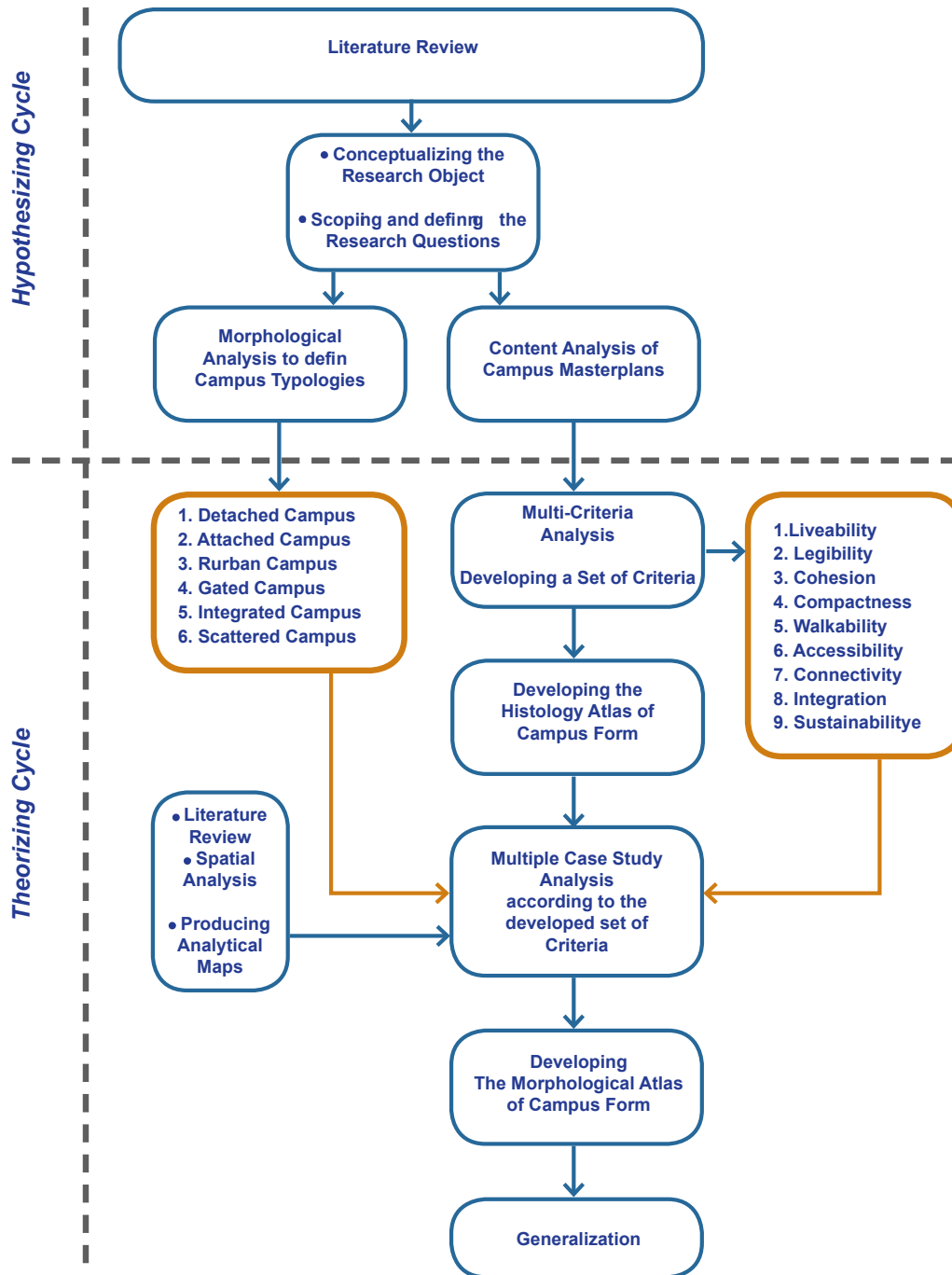


Figure 1.1: Research methodology Diagram.

1.6 Thesis Structure

This dissertation comprises two sections: hypothesizing cycle and theorizing cycle. The first section, hypothesizing cycle, consists of four chapters and mainly focuses on theoretical concepts and conceptualization the research object. The first chapter is the introduction part that describes the study background, research questions, research objectives, scope of the research, and methodology. The second chapter investigates

the universities' historical background, their recent responsibilities in the changing global world, their third mission activities, their impact on their urban space, and the future of universities. The third chapter reviews the spatial evolution of universities within their long history and studies the morphological attributes and physical features of the university campus, and identifies six typologies of the university campus in relation to their residing urban space. The fourth chapter investigates the concepts of sustainability and liveability in relation to urban form and university campus space.

The second section, theorizing cycle, encompasses the theorizing phase of the research and includes three chapters. The fifth chapter describes the dissertation methodology. The sixth chapter is devoted to a comprehensive multiple case study analysis and provides a description of the university's performance in relation to sustainability and liveability dimensions. The seventh chapter is the concluding part and provides the final remarks.

2. UNIVERSITY AND THE CITY: FROM THE PAST TO THE PRESENT

2.1 Introduction

The university, as an institution, has evolved within a multifaceted local and global system. From the outset, universities have encountered a twofold situation. In one hand, they developed their internal organization according to their institutional mission and vision, in an autonomous manner. On the other hand, they have had a multidimensional relationship with their hosting community and later with the global world. However, recently, the nature of universities is being challenged by the rapid development of the outside world which has made them be in a constant change. Their missions and responsibilities have been altered and consequently, their physical and institutional organization have been restructured according to the new realities of the society.

The university-city relationship has experienced profound alterations within a large space and time spectrum. In some periods, there has been a reciprocal coalition between both parties to operate from a shared vision, and in some other periods, there has been conflicts and tension between the two entities. However, at present, both the university and the city are more aware that this is a mutually beneficial relationship where the prosperity of the university and vitality of the surrounding community are correlated to each other. It is assumed that contemporary universities and their settled urban spaces are shaping - or already have shaped- the 'knowledge cities' or 'knowledge districts'. Universities currently are more conscious of their important role in contributing to the improvement of their societies. They attempt to take responsibilities in the sake of both their affluence and their societies' development.

In this sense, overviewing the history of higher education institutions (mainly European universities and American university campuses) and understanding their interaction within a course of history can shed light on the recent university-city relationship. Exploring the current role of universities regarding their urban space, mainly from the standpoint of universities' impact on cities, will also provide insight into the future of universities.

2.2 Historical Perspective on Evolution of the University

Along with the transformations in urban spaces, the form and mission of higher education institutions in Europe have been altered during centuries. Within the course of time, the physical form of universities and their relationship with cities has been fluctuated between being separated or connected. It was mainly influenced by the social, cultural, political, and economic conditions that dominated the era and the local context. In addition, within this evolutionary period, the number and size of universities, the number of student enrollment, the content of programs, and the mission of universities have altered drastically which have put a significant impact on the broader society as well.

The history of higher education dates back to ancient societies in the Islamic World, China, and India. Some of the Medieval Islamic universities have continued their existence to the present time such as Al Qarawiyyin, established in 859 in Morocco and Al Azhar in Egypt, founded in 970 (Meusburger et al., 2018). In the western world, higher education has existed since ancient times like the Plato's Academy but the institutionalization of higher education occurred in the Middle Ages. The term of "University" has root in Latin word of "Universitas" which means corporation or guild. In the West, the earliest universities, as institutions, appeared in Bologna and Paris and developed from monasteries. According to Burke (2000) "The rise of cities and the rise of universities occurred together in Europe from the twelfth century onward". The medieval university primarily was initiated by the foundation of the University of Bologna (in 1088) and continued with Paris (in 1150) and Oxford (in 1167). These universities are considered the archetype of the European university. This trend soon followed in other major European cities within the two-centuries time period. By 1400, forty universities were established in Europe (Brockliss, 2000). Universities were the main sources of knowledge in the affluent agricultural towns. They provided the town with qualified graduated staff. They were located in the urban milieu, benefiting from urban services and gradually influencing the urban identity of their context.

However, at the outset, universities were a community of masters and students and the education occurred in the houses around the town, rented by masters. According to Brockliss (2000), in the Dark Ages of the classic era, education was pushed back to the safe place of cloisters and monasteries. In spite of being embedded in town centers,

they were secluded and autonomous institutions and students and masters had no sense of faithfulness towards their hosting cities. In the 12th and 13th century, learning took place out of monasteries but still in clerical institutions which were settled in urban settings. The first universities including Bologna, Oxford, and Paris, were located in the most important points of the urban fabric, adjacent to administrative and justice centers and had religious status associating with the Church.

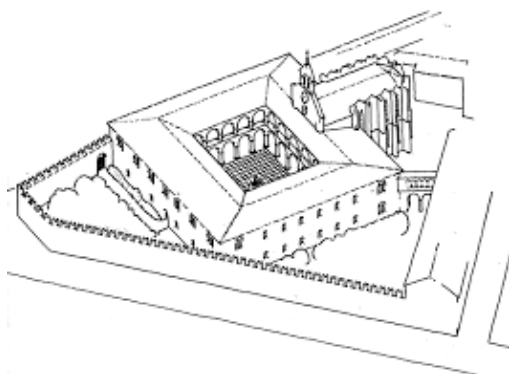


Figure 2.1 : Isometry of Spanish College, University of Bologna (Rückbrod, 1977, image 18, Retrieved from Bott, 2018).



Figure 2.2 : Courtyard of Spanish College, University of Bologna (Url-1).

Soon, the city governors got aware of the importance of the higher education institutions for their territory and tried to establish their own institutions in order to nurture their servants. So, towards the sixteenth century, the university was a prestigious and luxury institution and was critical entities for the reputation of the ruling system. For this purpose, within the course of the 1600s and 1700s, many universities had been established in most of the large cities of Europe to give prestige to the state in which they were located and their graduate students, mainly clergies, would carry out a key service role as civil administrators.

As the primary universities were self-sustained institutions with no public endowment, the establishment of university colleges in the 14th and 15th centuries were a successful episode where students and masters could live in common in purpose-built structures. Though, universities had only one or two colleges which could not address all the students. The most successful examples were Cambridge and Oxford which could change into collegiate universities. In both centers, colleges succeeded to provide living and learning opportunities in hostels and halls for their students.

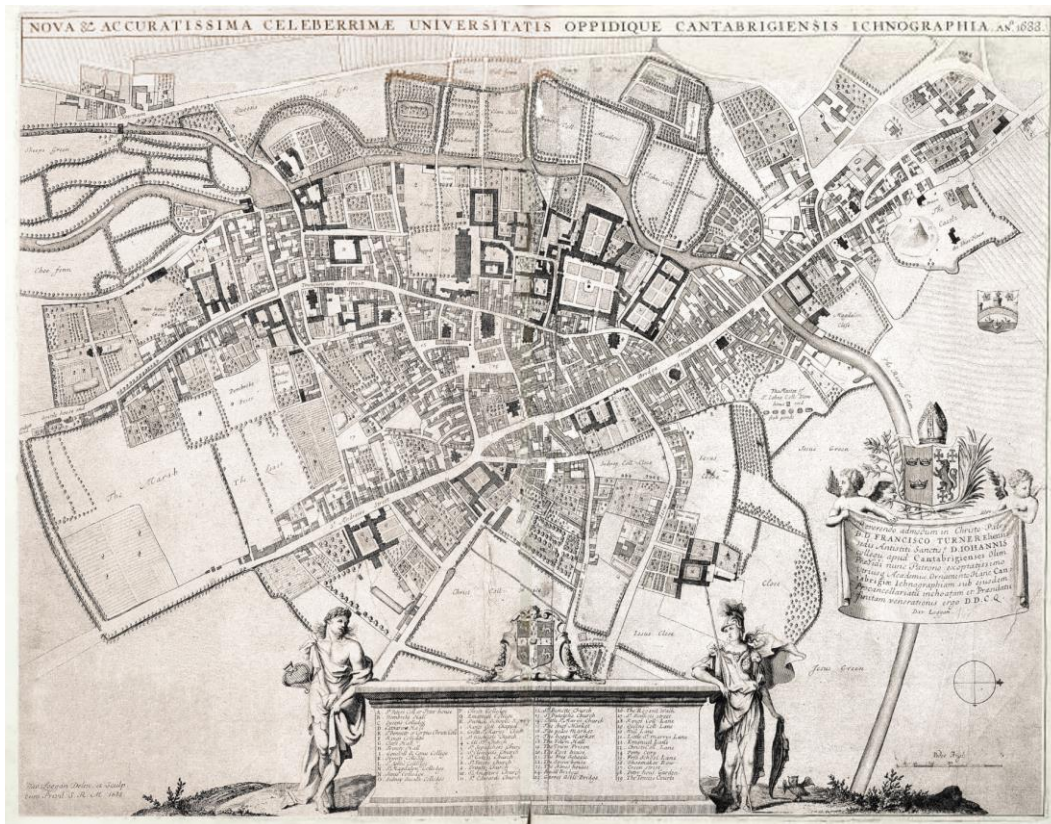


Figure 2.3 : Map of Cambridge by David Loggan. Dated 1688, published 1690 (Url-2).

Considering universities' urban position, it can be noted that the university and city were symbiotically integrated from the first period of foundation. Although the traditional universities were private, self-financed and privileged institutions, they were dependent on their hosting towns to provide services and accommodation needs. Thus, from the beginning, the city and university have interacted with each other and universities also have had a significant economic benefit for their towns. However, universities primarily had a privileged status and the students and masters benefited from the municipal services, tax exemption, and judicial advantages over the townsmen. To some extent, the severe conflict between town and gown rooted in this state of alienation and privileged-ness. The conflict spread all over Europe and resulted in fights and even murders. This situation was an impetus for many university migrations, considered as a common issue, such as relocation from Oxford to Cambridge in 1209 and many new universities were founded this way (Brockliss, 2000).

Since the nineteenth century, the university-city relation got better. In Cambridge and Oxford, students put aside the traditional distinct identity, reflected in their uniform

and behavior, and started to socialize and get integrated into the mainstream of society. Students could assimilate into the urban population and to some extent, they had the opportunity to practice their expertise in their community - particularly in fields such as law and medicine (Brockliss, 2000). In the late nineteenth century, the university-city relationship was very close and most of the universities were municipal institutions serving the economic demands of their residing city. Their association even strengthened by the inclusion of the new technological and social subjects in the teaching curriculum of universities.

Other noticeable alteration in the higher education system came up with changes in the curriculum. Before the 1800s, the universities were teaching institutions mainly focused on four topics: theology, philosophy, law, and medicine. With the Renaissance, new practical subjects were introduced and mere religion slightly lost its dominance in the mission of higher education institution. Within the course of the 16th and 17th centuries, many universities expanded their educational topics to geography, natural science, and law. The universities' subject orientation changed from theoretical subjects towards practical issues which could serve the needs of the society and the state.

The emergence of the modern university can be associated with Humboldtian reforms as a result of the social, political and economic changes of the 19th century that radically altered the system of higher education. By the foundation of the Humboldt University of Berlin in 1810, research universities were emerged. The curriculum shifted to teaching new practical courses including humanities, natural science, engineering and industrial chemistry in the civic universities of England or Germany. The need for educated civil workforces and engineers triggered the establishment of polytechnic universities. Karlsruhe Polytechnic School, École Polytechnique in Paris, and the Swiss Federal Institute of Technology (ETH) in Zurich were founded with the same initiatives (Bott, 2018). The research universities were initially founded to cooperate with factory owners and local enterprises. Moreover, university professors were more involved with political, social, and health care issues of the society attempting to put their knowledge at the service of the community and doing so were respected by the community. Primarily, knowledge production was characterized as an elite concept and belonged to a specific group of society. It aimed at creating self-contained spaces that physically separated from the surrounding context. Thus, the

notion of Humboldtian university was a major alteration from this standpoint. However, in the 19th century, the university still was addressed to the bourgeoisie and aristocracy.

Likewise, the traditional system of separated departments and individual scientific disciplines went under a revision in the 1960s and 1970s, and collaborative approach and cross-disciplinary research were praised.

Another noticeable issue was the increase in the number of students' enrollment which steadily occurred in the 13th and 14th centuries, 16th and 17th centuries. It considerably got momentum in the 19th and 20th centuries especially after the boom of the 1960s and establishment of the mass university. However, only 1500 universities existed worldwide before the 19th century which has experienced a boom since the 1970s. What happened between 1968 - 1974, also reflects the academia's concern about the social and class issues and the problems of the society. Nowadays, the number of citizens who have graduated from universities has been increasing widely and as a result, they have a sense of belonging toward the universities and their societies. Moreover, a mutually beneficial relationship has been created between the university and the society and many facilities of the universities are shared by the community and universities have a great impact on the development of their local regions (Brockliss, 2000). Now, it is evident that the traditional town-gown notion is not very distinguishable in the mainstream of society in the age of mass culture and mass university.

The rapid growth in higher education institutions of the 1950s and 1960s was a global phenomenon but had different motivations in developed and developing countries. In developed countries, the main trigger of universities' expansion was the need for a skilled and qualified workforce which could have been achieved through academic education (Anderson, 2006). In developing countries, the growth of universities was an initiator of economic development and construction of nation-state (Jöns, 2016).

It is interesting that on the other continent, on the opposite side of the Atlantic, "the campus model", another type of university was developed that is arguably the most significant model in the recent higher education system. The establishment of colleges in the United States initiated in the colonist's aspiration to educate the clergies. In addition, they attempted to enculturate the primary settlers with the cultural traditions

of the Old World and create a new England. Thus, Harvard College was founded in 1637 in an area named Cambridge near Boston as the first American university; and afterward, eight other colonial colleges were established (Coulson et al., 2011).



Figure 2.4 : "A Westerly View of the Colleges in Cambridge New England," line engraving (after Joseph Chadwick), by the American engraver and silversmith Paul Revere (Url-3).

The American campus model, initiated in the United States, has its roots in Cambridge and Oxford collegiate system - embracing studying, living and social activities of students. However, the model of American universities although appreciated the notion of the community structure of English colleges, they had not followed the monastic-style, introverted, enclosed quadrangle planning system. This model is also a notable shift from European universities such as Bologna where merely education was happening inside the gates of the university and accommodation and other social needs were addressed in the surrounding urban context. The American model privileged separated edifices situated in open landscape which addressed the community. Harvard and Yale can be considered the most impressive structures of New England in that era. Although Harvard, as the first American university, had roots in Oxbridge model, it was physically distinguishable from English universities of Oxford and Cambridge. It was established as a group of separate structures arranged

around a courtyard and was free for citizens to pass through. Harvard university has preserved its buildings from the 18th century that creates a harmonious connection between structures of early days and new establishments.

It was in the 19th century in the United States that the idea of establishing the university campuses around the pastoral and rural areas was very welcomed. The idea was separating the academic environment from the distractions of urban space and settling the students in a setting appropriate for educating and living. Many new universities also were being founded, near but not in a large developing city, in newly settled territories to support the local community. It should be noted that many of these campus universities, now, are surrounded by urban context because of the urban sprawl.

Before the Civil War, more than five hundred colleges were founded in the US but only a hundred of them could sustain. The main educational program of these colleges were liberal arts, classical languages, and literature. However, in the late 18th-century mathematics and natural science were added to their curriculum (Dober, 1963). Thus, the modern American University which is arguably the most prominent model in the higher education system has roots in three primary notions; the English collegiate model, the German research university, and the concept of providing service for the society.

Though the campus university model was the manifestation of American ideology towards education and society. This approach has been presented well in the University of Virginia, founded by Tomas Jefferson, third president of the United States, in 1819 and well expresses his notion of the “academical village”. The institution embraced the principles of Enlightenment, praised the physical setting as the fundamental element of education and expressed a sense of openness towards society (Turner, 1984).

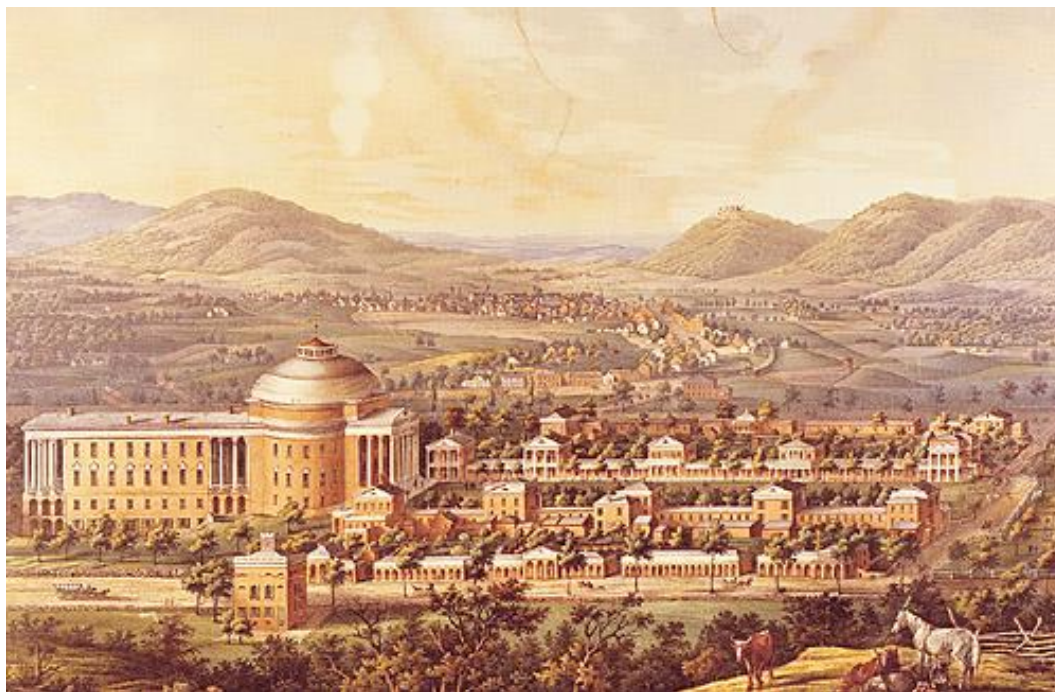


Figure 2.5 : University of Virginia. Lithograph from 1856 (Url-4).

In the 19th century, two approaches towards university campus became widespread in the United States. One was the approach of Olmsted which attempted to create a picturesque nature. He advanced a “rural neighborhood” concept and structured a park-like campus setting united the nature and community. This model applied in many universities including Stanford University, University of Vermont, Kansas and Michigan University and Washington University in St Louis. The other approach was the Beaux-Arts model based on the “City Beautiful Movement” and ignored the nature and valued urban pattern. Following this style, many universities considered themselves as cities and phrases like “The City of Learning” and “Collegiate City” came into being. This model illustrated in many universities such as Columbia University in New York, Rice University, Emory University and the University of California at Berkeley (Coulson et al., 2011).

Notably, on the other continent in Europe, university model has not been changed remarkably since the Renaissance until the early 19th century. In this era, the university expansion in Europe got momentum and witnessed a boom in the second half of the century. The rise of middle-class was also a significant force and education was approached as an intellectual, social, and economic potency. Primarily, universities were located in historic buildings in urban spaces and at the beginning of 19th centuries many of these premises were in poor conditions. With the new boom,

many of these edifices were renovated and many new premises were built across Europe. These new massive constructions were the demonstrations of the new era parsing progress and youth spirit and pushing back the medieval ecclesiastical and elitist isolation of higher education institutions. The spirit of the modern era was well manifested in the architectural expression of universities as single, monumental, symmetrical, assertive edifices which conveyed the neo-classical Renaissance style. While this trend was common throughout Europe, in England, Redbrick academic institutions became popular. The British new universities were inspired by Victorian style and the red brick edifices and were a complete departure from the Oxbridge model. The British universities in the industrial cities such as Liverpool, Leeds, Birmingham, and Manchester were non-collegiate institutions, supported by the industries, developed along with their hosting cities and were interwoven with their urban fabric (Coulson et al., 2011).

Another important issue to be noted is that the American university provided all the needs of students and staff including accommodation, sports, recreational and cultural facilities within a self-sufficient unit objecting both formal and informal learning. This elite status and separation from the neighboring town, however, intensified the state of contradiction between university and city. Sometimes this isolation was necessary because their neighborhood was not safe or was in a decaying situation. As a result, the relationship between academics and community was very weak and even sometimes hostile that highlighted as the notions of “ivory-tower” and “town-gown”.

However, while the United States was developing, the education system also was boosting and many new universities were founded in the competition between different communities to attract new incomers. Up to the mid-nineteenth century, the process became more common and large plans prepared which re-arranged the physical characteristics of the American institutions from the moderate and ordinary-like plans of Harvard to the large colligate quadrangles, known as the campuses. With the Gothic Revival in the turn of the 20th centuries, universities including Harvard and Princeton started following the Oxbridge’ tutorial system and revising their ideal campus concept in favor of the medieval collegiate model. Thus, quadrangle structures and enclosed courtyards emerged in an American university atmosphere.

The world following the Second World War witnessed major alteration in any aspect of society, which was evident also in the higher education system. In this period, the

number of students' enrollment increased dramatically. All-round the world. The need for scientific expertise was more understood by governments. Thus, the universities did not conduct research on their own sake. They went towards generating applied science to serve the community and strengthened their collaboration with the states and industries. New faculties and various degree programs were added to the curriculum of universities.

In the United States after World War II, democratization of higher education and passing the Land Grant College Act reformed the higher education system and provided education possibility for more people who could not afford the private institutions. It also supported the establishment of universities on larger lands mainly near capitals or in rural areas. This was a vigorous period in the higher education system of the United States and many universities were evolved to the extent that can be considered as mini-cities in terms of scale and complexity. Le Corbusier describes it as "the American university is a world in itself" (Coulson et al., 2011). Many issues related to urban planning such as movement got importance and the International style became widespread in the modern era. Subsequently, the landmark structures emerged as well and new edifices were distinctive individual forms which less paid attention to spatial composition and coherence. Clark Kerr (1995) also describes the American universities of the new era as the big campus. Many post-war universities were constructed as the entire totality in large land portions instead of piecemeal growth system such as Santa Cruz campus and still considered the "academical village" notion of Jefferson.

However, the post-war British universities of the 1960s were different from American universities. The changes occurred also in British universities as well. The British university structure was still small and hierarchical. Though the third generation of British universities emerged as "the new universities". These New universities such as universities of Sussex, York, Warwick mainly were constructed in greenfield areas and they emphasized on the community sense of traditional Cambridge and Oxford universities.

Across the European higher education history, universities have been embedded in central urban areas in single assertive buildings and they did not provide accommodation facilities for their students. By the 20th century and the increase in students' enrollment, although they obtained purpose-built premises their various

edifices were sprawled around the urban space. In the post-war era, many universities initiated to construct campuses in the outskirts of urban areas and considered the well-being of their educational community.

Building upon Brockliss (2000), the beginning of the campus model of European universities is related to the criticism-based literature of medieval and early-modern moralists. They claimed that although students were under surveillance in educational space, there were concerns about their living in the city, as a place of immorality, without the paternal control. Although Campus University is originally an extra-European notion, it has also an important impact on the European university system.

However, the romantic concept of isolating university space from the outside world and locating in nature is perfectly manifested in American campus model and later has influenced the European universities and many other universities throughout the world. The main reason was increasing the number of students' enrollment.

Since the twentieth century, universities grew significantly around the world and their missions and vision altered accordingly. This issue required the universities to get enlarged which was not so feasible within the historical urban fabric of European cities and many new universities were founded in urban peripheries. In early 20th century, new organizations established in green-field areas, such as Aarhus in Denmark or on the industrial sites such as Manchester, Leeds, and Liverpool and after the second half of 20th century many universities were founded in the outskirts of the European cities but they were not a sophisticated model of American campuses as a place to study, live and entertain (Brockliss, 2000).

In this respect, their organizational layout also changed according to new transformations. Different departments and faculties emerged and more attempt to put on research and outreach rather than just education.

In the Post World War II period, the American campus model became a global model. Many universities were established around the globe, mainly under colonial impact of Europe and the United States, including Tsinghua University in Beijing, Tongi University in Shanghai, University of Cape Town, University of Calcutta, University of Bombay, the Technische Hogeschool (TH) in Indonesia, and the first Australian university in Sydney (Bott, 2018).

Modernism also emphasized on the formal homogeneity and most of the new universities which founded after WWII did not convey any sense of distinguishability. The standardization of the 1960s brought up monotony and anonymity in the university buildings which rejected in the succeeding periods. Thus, succeeding in the present time, aesthetics and fashion become a key component of university design. With the rise of post-modernism, historical and contextual styles and rational organizations and human-scale structures were favored. The recent era, also privileged the iconic and star architecture and many universities such MIT utilized it to brand themselves as the cutting-edge institutions to compete in the global knowledge world which can be mutually beneficial for the universities and their hosting cities. Moreover, in the age of information and with the advances in technology, the virtual university concept has opened its place in the mainstream of higher education system. Thus, both university and city need to recognize the necessities of successful reciprocal interaction in the 21st century.

2.3 A Changing Context: The New Mission of the University

As discussed before, universities have had a long history of evolution and they have been in constant transformation according to the external socio-cultural, economic, political, and physical conditions. In the past, knowledge production was considered an elite task and separated from the mainstream of society. While, today, there is a need to broadly dissemination of knowledge among the mass of society. The new requirements of the society and the changing global context have made universities to be more inclusive. To succeed, they have aligned their mission with the new demands. The changing relationship between universities and cities has changed the recent urban reality. With the growth of the knowledge economy in the twentieth century, universities have been transformed into valuable assets for their residing cities. Cities reinvent themselves as knowledge cities and their universities and institutions not only undertake a pioneering role in the social, cultural, territorial and economic development of their urban context but also act as laboratories for a new way of thinking and living culture. The societal demands have assigned to the universities, has intensified the necessity of revising the role of universities to better address the recent needs of society (Hoeger, 2007).

Traditionally, universities' main missions were education and research that supported by administrative functions. However, universities' recent mission, indicated as "third mission" mainly implies "outreach" and "engagement" activities with the community. Molas-Gallart et al. (2002) define the third mission activities as: "[...] concerned with the generation, use, application and exploitation of knowledge and other university capabilities outside academic environments. In other words, the third stream is about the interaction between universities and the rest of society". The third mission of universities beyond teaching (first mission) and research (second mission) is associated with their participation in economic, socio-cultural, spatial, and environmental activities of the society (Razavivand Fard et al., 2017). Considering the strategic plan of universities and their defined objectives and strategies in masterplans, the contemporary universities have mostly underlined the issues of education and research, social and personal development of students and community outreach and public service (third mission).

In this respect, the traditional mission of universities has faced a radical shift from top-down teaching to learning and research, and then to service and outreach. This alteration is well manifested in the vision and mission of universities to connect with their urban context. So, the recent responsibility of universities is twofold: in one hand, they provide the best atmosphere for their traditional mission of education and research and on the other hand, they enforce the actions for connecting academia and society. Universities are sometimes considered as "anchor institutions" or as "civic institutions". The "civic university" concept of John Goddard (2009, 2018) assumes universities as an integral part of their society. He states "the engaged civic university which I propose is one which provides opportunities for the society of which it forms part. It engages as a whole with its surroundings, not piecemeal; it partners with other universities and colleges; and it is managed in a way that ensures it participates fully in the region of which it forms part. While it operates on a global scale, it realizes that its location helps form its identity and provides opportunities for it to grow and help others, including individual learners, businesses and public institutions, to do so too" (Goddard, 2009).

Today's universities intend to move beyond their borders and reach out to their host communities. Universities are gradually opening to the outside, contributing to economic, social, cultural, and physical development processes. Urban outreach

initiatives are more about fading the borders between university and community rather than just reaching out of the university boundaries. This integration is facilitated through defining mutual purposes and actions for university-city collaboration.

Embracing these new responsibilities, universities are largely conducting new strategies aiming at creating synergy with their urban context to build an atmosphere that can support these dynamic flows required for a more sustainable urban space.

Urban universities search for concepts that contribute to the development of their residing cities and improve their status. Campus universities look for strategies to redefine themselves and foster a new urbanity in their suburban locations. In this sense, universities are the engines of synergies. In all these endeavors, different aspects have been retained including spatial structures that support the internal knowledge transfer and the social interaction through various strategies and ideologies that are designed to promote urban life and get integrated with the urban space. The objective is to create an atmosphere that facilitates the flow of necessary synergies to create sustainable knowledge centers for the rapidly changing needs of society and the economy (Hoger, 2007).

Contemporary universities are more open to the outside world. They accepted that they can no longer be mono-functional and isolated entities because the ideal traditional “self-contained” campus type is not in congruence with the new concepts of permeability, participation, and engagement. The universities of today are entrepreneurial institutions. In accordance with the notion of participation and engagement, contemporary universities, as the large-scale institutions, are deeply involved in supporting local economic development and contributing to the social fabric along with other large urban institutions such as museums and hospitals. They act as a link between local, national and international partners (Benneworth et al., 2010; Haar, 2010).

With the wide acceptance of the “knowledge society” notion in the last decade and transformation of universities’ responsibilities, two concepts of interdisciplinary collaboration and synergy have been highlighted. Building on that, universities are the leading agencies in addressing the real problems of society, which are complex and multidimensional and require more interdisciplinary solutions. Thus, universities are collaborating with industry, community, and government according the framework of

“Triple Helix” (Etzkowitz, 2018; Etzkowitz and Webster, 1998; Etzkowitz et al., 2000) and “Quadruple Helix” (Arnkil et al., 2010). They create ties, for instance through R&D centers and techno-parks, to exchange the educational and research activities with other academic networks, industry, and businesses and cooperate with local leaders.

Thus, universities play a central role in the creation of local networks and urban governance. At the same time, the tertiary education institutions are able to guarantee the process of internationalization of a local context in their guardian role of knowledge, through the redundancy of human resources and the circulation of knowledge through publications, conferences, and patents according to which the university leaves its presence on the urban landscape. Universities are real active players in mediating between the global system of knowledge production and exchange systems, contributing not only to the growth of the region in which they operate, but also and above all to the enhancement of technological profile of localized organizations on the region (Bramanti and Salone, 2009).

Universities are also problem-solvers. They deal with the many recent challenges such as socio-economic inequalities, climate change, unemployment, population aging, and health issues. They are the best organizations which can offer interdisciplinary solutions and progress towards sustainable development. Hansen and Lehmann (2006) count universities as development hubs refer to them as hubs and initiators of cooperation with businesses and local communities on the road towards sustainable development. It is stated that through providing research-based knowledge and education (directly) and spin-offs and business incubators and other facilities (indirectly), they contribute to economic development. They believe that universities are placed at the center of change. They are development initiators as they perform a catalyst between different stakeholders.

As the major urban development nodes, they profoundly transform their urban milieu, particularly in medium-sized towns. They animate the processes of social and economic development and generate new and innovative projects, particularly at their local contexts. Perry et al. (2009) presents various empirical shreds of evidence of universities engaging in urban development through acting as employers, purchasers of the land, and owners of permanent large areas. Some examples of European universities in medium-sized cities show that the presence of that institution represents

it as the main economic actor such as Oxford in England, Leuven in Belgium and Pisa in Italy in which the relevant universities play a vital role as actors of urban transformation, centers for the production of knowledge and technological innovation centers, new cultural and innovative projects. There are many examples of universities that have transformed the conditions of their hosting space in different aspects. One of them, as an instance, is the relocation of the new campus of University of the Arts London that created a sequence of outputs resulting in the revitalization of the area. It implemented as a part of a large urban transformation of 69 acres of railroad area to integrate this large land to the city. Along with the provision of space for various art and cultural events, leisure activities in the designed public open space, the presence of 5000 students and staff boost the economy. Many buildings of the former industrial area renovated for adaptive reuse and obtained new functions related to the College of Art (Lotus International 165, 2017).

Being research infrastructures and high technology living spaces for students and researchers, universities are associated with urban identity construction and its ability to be open and inclusive. Thus, universities facilitate changing the position of their hosting cities in the competitive global network. Academic prestige is inevitably one of the main goals of universities which is also manifested in their architecture and campus planning. In this regard, the position of universities plays a critical role to be strongly integrated. Universities have encountered a global competition for attracting students and academic body and in this regard, the physical features of their campus environment play a key role in changing the game. For this purpose, many universities, even the most prestigious ones, largely invest in their image and physical infrastructure. Especially since the twenty-first century, it has been a rising trend in universities attempting to expand their physical environment particularly in the US and afterward in England and later around the world. Higher education is a global industry and universities aims to be more international. Universities are competing to attract a more diverse student body. This process of internationalization is not limited to the western world anymore and for instance, some Asian countries such as China, Singapore, and Malaysia are attempting to be the education destinations. The approach towards diversity has an impact on university space organization considering the needs of different religious, ethnic, and age groups and providing services to support them.

Universities are considered true actors of new urban governance and protagonists of international relations in the city. They promote the city's ability to attract new talents and resources (Bonaccorsi and Daraio, 2007). The cities compete with each other as well as their universities do with each other. In both cases, they build new strategies for the competition both in terms of inputs and in terms of output and also in the final positioning of resources. The city, therefore, continues to be a key resource for the university, and the university as well is more profitable for the city itself. Today it still makes sense to discuss the city in search of universities and universities in search of the city, because, even though poles of the relationship are both profoundly changed over the time but they continue to cooperate from a shared vision.

2.4 University's Impact on Urban Dynamics as the Node of Urban Development

Contemporary universities are considered as the pivotal actors affecting urban dynamics (Gibbons et al., 1994) and their interaction with the urban space create multidimensional impacts. The impact of universities on their urban context can be observed from four interrelated perspectives: 1) economic impact 2) socio-cultural impact 3) spatial impact and 4) environmental impact.

2.4.1 Economic impact

Universities play a leading role in the economic development of their hosting cities (Benneworth et al., 2010; Charles & Benneworth, 2001; Goddard et al., 2016). University activities have a direct impact on their urban milieu on different scales. University staff and students are important actors in using local services and housing market. Universities also act as the main agencies in the labor market by providing many job opportunities, particularly for local citizens. They are also among the main consumers of local goods and services. They initiate and support new businesses, incubators, and spin-offs and in this sense, many local small businesses and companies prefer to be settled close to universities to use its advantages (Van der Wusten, 1998). The universities are locus of production and dissemination of knowledge, science and technology. So, they are pioneer institutions in providing opportunities for innovation and technology transfer, promotion of businesses and industry through education, research and R&D activities, patenting and licensing.

Universities undertake two important complementary roles; in one hand, they act as the international gateway through creating connection with the global network and

branding their urban space (Benneworth et al., 2010) and on the other hand, they are both relation-makers (Bramanti and Salone, 2009) in the local area with the task of strengthening the interaction between the actors in the area and also, they are initiators and supporters of new businesses, incubator services and spin-offs. Van den Berg and Russo (2004) study the importance of higher education institutions on economic growth from two perspectives: firstly, teaching and research activities of universities have direct economic impact including providing new job opportunities and services and secondly universities are the main places for nurturing human capital (as knowledge spill-over). Concerning this first aspect, the new competitive knowledge-based society requires more educated and high-skilled employees that on one hand, results in rising the enrollment of people in higher education institution and consequently, increasing in number and expansion of universities. On the other hand, this human capital are so mobile because of availability of future career opportunities related to their skills that requires universities to compete with each other to attract and retain their students and faculty and this fact results in changing the geographies of higher education (Wiewel and Perry, 2008). For this purpose, universities need to provide infrastructure and facilities for enhancing their human capital and also for branding and improving the socio-cultural and economic prestige of their urban environment. These impacts vary depending on the relation between the city and university and can be on a large scale or small scale. So, the size and location of the university in relation to its urban space plays an important role in this regard (Raspe and Van Oort, 2006).

2.4.2 Spatial impact

Universities are embedded in an urban setting and in a direct connection with the immediate physical environment. They are to some extent dependent on their surrounding urban milieu and they are in the position of changing their context. They have a major influence on their territories because of the specific characteristics of their functions and activities. They are large scale institutions that possess large land areas for their educational and civic activities. Thus, they are considered as urban developers and as drivers of urban transformation (Perry and Wiewel, 2005; Perry et al., 2009; Sherry, 2005). With changes in the higher education system and the increase in the number of students' enrollment, universities have accepted new responsibilities besides the traditional role of education and research. Indeed, the way universities

interact with their host urban spaces has changed widely. On one hand, universities request for additional educational spaces and facilities to meet their institutional needs. So, they require to expand outside or on the edge of their boundaries. This fact, inters universities in the realm of the real estate development where they need to purchase or rent and develop lands. On the other hand, universities are obliged to provide accommodation for their students which is one of their major challenges and has a significant impact on real estate landscape. This need can be addressed by in-campus or out-campus dormitories or through the private housing market in the residing city. It critically affects the housing market because of the shortage of available housings and also the behavioral differences between students and citizens in terms of both spending patterns and lifestyle (Van den Berge and Russo, 2004). Likewise, in some cases, universities are situated in areas that are socio-economically deteriorated or unsafe areas. Thus, universities are involved in urban regeneration of their neighborhoods in collaboration with external partners and public state to enhance the socio-economic status of the area. The issue also enables them to enhance their prestige and brand the hosting city. However, according to Van der Wusten (1998), universities that are located in secure middle-class urban settings may lack the driving stimuli for development. Universities embedded in vibrant cities with different kinds of entrepreneurial activities have more possibilities to get connected and involved with their context and metropolitan cities stimulate universities' integration to the international networks.

The concept of universities as “the urban developers” is widely practiced in the United States of America and is extending vastly to other parts of the world. The notions of “place” and “place-making” is mainly at the core of universities' urban transformation practices. Doing so, they are creating more vibrant and safer places that give them competitive benefits. The mixed-use development is an efficient model set by universities that amplify their corporate performance.

2.4.3 Socio-Cultural impact

Universities have an active role in socio-cultural development of their regions. They influence their environment by offering new ideas, new taste of art and aesthetics and critical comments. Many of cultural and aesthetical trends have roots in universities and they are among main performers in nurturing professionals and artists and directing the aesthetical and cultural approach of their era. Universities use their virtual

and physical spaces to offer many educational programs for public and organize many activities including seminars, conferences, public events, festivals, art exhibitions as well as sharing their facilities including theaters, galleries, libraries, laboratories, sport facilities with the public.

Existence of a university in an urban district also influences any aspect of everyday life in that area and can be considered a major parameter of vitality of the region. Because of this presence, many new functions are added to the area including recreational and cultural activities as well as new residences and dormitories. The existence of these activities boosts synergy to the urban context, enhances quality of life and very importantly increases level of safety and security of the urban space. Universities perform a quasi-civilian role that have a positive impact on the surrounding urban area (Campbell et al., 2006). It encourages participation of citizens as well as other partners and enhance the socio-cultural status of local community and promote the sustainable quality of life. These activities diffuse energy and vitality into urban space through many new functions such as cafes, restaurants, retail stores, exhibitions, and sport facilities. They perform as public spaces and activity nodes for their neighboring community.

2.4.4 Environmental impact

Universities, as large institutions, comprise many different functions that occur in massive facilities including educational, administrative, residential and recreational spaces, transportation and open space operations. Thus, universities act like small scale towns and their activities have a great environmental impact on the surrounding urban space as the result of the campus operations. Universities consume a huge amount of energy, water, material, and food and dispense an enormous quantity of waste and pollution to the atmosphere. They use productive land and water for their required missions and affect the biodiversity of the environment. Transportation also has a great impact on the environment from emissions and energy consumption point of view.

Thus, universities can enhance the awareness of the society about the environmental aspects through their research and educational programs on sustainability issues for both their students and faculty and also for the public. In this respect, many universities are moving in the path towards sustainability and controlling their impact on the local area.

2.5 Re-Structuring of University Space Concerning the New Demands

The ever-changing global world and recent university-city integration have influenced the spatial structure of universities in their internal and external boundaries. The physical places of universities are in a constant re-structuring. The spatial boundaries have been blurred to respond to new modes of learning. Universities are place-based entities that are hard to relocate and they are essentially linked to their residing location. Thus, the long-term success of universities is dependent on their location. In the era that the majority of the world population inhabit urban areas, the prosperity of both university and city is relevant to their mutual association. Through their urban outreach actions, universities are trying to embed themselves within their urban space to be “of the city” rather than being “in the city”. Thus, recent universities make use of their physical setting to be more integrated into their urban context and in closer contact with urban life. In this respect, den Heijer and Curvelo Magdaniel (2018), in their study of Dutch universities, has identified two main shifts from past to the present that can shed a light on future university. The first shift is noticeable in the change in the physical location of universities from a peripheral situation to inside-city locations. This demonstrates that the dynamics of urban growth influences the location and organization of universities. The second shift is the change from exclusive and mono-functional universities to larger multi-functional and open to public institutions that exhibits the potentials for collaboration in campus-city relations.

The paradigm of elite education, followed for years in secluded monastery-like educational environments, is not a matter of concern in the twenty-first-century learning atmosphere. The recent learning era welcomes more collaboration, permeability, transparency, and interdisciplinary approach. Renzo Piano in an interview about designing the expansion project of Columbia University campus said that: “One century ago, the only way to design a campus was monumental architecture, giving the sense of security. Today the university is in communication with life, so the story to tell today is completely different. It is more about permeability, more about participation. The model of university today is more related to reality.”

Today the university campus development projects do not merely consider their institutional and spatial requirements. Moreover, they attempt to engage external stakeholders to meet their needs as well. In this respect, the plan of the new Allston campus of Harvard University is a good example that describes the idea as: “Our

priorities are to determine existing regulatory environment, and to work cooperatively with internal and external stakeholders to realize this planning vision.” (Steinmetz, 2007). Participating in urban revitalization projects is one of the most remarkable acts that universities conduct to be integrated with their urban milieu. Not considering the possible town-gown tension, universities attempt to reach the wider urban context through the large-scale development projects and also through sharing their campus landscape and amenities with the city. Meanwhile, they try to transfer their peripheral or sprawled academic sites to inside-city settings through these large-scale projects.

Other types of development projects that universities carry out are creating science and innovation districts that make it possible to open the campus to other target groups. In this regard, Schmitt (2007) describes obtaining a “shared vision” through creating a stage for collaboration of various stakeholders, complementary program and integrated sustainability concept as the essential factors for the development of a contemporary campus. The process of planning and implementation of the ETH Zurich’s sustainable campus as a Science City is a great representative of the mentioned “shared vision”. This process prioritizes establishing a shared vision and corporation to mere designing of new buildings or masterplan. In the ETH Zurich sustainable campus, the shared vision achieved through a participatory design process. Several workshops were organized and various stakeholders provided their resources through which several great ideas were achieved. Through the “future lab” and “design lab” meetings and workshops, the main idea of the Science City was formed. It was aimed at creating a holistic high-quality campus, and an innovative teaching and research center that attracts people from throughout the world. The ETH Science City is “a dynamic transformational projects” which shapes a dialogue with its various elements both inside and outside of the campus. It provides a focal point for international academics and public from diverse disciplines to be virtually connected to the campus and collaborate. It is a remarkable example of bottom-up decision making and accumulation of individual initiatives to create a stimulating campus. ETH Zurich functions as “a veritable hub of knowledge” (Schmitt, 2007). Schmitt (2007) emphasizes the importance of a complementary program rather than mono-functional programs. It can be achieved through a long-term strategic plan with support from science, industry, and general public. In this sense, the main mission of university, education and research, is prioritized in the planning of the university and furthermore

the transdisciplinary discourse and collaboration through exhibitions, events, workshops, executive programs and courses need to be planned. The physical setting of the university is an initial point and the latter part composes the programs such as the innovative Multimedia Lounge that set a platform for knowledge exchange between academia and society. Through these interactions, it is expected to obtain sustainable values. It is significant to mention that this type of design thinking mainly emphasizes on the collaboration of a team of designers, programmers, and decision-makers, like an orchestra, rather than a top-down planning system.

The university-industry collaboration aftermath is transforming the scientific research to high technologies. It can be noted that this partnership in a larger scale is taking place within “innovation-districts” where the of cutting-edge institutes and high-level firms agglomerated and link with incubators, businesses, and start-ups. They have a mixed-use urban nature which is distinct from sub-urban science-parks. Their main purpose is learning via experiment and as a result, they have an open and recognizable spatial configuration where they consider connectivity and adaptability. The concept of innovation district mainly conveys urban outreach objectives which attempts to move beyond the town-gown gap.

In accordance with the sustainable initiatives, the notion of “Adaptive reuse” is highly appreciated by universities. Through adaptive reuse of existing buildings, universities contribute to sustain environmental issues and reduce the financial costs of building new constructions. It gives an impetus to preserve the historically precious structures from deterioration. It is also a good solution for the increasing spatial requirements of universities particularly in urban areas which finding available land is a problem. Thus, many universities have put the adaptive reuse on their agenda for their own edifices or the existing structures of the hosting city like the job done by University of Brown and New York University in the US, the Vrije University in Brussels. This issue can be a good practice in enhancing university identity and boosting university-city interaction, especially for urban universities as many of old abandoned structures are rooted in urban centers. Moreover, these old historical edifices mainly are part of the collective memory of the society. Adaptive reuse is also used as a strategy in regeneration of many deteriorated urban areas as the case of Bilgi University, Santralistanbul Campus in Turkey or the Savannah College of Art and Design in the US.

University campus design and master-planning is an arena “to express the mission of the university in built form” (Edwards, 2000). Universities have been communicating and sending messages through their architecture since the medieval era to the present time. Hence, their new academic visions, pedagogical restructuring, and urban outreach roles have been manifested in their physical organization. It was the idea behind many campus planning in the UK in the 1960s to mix the teaching, learning, research, social, and administrative spaces. Doing so, students and staff could/can work together more effectively and would create a higher sense of community.

Furthermore, university campus architecture is the manifestation of the university’s mission and is a significant marketing and branding mean in the global knowledge-economy (Edwards, 2000; Kenney et al., 2005). The mission of an institution expresses its vision. Thus, universities compete to inspire the talented students, researchers, and faculty. To do so, in addition to academic prestige and research accomplishment, the physical environment of university campus gains more importance. An attractive and vibrant campus setting is a critical means to achieve the institutions’ mission. In this sense, the campus visits and tours have gained more importance and universities, including prestigious institutions like Harvard University, try to create a memorable impression to attract new students. Universities also implement world-class projects can be named “Starchitecture” in branding and enhancing their global image. Guggenheim Museum by Frank Gehry in Bilbao is a great example of changing a city’s global status and fame, and economic growth through establishing a landmark building and a cutting-edge project such that later called the “Bilbao effect”. Likewise, MIT in the US has programmed to transform the neglected areas of its university setting to a showroom of architectural masterpieces designed by celebrity architects. Thus, many universities’ administrators attempt to use high-profile architecture as a tool for branding themselves and be powerful in the competitive knowledge economy. However, the notion needs to be commissioned sensibly in order not to harm the university identity as a university campus still should convey the sense of unity and harmony.

Hashimshony and Haina (2006) identifies key factors influencing the design of future university as:

- Financial challenges: As the result of decreasing government support, universities are obliged to meet their financial needs and for this purpose they

have been engaged in activities that has commodified knowledge such as patenting, providing educational programs for public and private sector, and privatizing their services such as dormitories and sport facilities.

- Collaboration with industry: In the competitive global economy, industries are becoming more innovation and technology-intensive that require close cooperation with scientific institutions.
- Increasing student population and greater diversity: Democratization of higher education and the significance of knowledge for the society has changed the population status of higher education institutions. In contrary to the past form of knowledge for elite, the current body of university students is so diversified from various socio-cultural, economic and ethnic backgrounds and gender.
- New patterns of teaching and learning: Rapid transformations in technology and communication system have eased the possibility of access to knowledge through virtual university. “Distance learning” and “electronic learning” provide options for education, independent of time and place. However, this sort of education still lacks a sense of community, and social interaction and in-person communications which is an important form of informal educational experience.
- Growth of interdisciplinary fields of knowledge: Traditional university system was based on a hierarchical structure but the contemporary education system is characteristically more interdisciplinary.
- Openness to the community: In the current world, leisure activities gained more importance for individuals and many universities are offering opportunities for the public such as lectures, courses, cultural programs, and sharing their facilities. This fact increases the communication between university and society and blurs the boundaries between them.

Nowadays, higher education institutions are in a challenge to respond to various pedagogical, societal, financial, and administrative needs. Traditional education modes are inadequate and new models of education and research are replacing the old traditions. With the advent of technology and communication, online learning such as MOOC (massive open online course) has become a widespread phenomenon that offers an alternative platform for learning. Thus, some writers have claimed that

university campus as a physical reality is becoming a phenomenon of the past and now the learning can occur in any place from a cultural center and workplace to a shopping center using ICT (Harrison and Dugdale, 2004). According to Harden (2012) “The residential college campus will become largely obsolete”. So, according to this sort of studies and viewpoints, “e-university”, “m (mobile)-learning”, and various types of distance learning are increasingly replacing the physical space of university. However, other researches are emphasizing on the benefits of the university's physical environment on learning objectives (Strange and Banning, 2001). “The physical and the emotional become inextricably intertwined to form an almost palpable ‘sense of place’, one that has profound if not always clearly understood meaning to many members of the campus community” (Kuh et al., 2005). Although the rapidly evolving technology and communication systems may not diminish the physical reality of university, it has a great impact on the typology and organization of physical facilities to support the new modes of education.

“It is a truism that a university is a society founded for the advancement of learning and the dissemination of knowledge, this means that it is constantly changing, always on its way, its work never completed. Departments expand, contracts, quadruple in size, or virtually disappear within few years, often in defiance of the most knowledgeable and expert forecasts. Every building and each layout, so optimistically and thoroughly designed, seems to become within a decade not only out of date but physically hampering to the future. Any attempt therefore to constrict its movement artificially, either academically or physically, seems doomed, and rightly doomed, to failure.” (Casson and Conder, 1958).

However, it has been widely accepted that learning is not merely occurred formally and the informal knowledge exchange is a significant part of the education and learning process of any student. Recently, there is a great emphasis on “flexible” learning spaces as spaces in which diversified activities can be conducted by diverse user groups simultaneously (Chism, 2006; JISC, 2006). Thus, it has supported by many scholars that university campus and building design need to enable particularly informal learning. In this sense, the more effective learning can be the result of encounters and interactions between students and staff and the campus need to offer a wide range of spaces for studying, working and socializing (Kuh et al., 2005). It is also highlighted the importance of creating human-scale setting which convey messages

through buildings, landscape, and signs that affect the sense of belonging, well-being, and identity of students.

It is noticeable that physical space has been and still is an integral part of learning and education. Though, the type and organization of the learning environment have progressed with the advent of technology. New ideas and concepts have been introduced and accepted by university designers and policy-makers including engagement, outreach, interdisciplinary, transdisciplinary, transparency, permeability, flexibility, innovation, and so forth. Kornberger and Clegg (2003) claims on a relationship between campus spatial layout and its organization's operation and suggest an "architecture of complexity". They advocate "generative buildings" that are designed by or with their users instead of creating mere monumental buildings. Building on the notion of "heterotopia" of Foucault (1971), they state that a learning environment is "a space for experimentation and temptation, where discussions about existing orders of things and discourses can happen...a place where one can hear voices that are not normally heard... [where one] could restructure an organization's image of reality". The Open University Business School building in Milton Keynes can be considered a case of this "heterotopian" perspective that has been designed to provide flexibility for users and offer spaces for diverse activity types including individual workplaces, reunions, socializing and so forth. In the same way, the University of Sussex has provided flexible space for "the creation of collaborative and innovative research environments" (Temple, 2007). The flexibility is also a crucial issue in facing new technological changes which are advancing very rapidly and unanticipatedly. This flexibility can be traced in size, arrangement and form of the space as well as creating HIVEs (highly interactive virtual spaces), stimulated environments, clusters and peer-to-peer environments for interactions such as cyber cafes, external and individual work environments which are ICT-rich spaces. The JISC study (2006) states a change in the entire pattern of university space has a significant role in improving learning outcomes.

Hence, it is also suggested that the design of twenty-first-century university space should sustain problem posing and solving, support interactions, facilitates bluing the boundaries between disciplines, and recognizes the role of serendipity and story-telling in science through creating spaces for unplanned encounters and experiences (Narum, 2004). Making an emphasis on the importance of informal exchanges and interactions,

the residential accommodation of students and staff and combining living and working and socializing have become a major factor in designing university campuses (in case if the space availability cannot be an obstacle) (Kuh et al., 2005).

As mentioned, with emphasis on collaborative and interdisciplinary practices, the physical space of university is the main place that embodies this notion. So, many new research centers have been established within the university body that also cooperate with industry and external partners.

In terms of architectural attributes, these centers are largely flexible which can easily embrace new technologies and be adjusted for future uses. Also, they embrace the idea of communication and collaboration. The facilities are mainly accessible by all users and plenty of spaces have been designed which fosters interactions and stimulates proximity.

The concept of “joint-venture” buildings expresses the idea of collaboration. It essentially conveys the partnership of a university with other universities, research centers, industry, and other institutions such as health agencies. The spectrum of their collaboration varies from a mere share of facilities to strengthen cooperation. In the age of funding cuts, joint-venture is a great value in terms of reducing the financial costs through pooling the resources particularly in case of expensive scientific facilities. It is also offering opportunities for students and researchers to bridge the gap between education and practice and provide employment potentials for them. They are also grounds where universities proclaim their integration with the community and overcome the ivory tower tension.

The concept of “hub” well presents the multi-dimensional character of contemporary university. It is a high-tech, innovative, mixed-use single building that various functions from academic to social and recreational activities are taking place there. The hub’s nature is more informal offering more integrated services which is different from traditional formal learning environments. The hubs are largely the manifestation of the paradigm shift in education and learning attempting to meet students’ expectations and enrich their experience.

Today’s universities notice their real estates to implement strategies to develop a vibrant and sustainable environment which addresses the long-time learning and living needs of their users (Coulson et al., 2018). They use their capacities to conduct

expansion or revitalization projects and revising their masterplans. They follow some steps for this purpose as evaluating their physical setting, identifying the institutional goals and guidelines, determining the potentials for revitalizations, and framing the implementation strategies. The proposed principles mainly need to support institutional missions, inspiring the cross-campus connections, and enhancing the public realm.

2.6 Summary

Although early universities in Europe were situated within the urban milieu, knowledge production and education exclusively to an elite group of the society. The education occurred in mono-functional and gated spaces that were purposefully separated from the mainstream of the society. Within their long history, universities came outside of their enclave and became an integral part of their societies. Today, universities are the main drivers of economic development and contributors to social life. They are the initiators of many new ideas and aesthetical and cultural trends. They enhance the socio-cultural status of the society by offering many public programs and events and sharing their facilities with the local citizens. They are engines of synergies in the city.

Recent universities are well aware of the importance of establishing a successful and strong tie with their hosting urban context. This mutual connection is reciprocally beneficial for both entities as universities are considered the nodes of urban development and the prosperity of universities is considerably dependent on their surrounding urban space. Thus, contemporary universities are partaking new responsibilities that have economic, socio-cultural, spatial, and environmental impact on the cities. Universities are one of the main consumers of goods and services in the district and the main providers of jobs and opportunities. They are major generators of knowledge, innovation and technology and supporters of new businesses and industries. They are the gateways of the city towards the global world.

They are large institutions that possess and purchase large land areas that have a great territorial impact in the setting. They are involved in the real estate market as well and are considered urban developers. They are important agencies in the regeneration of urban areas and spatial development of the hosting cities in collaboration with external stakeholders.

They are also among the main consumers of energy, water, productive land, materials, and food and have a noticeable environmental footprint.

Considering the important role of contemporary universities in their surrounding urban context and also in the macro-scale on the global world, many universities are revising their position towards their immediate cities. They are accepting new responsibilities and getting more engaged in the challenges of their urban milieu. They are attempting to progress in the path towards a more sustainable university-city interaction. In the 21st century, universities could be feasible and sustainable to the extent that they can manage and balance the global changes. For this purpose, campuses should be planned to accommodate new responsibilities, concepts, and purposes and incorporate them with their traditional missions. It is more complicated in contemporary universities as they are the agglomerates of various multi-functional and specialized structures in contrary to historical universities that could operate within some buildings (Dober, 1992). The need for a high-quality education and to address the requirements of a diversified civic audience in the 21st century transcend the traditional education system. The university physical setting has a crucial role in strengthening and enabling of the institutional mission. Planning the university space to address these extensive challenges is the principal part of universities' mission.

Although some critiques such as Sebastian Thurn (2012) has anticipated that within 50 years many universities will be out of business as a result of widespread online learning, still the academic experience without a sense of place is improbable. However, the higher education system is changing rapidly and universities need to keep pace and get adapted to these quick evolutions. The questions such as how the architecture and urban planning of university campus will be in the future and which parameters shape the future university and its typology are in the recent discourse of university campus planning. The reality is that designing a university campus is not on the responsibility of a mere campus designer anymore. It has become a more complicated matter as contemporary universities are among the largest and the most complex institutions. The planning of this kind of large-scale real estate requires a holistic, and participatory planning approach. It necessitates a clear long-term plan for the resilience of a such place-bounded organization.

The following chapter discusses in more detail the chief role of universities' location and physical space in supporting institutions to achieve their goals in terms of education, research, social development, and urban outreach.

3. UNIVERSITY AND THE SURROUNDING URBAN CONTEXT: MORPHOLOGICAL CHARACTERISTICS OF THE UNIVERSITY CAMPUS

3.1 Introduction

University education is tightly linked to the concept of place. University's mission and its physical form are interwoven issues. The physical environment of a university not only addresses the institutional demands but also bears its community spirit and identity. The location of a university campus is a critical aspect of its residing city. Any university exists within its surrounding urban pattern and in a direct interaction with it which is inseparably associated with the concept of place. University encounters with its context in their interface space where their needs and aspirations confront. This encounter has an impact on the social, cultural, economic, and physical attributes of both domains in a micro and macro scale.

It is remarkable that universities have had particular architectural typologies during the history which have resulted in creating specific spatial relations with their hosting urban milieu. Universities interact with their surrounding place not only through their architectural elements but also, they express their intellectual, physical and civic relationship with their urban context through the visions, missions, and attitudes (Haar, 2010). The physical organization of the university demonstrates the extent of its integration with its urban context; socio-culturally, economically and physically. Bender (1988) refers to the European university as "a semicloistered heterogeneity in the midst of uncloistered heterogeneity" and emphasizes on the notion of campus as place and as a locus.

Within the long spectrum of higher education history, from the medieval period to the present day, university education and university form has altered radically according to philosophical, social and cultural forces of each era but universities always were in a kind of interaction with their hosting context (Bender, 1988; van der Wutsen, 1998; Wiewel and Perry, 2008). The university campus is considered an urban development

engine. It influences the shape of its adjacent urban fabric, attracts people, generates activities, and forms the urban identity.

This chapter studies the university campus as a place and examines the morphological characteristics of university campus concerning its urban context and its relationship with the residing urban space. It primarily reviews university space evolution within the history from the medieval era to the present day mainly in Europe and the United States. Then it explores the concept of “Campus” as an autonomous space or an urban entity and attempts to provide an overview of university and city relationship. Subsequently, it explores the different types of relationship that a university and the city create in terms of physical and morphological features and it studies the physical features of university campuses.

It is important to notify that the notion of “morphology” and “urban morphology” is a broad concept. Urban morphology mainly considers the study of the form of settlements and the processes of their formation and transformation. It deals with the spatial structure and character of urban or rural areas by investigating the patterns of their components. Urban morphology studies the urban form and as a subfield studies the social forms which expressed in the physical layout. In this sense, it explores issues including urban tissue, physical form, social form, natural context (land relief, quality of soil, climate, solar and wind exposure, types of natural landscape, etc.), economic aspects related to urban form, and so forth. However, within the scope of this research, only the issues related to the physical form have been considered.

3.2 The Spatial Evolution of University in Relation to the Urban Context

From a spatial point of view, Medieval university is an outcome of the Renaissance of the 12th century and the University of Bologna can be considered its prototype. The primary universities evolved from monasteries and gradually developed to address the needs of their societies. They initially didn't possess any permanent physical space and mainly the lectures were held in single existing buildings rented by masters. Thus, university activities were housed in separate buildings spreading around the urban space. So, historically the university and city have been in a close encounter from the early period. However, possessing no permanent edifices made them have little fidelity towards their context and eased their migrations in case of a conflict. As Caldenby (1994) argues, early universities were not anchored institutions and not attached to

their residing urban context. The reason roots in the fact that in the beginning they did not possess purpose-built structures and they could easily change their location.

Though within the course of two centuries, universities highlighted their significance for their region and they have evolved in many European towns. In the Middle Ages, with an increase in the number of students, universities started to acquire their own properties and erected purpose-built edifices in urban settings. Though they were located in the urban context but were not a part of their towns. Universities needed cities for their accommodation and basic needs of students and the cities valued the contribution of universities to their economic prosperity (Brockliss, 2000; Coulson et al., 2011).

With the advent of the Renaissance, many universities straightened their urban presence by acquiring academic precincts which included various facilities such as lecture halls, libraries, chapel, and housing. They were very distinctive and elaborated edifices emphasizing the institution's power and prestige. Their central location and visible structure imply that to what extent universities were tightly embedded in their urban setting.

To be noted, the English collegiate system was the common form of university space. It was a single enclosed quadrangle building configured around a courtyard. They were functioning as a space for living, studying and socializing of students. These edifices had a distinct architectural form revealing their academic and social identity. Turner (1984) identifies some intentions for the architectural structure of early universities being constructed as the introverted quadrangle edifices; the impact of monastery cloister, the possibility of controlling and surveilling the students, the protection from the outside world, and the optimal utilization of small lots (Hashimshony and Hania, 2006).

Universities of Cambridge and Oxford are considered the archetypes and the best icons of the Collegiate system. The colleges within the body of these institutions provided the opportunity for masters and students to live communally and study in solo-space. These two universities were expanded their precincts around the town within a long time and in a piecemeal manner. With an impressive structure and a stylistic unity, they have been dominating the identity of their urban space since then.

After 1800, the city and university became more linked together and then they symbiotically merged together in the modern era. Universities advanced their curriculum, got expanded or spread out in the urban space as multi-site institutions. So, primary universities had a particular architecture with visible, introverted edifices in the urban context distinguishable from the mass of residential buildings. However, after the modern era, they lost their physically isolated identity and became - socially and physically - an integral part of the urban fabric. Depending on their financial status, the traditional university structures were ordinary buildings within the pedestrian landscape of the residing town or the richest ones were manifesting the architecture of palaces and churches and they were formed large urban edifices. In addition, many of these edifices were flexible structures that could be used for different purposes and change their functionality. With modern architecture, many universities have been founded expressing formal uniformity and do not convey any of traditional distinguishable structures (Brockliss, 2000).

Later with the alterations in the university system in Europe and getting a more specialized identity, the student population was increased remarkably. So, European higher education experienced a building boom in the 19th century. While it was not possible to address the need for extra space within the urban space, many academic buildings got spread out around the city. Moreover, many old university facilities were in a deteriorated condition which necessitated restoration or re-construction. Many of these universities which were renovated or rebuilt followed the spirit of the era such as Lund University, University of Graz, Uppsala University and University College London. They were forming assertive structures like the temples of education with stylistic plurality and open to the outside world.

Hence, another noticeable alteration after the Second World War and with the student enrollment boom was the European campus university which became more widespread throughout the continent since the 1960s (Caldenby, 1994). Many universities were constructed on the outskirts of the cities which had more possibility for land acquirement and for further expansion and they obtain visible boundaries and cohesive identity. This typology, although it was detached from the city, in contrast to American university campuses, did not provide accommodation or leisure and sports facilities for their students.

This reality touched upon the English universities as well. According to Dober (1965), Great Britain was like a design laboratory providing ideas for American campus. Particularly, the immediate Post World War II period was a significant moment in the history of the British higher education system where the national government take control in hand to improve the quality and availability of facilities. In this period, as a result of population growth and the desire for obtaining higher education, the availability of places couldn't meet the demand. Therefore, it was aimed at developing educational facilities around the country with the assistance of the University Grants Committee, the fund-providing lever of the national government. The importance put at creating the space of communality and reducing the strict activity-based zoning in physical planning of new facilities which provided the space of communication and connection all around the institution. This attitude supported the sense of belonging specifically on large campuses. Dober (1965) states that new universities in England had started to obtain farmlands and properties outside the urban center to establish self-sufficient educational environments. However, the dilemma of funding rural universities in Great Britain differed from the United States because of the larger density of urban development in Great Britain and unsteady economy that put burdens on establishing new universities on occupied sites without large relocation of university structures. Thus, the ideal university typology for many English architects and academicians was an urban infilling where the university edifices were scattered within the urban space. Universities of Oxford and Cambridge are good examples that unintentionally were developed with the same approach during the centuries. It is important to mention that this approach has great opportunities for renewing the central urban areas in need of redeveloping and revitalizing.

While in Europe universities were expanding their prestige, the English colonists in the United States were creating their ideal world. The first American university to be erected was Harvard University which was founded in a village near Boston. With the success of Harvard, eight other colonial universities were founded consecutively.

Although American university campuses rooted in the English Collegiate system, but from outset they rejected the enclosed monastery-like planning. They were self-sufficient institutions, purposely isolated from the urban fabric. They were constructed in the rural and green filed areas. Within a large natural landscape, they had an expansive spatial configuration with outward-looking buildings and open to outside

world and community. In contrast to the European model, they addressed all the needs of the students including studying, living, and socializing within their campus boundaries. The University of Virginia, expressing “the academic village” notion, is an iconic example representing the connection between academic and social life.

Campuses designed in 19th century America were ambitious settings. The natural environment was the most important component of these precinct designs. Many campuses were designed by Olmsted. For him, nature was a remedy to urban life and believed that “the colleges should be located neither in the country, where they are removed from civilization nor in the midst of the city with its destruction. They should be located somewhere in the middle of the spectrum; as an integral part of a larger community whose special physical character would promote a beneficial environment for students” (Turner, 1984). This philosophy had a great impact on American campus planning until the next century. Stanford University and Washington University were designed with this idea. The Beaux-Arts movement was another influential trend of campus planning in the 19th century the United States which emphasized on the axial layout with monumental edifices lined along axes and expressive focal points. Columbia University in New York and the University of California in Berkeley are great examples of this approach.

Post-World War United States also witnessed a change in the higher education system and a drastic increase in student population and their diversity which occasioned with transformations in university buildings and campus planning. Le Corbusier outlines it as “the American university is a world in itself” where many universities could be considered as mini-cities in terms of complexity and scale. In this phase, the international style defined the architecture of the era. Movement and circulation were one of the most important concerns of campus planners (Coulson et al., 2011).

Modernism brought a new trend for campus planning. In the pre-modern era, the stylistic and formal master plans were the major initial point of any campus construction but the modern era more preferred individual buildings and landmark forms with an informal planning approach. So, spatial configuration and visual unity were not on the top of the design agenda. This trend is well presented on the campus of MIT which comprises iconic edifices designed by famous architects.

Based on Clark Kerr's (1995) concept of multi-university, the “whole-cloth” planning trend emerged in the Post-War era and many universities were founded with totality and unity like Santa Cruz campus. This trend widely put its traces in Europe as well. By the 1980s, historical roots prevailed the architecture of the postmodern era and open space, human scale, historical forms got popularity for almost two decades. Current era welcomed “starchitecture” and iconic edifices such as MIT campus. Many universities and also their hosting cities utilize this approach as a potential to brand themselves and attract the most talented human capital (Coulson et al., 2011).

3.3 University Campus: An Autonomous Precinct or an Urban Entity

A university campus is traditionally a place where the institutional buildings of a university or a college are located within it. It usually (particularly in the US) includes academic spaces, lecture halls, libraries, recreational facilities, dormitories, open and green spaces, and other facilities.

The Latin word “campus” originates from the word “field” and primarily was used in 1774 referring to Princeton University. It originally has roots in the American tradition and as Werner Hegemann defines; it is “a piece of land that is covered with the buildings of an American university” (Turner, 1984). The word referred formerly to the college grounds but gradually indicated the whole university compounds. Muthesius (2000) connotes that the term campus is the manifestation of differentiating university space from its surrounding context and identifies its separation and independent identity.

One of the most remarkable highlights in the history of higher education and the university campus was the concept of “academical village” which was proposed by Thomas Jefferson. This concept describes the universities and colleges as communities in themselves, as cities in microcosm (Turner, 1984). It underlines the fact that American university initially is rooted in Collegiate System of medieval English universities, as a place for collective living and studying. It less resembles the typical European university system that is more focused on academic tasks rather than students’ living issue.

As stated before, the tradition of locating university campuses in separate areas started from the colonial period in the United States and emphasized the autonomous identity of universities as a community in itself. The issue more intensified later by situating

university campuses in the countryside and rural areas which can be considered a rupture from the European tradition. The fact is highly obvious in university campus planning. Planning of American universities considers openness and spaciousness such as Harvard University as the most significant example presenting detached buildings which are located within a park-like green space and neglects the European cloistered buildings. Thus, the word of campus well manifests the physical nature of American university, its unique *genius loci*, which is well presented in its architecture. Regarding Turner's (1984) "campus sums up the distinctive physical qualities of the American college, but also its integrity as a self-contained community and its architectural expression of educational and social ideals." As referred to the academic village notion, the layout of the American universities was organized as buildings within the open green space where different functions including educational spaces, residential buildings, service, and recreational facilities were aggregated within the campus boundaries. It was attempted to convey the sense of community and idealize a utopian vision of society. Thus, it was not just a matter of education but, in a more societal expression, it embraced the mission of creating a civilization.

Emphasizing the term campus as an American ideal, it is important to outline the significance of European and medieval English universities on the higher education system since the twelfth century onwards. European universities and English Collegiate university system are mainly noticeable for the issue of being embedded within the urban fabric of cities. They embraced the task of supporting students' academic life and facilitating their social life in the urban context while protecting them from the external world disruptions. They were planned as cloistered quadrangle premises scattered within the urban area. In terms of Christiaanse (2007), it can be stated as "an interconnected deconcentration of specialized clusters, which together constitute a network of knowledge and individually function as catalysts for their immediate surroundings".

Reviewing the historical evolution of university campuses reveals that university and city have had a complex relationship fluctuating between being integrated or separated. The town and gown tension has been a part of their history because of their different functional and socio-cultural background. Educational institutions have been considered, for many years, as cities within cities, clustered and isolated with no interest in their urban setting. However, the two domains have long been needed each

other for their existence and prosperity. In global cities such as London or New York, this conflict was and is less vivid because of the global character of the city but in smaller cities, universities mainly have had distinctive attributes, different from the hosting city although their symbiotic connection is fruitful for both of the entities (Bender, 1988). Universities have had a key role in the transformation of urban spaces, just as cities have critically influenced the spatial development of many universities. Once being designed as out-city campuses, many universities such as the University of California Berkeley are now urban precincts and tightly connected to the urban spaces. Though, recently, the significance of mutual collaboration between two entities is more recognized (Haar, 2010). This perspective has strengthened with the advancement in the university system and changes in urban space. The primary research and education function of universities have been transformed to more collaborative and interdisciplinary activities which require connection with industry and other institutions rather than being isolated. Doing so, urban space can be a perfect setting for these relationships. The reality of cities has also changed extremely. In the age of communication and economic development, cities are the milieus where proximity can create opportunities for interaction between industry, culture, economy, management, etc. (Hall, 1998). Thus, cities are functioning within a network that universities are one of the key agents in their milieu.

In the present day, universities are more considered urban entities regarding their function and identity. They are in a relationship with their urban territories. Their physical space is the main ground that they demonstrate this association. Their mission, vision, and character are expressed through their physical features, activities (urban outreach) and the ties they are trying to create with each other.

The concept of multiversity proposed by Kerr (1995) mainly emphasizes the diversity and complexity of activities conducted by universities in both organizational and spatial perspectives. Universities are large institutions that obtain huge physical spaces and many diverse functions are occurring within their campus setting. This fact shows the importance of new appropriate design for university campuses. Many modern universities were constructed as single large edifices. They embed many different activities such as education, leisure, accommodation, and commerce which address the needs of both the city and university (Banham, 1976). Therefore, these large multi-

function institutions have a great influence on the urban fabric and need to provide a sound response for requirements of contemporary urban space.

3.4 University Mission and its Setting

The mission of a university is the foundation for any decisions and actions of the institution. The academic programs, university edifices, the social life of the university, and its relationship with the local and global society is based on these institutional values. The campus physical setting plays a key role in the actualization of the strategic objectives and chief values of the institution (Coulson et al., 2011).

Observing numerous university mission statements, the teaching and research, social life, and public (community) service have been identified as the most common institutional principal values.

The campus facilitates the main teaching and research mission of the university by providing classrooms and laboratories for formal learning. Informal learning is also an important part of a university experience that happens in less formal spaces such as outdoor open spaces, corridors, multi-purpose spaces, and hubs. In this sense, informal learning can occur in any space which provides opportunities for interactions and exchanges. Thus, interdisciplinary programs and mix-use spaces are highly valued in many of university mission statements and campus masterplans. This necessitates a campus that promotes a sense of community, open knowledge and idea exchanges, multidisciplinary, and collaboration concepts. The layout of the campus with a high level of proximity and adjacency of programs can stimulate communications and develop collaborations.

The university is a microcosm of society and also an integral part of society. To do so, it is a pioneering agent in nurturing human capital, fostering social and economic well-being and promoting the sustainable development of its hosting neighborhood, city, and region. Opening up to outside and community outreach is a core value in contemporary universities which is linked with the institution's function. It is largely manifested in their relationship with their adjacent neighborhood. The relationship between universities and their residing cities has had a complex form of connection or separation. They are conscious of the profits of cooperation and meanwhile, they want to preserve their autonomy. Accepting the numerous benefits of a university to a neighborhood, it may bring about several problems including traffic congestion,

changing the social norms of the area, housing shortages, tax exemption, and the university expansion in the fabric of the neighborhood. Conversely, there are some challenges for universities such as unappealing and deteriorated neighborhoods that influence their capability to attract prospective students and faculties. However, creating an alliance rather than an adversary is more beneficial and can contribute to the development of the area. Many university authorities have noticed that they need to contribute to creating a prosperous community. They are aware of the large benefits that a symbiotic relationship can bring for both the university and the city. In this respect, the location of a university plays an important role and is one of the parameters that define the type of university-city relationship.

Hashimshony and Haina (2006) recognize five key factors that exemplify the physical structure of a university campus as size, spatial configuration, boundaries and accessibility, functional organization, and location.

- Size (small vs. large): Indicates the total area of university campus excluding the open area between buildings. The size of university campus can be changed in three ways: (1) because of virtual learning some educational spaces such as lecture halls or study halls can be reduced or eliminated (2) because of privatization of facilities some spaces such as sport facilities and residential halls may be removed outside the campus boundary (3) collaboration with industry can increase the size of university space because of adding some extra functions and workplaces to the university compound or decrease the university space because of exporting some functions to outside existing industries.
- Spatial configuration (compact vs. decentralized): There is a dichotomy between being confined and centralized or being decentralized. In former, there is a possibility of a better connection between different fields of knowledge, creating a more internally cohesive space regarding new modes of knowledge generation, and need for collaboration. On the contrary, the latter is the result of the possibility of off-campus education and privatization. Nonetheless, scattered spatial layout may affect the social quality and potentials of varied formal and informal interactions through reducing the face-to-face interactions and losing the sense of community.

- Boundaries and accessibilities (open vs. closed): Boundaries of a university determine the extent of openness or closed-ness of the university to people outside the university and can be metaphorical or physical. The traditional concept of “ivory tower” derives from universities’ isolation from their community. However, universities' social responsibility and the new notions of collaboration with external partners and permeability to the community cause fading the physical boundaries and integration of university human body to the daily life of the community.
- Functional organization (zoning vs. mixed uses): In the classic hierarchical education system, departments were separated and the spatial zoning was praised. But in interdisciplinary knowledge model, there is a need for mixed-use spaces for more connection between different places and functions, and collaboration with industry. The mixed-use strategy facilitates more spontaneous and flexible activities and enhances a dynamic lifestyle.
- Location (integrated vs. isolated): The current university adopts the notion of interconnectivity and emphasizes collaboration with industry and integration with the community. This issue influences the location of the university concerning its hosting urban space to be inside the city or close to the industries. However, distance learning can decrease the importance of the physical location of universities.

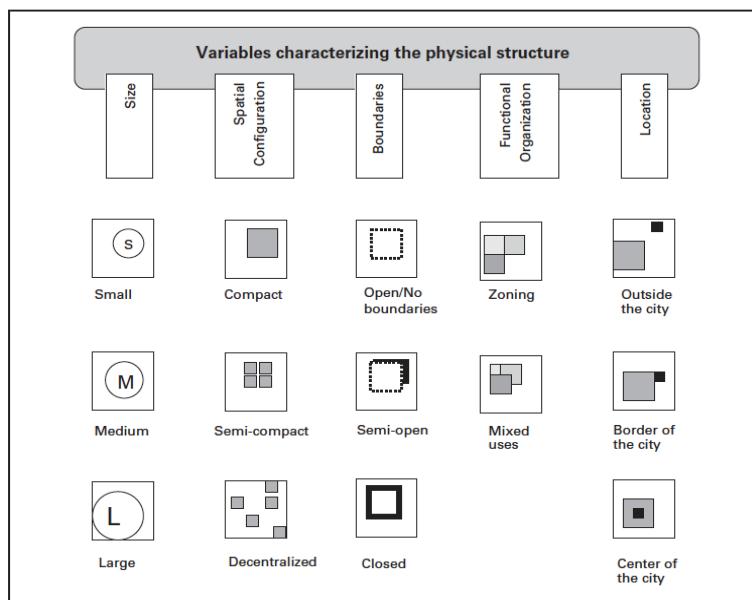


Figure 3.1 : Graphic presentation of alternative values for each spatial variable (Hashimshony and Haina, 2006).

However, there are some ambiguities about the extent of university activities that occur in virtual space, the extent of the university's willingness towards closed-ness, and the extent of desire to have a compact spatial layout. Indeed, these uncertainties have a profound impact on the future form of university physical configuration (Hashimshony and Haina, 2006).

The location of the campus site is a critical issue that has an important role in the physical characteristics of the campus space and its relationship with the residing urban context. Selection of site for new campuses is based on the criteria defined in preliminary programming of campus development. The principle criteria to be considered are: (a) Size and condition; the square meter of campus depends on student enrollment and should also consider the future increase. The selected site should be in one piece and the rectangular sites are proffered in contrary to irregular shape sites. The slope, topography, soil condition should be noticed. (b) Setting; setting is the surrounding environment of the campus. It should be in the area which is compatible with educational purposes. Availability of urban facilities such as commerce, housing, health care services, recreation, and cultural amenities, etc. is an important issue. (c) Accessibility; it is related to the availability of different transportation modes and suitability of various movement networks. (d) Cost; the cost of land acquisition and the cost of preparing the land for development is considered (Dober, 1963).

However, considering the increase in student enrollment and the decline in university infrastructure, the university expansion and redevelopment projects are more probable than establishing new universities. The expansion of a university is implemented due to the increase of student enrollment and changes in educational programs that necessitate additional spaces. According to Dober (1963), the physical expansion of a university is addressed in six ways: (1) Renovation; modest or extensive renovation (2) Accretion; adding small or sizeable extensions to existing constructions (3) New construction; adding new facilities to campus space vertically or horizontally (4) Land assemblage; acquiring land parcels (5) Satellite campuses; construction of new campuses with autonomous administration but connected to mother institution (6) New campuses.

Dober (1965) in investigating the English university campus planning of the time points out to the importance of the planned piecemeal growth with a specific focus on creating a space for the maximum connection between different parts of the campus.

In so doing, it was different from American campus tradition and various university structures were not separated and self-sufficient facilities, sprawled around the landscape and nor were isolated quadrangles attached to shared space. For the campus planning, all the feasibilities were considered such as size limits, budget, staging, curriculum, required spaces, and equipment.

Relying on Dober (1963) the university campus development plan designates the organization of land uses, the arrangement of circulation network, provision of required land for future expansion, and creating a design system that incorporates functional and aesthetic elements. The main physical components of a campus plan are buildings, outdoor space (as an attached to structures or as an autonomous function), and supplementary components such as circulation and utilities. The arrangement of these elements in the campus plan based on a program which obeys the institution's objectives and external obligations. Clearly, the physical setting of a university expresses its mission, vision, and values and convey a message about the institution.

Campos Calvo-Sotelo (2014) proposes the notion of “educational campus” which mainly based on the relationship between universities and cities. “Educational campus” is a university-spatial philosophy asserting innovative transformation of the university's physical space in the path towards a spatial quality. According to this concept, an excellent campus embodies the values covered in ten principles (Campos Calvo-Sotelo, 2014):

- 1) Utopia and integrated planning: based on integrated planning strategies that consider flexibility in time and space and planning not the mere architectural elements but framing a living process.
- 2) Community of learning and research: supporting the sense of community, personal encounters, and multiple functions in the community of research and learning, and stimulating the sense of belonging through the physical setting.
- 3) Spatial harmony: fostering aesthetical harmony and attraction and forming a place in the collective memory of the hosting community.
- 4) An emotional and intellectual embracement: the plan, form, volume and texture of university architectural components should stimulate well-being of campus users.

- 5) Nature and art: as a complementary educational experience, the physical body of campus can be designed as a cultural artifact appeared in campus interior and exterior spaces, and nature can be an integrated part of the campus urban space.
- 6) Image and accessibility: fostering the community engagement value beside the missions of education and research, and providing physical and conceptual accessibility.
- 7) Adaptation to the environment and sustainability: arranging university's vision in the way concerning the environment, climate, biodiversity, and sustainability for example in the choice of construction materials and techniques, reducing carbon footprints, using renewable energy sources.
- 8) Memory and Avant-Garde: Honoring of the memory of planning and architectural paradigms, inherited from the tradition of "places of learning", as a source of intellectual resources that nourish design. Both wholly new projects, with their wide freedom to experiment with form, and adaptations of pre-existing buildings (as the testimony of a positive change in previous functions) should imbue themselves with a sense of modernity and the avant-garde, lending luster to the intellectual identity of academia.
- 9) University-City relationship: nurturing synergies between these two realms, and fostering the presence of the academic body in the social life of urban space.
- 10) Innovative and teaching and learning modalities: designing places that stimulate innovative modalities, and creating intelligent locations for knowledge exchange and communication.

Thus, obtaining a forward-thinking campus planning approach, a university needs to value a close connection with the hosting social and urban organism and reinforce synergies between them. It needs to establish partnerships with the local and global partners to exchange ideas and share facilities and also develop collaborations with other higher education institutions. It needs to certify that the campus planning is in accordance with the urban planning principles. There is a need for a holistic and integrated approach for campus planning. The campus's physical environment is a key asset that helps the university to achieve its academic missions and nonacademic objectives.

3.5 Location of the University within the Urban Context

University campuses are established in urban territories and create a relationship with the surrounding context. Within their long history, universities have been fluctuated between being open or closed to the external world (Giliberti, 2011). The extent of this closure or openness vary regarding many factors and according to Van der Wusten (1998), it is difficult to understand the optimal degree. However, there is still a disagreement over the appeal of openness and interaction with the urban environment in contrast to the increasing establishment of the gated communities. While in Europe and the United States, the postwar university campuses are undergoing a revision, in many other parts of the world, for instance in many Asian countries, the self-contained, mono-functional and disconnected campuses are still considered symbols of prestige and not socio-spatial problems (Christiaanse and Hoger, 2007).

Currently, there is a variety of typologies regarding universities' location and the way they interact with their surrounding urban fabric which has been initiated from the main two models of urban university and campus university. Indeed, concerning these several typologies, their impacts and consequences vary both for universities and their residing territories. The campuses which are situated inside urban areas or in close proximity of a city have more impact on the surrounding city than rural and greenfield campuses. Thus, the level of their interaction is higher which can cause stronger collaborations and result in the development of both domains (Hoeger, 2007).

Within the literature, on the location of university campuses, various typologies have been identified which have been originated from the main two campus models- in-city and out-city campuses.

Hoeger (2007) distinguishes four types of university campuses according to their main mission and attempts to make an interrelation between university campus morphology and its mission. These four categories include (a) Greenfield campus (b) High-tech campus (c) Corporate campus and (d) The new urban campus.

Den Heijer (2008) through studying Dutch universities categorizes university campuses to three types, considering their real estate value. They are (a) campus as a separate city (b) campus as a gated community within the city but with or without gates and (c) campus integrated with the city. Den Heijer (2011) in another study, but similar to her previous work, proposes a scheme for the campus that assume three spatial

configurations as (a) outside of the city; (b) within the city and (c) integrated into the city.

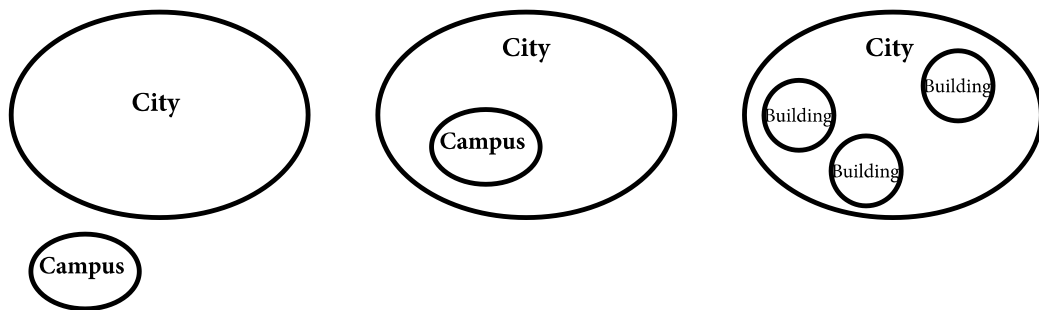


Figure 3.2 : The spatial configurations of the campus the type of campus (den Heijer, 2011).

Van den Berg and Russo (2004) addresses two typologies of campuses as (a) Formal, which has conservative attributes and isolated from the urban context and (b) Informal that is situated in downtown areas and offer many chances for interactions.

Karabay (2016), in her master thesis conducted in Politecnico di Milano, has investigated the environmental sustainability of university campuses in different environmental and physical contexts. She has identified four different types of campuses in terms of their location and environmental impacts as (a) Inner-city (urban) which is integrated into the city, (b) Rurban which is the mix of rural and urban campuses and they were originally rural campuses which during the phase of urban development became urban or sub-urban settings (c) Urban oasis that has a vast green campus area within a dense urban fabric and (d) Rural campus that can be also assumed as green-field campus.

Caldenby (2009) tracing back to the history of scientific knowledge production in universities identifies two categories of (a) Internalist tradition and (b) Externalist tradition. These two categories also determine the physical arrangement of universities and their relationship with their hosting cities. The internalist perspective is run by inner driving forces which mainly addresses a specialized and elite group of the society. It is more closed, introverted, and self-sufficient. The internalist category itself encompasses three sub-typologies (1) college (2) campus university and (3) external university. For the externalist perspective, the external reality is considered the prerequisite for the development of science and the university is closely engaged with the outside community. The externalist category is also reflected in three typologies

as (1) Universitas (2) institutional university and (3) city university. These three typologies are more open, extroverted, and integrated to urban space with more permeable boundaries. These six typologies vary in terms of being introverted and self-sufficient or being extroverted and being involved in society.

Hashimshony and Haina (2006), investigating a well-designed university of the future, propose four possible scenarios for university campuses as (a) the mini-university (b) the new campus (c) the university-city (d) the combined scenario (of a and b scenarios). They examine the physical layout of a university campus in terms of size, spatial configuration, boundaries and accessibility, functional organization, and location which has been shown in Figure 3.3.

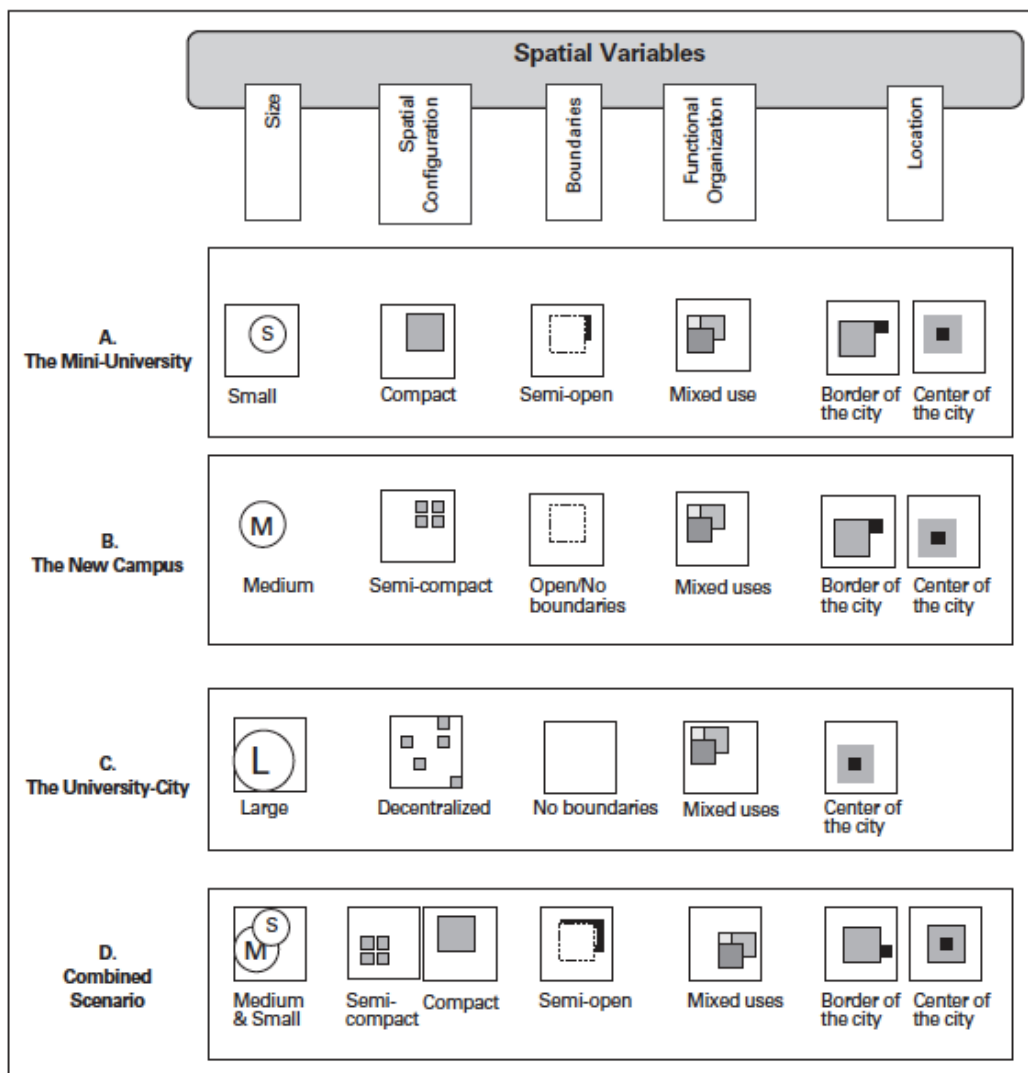


Figure 3.3 : Graphic presentation of spatial characteristics of four scenarios of universities proposed by Hashimshony and Haina (2006).

One of the most influential studies for the sake of this research is the categorization done by Pablo Campos Calvo-Sotelo (2014). He emphasizes on the importance of university morphology and spatial organization as a key factor in achieving excellence in university campuses and optimizing their urban and architectural dimension. In this respect, he categorizes university campuses in different types according to territorial distribution, location model, and internal organization. He classifies university campuses due to their distribution within territory as (a) Territorial; is polycentric with no central seat, (b) Local; with polarized central seat with respect to a specific city, and (c) Associate; with a strong tie to a moderate-size urban space and proximity to another larger urban center. Moreover, universities territorial structure can be (a) Mono-site or (b) Multi-site.

In this sense, he makes specific emphasis on the morphological characteristics of university campuses in association with their hosting cities. In terms of location, he identifies four models as (a) Dissociated; located in a sufficiently remote area, (b) Polarized; separated from the urban fabric but does not embrace extra-university component, (c) Super-peripheral; it can be a specific case of polarized model as separated from the urban fabric but it is linked to smaller satellite of the main city or a small locality, (d) Urban; is directly connected to the city fabric and has four sub-models as: (1) Peripheral; situated on the urban periphery in a contact with urban structure, (2) As urban fabric; has a form of aggregate organization and is dissolved in the form of blocks within urban fabric, (3) Isolated within the urban interior; is embedded in a zone incorporated to the urban fabric but has a sharp form distinct from surrounding urban tissue, (4) Diffuse within the urban interior; is located in several isolated buildings sprawled around the urban fabric which do not make a compact and unified entity. University campuses concerning their urban context can be (a) Integrated; inserted in the urban fabric and its dynamics or (b) Segregated; unconnected to urban space and its functional dynamics.

Considering the spatial layout of university campuses within their internal space, the author analyzes universities' internal structure, typological elements, and relations with the external context. In this respect, universities may be (a) Extroverted; openly oriented towards surrounding urban space or (b) Introverted; structured inward-looking. In terms of planning of the physical organization, universities have been classified as (a) Symmetrical; on an axial or central symmetry, (b) Balanced;

configured with a symmetrical pattern and have a balanced arrangement of volumes and voids, (c) Unbalanced; does not contain any balance of mass or space. Furthermore, the internal organization of university campuses can convey six types as: (a) Mesh (b) Reticulate in general (c) Right-angled reticulate (d) Grid (e) Linear (f) Central; which itself can be divided as Concentric, Eccentric, Multi-central, (g) Radial (h) Organic, and (i) Irregular geometries which can be emerged generally from unplanned processes or in adaptation to the natural or urban context.

This categorization model has been demonstrated as a diagram in Figure 3.4 and has been used as the main reference point for the identification of six university campus typologies which have been analyzed within the scope of this research.

Concerning the university-city integration and in congruence with the categorization done by Campos Calvo Sotelo (2014), Da Silva et al. (2017) have studied the genotype of university precincts and classify eight types of university campuses as (1) autonomous precinct (2) attached precinct (3) inner precinct (4) developer precinct (5) self-enclosed precinct (6) open precinct (7) scattered Precinct (8) ubiquitous precinct. They describe what are the various campus genotypes regarding three factors of mission, character, and focus.

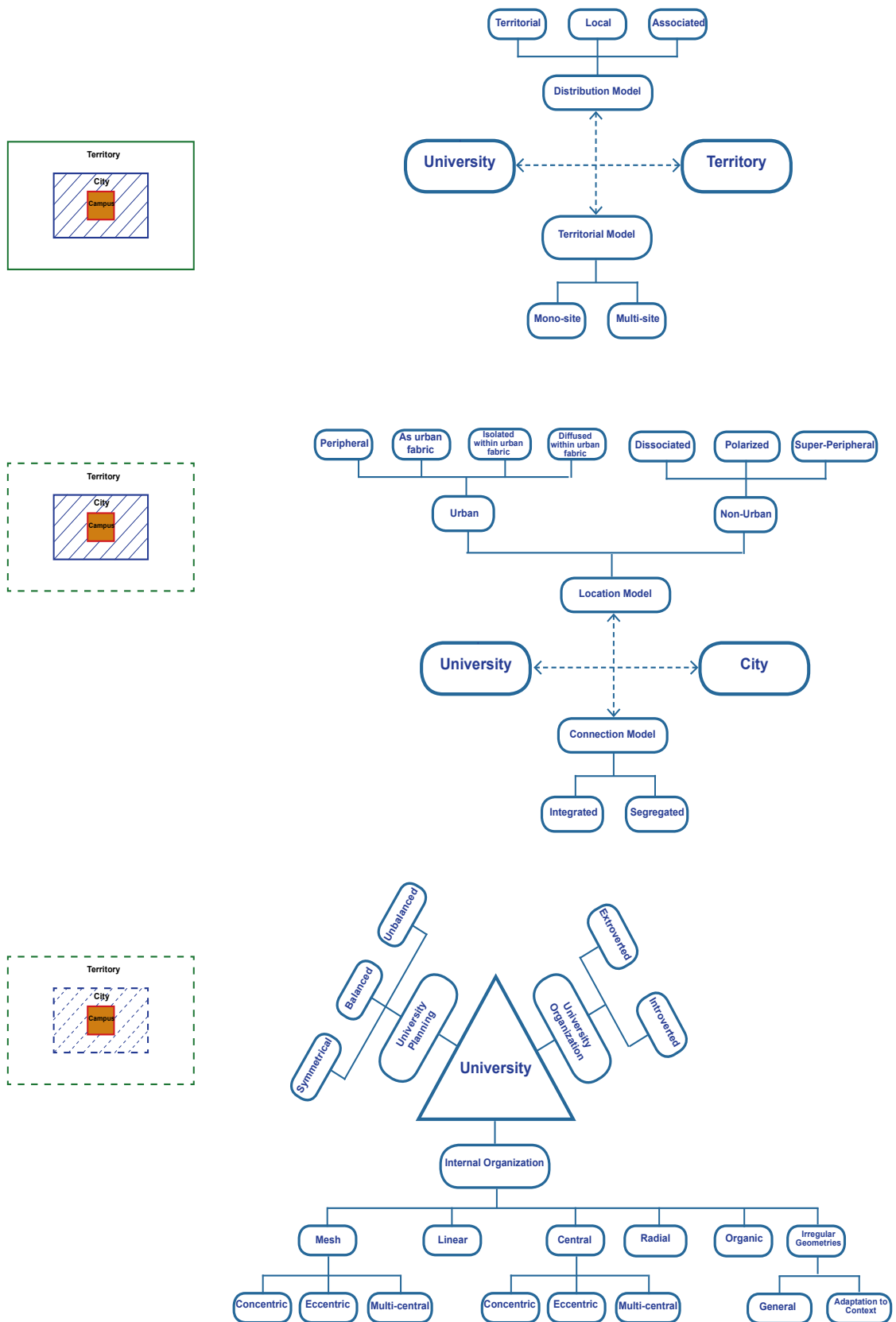


Figure 3.4 : Spatial Typologies and Connections between Campus and City (Source: Author based on the research by Campos Calvo Sotelo, 2014).

3.6 Defining University Campus Typologies

As mentioned, university campuses can be divided to main categories in terms of their position within their hosting urban space. They can be out-city or in-city campuses. Based on the investigated literature on the subject of relationship between universities and cities and their morphological characteristics, this research identifies six typologies of university campuses encompassing: (1) Detached campus, (2) Attached campus, (3) Rurban campus, (4) Gated campus, (5) Integrated campus, and (6) Scattered campus. Considering their urban location and campus physical features they are assumed to have specific characteristics.

CAMPUS TYPOLOGY	SCHEME	CHARACTERISTICS
Detached Campus		Out-city Separated Self- sufficient Mono-site Clustered Low morphological connections
Attached Campus		Out-city Quasi-Separated Self- sufficient Mono-site Clustered Low morphological connections
Rurban Campus		Formerly Out-city Connected Self- sufficient Mono-site Clustered Mid- high morphological connections
Gated Campus		In-city Gated Self- sufficient Mono-site Clustered High morphological connections
Integrated Campus		In-city Connected Integrated High morphological connections
Scattered Campus		In-city Sprawled Dependent on the city Multi-site Integrated High morphological connections

Figure 3.5 : University campus typologies regarding their physical and morphological characteristics in relation to their urban context.

3.6.1 Detached campus

This typology encompasses out-city campuses which are separated from their urban space. It refers to a university campus model which is located remote from the

neighboring city and creates very few morphological connections with the nearest city and functions almost autonomously. In some cases, particularly in historical universities and American campuses, the fundamental motivation is to separate the learning environment of the university from the reality of the urban context and in some other cases, lack of sufficient land in urban areas and the need for future expansion has directed university authorities in selecting their location in remote areas. Because of the dissociation from the adjacent city, these campuses are obliged to acquire any kind of required facilities within their institutional body including the learning environment, commerce, sport, leisure and entertainment, and accommodation. Thus, studying, living and socializing take place within the campus setting. This permanency of in-campus activities can increase vitality and socialization in one hand and can cause independency and seclusion from the urban space in the other hand. This typology usually encompasses mono-location and clustered campus settings with defined boundaries. The accessibility may be considerably low in this typology. So, creating a proper and sustainable transportation system is one of the most important issues here.

3.6.2 Attached campus

This type of university campuses is out-city campuses which have been mainly located in the outskirts of an important city and establish physical ties with the adjoining city in spite of being self-contained. Their peripheral position imposes some degree of isolation as well as proximity and connection. They create visible boundaries with the outside realm. These campuses are mostly mono-location entities and obtain various kinds of amenities for their faculty, staff and students in their setting such as educational, recreational, sport, commercial, and residential facilities but it depends on the users' preference to live in the campus or commute. The level of accessibility of these campuses can be low and still transportation is an important issue. Generally, in this typology, the further need for physical enlargement of university facilities is not a critical issue but, in some cases, there is less possibility for the expansion because of the expansion of the edging city.

3.6.3 Rurban campus

Referring to the initial planning intention, this typology can be considered an out-city campus. It indicates a model that the campus has been initially founded in the

proximity of small urban areas or rural areas but during a course of time, the urban area has been sprawled and spread out towards the campus. Thus, they have been connected to the city as a result of urban development. This typology is common in the case of many land-grant universities of the United States. This kind of university campus is assumed as important engines for the social, economic, and physical development of its surrounding urban fabric through offering various facilities, employment opportunities, promoting businesses, and enhancing the socio-cultural status of the hosting urban context. Although they have had visible boundaries, during the process of urban development, the city and university have been created strong connections with the considerable level of accessibility in many cases. They have a central urban position or they are attached to the hosting city and they have a good accessibility level.

3.6.4 Gated campus

This typology comprises in-city campuses where university precinct has been located within the urban fabric. However, in spite of acquiring an urban position they are closed, inward-looking, and gated towards their urban context. They have clear and distinguishable boundaries with external urban space. In many cases, the campus is compact and clustered. There is a level of self-sufficiency by providing many facilities and supporting activities within their body but the vicinity to the surrounding urban area causes connections in terms of using shared facilities and offered services by hosting city. Thus, accessibility is high and permeability is allowed to some extent and is mainly controlled.

3.6.5 Integrated campus

This model belongs to in-city campus category and acquire central urban position. It is highly integrated with the surrounding urban context and creates high spatial ties with the surrounding area. In many cases, these campuses have been evolved with their adjacent urban space during the course of time and doing so, have high level of morphological and spatial similarities. Campus and city are interacting with each other and sharing many facilities and services. There is no rigid and clear border between two territories and the level of permeability and accessibility is very high.

3.6.6 Scattered campus

This model includes in-city precincts and has been formed as an aggregate configuration of different independent buildings or small campuses that are sprawled around the urban fabric. This typology is very common in historical European cities which initially formed as the aggregation of different buildings. In some cases, they acquired existing buildings which were scattered around the city and (re-)used them as their educational spaces. In this typology, university and city are integrated and there is no border between two entities. The university is a significant part of the urban fabric and both territories contribute to the daily life of each other through sharing their facilities and offering various opportunities. There is a physical distance between different sites of the university setting but accessibility is high. Thus, commuting can be provided by university shuttles or private or public transportation means between several university precincts.

3.7 Summary

University edifices, the open spaces between the buildings, and the space surrounding them which constitute the physical form of universities, used to be considered as a blank canvas that institutional, academic and daily life of university body was portrayed. The task was and is generally taken by architects, planners, engineers, facility managers, and policy makers to make decisions about. However, rather than just being a blank canvas, universities extremely influence what is occurring within their boundaries and also their adjacent urban area and even in a macro scale they have a global impact. The critical issue to seriously think about is once universities are established in a place hardly ever can be replaced, given examples are many historical universities in Europe and American university campuses. This issue also emphasizes the fact that universities not only are using a place as their setting but also, they re-create it (Temple, 2014).

Within a long spectrum of university evolution, they have experienced many transformations in their institutional functions and their physical space. They have been fluctuating between being integrated or separated considering their surrounding urban context. However, they can be considered as urban entities. They either have been embedded within the urban fabric of hosting cities and they are in a close interaction with the context or they have been separated from the context created an

urban space within their own setting – a kind of heterotopia in terms of Foucault (1971). However, in recent years, it has been widely accepted by universities and cities that their prosperity is dependent on creating a beneficial mutual relationship. In this respect, the location of universities and their physical features play a profound role in fostering synergies and enhancing the interaction.

Considering universities urban location and their physical and morphological characteristics, this research identifies six typologies of campuses including (1) Detached campus, (2) Attached campus, (3) Rurban campus, (4) Gated campus, (5) Integrated campus, and (6) Scattered campus. Considering their urban location and campus physical features they are assumed to have specific characteristics.

4. UNIVERSITY CAMPUS FORM: CONSIDERING SUSTAINABILITY AND LIVEABILITY

4.1 Introduction

Universities are a microcosm of a city. Considering their large size, the variety of activities, and their important responsibility, university campuses share many features of urban space. Similar to an urban setting, built spaces, open spaces, movement networks, services, connections, and hierarchies are also major elements of a university setting. Thus, the principles which are applicable to urban design can be applied to university campuses as well. Campus design is similar to urban design with the arrangement of main components; buildings, open spaces, and circulation. This configuration faces some differentiation when is applied to diverse contexts according to the history, culture, tradition, environmental, and physical nature of the local setting. The existing setting features, land qualities, and climate influence the form of formal and informal models. In any context and with any design strategy, a university campus should be organized in a way that creates a convenient, healthful, beautiful, comfortable environment (Temple, 2014).

The presence of a university strongly tied up with its physical form and it is not just the matter of providing a space for learning or creating a global brand but it has a larger influence on the educational, social, cultural, and economic life of the academic community and the broader society. As Chapman (2006) argues, “the institutional story is told through the campus . . . The campus is an unalloyed account of what the institution is all about.”

It is noticeable that the campus physical features influence the quality of a university space and academic life (Caldenby, 2009). A university campus with a high-quality urban space can attract high-quality human capital, assure the presence of people, support diversified activities, and stimulate the flow of synergy that consequently contribute to the vibrancy, livability, and sustainability of campus space and surrounding urban context. However, quality is a broad concept and needs to be operationalized in terms of the study objectives. In literature related to urban form,

concepts of sustainability and liveability are interrelated. Accordingly, sustainability endorses a better quality of life and a more liveable urban environment.

In the literature concerning the university and city, it has been widely emphasized on the importance of universities in creating synergies and reinforcing development in their urban context (van der Wutsen, 1998; Hoeger, 2007; Campos Calvo-Sotelo, 2009, 2011, 2014). Besides, numerous studies conducted on the standards and norms of classroom designs and less has focused on the design principles of an entire campus setting. Hence, there is a gap in the literature to understand how the physical features of a university campus can contribute to enhancing the quality of university space and surrounding urban space. Building on this, this chapter addresses the issues related to liveability and sustainability, which are qualitative, and attempts to materialize them concerning campus form.

4.2 Reviewing Sustainability in Relation to the University Campus

Recently, the notion of sustainability is at the core of the relationship between people and their urban space. Sustainable development is emphasized in a vast number of literature and action plans addressing a more sustainable and Liveable environment. In this context, urban form and physical characteristics of urban space have a significant impact on achieving sustainability. Kevin Lynch (1981) outlines urban form as “the spatial pattern of the large, inert, permanent physical objects in a city.” Urban form is combined with features linked with urban design and land-use patterns, transportation system. Anderson et al. (1996) describe the urban form as “the spatial distribution model of human activities in a certain juncture of time”. Sustainable urban form is correlated with design concepts.

More recently with the movements such as New Urbanism, Compact City, and Smart Growth, the importance of urban form on sustainability has been discussed more widely. Doing so, some metrics and indexes have been developed by scholars to measure various dimensions such as compactness and density to assess the sustainability level of urban space (Wheeler, 2008). Thus, it is underlined by scholars that the physical form of an urban space influences its sustainability (Williams et al., 2003). Creating a sustainable space means to develop a set of relationships and morphological strategies. Through organizing the elements of the built form (e.g., buildings, street patterns, urban blocks, lot configuration, landscape, and the layout of

public spaces). To do so, the sustainable development aims at enhancing compactness, reducing the travel distances, restricting urban sprawl, decreeing nuisances including pollution, CO₂ emissions, and noise, providing an economic cost for public and individual transportation.

Wheeler (2003) underlines that five key urban form factors including compactness, contiguity, connectivity, diversity, and ecological integration are highly important to achieve sustainable urban development.

According to Christiaanse and Hoeger (2007) sustainable urban design is broader than mere technical terms that most of the architectural and urban projects are evaluated regarding them. In this respect, “sustainability” covers urban and social sustainability factors as well and emphasizes spatial organization and social behavior.

Jabareen (2006) in a prominent study on the relationship between urban form and sustainability has defined seven main principles to achieve urban sustainability. These factors are compactness, sustainable transport, density, mixed land use, diversity, passive solar design, and greening.

In investigating and measuring sustainable urban forms, through analyzing connectivity in different urban fabrics, Serge Salat and his colleagues also adopt a three-dimensional model consist of urban form, social and economic, and environmental items with an emphasis on the significance of the urban context. In this scheme, urban morphology is an essential element in achieving sustainable development while it covers the three pillars of sustainability; society, environment, and the economy, without being reduced to each of them. So, sustainable development needs realizing the dynamics of urban forms as structured human and physical organizations.

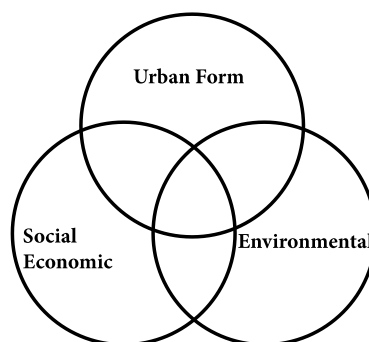


Figure 4.1 : A triptych of concepts (Salat, 2011).

The urban form addresses the social concerns through enhancing the quality of life of citizens, environmental concerns through decreasing energy consumption, and economic concerns through valorizing places, stimulating activities and saving money by reducing energy consumption. Serge Salat (2011) notes that a sustainable urban space needs to facilitate and encourage citizens' walking, biking and using public transport for reaching most of facilities and activities. Likewise, a sustainable city needs to be adaptable regarding the new demands for changes and replacements within time. Open green space for public use need to be anticipated in a sustainable urban context and they must be distributed within the urban fabric in the form of green corridors and human-scale parks. In his opinion, connections are the fundamental element of any sustainable urban space and are essential for establishing human society. Salat and his colleagues organized the indicator types in seven categories as intensity, diversity, proximity, complexity, form, connectivity, and distribution. They suggest an overlapping of categories that focuses on their mentioned main ideas and these are continued by a subdivision by the involvement of the indicators with one or more of the three constituents of their triptych consists of urban form, environment, and social and economic modules. This approach is more detailed by a subdivision of indicator types and then ultimately the overlap of spatial scales is considered.

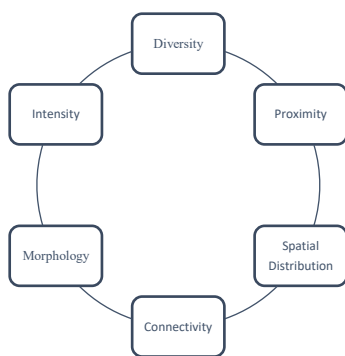


Figure 4.2 : The spatial analysis grid that guides the analysis and works out objectives (Salat, 2011).

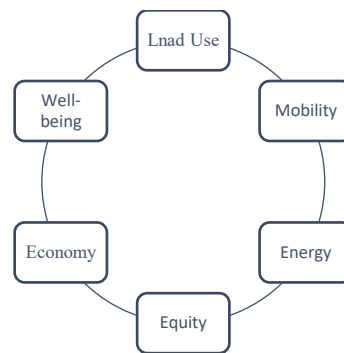


Figure 4.3 : The fields of actions concerned by the analysis, which all are means to reach sustainability objectives. (Salat, 2011).

Overall, several studies conducted on the issue have described the urban form as a fundamental aspect of sustainability that fosters citizens' presence in public space and their social interaction involving in diverse activities.

Considering urban form sustainability in the context of university campuses, there are very few studies on the issue. The literature concerning sustainability in higher

education mainly has grounded on developing comprehensive frameworks, university campus assessment tools and protocols such as STARS, CSAF, USAT, AISHE, GreenMetrics and so on. A vast number of publications have been created on the issue of sustainability in university campuses concerning its environmental, economic and social aspects addressing issues such as environmental management, real-estate management, green campuses, educational responsibilities (Clugston, 1999; Clugston and Calder, 1999; Creighton, 1998; Eagan and Orr, 1992; Filho, 1999; Foster, 2001; Heinz Family Foundation, 1995; Keniry, 1995; Krishnamurti, 1996; National Round Table of the Environment and the Economy [NRTEE], 1992,1995; Orr, 1992, 1994, 1999, 2002; Ospina and Osttveit, 2000; Page, 1989; Stapp, Wals and Stankorb, 1997; Thompson and van Bakel, 1995; Uhl and Anderson, 2000 and 2001; UNESCO, 1999; van Weenen, 2000; Whyte, 1999) but less has attempted to investigate its correlation to architectural and urban design issues. According to university campus sustainability assessment frameworks, the practices that universities participate in the sustainability pathway are categorized into four modules: education, research, operation, and community engagement (Stephens et al., 2008; Fischer et al., 2015).

Campus Sustainability Assessment Framework (CSAF), describes campus sustainability as: “A sustainable campus community acts upon its local and global responsibilities to protect and enhance the health and well being of humans and ecosystems. It actively engages the knowledge of the university community to address the ecological and social challenges that we face now and in the future”.

Universities because of their educational responsibility and their size and influence on their societies are key agents in directing society and forming its future and the transition towards a sustainable environment. Universities are also among main enterprises in the society that consists of facilities, departments, land, human and economic resources, and policies and act as large businesses. So, sustainability practices can be integrated into their research and educational programs as well as their operations and should be manifested in their physical setting. So, universities have realized that they need strategies that benefit students, staff and also community inhabitants. Today, many universities are attempting to improve their facilities regarding this concept to be more connected, coherent, green and pedestrian-friendly as well as being integrated into their surrounding urban context (Wheeler, 2003).

4.3 Reviewing Liveability in the Relation to the University Campus

According to the Oxford dictionary, 'Liveable' means 'worth living'. Liveability is a broad concept. According to Girardet (2004), liveability and sustainability are correlated though may not always imply the same issue. He describes a liveable city as one with well-defined neighborhoods with appropriate facilities within a walking distance, attractive public spaces, with vibrant street culture, well-connected, affordable, and clean. Douglass et al. (2004) consider the notion of the liveable city as a "healthy, convivial and socially just living, being shaped by the conditions of their natural and built environments".

Livability and the concept of liveable urban space are very much related to the notion of quality of life while it is associated with the vitality and congeniality of urban space. In this case, the liveable urban space is linked with the notions of being safe, healthy, economically vibrant, socio-culturally vigorous and greener. It can be also represented as the manifestation of sustainable urban space. A liveable urban space implies an attractive quality of life conditions embracing appealing public space, social activities, sense of community, environmental resiliency, and economic vibrancy.

Lennard (1997) studying on urban design principles has identified factors for enhancing social life and well-being as: safe and comfortable pedestrian network, a central neighborhood square, human-scale urban spaces, visual enclosure fostering a sense of belonging, natural elements to increase sensual enjoyment, intricacy and variety to stimulate curiosity and encourage exploration, intimate and personal territories besides significant structure to contribute to meaningful experiences, spatial definitions, appropriately designed seating locations and arrangements. Lynch (1981) in his prominent work "good city form" has identified five influential aspects as: vitality (a healthy environment), sense (sense of place or identity), fit (a setting's adaptability), access (to people, activities, resources, places, and information), and control (responsible control of the environment). It is these qualities of the urban spaces, like being fit and presenting vitality, that promotes safety and sustainability and enhances users' satisfaction. Gehl (1971) has investigated the various outdoor activities that occur within an urban space. Emphasizing the physical attributes of the urban space, he has identified three different types of activities as necessary activities, optional activities, and social activities which can take place in an urban setting. In

this sense, the urban environment can be a catalyzer to stimulate diversified actions and behaviors and encourage social interaction.

Jacobs (1961) also has highlighted the significance of creating mixed-use urban areas which contribute to the promotion of urban diversity and supports the presence of people in urban fabric which is also crucial for safety and security. Jacobs (1961) supports the notion of diversity and vibrancy in the space. Norbert-Schulz (1979) emphasizes the local identity and history of the place while Lynch (1960, 1981) discusses the significance of image, place identity and components of a good city form. Later, Jan Gehl (2010) and Matthew Carmona et al. (2010), have investigated the use and design of the public space, urban form development, urban quality dimensions. Alexander (1966) and Salingaros (2005) have studied the issue of permeability. Permeability is also a fundamental factor in creating interconnections and visual attraction. This highlights the importance of creating permeability and connectivity between different activity nodes (in our case between two domains of universities and cities and also between different parts of the campus). Existence of various land-uses and different functions facilitate the occurrence of a variety of activities, social exchanges, movements and flows in the urban space. Existence of user-friendly and diversified public spaces is key in creating a liveable and sustainable environment in which the social interactions are more intense. Public spaces also have an important role in creating identity. High density and mixed land-use provide a plentiful web of varied destinations that stimulate the links for pedestrians, bikes, and public transportation with a shorter distance. Accessibility by pedestrian and bike network enhance also the visibility inside the urban districts. The optimal size of a district is about 400 m from the center to the edge that is equivalent to a distance of five minute-walk (Salat, 2011).

Smith et al. (2003) have investigated the relationship between physical form and quality of urban community and proposed a framework in this regard. They have tried to recognize the psychological, social, and physical factors that contribute to the quality of an urban community. In their prominent study, through analyzing a vast design literature and guidelines on the issue, they have identified six main categories related to the quality of life including livability, character, connection, mobility, personal freedom, and diversity.

Within the literature related to higher education institutions, there are few pieces of research that have targeted the issue of the relationship between campus design and liveability in a holistic manner. There are several studies that have focused on specific factors such as social interaction in a qualitative manner. Among them, Temple (2009) has touched on the features linking social capital and space and place. He identifies physical capital as some of the factors that influence the quality of university space are the setting, scale, internal spatial relationships, unique design and historical features, and how well it is maintained (Temple, 2014). It is also emphasized the idea of encounter management for developing informal contacts that can be socially catalytic in increasing interactions and enhancing learning (Strange and Banning, 2001). Thus, space that stimulates individuals' encounters is "sociopetal" or socially catalytic which highly nurtures the sense of community and involvement of users. Thus, the quality of universities and university education is intimately dependent on the quality of their architecture and their urban quality.

4.4 The Interrelation between the Concepts of Liveability and Sustainability in Relation to Urban Form

Cities (urban spaces) are not machines or objects but they are live organisms that are born, live, and die (Salat, 2011). The sustainable development and sustainable urbanism are not all about energy consumption, waste, and water but it deals with the real-life of this living organism. It is as much related to the economic and social characteristics of this organism and is grounded in its cultural identity. The form of the city is a complex entity. It is a platform where all of these parts take their role to create a totality.

It can be noted that a city, as an urban form, is a composition of parts and their modes of relationships. According to Salat (2011), "The form of a city is constituted by the spatial and social patterns that compose it and that allow us to describe its networks, its built spaces, and its empty spaces in geometric, topological and hierarchal terms in two, three and even four dimensions, incorporating the temporal depth that every city contains." Serge Salat (2011) believes that urban form is an aggregate of social and physical aspects, created within a time spectrum and has complexity within itself.

The connection is a key component in forming a sustainable urban space. A coherent urban form is fractal by nature. The fractal nature encompasses complexity and

connectivity which is represented in all scales. Within a complex and connected urban structure, there exist plenty of nodes and connections of the same type. Salingeros (2005) identifies three structural principles of the urban web as nodes, connections, and hierarchy. Nodes are places of people activity such as home, office, park, café, and so on that their interconnections form the urban mesh. The complementary nodes are connected through paths. There can be several curve paths between two nodes. Existence of a hierarchical fractal order leads to a successful urban network. A fractal hierarchy in different scales usually is created within a course of history.

A living city contains interactive edges where inhabitants' interactions occur. Building on Salingeros, a living city is composed of an optimal sequence which creates an accessible and connected urban space. These sequences are: defining the empty spaces of the city including open spaces, green spaces, and pedestrian spaces; defining pedestrian connections; defining the buildings; defining the paths (Salat, 2011). In a well-connected urban form, there are numerous intersections and the whole urban space is connected through pedestrian paths which also continue between inside and outside of the buildings.

From another perspective, Kevin Lynch (1960) identifies five key elements of a city as paths, edges, districts, nodes, and landmarks. He explains their interrelationships as “it is the orchestration of all these elements that provides a form for a dense and brilliant image that will help the city extend outwards as a true metropolis.” According to him, these elements of urban space should be used to create a visible, harmonious, and well-defined form. This form of the city embraces main functions including movement, principal uses, and main focal points. A well-defined urban form with identifiable characteristics fosters residents' connections and enhances the sense of place.

Regarding Lynch (1981), “The city is not just an object that is perceived – and perhaps appreciated – by millions of people of very different background and characters, but also the product of a large number of builders who are constantly modifying its structure for their particular purposes”. In this respect, the city needs to stay readable for its inhabitants and its neighborhoods, roads, and landmarks should be distinguishable. In doing so, a user can understand its elements and arrange them into an intelligible scheme. A readable city is a well-organized setting that plays a social role, it shapes distinctive images, creates harmonious interactions, and fosters

activities. The form and image of urban space are a crucial factor in creating orientation and promoting congruent communication between citizens and their surrounding urban setting. Neighborhoods are living organisms, integrated into the city and embrace inhabitants physical and social lives. In sustainable urban development, neighborhoods are designed in a way that enhances the quality of life of residents and stimulates social exchanges. They deliver diversified types of social, cultural, economic, and natural functions.

The contemporary urban spaces are complex realities that lack consistency - physically and visually - that the inhabitants can hardly create a meaningful relationship. Indeed, there is a need for a notion of collective form that relates meaningfully the components of cities; buildings, space between buildings and green spaces. Based on Salat (2006), this can be achieved through sustainable development. A sustainable urban form respects harmony and unity. Unity is a complex issue, created from multiple relationships between constituent elements of composition where more relationships develop richer unity. Harmony implies a perceptible collective image that still each component carries its specific character. Different elements of an urban form are built volumes including buildings, monuments, the space between buildings that connects or divides them including squares, roads, and passages, the nature including trees, gardens, rivers, and lakes (Salat, 2006). These urban form components should be grouped according to some compositional parameters such as contrast, symmetry, balance, proportion, scale, materials, and character to establish unity and harmony.

Fumihiko Maki proposes the idea of “group form” to achieve a harmonious and united composition. Building on traditional European towns, he states that urban form evolves from a system of generative elements in space. These elements are cores of spatially, functionally and socially collectivity. Human activities, movements, and interactions with society are the sources of generative elements. According to Maki, contemporary cities “suffer from an inadequacy of spatial language to make meaningful environments”. Cohesion is one of the key aspects of a sustainable and liveable urban space. The hierarchical agglomeration of different components is pivotal in forming a coherent urban fabric. It embeds connectivity and complexity within its core. In spite of having different characteristics and functions, the accumulation of these varied and mixed urban components creates a complex and interactive whole. In Riboulet’s word “Piece by piece, the buildings join together, the

fronts from a continuous line that determines the ‘solid mass’ of the city, whereas the empty space – which is by no means what is left over – is also given shape. It is public space that, in its turn, inflects and orients the future developments.” (Riboulet, 1998).

The extent of which an urban space offers the potential for inhabitants’ activities and strolling can be a determinant parameter of the quality of life that space. These are “positive exterior spaces” (Salat, 2006) that have framework, created by purpose and foster a centripetal organization within itself. So, the urban open space is not a negative space or a void between buildings and it requires to be designed properly. It needs spatial order, clear-cut boundaries that encompass activities, and has layers which creates depth, “pleated space”. The material and scale of the exterior space should be on a human scale that conveys the intimacy.

The open public spaces, above all, are the places for people’s gathering and social life. Thus, expressing the qualities that enhance people’s socialization experience is a key issue in assessing the vitality of the space. This vitality is dependent on many physical parameters of the space including harmony, balance, contrast, symmetry, scale, proportion, color, material, texture, ornament, and so on. For instance, an enclosed, convex square provides a more inviting and engaging space for being involved in optional and social activities. Camillio Sitte (2006) supports the curved and irregular paths and squares with great urban variety and potential of diversified activities and the possibility of surprise, which can be seen in organic fabrics like Siena. In a city like Siena, mainly the perspectives are closed and direct to a focal point or monument and its unique visual and physical character intensify a sense of mystery, surprise, and complexity. On the other hand, the Haussmannian straight axes with symmetry and simplicity convey a good sense of direction and long vistas. Eventually, an appropriate combination of curved and straight paths is required. The streets and paths are not merely empty spaces or traffic routes. They are civic urban entities, sites for people’s encounters, places of individual and collective memory and sites for rituals. The squares and plazas have a vital function in the social life of citizens. They are connected to the continuous urban fabric and are enclosed in a way that gives them a character of concave space. They focalize the utmost intensity of civic life. At the same time, they are hubs that some streets intersect. Salat (2011) argues that “Instead of ultra-hierarchical road networks and scattered urban landscapes, sustainable urbanism requires public spaces with continuity, less road hierarchy, a dense, integrated street

network, and a complete and diversified transport system that is interconnected across speeds and distances. We need to understand in a very precise way the system of urban streets that structure a city's morphology." The street pattern and their relationships are a key factor in the legibility of the city and the perception of residents. Jane Jacobs (1961) as well puts the streets at the core of urban life instead of mere circulation traffic roads. Alexander (1966) also describes streets as multifunctional urban patterns. Considering the different speed of pedestrian routes and automobile roads, the two sorts of movement should not be divided but it needs a good organization. Pedestrian public spaces need to be continuous and not fragmented. The street pattern needs to be connected and diversified. In a walkable city, the routes between two nodes have a reduced size and organized in a fractal manner, according to the hierarchy of scales.

The smaller size of urban blocks and the higher density and the shorter distance of intersections in an urban fabric are also key indicators in sustainability and vitality of urban space.

Making an analysis on different urban forms in traditional European cities, Chinese, Japanese, and in the USA and the modernist cities, Salat (2011) states that "A sustainable city must enable people to walk, bike or use public transit to get to most services and activities, and make the use of private cars an exceptional occurrence. Indeed, even if car emissions are reduced significantly, this mode of transportation necessitates the construction of roads and parking lots that consume space and materials." He acclaims the incremental growth of Roman cities which embrace hierarchy, complexity, and adaptability. He advocates the significance of social exchanges in public spaces such as streets and squares. According to him, in a sustainable city, open green spaces need to be human scale and be distributed around the urban space and be accessible for residents. According to Salat (2006), three essential factors for sustainable urban development are protecting the environment, supporting diversity and mix of building types in neighborhoods, and creating a downtown which is compact and walkable. He also describes three imperatives for smart growth as preventing the conversion of the rural lands at the cities' peripheries, supporting infill development and renewal of old areas, and creating a well-connected transportation system to reduce the automobile use.

However, human activities have many environmental impacts such as traffic congestion, air pollution, thermal degradation, noise, and deterioration of air quality.

The compact city is one of the proposed solutions. Building on Richard Rogers (2000), “if planned in an integrated manner, dense cities can be designed to better use energy, consume fewer resources, reduce pollution and not spread over the countryside. This is why we ought to concentrate on the idea of the “compact city” – a dense and socially diversified city where economic and social activities intersect and where communities are grouped into neighborhoods.”

According to Salat (2006), a compact city supports mixed land-use where the social and functional mix decreases travel needs and reduces social segregation. It rises densities, particularly in city centers and also in housing areas through using interstitial spaces and developing on wastelands. It recovers public areas with social and environmental function by forming land banks. It fosters urbanization around the accessible public transportation corridors through locating commercial activities and residential spaces in these nodal points. Therefore, the form of a city has a significant influence on the amount of energy use. In urban spaces with higher densities, energy, and environmental issues improves through reducing energy consumption for transportation. As highlighted by Rogers (2000), “a compact city comprising complementary activities is friendlier and can reduce the need for car travel which, in turn, enormously reduces the energy used for transportation which, generally speaking, represent a quarter of city’s overall energy consumption. Fewer cars mean fewer traffic jams and better air-quality which, in turn, encourages people to use bicycles or walk to their destinations rather than use a car.”

Thus, sustainable transportation is the key to sustainable urban planning. In this respect, various transportation modes including walking, biking, train, tramway are complementary and inter-modal. To achieve the best result, these offered services should be improved and the spatial planning should support these transport means through adapted routes and specific lanes.

According to van Kamp et al. (2003), the concepts of quality of life, livability, and sustainability are interrelated as they all signify the notion of human-environment interaction. They define the environment as the sum of built, physical, economic, social, and cultural aspects. They also highlight the concept of quality of place which is more related to the environment in comparison with the quality of life which is more person-related. They state that livability and quality of life are objects of “here and now” while sustainability is more related to “person-environment fit in the future”.

The political theorist Micheal Walzer (1986) has categorized urban spaces into two diverse types: “single-minded” and “open-minded”. “Single-minded” signifies an idea of urban space which addresses a single function. “Open-minded” represents a multi-functional urban space that is designed to embrace the diversified uses and is open to public participation. Open-minded spaces, such as parks, squares, cafes, stimulate activities and encourage the presence of people. They are very lively and provides the opportunity to do something in common and convey a sense of identity, awareness, and mutual respect.

Applying a specific activity type, a particular spatial characteristic along the streets can contribute to creating a sense of continuity. The roads also need visual hierarchy to be identifiable. Existence of departure and arrival elements and focal point also enhance the sense of identity of citizens. To enhance the liveability of cities, it is necessary to conserve the historical buildings, transform streets to principal public open spaces, and encourage the mix activities. Public spaces not only embody inhabitants’ necessary activities but if the public space is attractive, the users will be engaged in optional activities as well. As a result, sociability and informal exchanges will be stimulated. To achieve a harmonious urban space, the movement spaces should be designed properly. The motorways do not convey a sense of intelligibility and are not perceived by people as a part of their urban setting. To enhance the harmony between inhabitants and the living environment, the urban space needs to be intelligible and visually cohesive. In this respect, the roads need to be an integral part of public open spaces and means for communication. They should have an interconnected system to avoid urban space fragmentation.

4.5 Physical Features of the University Campus Space

In the higher education literature, the impact of campus space on the academic and social life of the university is mainly discussed considering the pedagogical and psychological aspects (Boyer, 1987; Griffith, 1994; Strange and Banning, 2001; Temple, 2009) or has been studied normatively in the profession of campus planning. However, the issue has not received wide attention in the academia considering architecture and urban design attributes of the campus. While physical attributes of the campus are among the key items that create a large impression. The spectrum of this impact can vary from the visual attributes such as art works installed within the campus

to more micro outcomes. The physical environment is a milieu that diversified activities occur within it. This is an obvious fact that the quality of space and the physical attributes of it affect the performed activities, interactions, engagements, and feelings. Though this is not specifically referring to an urban space, it is a common sense that can be attributed to campus setting as well. Thus, it can be assumed that there is a correlation between the spatial quality of university space and the quality of academic and urban life.

The university space has a social dimension that requires addressing users' needs along with the institutional requirements. Thus, the space of a university is the consequence of designers and policy makers' decisions in one hand and is the outcome of users' behaviors and activities on the other hand. The social dimension of spatial production is a matter of consideration. As Hillier and Hanson (1984) state, "the ordering of space in buildings is really about the ordering of relations between people". The interactions within the physical setting of a university touch the existing community within the university organization and contribute to creating its culture. This issue transforms the space of the university to a place. And arguably, universities' space and place have an impact on the academic life of the university in a complex way (Temple, 2014).

University campus can be considered as a "Third place" (Campos Calvo-Sotelo, 2014) that represent a space between the domestic environment and a work-space. So, a range of diversified everyday activities occurring in this space from education and learning to socializing, commerce, leisure, and gatherings. This sort of space offers opportunities for informal interactions due to the flexibility of its outdoor spaces. John Worthington (2009) proposes "landscapes for learning" instead of learning venues that highlight the importance of providing opportunities for diverse activities within the same setting. These settings are capable of fostering interactions, or social activities in terms of Gehl (1971), rather than facilitating only necessary activities. "The Hub" project in London is a good example of this kind space that embraces various functions of offices, library and an Art University in the same complex which at the meanwhile provides a stage for work, socialization, education, and innovation (Campos Calvo-Sotelo, 2014).

Strange and Banning (2001) state that "although features of the (campus) physical environment lend themselves theoretically to all possibilities, the layout, location, and arrangement of space and facilities render some behaviors much more likely, and thus

more probable, than others.” University precinct provides a ground for education, research, informal knowledge exchange, socialization and also living. A well-designed university campus encompasses components that can generate optional and social activities (Gehl, 1971), foster encounters, ease the movements and guarantee the presence of people as well as conducting the main mission of education and research. A well-designed university campus is a robust and responsive environment, in terms of Bentley et al. (1993).

It is stated that more than 50 percent of learning in a university is happening in the form of informal learning and through the out-of-classrooms activities (Kenney et al., 2005). In this sense, the entire campus function as a learning setting and should be planned properly to enhance the students’ academic and social learning experience. The learning campus is the one that increases the potential of interactions (both intentionally or unintentionally) and set a pleasant ground for diverse activities. Strange and Banning (2001) in their book “Education by Design” emphasize on the significance of student involvement in their learning outcomes and state that the campus configuration and design, availability and flexibility of diversified spaces on campus enhances the involvement of students.

The main components of a campus setting including the arrangement of uses, organization of walkways linking the uses, the configuration of open spaces, the density and mix of functions largely influence the vibrancy and vitality of the campus environment. These core aspects can be derived from vibrant urban space design principles and applied to university settings.

Another noticeable issue which has been considered by many of campus planners is that the campus design conveys the concepts of placemaking and placemarking (Dober, 1992). Placemaking defines the pattern of the campus plan, the arrangement of campus land-use, location of buildings and functional open space, circulation (pedestrian and vehicular) network and delimiting campus boundaries and its interface with the surrounding context. This plan creates a framework to meet functional, programmatic, and visual objectives. A well-defined campus plan can express universities’ position within the larger society, resolve land-use conflicts, and settle decision of site location. Placemarking includes the conceptualization of physical attributes of campus for creating a sense of place and visual identity. Landscape

elements, style, artworks, landmarks are among the items contributes to university placemaking.

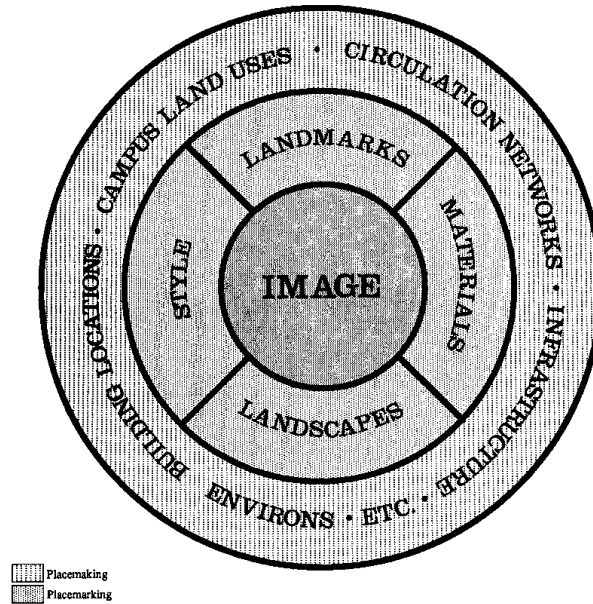


Figure 4.4 : Conceptual Diagram of Campus Design Factors (Dober, 1992).

Dober (1992) through analyzing a vast number of university campus planning identifies the key factor for campus design in terms of placemaking and placemaking (Figure 4.4). The campus plan embodies three main components of the setting: landscape, circulation, and the buildings. The planning initiates with the configuration of landscape framework and afterward, the built form is designed to frame and surround the open space.

The public space is a vital component in shaping the sense of place that is inevitably correlated with the campus experience. The paths, plazas, courtyards and all open spaces of the campus landscape are the places where informal encounters taking place. Therefore, these spaces need to be vibrant, dynamic, attractive, and memorable to enrich the campus experience. Many campus revitalization projects, particularly post-war campuses, are conducted intending to inject vitality and homogeneity to the campus landscape as well as supporting the sustainability issues.

Moreover, residential universities can increase interactions where students spend more time in common places and get engaged in social activities. Conversely, the strategy to place or relocate the student housing out of campus setting for opening space for other functions may have a negative impact on student involvement. Thus, fostering a community on campus has been a principal objective and can be traced back to the

fundamentals of higher education institutions, particularly in American universities with the objective of the open idea exchanges. Hence, the sense of community is considered a fundamental quality for creating a vital campus. The old universities and colleges mainly have an attractive and human-scale campus core that promotes a sense of community and vitality of the precinct. Though, the new trend in campuses with large isolated structures and the need for automobiles and large parking lots have decreased the vibrancy of the campus environment. “Like a town or small city, the campus is a community that is defined, in part, by geography” (Kenney, et al., 2005). In this geographical setting, students live, study, work, entertain, and socialize.

The plan also defines the kind of relationship and collaboration that campus creates with its surrounding city – having a blurred boundary or a being gated. Circulation and parking areas are approximately the second-largest land-use in campus after athletic and recreation functions. Thus, they are critical components in designing a sustainable and efficient campus. The plan deals with the challenges of integrating or separating the automobile, service, pedestrian and bicycle networks. Their balance and distribution are critical issues of any masterplan. On one hand, the existence of large parking lots in the campus boundary negatively influences the safety and also the image of the campus and on the other hand, the campus core is more pleasant without the vehicular traffic.

The masterplan defines the movement network aspects as:

- The extent to which pedestrian and bicycle activity is encouraged or automobile use is accommodated,
- How close vehicles are allowed to which buildings or functions for convenience or for maintenance,
- Whether access for servicing is centralized or decentralized,
- What considerations are required for safety (Kenney et al., 2005).

In addition to main components, a university campus, particularly in the US, embraces various types of activities including instructional faculties, libraries and museums, research centers, extracurricular activities center, institutional services, housing, sport, and recreational areas, circulation and parking, and utilities (Dober, 1963). In American campuses, the library was considered the focal point of the setting because of its monumental, compositional and educational importance. But after 19th century, the library became decentralized particularly in large campuses and departmental

libraries emerged and the spatial layout of the library changed to embrace new activities like seminar rooms, auditorium, and vaster studying space for a larger group of users. Extracurricular activities center encompasses functions like university union, faculty clubs, chapels and churches, auditorium and theatres. They are mostly memorial buildings. Institutional services include academic affairs, student affairs, financial operations, plant operations, special services. Delivering housing facilities differs among higher education institution and it is provided in some universities but the quality and quantity of the residential facilities also vary among the universities. considering the location of housing units, it is preferred the multi-centric model where the residential zones scattered within the campus setting but generally, they are located in peripheral areas of the site rather than the central zone.

Campus spatial configuration, quality of open space, accessibility and movement ease, building designs, availability of facilities including libraries, student housing, recreational spaces can contribute to the success of a university.

Campus design and planning is a critical issue that directly shapes and controls the way the university is behaving through its physical space. The master plan is the main tool that represents the philosophy of any university and directs its development (Dober, 1996). Furthermore, the physical setting of universities plays an important role in articulating and achieving their institutional missions and objectives. University campuses provide the required setting for formal learning and education and meanwhile they create an environment for less formal learning and other activities. Enhancing interdisciplinary programs and fostering collaborations provide a productive educational experience and can contribute to the development of society. James Duderstadt, president of the University of Michigan, in his prominent book “A University for 21st Century”, states that “Beyond formal education in the traditional academic disciplines and professional fields, the university has been expected to play a far broader role in the maturation of students ... The campus experience we tend to associate with undergraduate education does a remarkable job in preparing the student for later life. And clearly, it does so through a complex social experience extending far beyond the classroom and the curriculum.” (Kenney et al., 2005). Building on universities third mission, they must function as pioneers in nurturing citizens for their future societal roles and contribute to the economic and social wellbeing of their residing urban cities.

Considering universities diverse visions and missions, campus plans may have a broad and diversified scope. Masterplan addresses the objectives of the university such as attracting students, improving the educational environment, contributing to the adjacent community, enhancing liveability, and supporting sustainability.

Kenney et al. (2005) identifies a comprehensive campus plan encompassing nine principles:

- The priority of total plan to individual buildings and spaces.
- Using compact and mixed campus land uses to enhance livability and interactions.
- Shaping an identity through landscape elements that convey the campus unity and its relationship with surrounding urban setting.
- Forming a mutual physical connection with the surrounding urban space.
- Creating placemaking through campus architecture.
- Adding meaning and identity to campus urban space.
- Considering environmental issues.
- Controlling the auto circulation.
- Considering innovative approaches and technology.

One of the good studies related to this dissertation is the research done by Hajrasouliha (2017). He has reviewed 50 American university campus master plans which mainly created after 2000 in the USA and has identified their common objectives and challenges. He has categorized them in 10 categories and 100 recommendations which reveal the most important factors for university campus designers. Regarding these categories, it can be better understood which qualities were at the center of importance for campus designers. These 10 categories are defined as (1) walkability (2) sense of community (3) livability and safety (4) environmental sustainability (5) landscaping (6) town-gown relationship (7) identity (8) imageability (9) partnering (10) learning environment. Then, he has investigated the morphological dimensions of campus planning on the academic success of students.

1. Walkability: improving the circulation network within the campus.

2. Sense of community: strengthening a sense of community by supporting student involvement in different activities out of classrooms.
3. Livability and safety: increasing student residences to improve security and quality of space.
4. Environmental sustainability: concerning environmental sustainability in campus planning.
5. Landscaping: conserving the campus identity through natural landscape elements.
6. Town–gown relationship: creating a good integration with the socio-economic and built fabric of its urban context.
7. Identity: promoting the identity of the campus and respecting the history.
8. Imageability: providing a memorable and beautiful campus environment.
9. Partnering: collaborating with external partners.
10. Learning environment: promoting a successful academic atmosphere.

Hajrasouliha (2017) proposes the “American Campus” concept by examining the most common campus planning goals and actions reviewed in masterplans.

A campus plan does not merely illustrate the layout of the space but it also embodies the institutional strategies and values. The plan directs the organization of activities, arranges the proximity and location of buildings, fosters interactions, supports the community, and reflects the physical and social connection between the university and the residing urban space.

Any campus plan needs to be comprehensive and addresses the vision of the institution, guide the growth and change, and reinforce the strategic plan. The didactic and community vision, history, culture, tradition, and the context are bases of a good campus plan (Kenney et al., 2005).

4.6 Summary

In the literature related to urban form, notions of sustainability and liveability are interrelated. Accordingly, sustainability endorses a better quality of life and a more liveable urban environment. University is a microcosm of a city. Considering the large

dimension and the diversity of functions, the university campus has many common attributes of an urban space including built space, open space, circulation networks, and their configuration and the relationships between these components. Therefore, the design principles that are applied to urban space can be applicable to a university campus, considering the specific function of a university. Building on this, the sustainability and liveability factors which are related to an urban form can be referred to the campus form. Developing a sustainable urban environment signifies to set a group of morphological strategies and relationships through arranging the components of urban form. These principles ultimately intend to diminish the urban sprawl, increase compactness, decrease commuting distances, reduce energy consumption, CO₂ emissions and pollutions. Livability and the concept of liveable urban space are very much related to the notion of quality of life while it is associated with the vitality and congeniality of urban space. Thus, a liveable urban space indicates an inspiring quality of life situations with attractive public space, social activities, sense of community, environmentally resiliency and economic vigor.

In this context, universities because of their educational mission, their large size, and impact on their societies are key agents in directing the society, forming its future and the transition towards a liveable sustainable environment. Universities are among chief organizations in the society that comprise infrastructure, facilities, land, human and economic capital, and function as large urban enterprises. So, sustainability initiatives can be incorporated into their research and educational agendas and their operations and should be manifested in their physical setting. To do so, universities have concerned that they need strategies that profit students, staff and also a broader community. Today, many universities are attempting to improve their facilities considering the concepts of sustainability and liveability to be more connected, coherent, green and pedestrian-friendly (Wheeler, 2004) as well as being an integral part of their surrounding urban context. It can be admitted that there is a correlation between the spatial quality of university space and the quality of academic and urban life. Physical attributes of a campus setting can be well outlined by a comprehensive campus plan. Campus plans outline the institutional objectives of the university including attracting prospective students and faculty, promoting the quality of life, improving the academic atmosphere, contributing to sustainability goals, and improving the quality of proximate urban space. Research on the campus design

strategies can assist scholars to develop a theoretical framework and also help practitioners and campus designers to be more aware of their design consequences.

Recently, many universities got more aware of the significance of their urban position as well as their campus planning on representing their objectives. It has a great influence on attracting talented students and faculty, reinforcing research and education, enhancing the quality of life, promoting vitality, contributing to sustainability, supporting the prosperity of surrounding urban space, and initiating urban developments. In the next chapter, the factors that influence livability and sustainability of a university campus urban space and surrounding urban space have been explored in more detail.

5. METHODOLOGY

5.1 Introduction

This chapter focuses on describing the methodological process of this dissertation. It explains the steps conducted in two main cycles of the research: hypothesizing cycle and theorizing cycle. The hypothesizing cycle follows a qualitative approach. It mainly concentrates on literature review and the conceptualization of the subject of study. Theorizing cycle discusses research methodology, case study analysis, testing the hypothesis, measuring the criteria, interpretation, generalization and developing an index.

5.2 Research Methodology

The research comprises of two stages: hypothesizing cycle and theorizing cycle.

The hypothesizing cycle follows a qualitative approach to hypothesis making. The first step includes the exploration of the subjects of university-city relationship, university campus form features, liveability, and sustainability and subsequently, conceptualization of the research object. In this phase the research questions are defined as:

- How do physical features and morphological characteristics of universities and their third mission objectives in terms of urban outreach activities influence the sustainability and liveability of university campus urban space and surrounding urban space?

And it follows by the sub-questions as:

- What are the main criteria that influence the sustainability and liveability of university campus space and surrounding urban space?
- To what extent does the impact of these criteria vary in different typologies of university campuses?

In the second step, considering morphological attributes of university campuses and their surrounding urban context, morphological analysis is applied to define and

characterize the investigated six typologies of university campuses. These campus typologies include (1) Detached campuses, (2) Attached campuses, (3) Rurban campuses, (4) Gated campuses, (5) Integrated campuses, and (6) Scattered campuses.

In the third step, through a literature review, the concepts of sustainability and liveability concerning the urban form and campus form are explored. An interpretive study is conducted on the university campus design principles and campus master-planning strategies.

The second stage includes the theorizing cycle. Based on the studied concepts in the hypothesizing cycle, it intends to provide a theoretical framework.

In the fourth step, in addition to the finding of the interpretive study, a content analysis of campus masterplans is conducted. The masterplans have been selected randomly throughout the world excluding the American campus masterplans. The content analysis attempts to identify common goals, strategies, and actions which have been identified by campus planners. Then, the findings of masterplan content analysis are merged with the findings of the study done by Hajrasouliha (2017) on American campus masterplans and the general campus planning principles are derived.

The fifth step follows a multi-criteria evaluation method. In this respect, the obtained criteria related to campus form sustainability and liveability is merged with the main principles and design strategies of university masterplan emphasized by practitioners. A set of criteria is developed that encompasses nine main criteria and twenty-eight sub-criteria. This set of criteria covers the aspects related to campus form design in terms of sustainability and liveability and also university mission in terms of urban outreach activities. The multi-criteria set includes Liveability, Legibility, Cohesion, Compactness, Walkability, Accessibility, Connectivity, Integration, and Sustainability.

In the sixth step, to assess the performance of campus according to each sub-criterion, “Histology Atlas of Campus Form” is developed that illustrates the morphological dimension of each criterion in three levels between the best, the average, and the worst performance. It functions as a system of weights for the indicators providing a visual system of demonstration.

Developing the “Histology Atlas of Campus Form” makes it possible to evaluate the campus spatial maps and score them for each criterion in a base of three-point Likert

scale. Quantitative scales are derived from the literature and descriptive explanations are provided to validate the case study comparisons.

In the seventh step, a multiple case study research is conducted. In this section, fifteen university campuses, throughout the world, are selected among the best representatives of the six campus typologies. Primarily, the documents, existing literature, university websites, annual reports, campus planning reports, maps, masterplans, and campus development statements are examined. Then, for each case study, a morphological approach is obtained and an in-depth study is implemented through which the university campus history, development processes, third-mission activities are analyzed. Then, a spatial analysis applied for each university campus. To do so, Campus masterplans, Google maps, Google Earth maps, Openstreetmaps are used to create more accurate maps of the current situation of each campus. Then, several spatial analysis maps are developed that address the proposed set of criteria. The produced spatial analysis maps are re-examined qualitatively according to the criteria set. A table is developed for each university campus that comprises the qualitative description of each sub-criterion based on the maps and the synchronic-morphological studies of the campuses. In the eighth step, an interpretative approach is conducted to describe the findings of the theorizing cycle.

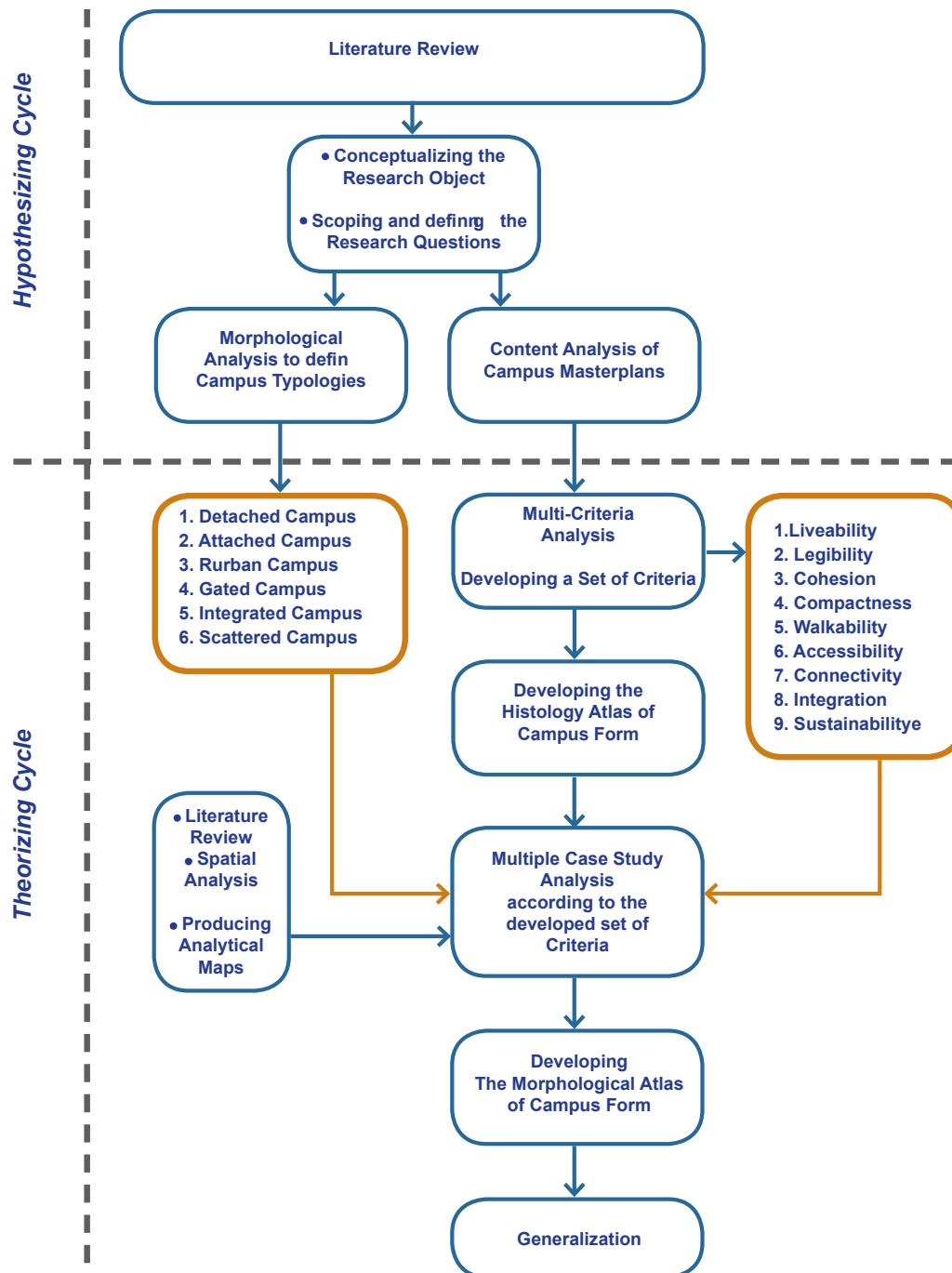


Figure 5.1 : Research methodology Diagram.

5.3 Morphological Analysis to Identify Campus Typologies

In this phase, a comprehensive literature review is conducted on the history of the relationship between university and city, universities' spatial evolution and their morphological and physical features. Considering their historical background and morphological characteristics, university campuses can be divided into two main categories in terms of their position within their hosting urban space. They can be out-

city or in-city campuses which each of them has different typologies. In this research typologies of university campuses have been defined as; (1) Detached campus, (2) Attached campus, (3) Rurban campus, (4) Gated campus, (5) Integrated campus, and (6) Scattered campus. Considering their urban location and campus physical features they are assumed to have specific characteristics.

5.4 Developing an Analytical Framework

5.4.1 Content-analysis of university campus masterplans

Campus masterplans address the university's goals, objectives, and missions. In spite of the existing complexity and diversity considering diversified university masterplans, their defined strategies can be used as a complementary source for the existing academic literature on the subject of fundamentals of a university campus physical space.

Following the research done by Hajrasouliha (2017), this research has made a content-analysis of university campus masterplans and campus development reports. For this purpose, forty campus masterplans were selected randomly throughout the world excluding the American university campuses. The list of selected masterplans has been provided in the Appendix A.

The masterplans were selected through a web search with the keywords of “campus, masterplan, development plan” and also from some university websites. Among the available masterplans, the ones which were in English were selected. It should be noted that, in spite of the vast number of existing university campuses around the world, the available campus masterplans were very limited. The selected campus plans were analyzed in detail for their problems, goals, strategies, and actions.

The selected campus masterplans have different history and culture, social context, physical and climate conditions. However, there are many similarities in their identified goals and strategies. In addition, the identified goals and actions show a high level of similarity with the findings of the previous research by Hajrasouliha (2017) on American campuses.

This research does not aim at offering new campus design norms and guidelines but it intends to investigate within the existing existing scientific and practical knowledge, acquire and re-classify the influential principles and conceptualize them as a set of

criteria to provide a theoretical framework for further research and practice in this field.

In this regard, this process made it possible to provide a theoretical framework of campus form sustainability and liveability, grounded on the standpoints of the practitioners.

5.4.2 Analytical criteria definition

In this respect, a literature review has been done on the subjects of the university's third mission and urban outreach activities, urban form, sustainability, liveability, and campus design principles. Then, through an interpretive study, the main issues have been conceptualized. Subsequently, the whole acquired data from the literature review and content analysis have incorporated to create a set of criteria. The proposed set of criteria comprises nine criteria including liveability, legibility, cohesion, compactness, walkability, accessibility, connectivity, integration, and sustainability and twenty-eight sub-criteria. From the whole twenty-eight criteria, twenty-two of them is directly related to campus form.

It should be noted that the definition of criteria is based on the judgment of the researcher about the relevance of the parameters. In identifying the criteria, other indicators such as the ones related to economic and energy-related aspects were not included. This fact does not reduce their significance and merely signifies that they play a role with respect to other research questions.

5.4.2.1 Liveability

This criterion refers to providing a vital, vibrant and secure campus setting. A prosperous campus needs to address the issue of sense of community and collegiality which is largely achieved through mixed-use strategy. It has been a key objective of campus planners since the early collegiate model universities which were places for learning and living. Creating a mixed land use is one of the most influential strategies in enhancing liveability and vibrancy. Mixed land use signifies the diversity of functions in terms of land use and proximity of activities. It decreases the need to travel and guarantees the accessibility to different services in a short distance, encourages walking and bike usage, and improves security in public spaces. Leon Krier (2009) also states that the functional mix of activities decreases the need for car trips in long

distances and consequently increases the vitality of the urban space at different times of the day.

Diversity promotes desirable urban form and embodies the cultural and social context of urban form. As emphasized by Jacobs (1961), “In dense, diversified city areas, people still walk, an activity that is impractical in the suburbs and greyest areas. The more intensely various and close-grained the diversity in an area, the more walking. Even people who come into a lively, diverse area from outside, whether by car or by public transportation, walk when they get there”.

Diversified activity types comprise the university’s function including academic, research, residential, sport and recreational, support services such as offices, storage, student services such as cafés, shops, and book stores, and parking. Existence of various activities particularly extracurricular activities encourages students’ engagement and enhances the sense of collegiality. Mixed-use of these activities within the campus setting stimulates interactions and generates vitality. Conversely, zoning and separation of activities may cause secluded districts during peak-off hours. In this sense, designing academic and residential functions collectively can enhance the use of place during the night and weekends and enhances the liveability. Research facilities and laboratories in many universities have a twenty-four-hour access nature and mixing them with academic functions can enliven the setting. Moreover, setting a common platform for collaboration of researchers from various disciplines is a matter of importance in the recent knowledge-intensive world. To create a cross-disciplinary collaboration, it is also advised to integrate offices from various departments which increases contacts and idea exchanges. A student center like a hub or a multi-purpose center is a good example of shared space to see and to be seen. It intermingles many diverse activities such as cafes, restaurants, shops, bookstore, library, bank, and so on and creates a highly frequented and vital environment. In the campus which is resided in urban areas, many of student-service functions can be shared with the public to reinforce the university-city connection.

Considering the required large land and activity type, sport and recreation facilities often are located in campus peripheries and isolated from the campus core. Parking areas are also among the functions that need to be separated from the campus core.

Therefore, it should be noted that creating a mixed-use precinct bring out many advantages including enhancing the safety, potentials for flexible future expansion, attracting prospective students, enhancing the collegiality and sense of community, and improving the learning outcome. Existence of well-designed and connected open spaces for social interactions and communications is also a key aspect in promoting vitality. Open spaces play a significant role in the academic life of the campus through setting a stage for diversified shared activities, communications, gatherings, as well as working and studying. Greening and green space is also a key factor in achieving liveability and sustainability where encompasses nature as an integral part of the urban setting in a diversified open landscape. Campus green areas provide “places in which the campus community interacts” (Kenney et al., 2005). The green areas have different types including shrub and vegetation, tree lines, well-preserved lawns, grass fields, natural forests, and agricultural lands.

5.4.2.2 Legibility

It means the ease of recognizing and organizing different parts of urban space in a coherent pattern. Space is legible when its different components such as districts or landmarks or pathways, are identifiable and can be categorized into a pattern. It is correlated with the concepts of way-finding and mental image. In this sense, an ordered physical setting can produce images, give a frame of references, play a social role and forms activities. It means that the environment not only needs to be familiar but also should be distinctive and legible (Lynch, 1960).

Lynch (1960) explains that an environmental image can be considered into three constituents as identity, structure, and meaning. Identity refers to the state of identification of an object when it is recognized as a distinguishable entity. Then an image should carry a spatial or pattern relation with the observer and other objects. Lastly, the object should convey a meaning to the observer - emotional or practical.

Lynch (1960) identifies imageability as the quality of a physical entity that can arouse a sharp image in an observer through its shape, color, and arrangement. Imageability can be called legibility or visibility. A highly imageable physical setting would be well-formed, distinct, coherent, clear, and remarkable. He identifies the elements of a physical form as path, landmark, edge, node, and district. The image of physical form is an accumulation of these elements patterning together in a harmonious way.

Paths as the lines of movement are the main elements of arranging a physical setting. They can contain some specific characteristics that heighten the quality of space such as adding specific texture, color, lighting, smell, sound, greenness, etc. or organizing some activities along the paths, or creating a visual hierarchy or functional hierarchy. A path should convey a sense of orientation and has a destination. The landmarks are important elements in creating imageability. They need to be visible, in contrast with the surrounding elements of the context, and well-located in the spatial structure (Lynch, 1960).

A legible campus creates a memorable and beautiful environment. It reinforces the identity and unique character of the setting as a constantly evolving environment and meanwhile values the history of the university. A legible campus is a memorable setting with unique and appealing spaces enhances the daily experience of students. The memories are usually linked to a specific place in the setting such as a plaza or a lawn or an iconic building on the campus. Memorable places contribute to creating a sense of belonging and feeling of community. A good wayfinding and signage system, a well-designed and well-preserved campus, and an appealing landscape more than signature facilities create vitality and vibrancy and are influential components in attracting students.

Landmark buildings and historical edifices such as libraries or chapels can create a symbolic image of the university mission. To do so, the location of these buildings is important. The landmarks can be located at the end of axes or specific intersections. Some landmarks are located at the entrance of the campus and act as a special gateway. They represent the entire campus as a totality to the neighborhood. Starchitecture and landmark buildings by signature architects are the new trend that some universities follow to brand their precinct. However, it is important that the campus preserve its identity and can have a balance in the character within itself and with its regional location.

Sense of place is also an important aspect in a place to be legible. It is a personal phenomenon, related to experience and cognition as well as being related to the physical environment. In a specific manner, it has associated with university life, in a specific living period of any student. It is associated with campus space, the buildings, the field, and the perceived place, as the container of the collegiate experience. It is an accumulation of activities, events, perceptions, experiences that shape this sense

(Chapman, 2006). Moreover, the campus physical elements express the institution's reputations and shape its image and doing so, can contribute to branding the university (Kenney et al., 2005).

To be a legible campus, buildings and landscape elements are designed collectively to reinforce the identity of the campus. Buildings act as focal points. They have a common language that is shaped by the architectural style, materials, scale, and features. These attributes create a unique character of that campus. In this sense, the whole campus elements play a collective role to convey an intelligible and united totality.

5.4.2.3 Cohesion

A cohesive campus conveys a comprehensive idea and plan where all components of the setting cooperate to express an identity and a sense of place. The campus is the agglomeration of its various elements. Buildings are not individual structures but work as a part of a larger scheme. In addition to physical features, the landscape has social value to a campus setting. It reflects the history and culture of the region. The landscape is also shaped by use patterns of students and follows the construction regulations. It articulates the conditions of the residing setting whether being located in an urban or rural environment. The landscape also contributes to the visual aesthetics of the campus and enhances the experience of the environment. The landscape and open space create a memorable image of the entire campus. Both built and open spaces are designed together to express the character and identity of the campus. Harvard Yard or the campus core of the University of Virginia very well express this quality. The open spaces range from courtyards, quadrangles, roads, and sports fields to forest-like natural preserves and agricultural fields. Open space can be designed following hierarchy from open space to semi-closed and closed space or from informal space to formal space. Vistas can be created. Focal points, towers or other landmarks at the end of the axes and corridors can be very influential. New constructions need to respect the already existing campus spatial structure.

In this sense, the landscape articulates the spirit and character of the campus and creates a sense of integrity. A holistic landscape design underlines the entire campus plan, arranges the open spaces, structures the movement networks, conveys the university's attachment to a place and expresses its culture.

A campus with a strong spatial configuration has been designed in a way that buildings act as a part of a larger, interconnected, and coherent environment. Even not all of the buildings have a particular architecture but they are an integral part of the campus setting.

Having a formal or informal plan or having various architectural styles, the entire campus needs to be designed as unity. A well-organized campus expresses the placemaking. The university precinct also needs to be consistency with its surrounding urban context as well.

5.4.2.4 Compactness

Compactness considers compact urban form and also refers to contiguity and connectivity. It restricts future urban sprawl and reduces the transport of energy, water, products, materials, and people. It contributes to rural land protection and use of undeveloped land and redevelopment of existing structures and sites. It promotes quality of social life, social interaction and access to facilities. It assists in the reduction of energy consumption. Compactness can also imply the density of the precinct and the proximity of edifices. Density and compactness in the university campus can be used interchangeably when referring to the adjacency of buildings and functions (Kenney et al., 2005).

Density is the ratio of people or residential units to the land area. According to Salat (2011), density signifies “the concentration of objects over a reference area.” Considering the urban form, urban density indicates “the ratio of built m² on all storeys to the selected area on ground.” In the block level, the density refers to “the relationship of buildings to one another and to non-built spaces.”

Density can be a relative concept when the open spaces are considered, as types of open spaces differ. For instance, a park, green space or square are open spaces which form spaces for users’ socializations are completely different from open spaces such as parking lots. Thus, analysis of density needs to be completed with the analysis of the percentage of green areas, plot coverages, roads, and so on. According to Bosselmann’s study, the smaller spatial dimensions offer more variations, more changes in directions and influences people’s perception of time and place. However, a high-density urban space enhances social interaction, strengthen the setting centrality, and reduces automobile use.

According to Kenney et al. (2005), an important issue to be considered in measuring the density is to pay attention to the human qualities of place, intensity of uses and potentials for intersections. An environment that provides opportunities for interaction appropriate to its size, location, and culture – even in small or rural settings – the advantages of density can be recognized. Within defined boundaries, a campus can be vital and liveable whether it is compact or sprawled. The issue to be noted is that the perception of compactness and vitality is the accumulation of many factors including landscape, architecture, visual context, and topography.

In many old universities, such as American college campuses, the historic campus core has a high density. The high density makes it possible for students to move easily between different spaces and buildings, increases the potential of encounters and social interactions, and strengthens the sense of place and identity.

Another key issue is creating a balance between the appeal for the durability of symbolic campuses and the need for change and expansion without shaping a scattered centerless amorphous precinct. The need for growth has been the main challenge of many universities that have found the solution in suburbanization, following the pattern of American Land-grant universities which were established in large rural territories. The balance also needs to be kept between the desire to preserve the open space and spreading out and increasing the density of built form. Based on their uses and typologies, some structures of the campus such as sport and athletic fields, recreation centers, large laboratories, have a larger scale than other campus buildings. These massive structures occupy a larger land area which creating a balanced density and vibrancy needs a different approach. Thus, mainly these facilities are located in far distances from the campus core and this dispersal increases the need for car uses.

As the campus exists within an urban fabric, it is more agreeable that the density of the campus core transit smoothly to the surrounding uses.

Any place has a level of acceptable density but “there is no ideal density. For any given activity, there is a range of densities outside of which conditions are likely to be substandard and within which there are a number of thresholds marking a shift from one character with its particular advantages.” (Lynch, 1971). Using the metrics, like Floor Area Ratio and building coverage, to assess the density in university campuses is a new phenomenon of the last two decades but does little with defining the vitality

of the campus space. Thus, density cannot be applied uniformly across the campus and it would be more meaningful to use it along with other criteria on a selected area. Moreover, undeveloped areas and uses such as surface parking lots should be excluded.

Furthermore, for more accurate assessment of the vibrancy of a campus in terms of density, it is essential to consider factors including proximity, centers of activity, and character of space (Kenney et al., 2005; Lynch, 1971). The proximity of buildings and uses is an essential aspect of a prosperous urban environment. It increases the chance encounters and idea exchanges which are critical for informal learning, interdisciplinary collaborations, and collegiality.

A center – may have low or high density – is an identifiable place because of attracting functions, having a symbolic significance like as an urban core, or having a higher development density. In any case, it is a place that attracts a large number of people and activities and embodies a high level of interactions.

Character signifies that various features of a setting are in harmony. The features of a place that influence the perception of density are the size of open spaces to the height of surrounding buildings, the distance between edifices, the extent of enclosure or openness, the transparency of facades, the built coverage, the sunlight, and greenery.

Clearly, density in the university campus is a relative concept and a campus with low density in a rural area may seem denser than a campus with the same density in an urban setting. However, some aspects including culture, context, campus layout, and walking distances are important in the perception of density. Although the density is a relative concept, it has a direct impact on liveability and vitality of campus space. In this respect, a campus core with a higher density is more acceptable, particularly in suburban and remote campuses, to create more potentials for social interactions and to generate more vibrancy. Considering the campus layout, green space, enclosure, mixed-use, human-scale are important items in creating vitality. Regarding the walking-distance dimension, there is not a fixed norm but generally, a walking distance circle of ten-minute between classes and fifteen to twenty-minute walking distance in outdoor spaces are considered desirable by designers. However, many contemporary universities have a large number of students and a large campus space which obligate distances more than the desirable walking distances. In this regard,

instead of creating a sprawled layout it is more acceptable to create some campus cores that can serve to the entire setting. Creating an acceptable density generates individual intersections which in turn enhances collegiality and sense of community. Of the problems with suburban campuses or campuses with very low density is the issue of safety and lack of sense of place. Furthermore, higher density and proximity of buildings affect the microclimates and energy consumption in a positive way. It also reduces the cost of construction of roads and preserves the land.

5.4.2.5 Walkability

It refers to the movement network within the precinct and underlines the need to have a functional, secure, and intelligible circulation system. Walking and cycling are two environmentally-friendly modes of commuting that support social interactions and fosters liveability. Walking is the healthiest mode of commuting that enriches the experience of place. A pedestrian-oriented campus encourages walking trends by arranging safe and attractive pathways, and proximity of functions. In the areas where pathways and car roads intersect, the priority must be given to pedestrian walkways and traffic should be slow down. Bicycling is another desirable mode of transportation. To promote the culture of biking, there is a need for bikeways and bicycle parking. If there is a local bicycle network, the university should be connected to it. The bike-sharing system is a new trend that encourages the biking habit of students.

A key issue that affects the walkability of a campus setting is the layout of the campus and the placement of different functions. If various facilities and uses are located in close proximity, it can be reachable by walking or biking. If a campus is very large, walking to all areas may not be realistic. However, increasing density, creating a mixed-use model and providing diverse on-site services can enhance the walkability. Existence of on-campus housing also promotes the potential of walking and bicycling. Furthermore, creating a pedestrian-friendly zone in the campus core with a well-designed landscape and a network of connected and well-ordered pathways is a good strategy to reinforce the walkability of the campus and enhance the liveability (Kenney et al., 2005).

Managing the automobile on campus is a challenging issue. In one hand, there is a need for the automobile for services and commuting and on the other hand, the dominance of the automobile, particularly in the heart of the setting, deteriorates the

vitality, safety, and collegiality of the campus and bring about environmental impacts. Existence of the automobile necessitates the availability of parking lots. Large parking areas, as isolated and fragmented spaces, can cause the loss of sense of safety. Christopher Alexander (1977) states that “Very simply – when the area devoted to parking is too great; it destroys the land ... it is not possible to make an environment fit for human use when more than 9 percent of it is given to parking.” However, on some campuses, the percentage may go beyond 30 or 40 percent of the land. The need for large parking areas threatens green spaces. However, in suburban or in low-density developments and areas with the shortage of public transportation means, the dependence on automobile is inevitable. However, totally eliminating parking areas is not a solution and a balance should be provided to support vitality, safety, sense of community, economics, and ecology.

5.4.2.6 Accessibility

Accessibility is a critical dimension that is highly dependent on the campus location within the urban fabric. In this research, accessibility concerns two main issues. The first one is the ease of access and arrival to the precinct by walking, bicycling or using various transportation means. The second one implies the level of permeability and porosity of the campus boundary.

Considering the first aspects, it is related to access to the campus from outside either to people or services and goods. So, accessibility means the ease of reaching the campus from different destinations and by using different commuting modes.

It depends on the campus position within the urban context, whether it is in-city campus or out-city campus, with a central or peripheral position. Being an urban campus with a highly central position provides easy access to the setting by walking, biking and even public transport. Being located within the urban fabric but in a far distance from the center or having a peripheral or out-city position, largely necessitates the existence of a well-connected public transportation means. Otherwise, personal car usage would increase which negatively affects sustainability. Concerning scattered campuses, although they have an urban location and even central position but the need to commute between different precincts and buildings may increase the need for travels that affects sustainability. Thus, the availability of various modes of public transportation is a key issue in enhancing accessibility and increasing sustainability.

Moreover, being accessible by walking or biking is the most desirable condition for a precinct.

Carpooling and car-sharing is a shared mode of transportation which reduces automobile usage and has positive environmental impacts. Shuttle system provided by universities, inside the campus and between proximate precincts or to the city center, contribute to sustainable transportation incentives. An important issue related to the efficiency of on-off-campus shuttle services is to consider the areas that students mostly live outside the campus.

Sustainable transport is described as “transportation services that reflect the full social and environmental costs of their provision; that respect carrying capacity; and that balance the needs for mobility and safety with the needs for access, environmental quality, and neighborhood livability”. Sustainable urban form is the one supporting walking, using the bike and public transportation means and considers compactness which inspires social interactions. It also minimizes energy consumption, emissions and waste and use of land, facilitates affordable and equitable access and boosts the vigorous economy.

The second aspect is the permeability of the campus boundary which depends on the type of campus edge. Permeability can be visual or physical or both. The type of campus boundary and its porosity influences accessibility, physically and socially. Campus boundaries may be limited by various human-made barriers such as buildings, walls, fences, highways, railways and etc. or by or natural barriers such as forests, rivers, hills, and so forth. Physical barriers are used as a means of controlling. They decrease the integration and interactions. Existence of physically impervious boundaries has a negative impact on the social dimension of a university campus and consequently on its liveability and sustainability. However, visual permeability allows the visibility between inside and outside the campus.

Clearly, a campus with a high level of permeability reinforces the accessibility and enhances interactions and communications. It has a very positive impact on the relationship between campus and the outside community and enhance the integration of campus to its proximate urban context. The campus entrances play an important role in increasing accessibility and also enhancing the sense of identity of the

university. A distinctive entrance with designed architectural and landscape elements creates a welcoming and attractive arrival space.

5.4.2.7 Connectivity

It indicates the extent of connectivity of movement network between inside campus and its surrounding urban context. Connectivity is to some extent related to accessibility and refers to the level of permeability of campus boundary which enables the connectivity between interior and exterior space of the campus.

Connectivity in urban fabric is a key issue for the urban space to be a living organism as can be observed in historic towns. The connectivity can be social and spatial. A high level of connectivity enhances people's movements and interactions. The connectivity is at the core of urban sustainability. Connectivity is a core attribute in creating a society. Society is very much reliant on people's interactions which mainly occur in movement networks. According to Salingaros (2005), two nodes in urban space can be connected with a single straight line but also can be connected through numerous curve lines. This is in congruence with the nature of human beings as people does not move on a straight line. These multiple paths are aligned with users' diversified activities (Salat, 2006). Connections can be physical or visual which not necessarily overlap. The notion of connection proposes the bond and relationship between the minimum of two nodes in urban space. Connection is the initiating basis of networks that are made of nodes, connections, and hierarchy (Salingaros, 1998). In a city, interaction occurs when the nodes are directly or indirectly connected to each other (Salingaros, 2005). Salingaros (1998) states that architecture attaches structural components and spaces together in order to achieve cohesion. Noticeable spaces that also provide a node for human activities function as a focus for paths and are successful, but architectural sites that do not support human activity are not successful and become isolated from the urban network. Thus, a vital and flourishing urban space is more than the mere juxtaposition of buildings and it is much more the matter of connection. The connectivity is achieved through the paths and the interaction of people and the exchange of information. The existence of edges and places of intersections and transitions such as porous surfaces, arcades, and colonnades between two pedestrian nodes reinforces the continuity while spaces such as highways and parking lots cause fragmentation. The transitional spaces stimulate flows, synergies, and exchanges. They also preserve the continuity between interior and exterior spaces.

Other types of transitional space that can be very much influential in university campuses are service and recreational spaces such as cafes, restaurants, shops, bookstores, galleries, exhibition spaces, student centers and so on. This sort of space function as an intermediary between campus residents and the community inhabitants. They increase the chance encounters and stimulate social interactions. Thus, they contribute to the flow of synergies between campus and adjacent urban space.

Edges can make the continuity of form and give orientation along their length. They define the sense of inside-outside. Edges can be barriers or allow visual or movement penetrations and motivate the exchanges between two sides. Thus, accessibility and connectivity become important issues (Lynch, 1960). The permeability and porosity of campus boundary play a key role in strengthening connectivity. Limits, boundaries, and edges are elements which creates exterior space. They are defining elements in integrating or separating the spaces. Positive space is delimited by intention, involves people's interaction, and has an established order, while negative space is limitless.

5.4.2.8 Integration

Integration in one hand implies the physical connection between campus and the surrounding urban context. But on the hand and much related to the purpose of this research is related to the social interactions and the outreach activities of the university towards its community. Whether a campus is situated in a suburban area, or a small town, or in a city center, the type of connection that is created between two domains differ. However, the campus-city relationship is a key issue to be achieved. When a precinct is located in urban areas, students and staff live in the district and uses the services provided by the city. This situation can strengthen the ties between the university and the city. Clearly, the availability of services such as affordable housing, public transportation means, and recreational and social facilities are important items in attracting students and staff. Furthermore, the vitality and physical prosperity of the neighborhood is an important issue. For instance, for a campus being located in a deteriorated area it is more difficult to attract prospective students or being situated in an expensive area may not be affordable for faculty to live nearby.

On the other hand, cities expect their universities to contribute to their prosperity. In this sense, universities act as engines of social, economic, and spatial development. They create partnerships with external partners and got engaged in diversified outreach

activities such as providing educational programs for the public, exchanging the research outcomes, innovation, and technology transfer, collaborating with industries and businesses, reinforcing spin-offs, setting seminars and conferences, offering various socio-cultural activities such as exhibitions and performances. They also share their facilities and amenities with the adjacent community. Much important, universities take part in the regeneration and transformation of their urban context. It can be done through the expansion of the university or indirectly participating in regeneration projects. The expansion of the university in the neighborhood is a historical issue in their relationship. The fact has been created many conflicts during the long history of higher education institutions. Thus, creating a prosperous and mutually relationship is a need to achieve a more flourishing urban space.

Another aspect is the type of boundary that the campus has with its surrounding context. Previously, it was more desirable to set a rigid and distinguishable edge between campus and neighborhood but today the porous and blurred edge is more acceptable. Doing so, shaping a permeable boundary and creating shared uses such as cafes and shops in the campus peripheries can enliven the neighborhood. Depending on the characteristics of the campus and the culture of context, various types of lively stratum between them can exist. The campus can contribute to the vibrancy of the proximate neighborhood by providing the research, residential, cultural, and commercial interfaces. Moreover, in campus development, the physical characteristics of the context should be respected. Form of the precinct needs to respond to its surrounding urban context. For instance, Cambridge University is interwoven with its residing urban fabric and thoroughly interacts with the river.

5.4.2.9 Sustainability

This dimension mainly considers the sustainability incentives of the university. Considering the urban form, it relates to planning and constructing in a sustainable way. Concerning the university's third mission, it also encompasses all the university's endeavor to progress in the sustainable pathways. It embraces several fields which are different for any university according to its mission and also the sustainability campus assessment framework that it pursues. But generally, it includes categories such as education and research, energy, waste, water, transportation, operation, physical setting and buildings, community outreach, and so forth. However, observing university masterplans and development statements, there are many similarities in their

sustainability strategies. Reducing energy consumptions, preserving natural resources, stimulating community engagement, are among the most stated strategies to create a more ecological campus. These strategies address a range of aspects related to campus form such as placement of buildings according to sustainability norms, constructing energy-efficient buildings, conserving the existing green landscape and developing more green areas, increasing density and compactness, reducing travel needs and using sustainable transport, using infill development strategy and so forth.

The landscape and green infrastructure are among key items in achieving sustainability. It encompasses nature as an integral part of the urban setting in a diversified open landscape. It supports biodiversity, controls erosions, improves the water quality of watersheds, provides habitat for animals, reduces energy costs, enhances physical urban space through reducing pollution, advances the image of urban space and quality of life, fosters economic vibrancy and provides a more pleasant urban environment (Jabareen, 2006). The availability of green spaces is a key factor in decreasing temperature in the summertime. There is a need for a minimum of 30% of the green area to have a cooling effect. If the green areas are connected to water and wind, the cooling effect will be increased (Salat, 2006).

According to Kenney et al. (2005), the landscape principles for a campus to be environmentally sound include:

- Working in harmony with local environmental assets, such as wind, sun, geology, water, and native plant materials.
- More effective use of outdoor lighting.
- Reducing the acreage of light-maintenance lawns and manicured land.
- Use of trees and other plantings to ameliorate both the inside and adjacent outside environments of buildings, lessening energy consumption.
- Use of water resources to mitigate pollution and to reduce heating and cooling costs.

Clearly, the environmentally well-designed campus landscape contributes to reducing energy consumption and maintenance costs and generates a durable and attractive campus setting in integrity with the surrounding environment. In addition to landscaping, other design aspects that support sustainability initiatives are building orientation and massing, intermingling functions with similar energy requirements, application of natural energy sources, usage of high-quality and durable materials.

Sustainability has a social dimension as well. In this regard, nurturing students as committed citizens and enhancing public awareness is one of the responsibilities of contemporary universities. Many universities consider themselves as leaders in teaching and developing environmentally responsible behavior. Promoting environmental responsibility is a part of the agenda and mission statement of many universities around the globe. They offer educational programs for their students, staff, and the general public. The environmental stewardship also has indirect positive learning outcomes and some direct financial benefits.

Being generators and disseminators of knowledge in the sustainability path, universities also have the opportunity to practice the sustainability principles in their precincts. Establishing an institutional sustainability agenda has a wide long-term impact rather than constructing individual environmentally friendly buildings. Defining a sustainable development plan is a good initiative in real measuring the sustainability performance of the university. Institutions practice their sustainability knowledge in their campus design and architecture. They also can integrate this concept in their laboratories and didactic materials and involve the students and faculty in the real practice of sustainability. A well-designed campus that creates a memorable environment, and reinforces collegiality and liveability can be also a green campus.

5.4.3 Developing a multi-criteria index

The proposed set of criteria has been developed as a table (Table 5.1). The table has two main parts. The first main section includes the nine main categories and twenty-eight sub-criteria and a scale column. The scale column describes each criterion and scores it in a 3-point Likert model, between 3 (the best), 2 (average), and 1 (the worst), according to the performance of the criteria. This section is the general part. The second section includes the description and the value columns which are specific for each case study. Each criterion is scored between 3 to 1 according to the general scale which has been described in the first section and the reason for scoring for each sub-criterion is explained in the description part. To provide a visual description, the values are illustrated in a color form in the last column. Based on the visual illustration, the green color signifies score 3, yellow color shows score 2, and red color points out to score 1. This scoring system by colors is used to make a visual and descriptive model of the main criteria for each university campus and enable making a comparison between case studies.

Table 5.1 : Liveability and sustainability multi-criteria assessment table.

<i>University Name</i>					
	Criteria	Scale	Description	Value	Color Value
Livability	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3= Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus central space.) 2= Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus core. 1= Different uses are not mixed and campus has isolated areas far from the campus central space.			
	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3= There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2= There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1= There are not any designed open spaces, and many spaces are abandoned without possibility to use.			
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines. 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces.			
	4. On-campus residences	Rating the availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2= There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.			

Table 5.1 (Continued) : Liveability and sustainability multi-criteria assessment table.

	5. Extra-curricular activity facilities for academic body	Rating the availability of extra-curricular activities such as recreation facilities, athletic fields, exhibitions, art and cultural spaces, etc. considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility. 2= Average level of facilities and their accessibility. 1= There is not any extracurricular activities on campus.			
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided within surrounding urban space in a very close proximity.) 3= High and well-distributed 2= Average and concentrated. 1= Not available retail services on campus.			
Legibility	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space, for instance existence of unique character in terms of natural and built landscape, historical heritage, availability of focal points at the end of the streets for orientation, hierarchy of spaces and routes, from 3 to 1. 3= There is a consistent and legible character in the entire campus. 2= Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity. 1= There is not a cohesion in entire campus space.			
	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3= There is a distinctive architectural design in the entire campus. 2= Campus space is quasi identifiable. 1= There is not a cohesion in campus architectural design.			

Table 5.1 (Continued) : Liveability and sustainability multi-criteria assessment table.

	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3= Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and clock towers in a well-designed way. 2= Existence of landmarks and art works around the campus. 1= No landmark exists.			
<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout in a way that campus has a designed spin and open spaces are well-designed and defined by built spaces. Different spaces are connected through a hierarchy of spaces including main corridors, courtyards. Campus has a core space with defined open spaces or plaza with landmarks, enclosed open spaces, designed landscape elements and the entire campus layout is relatively symmetric and geometric. 2= The campus has neither planned, in the mentioned way, nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1= The campus has an unplanned layout.			
	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high level of morphological cohesion and consistency with the surrounding. 2= Campus is inserted within urban fabric with complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban space with no morphological consistency.			

Table 5.1 (Continued) : Liveability and sustainability multi-criteria assessment table.

<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying adaptive reuse and infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1= Occupying smaller and highly sprawled sites within the urban fabric far from each other.			
	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and the new constructions are mainly located within the existing developed areas. 2= Medium density. 1= Low density			
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking areas within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities. 2= The large parking areas are located in the campus periphery without fair distribution distance to all facilities or smaller parking inside campus. 1=There is not any available parking area. (Parking structures are not considered.)			
	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3= Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions. 2= Average continuity and organic distribution of paths. 1= Low continuity and not designed paths.			
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3= There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2= Medium availability. 1=No bike routes.			

Table 5.1 (Continued) : Liveability and sustainability multi-criteria assessment table.

	17. Car roads	Rating the availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space. 2= Medium accessibility and distribution within campus space. 1=Low accessibility and distribution.			
<i>Accessibility</i>	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3= Available inside campus 2= Available in campus vicinity. 1= No availability			
	19. Public transportation mean	Rating the availability of public transportation means inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3= High availability in a short walking distance. 2= Medium availability. 1= Low availability.			
	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3= There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible. 2= Medium accessibility. 1= Low accessibility.			
<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1. 3= Highly physical permeability without a physical. 2= Semi-closed boundary and medium visual/physical permeability. 1= Closed boundaries and impervious.			
	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, etc., from 3 to 1. 3= High availability. 2= Medium availability. 1= No transitional spaces.			

Table 5.1 (Continued) : Liveability and sustainability multi-criteria assessment table.

	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersections in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3= High continuity with high number of intersections campus is completely integrated with the surrounding. 2= Average continuity with average number of intersections. 1= No continuity			
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position. 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery). 1= Outside the city and completely detached.			
	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available. 2= Medium availability. 1= No availability.			
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3= Highly available. 2= Medium availability. 1= No availability.			
<i>Sustainability</i>	27. Green infrastructure	Rating the availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3= Highly available. 2= Medium availability. 1= No availability			
	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process. 2= In programming process. 1= No initiative.			

5.4.4 Histology atlas of campus form

5.4.4.1 Atlas of histology

The Histology is a branch of biology that examines the microanatomy of cells, tissues using a microscope. This method aims at identifying and visualizing the microscopic structures of tissues and assess the correlation between structures and function. Thus, “Histology Guide teaches the visual art of recognizing the structure of cells and tissues and understanding how this is determined by their function.” (<http://www.histologyguide.com>).

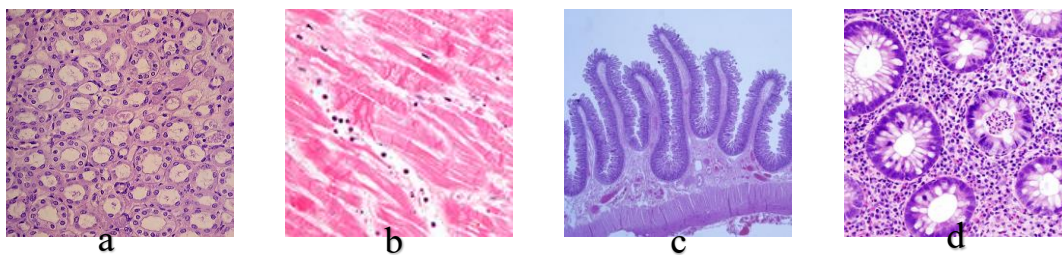


Figure 5.2 : Histology of Human Tissues (Url-5).

5.4.4.2 Developing a Histology Atlas of Campus Form

Grounded in the Histology Atlas in biology, a “Histology Atlas of Campus Form” has been developed (Figure 5.3). The proposed Histology Atlas illustrates the set of sustainability and liveability criteria of campus form in a schematic way. In this sense, the visual dimension of each criterion and its performance level has been demonstrated in three levels between the best, the average, and the worst performance situation.

Developing the Histology Atlas of Campus Form makes it possible to evaluate the campus spatial maps and score them for each criterion in a base of three-point Likert scale.

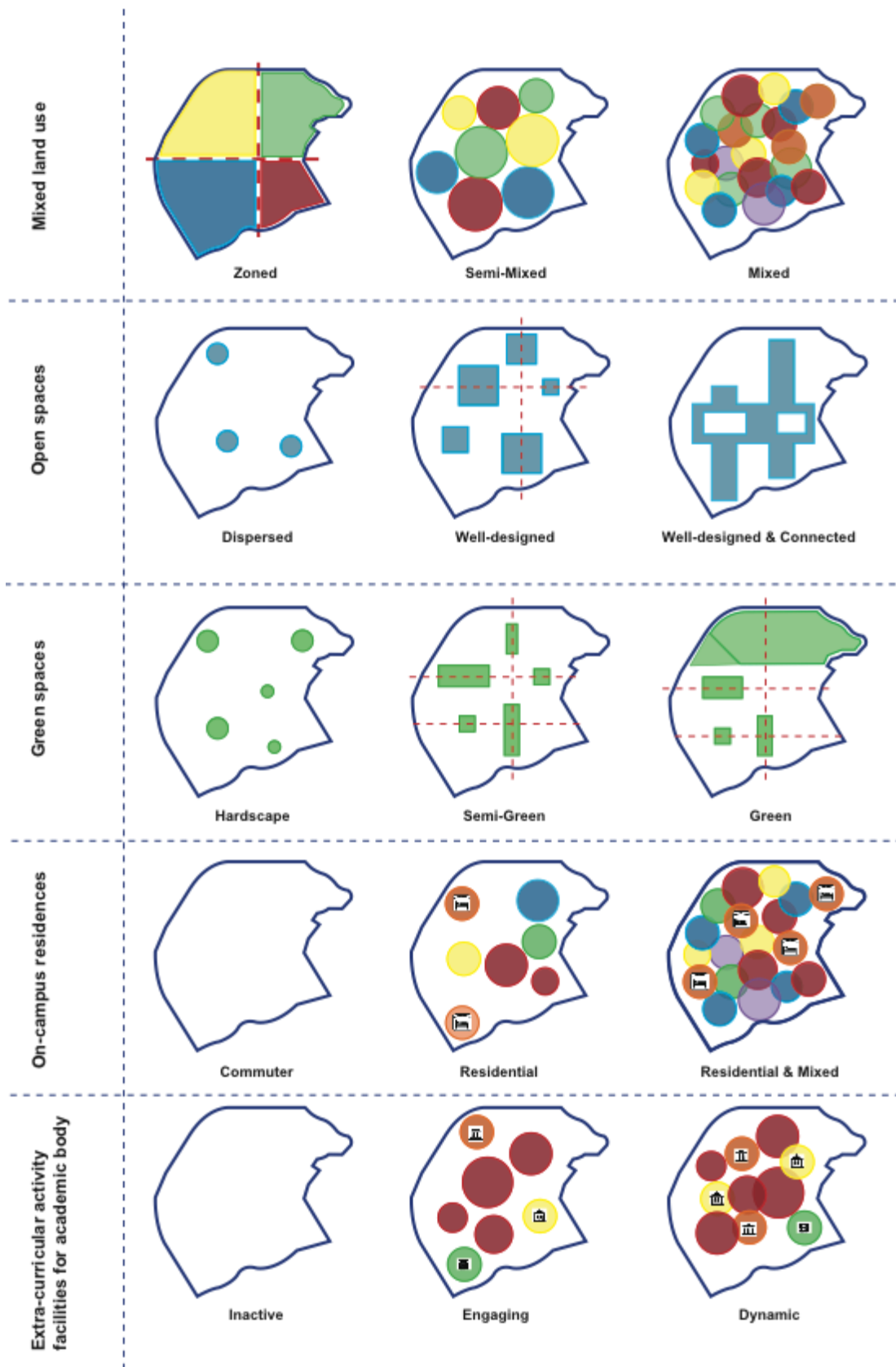


Figure 5.3 : Histology Atlas of University Campus Form.

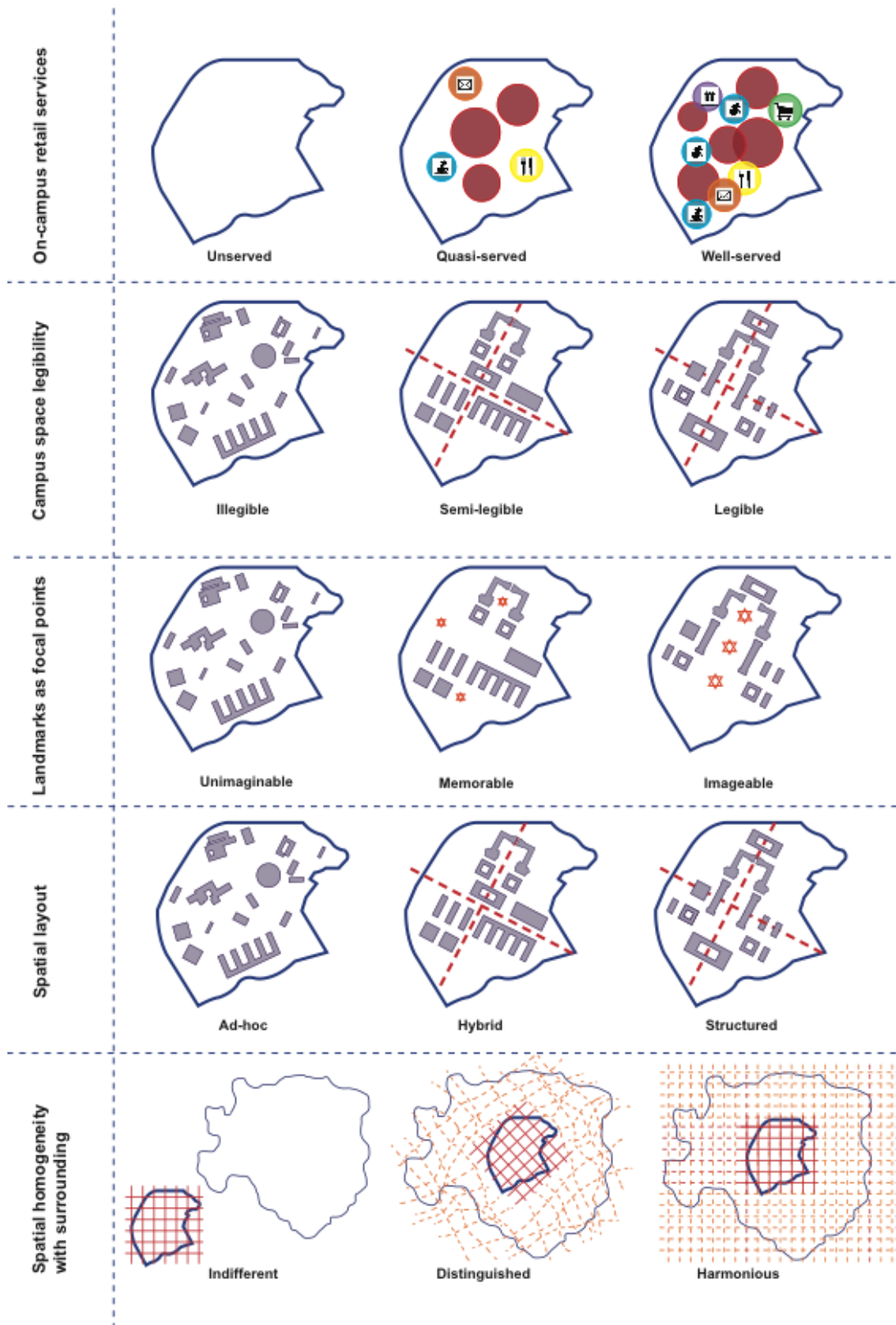


Figure 5.3 : Histology Atlas of University Campus Form.

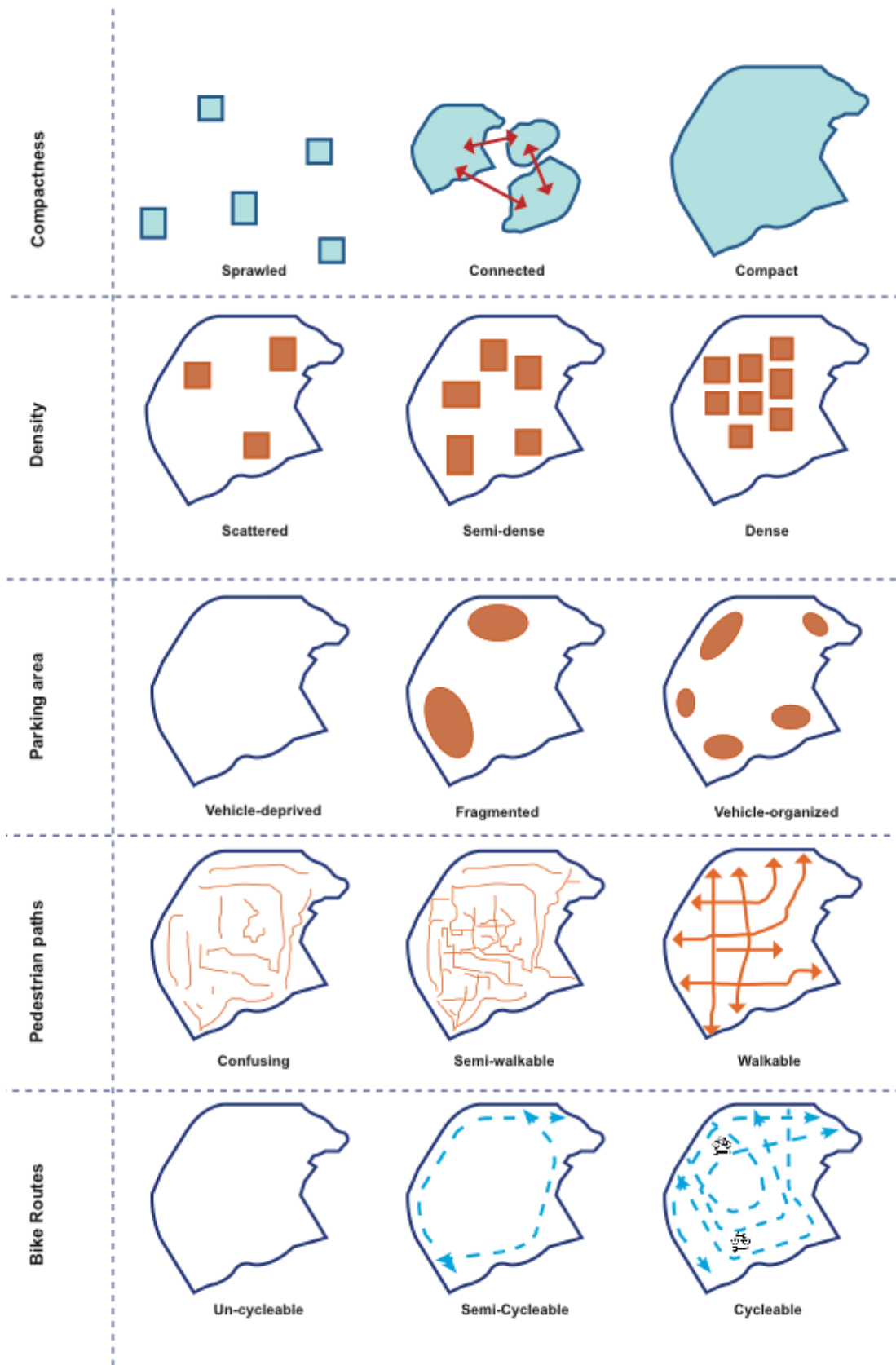


Figure 5.3 (Continued) : Histology Atlas of University Campus Form.

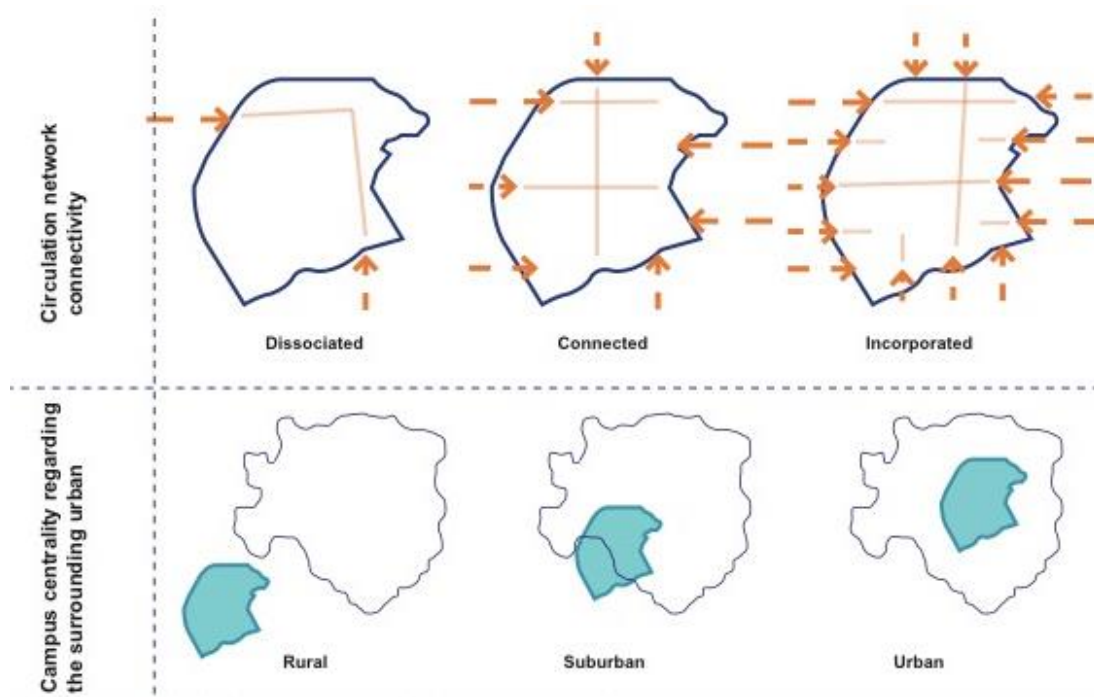


Figure 5.3 (Continued) : Histology Atlas of University Campus Form.

5.4.5 Case study analysis

To operationalize the model, multiple case study analysis has been conducted. It provides a better understanding of the proposed model and enables testing the developed set of criteria through analyzing a wider set of university campuses and making comparisons between them. This process uses an exploratory analysis, based on the acquired data through various modes of data collection and analysis, and generates a descriptive and interpretative analysis.

Data collection and case study analysis apply a systematic procedure. In this respect, fifteen university campuses were selected addressing the defined six typologies of university campuses. The case studies were selected from different climates, cultures, and social contexts and do not signify a specific geographical, social, environmental class. They are among the best representatives of their typology with a significant issue regarding their mission, vision, morphological attributes, and campus planning approach to be emphasized.

Primarily, the documents, existing literature, university websites, annual reports, campus planning reports, maps, masterplans, and campus development statements are examined. Then, for each case study, morphological analysis and an in-depth study have been implemented and the university campus history, development processes,

third-mission activities are analyzed. Then, spatial analysis is applied for each university campus. To do so, Campus masterplans, Google maps, Google Earth maps, Openstreetmaps are used to achieve more accurate maps of the current situation of each campus. Then, several spatial analysis maps are developed that address the proposed set of criteria. The produced spatial analysis maps are re-examined qualitatively according to the criteria set. A sustainability and liveability assessment table are developed for each university campus that comprises the qualitative description of each sub-criterion based on the maps and the morphological studies of the campuses. The produced analytical maps and the descriptive sustainability and liveability assessment tables for the fifteen case studies have been demonstrated in the Appendix B.

6. CASE STUDY ANALYSIS

6.1 Campus Form Modeling and Analysis

This chapter focuses on applying the proposed set of campus form sustainability and liveability criteria on the selected case studies. In this respect, fifteen university campuses have been selected addressing the six defined typology of university campuses. The case studies have been selected from different climates, cultures, and social contexts and do not signify a specific geographical, social, environmental class. They are among the best representatives of their typology with a significant issue regarding their mission, vision, morphological attributes, and campus planning approach.

Table 6.1 : List of Selected University Campuses as Case Studies.

Campus Typology	University Name	Location
Detached Campuses	Simon Fraser University	Canada
	Universiti Teknologi Petronas	Malaysia
	EPFL	Switzerland
Attached Campuses	ETH Zurich	Switzerland
	Utrecht University	The Netherlands
	UC Berkeley	United States of America
Rurban Campuses	Stanford University	United States of America
	University of Virginia	United States of America
	Trinity College Dublin	Ireland
Gated Campuses	Santralistanbul, Bilgi University	Turkey
	Harvard University	United States of America
Integrated Campuses	MIT	United States of America
	Free University Berlin	Germany
Scattered Campuses	University of Bologna	Italy
	Uppsala University	Sweden



Figure 6.1 : The geographical distribution of selected university campuses.

6.2 Case Study Analysis

6.2.1 Simon Fraser University

Typology: Detached Campus

University Name: Simon Fraser University

Campus Name: Simon Fraser University

University Foundation: 1965

Campus Establishment Date: 1965

Plot Area: 165 hectares

Student Number (2017): 34,990

Location: Burnaby, Canada

City Population of Burnaby: 232,755

City Area: 98.60 km²



Figure 6.2 : Aerial view of Simon Fraser University (Url-6).

6.2.1.1 University campus development background

The Simon Fraser University Burnaby campus has been situated on the top of the Burnaby Mountain, 8 kilometers from Burnaby center, the nearest city, and in the 20-kilometer distance from the center of Vancouver. It is isolated from the city of Vancouver and is well nestled within its landscape.

From the beginning, the campus physical design was considered as a key by its chancellor Dr. Gordon Shrum. He describes their intention and campus design priorities as “We have a general artistic responsibility to the whole public to create buildings that set a high standard of beauty and efficiency.” The inspiring design of the campus conveys the philosophy and aspirations of the modern higher education system of Canada. So doing, a competition was held for the campus design and main design criteria were defined by Shrum including continuity of spaces that students can move within spaces without the need to go outside and also grouping all spaces such as lecture halls rather than sprawling them around the site to create a wholeness. Arthur Erickson was chosen as the designer of the campus and his design has awarded several prizes as a most innovative campus design. The key aspects of his design are getting inspired by the landscape of the hilltop and organizing the space in a horizontal shape instead of multi-story buildings. In this way, campus design has valued the topography of the terrain. It has been shaped in the form of various terraces sounds like melting into the existing landscape and creating great vistas. It was inspired by the Acropolis and hill towns of Italy to incorporate mountain to design. Another innovative aspect of the design is that it praises the informal knowledge exchange and the interdisciplinary work rather than the formal and hierarchical atmosphere. The campus layout has been organized according to the use; educational, residential, social, and recreational instead of zoning considering the departments.

In this manner, buildings rather than spreading around the campus, have been aggregated in a large single building that creates a linear spine of the campus and all building are attached to it. The majority of academic spaces has been placed in the central Quadrangle, the visual hub of campus, which through the steps is connected to the covered mall. This mall is the heart of campus and functions as the hub for social gatherings and ceremony space. The student center, library, theatre, coffee shops, etc. are linked to it. Considering the climate of Canada, most of the academic, recreational, and service spaces are connected through covered pathways. This particular path

creates an opportunity for socialization and informal knowledge exchange. The campus design has considered future expansion. The planning of campus has been developed as a clustered and compact form in the core, expanding outwards. So doing, the surrounding landscape which is a rich forest hill has been preserved and will be used in case of need.

The campus embeds within its body various amenities including swimming pool, gyms and sports facilities, malls, libraries, theatre, museums, galleries, technology and science centers, and residential building. These facilities in addition to educational and administrative buildings have expanded on 1.7 km² land area.

The UniverCity village established in 2000 adjacent to the campus to support the lack of accommodation facilities in Burnaby hill. It is a mixed-used community district and has been awarded for sustainable planning and development. It is composed of four neighborhoods that offer diversified housing for the community from low to high-income group in addition to providing affordable housing. The residential building types encompass village-like low-rise buildings and mid to high-rise buildings.

UniverCity embeds many different facilities including a school, childcare, shops, cafes, restaurants, and many arts and cultural activities. It is connected to the city with four bus routes and also it offers electric vehicles and the car-sharing system as sustainable transportation means. The residents are served by Community cards that enable them to use facilities of SFU such as library, museum, gym and sports facilities.

6.2.1.2 Sustainability and urban outreach activities

Considering sustainability initiatives, Simon Fraser University embeds a Sustainability office within its body that supports developing and applying sustainability strategies. It monitors and assesses sustainability progress of the institution. SFU promotes and conducts various sustainability projects and collaborates with external partners in this regard.

Economic, social and environmental sustainability is an institutional priority project in different dimensions of the university including education, research, operations, administration, planning, and community engagement. SFU is a member of AASHE university sustainability assessment and it has also achieved several sustainability awards. UniverCity has been awarded for being a sustainable urban development project.

Simon Fraser University offers a wide range of outreach services. It has several educational programs for the public such as Public knowledge project. It collaborates with government and industry and offers a shared platform for cooperation. It conducts different programs and projects for community engagement such as the public square. A wide range of social and cultural activities, events, exhibitions, meetings, seminars, festivals are offered by Simon Fraser University (SFU Website).

6.2.1.3 The city

The city of Burnaby is situated proximately at the east of Vancouver. It is the third-largest city in British Columbia, Canada with a population of 232,755 and urban area of 98.60 km². It has been located between Situated between the city of Vancouver on the west and Port Moody, Coquitlam, and New Westminster on the east, and is constrained by Burrard Inlet on the north and the Fraser River on the south. It embeds several industrial and commercial companies. It has also a high ratio of green space.

Considering the urban fabric, it has an orthogonal grid spatial structure in most of the parts.

6.2.2 Universiti Teknologi Petronas

Typology: Detached Campus

University Name: Universiti Teknologi Petronas

Campus Name: Universiti Teknologi Petronas

University Foundation: 1997

Campus Establishment Date: 1997

Plot Area: 400 hectares

Student Number (2017): 7200

Location: Seri Iskandar, Perak, Malaysia

City Population of Perak: 2.48 million

City Area: 21,035 km²



Figure 6.3 : Aerial view of Universiti Teknologi Petronas (Url-7).

6.2.2.1 University campus development background

The Universiti Teknologi Petronas (UTP) is a private research university located in Perak, Malaysia. It was founded in 1997 and funded by oil company Petronas as a part of the plan to transform Malaysia into a developed nation by 2020. The main objective of the university was merging the scientific mission with cutting-edge industrial quality to nurture a highly qualified workforce for the industrial development of the country. It is honored Aga Khan architectural awards in 2005-2007 award cycle because of combining the academic education with hands-on experience, approaching the campus planning like a town-planning project, shaping medium-size buildings and blending various uses.

The site is near Bandar Seri Iskandar which is identified as a strategic regeneration zone and lies within the commercial corridor in a 30-kilometer distance from Kuala Lumpur. The university is situated in the proximity of a new administrative town and aims at stimulating economic growth and being the catalyst for regional development. The 1000-acre piece of campus land is a former woodland reserve with a rich plant species. It has been selected as a mean for the region to be competitive in the global knowledge economy. A large portion of the physical setting, 275 hectares, comprises tropical jungles with hills and valleys. The remaining 125 hectares are plain land with lakes formed by flooding disused mines that are used for university buildings. There is a 110-meter of height difference between the highest and lowest parts of the setting.

The campus structures have been designed as a whole cloth project. Various land uses are mixed including the academic, communal, and residential areas which create the campus identity and enables the future growth of the university.

The initial master plan was proposed by Arthur D Little in 1998. It is a star-shape concept diagram as a symbol of quality and excellence. It intended to express the vision of the university, site, and program. It provided the base of the plan to place different facilities and begin the initial design, which was then advanced by Foster & Partners with the collaborating GDP Architects in 2002. The plan expresses a spatially innovative approach to be adapted to the local climate and be in congruence with the physical landscape.

The masterplan includes main buildings; academic teaching buildings; lecture theatre and tutorial spaces; ancillary banking, retail, religious, social and sporting function; housing for all students and lecturers.

The main academic core is composed of five crescents and shape a radial geometry of the scheme within a park-like setting. The landscaped park is enclosed at the center of this structure. The teaching and research functions are placed in four-story blocks at the edge of the canopies. The plan highly emphasizes on the juxtaposition of the academic facilities, laboratories, workshops and sports facilities to create a multi-disciplinary educational experience. The student amenities such as lecture halls, student entertainment, student union, and student support facilities are located in four-pocket buildings at the four strategic nodes where the crescents encounter.

The drum-like Chancellor Complex is the signature edifice of the site which embeds the main auditorium and the resource center and central administration building. The two halves are linked by a covered public plaza, as the social hub of the campus. The pedestrian walkways link the entire project and merge in this public plaza. The sweeping ‘mega canopy’ roof is the eminent component of design and protects the pedestrian pathways from wind, sun, and heavy rains. Considering the climate conditions, the distance to walk between classes is 10-minute or 800-meter which creates a pedestrianized and efficient campus.

The arrangement of the development is based on the study of the following principles:

- Organization: Organize buildings to facilitate hands-on, multi-disciplinary learning
- Flexibility: Incorporate strategies to allow future campus growth and change

- Pedestrian-friendly: Recognize walking as the predominant form of movement on campus
- Accessibility: Provide disabled access throughout the campus
- Infrastructure: Concentrate facilities to minimize infrastructure cost
- Connection: Provide roads and walkways to the surrounding community
- Staff housing: Encourage investment in the community through off-site staff
- Housing policy
- External impact: Provide a strong visual impact from both Highway 5 and the SIDEC development
- Internal experience: Create an attractive cohesive campus image, a 'great place to be'
- Site features: Incorporate positive site features into a clear campus concept
- Landmarks: Locate significant buildings (library, mosque, etc) in prominent locations
- Covered walkways and concourses: Provide a connected system to shelter from the sun.

The campus entrance is through a ceremonial road along the landscape and lake before arriving at the Chancellor Complex. It creates a splendid backdrop for the vista along the landscaped road. Along the ridge-line, there is a place where the topography breaks and access to the setting are possible from that part without ruining the environment.

There are very few references to the native architectural tradition except the clay-tiled pitched roofs of existing campus buildings and the recent student housing. There is also a high-quality mosque as an icon of Islamic tradition.

The radial form uses the topography of the site to locate five major axes along which components of the university are structured. This concentrating form of the academic core within the valley intends to protect the natural topography of the setting. It reduces disruption to the site, separates the new campus from the existing one while allowing some existing structures to be reused, and provides a well-organized and walkable core campus. It also offers the flexibility for long-term expansion by preserving several open axes and offering the potential to create ties with the proximate uses. In the future development plan, it was anticipated to construct a stadium and a mosque which will be commonly used with the inhabitants of the new projected SIDEC town. New student residents are situated at the northern part of the academic core adjoining the

current residences. Further dormitories will be constructed in the next phases. For the long-term development, it has been proposed to construct research facilities in the southwest of the setting and it will form an intermediate area between the existing campus and the projected new town. Considering the landscape, it was intended to remove less than thirty percent of the flora and minimize the impact of constructions on the environment and integrating with the topography.

6.2.2.2 Sustainability and urban outreach activities

UTP has focused on three pillars of sustainable development (economic, social, environmental) for sustainable growth in both inside and outside of the university, society, and country. Its focus areas are Enhanced Oil Recovery, Carbon Dioxide Management, Deepwater Technology, Nanotechnology, Green Technology, Biomedical Technology, Hybrid Energy Systems, Intelligent Cities and Sustainable Resources. It has awarded a 5-star rating by the Malaysian Research Assessment Instrument for research, development, and commercialization.

UTP has an established institute to carry out the sustainability initiatives naming Institute of Self Sustainable Building. In congruence with the global sustainable development goals, UTP has launched the UTP Eco Project, a student-led endeavor, that is supported by Institute of Self-Sustainable Building. It is engaged at collaborating with external stakeholders to endorse sustainable development initiatives and promote a green lifestyle on campus.

6.2.2.3 The city

Seri Iskandar is a town located in Perak which is the fourth-largest state in Malaysia. It is one of the wealthiest states of the country and famous tin-mining activities that has a large influence on the state's economy. Considering the urban fabric, Seri Iskandar has a grid structure diffused within greenfield.

6.2.3 EPFL (École Polytechnique Fédérale de Lausanne)

Typology: Attached Campus

University Name: École Polytechnique Fédérale de Lausanne

Campus Name: EPFL (École Polytechnique Fédérale de Lausanne)

University Foundation: 1853

Campus Establishment Date: 1978

Plot Area: 62 hectares

Student Number (2017): 10,686

Location: Lausanne, Switzerland

City Population of Lausanne: 139,056

City Area: 41.37 km²



Figure 6.4 : Aerial view of EPFL University (Url-8).

6.2.3.1 University campus development background

EPFL is a public research university located in the French-speaking part of Switzerland in Lausanne. The history of EPFL can be traced back to the establishment of the Ecole spéciale de Lausanne in 1853 which then affiliated to Académie de Lausanne in 1869 and became a technical department. In 1890 the Académie transformed to be a university, EPUL (Ecole Polytechnique de l' Université de Lausanne). In 1969, EPUL was divided into two institutions UNIL (University of Lausanne) and EPFL (Ecole Polytechnique Fédérale de Lausanne). Though, EPFL officially initiated to function separately as a federal institute with 1400 students. The primary phase of current campus construction of EPFL and UNIL (they are located adjacent to each other in the outskirts of city in 6-kilometer distance to city center) was started in 1978 in the south-west suburb of Lausanne beside the Lake Geneva. The campus has been developed within several phases. As a result, the current 65 buildings

of campus embraces different architecture types. Between the 1970s and 1980s, modularized edifices were constructed. In the 1990s, some institutes and the Scientific Park was added to the campus. The modern period was between 2002 and 2004 when EPFL revised its structure to big schools to emphasize transdisciplinary cooperation. In 2010, a new library and prominent Rolex Learning Center were built. The Rolex Center is a multi-functional space in the core of the campus and embodies the areas for leisure, work, and service. In 2014, the campus was expanded and the Swiss Tech Convention Center and the Quartier Nord (which includes the students' residences and shopping areas) were constructed. The Artlab was inaugurated in 2016, composed of three parts as a space open to the public. It mainly includes museum exhibitions, music archives, and Festivals, and scientific expositions. The campus also comprises various facilities including restaurants and bars, conference centers, libraries, museums, banks, and student housing. There is also a sports facility on the shore of Lake Geneva which is shared by EPFL and the University of Lausanne. EPFL is the first higher education institution who acquired the International Sustainable Campus Excellence Award.

6.2.3.2 Sustainability and urban outreach activities

EPFL has a very well record of sustainability initiatives among higher education institutions. It has been achieved several sustainability awards including the Fondation Nature & Economie for the quality of its exterior design and the promotion of biodiversity in 2002, ISCN Excellence in Construction Award, as a reward for forty years sustainable buildings in 2009, Prix Vélo pour Entreprises cyclophiles, as a reward for the overall measures in favor of cycling on the campus in 2009, and The Imprim'Vert label certifies the actions taken by EPFL Repro to reduce the environmental impacts of their activities. The sustainability activities of EPFL supports environmental management including energy, waste, biodiversity, food, health and safety, mobility, equity, teaching, and research. It has an established Act for Change Lab since 2007 that promote sustainability in EPFL.

6.2.3.3 The city

The city of Lausanne is a city in the French-speaking part of Switzerland and is located on the shore of Lake Geneva. It is the fourth-largest city in the country with a population of 139,056 and the area of 41.37 km². The city is a focus on sports and known as the "Olympic Capital" since 1994. It is also the smallest city in the world

that have a rapid transportation system. Considering the urban fabric, it shows an organic structure in the suburban area surrounded by green lands.

6.2.4 ETH (Eidgenössische Technische Hochschule)

Typology: Attached Campus

University Name: Eidgenössische Technische Hochschule

Campus Name: Hönggerberg

University Foundation: 1855

Campus Establishment Date: 1961

Plot Area: 47 hectares

Student Number (2017): 20,607

Location: Zurich, Switzerland

City Population of Zurich: 415,215

City Area: 87.88 km²



Figure 6.5 : Aerial view of ETH Hönggerberg campus (Url-9).

6.2.4.1 University campus development background

ETH is a federal institute founded in 1855 and entitled as a polytechnic institute. The motto of the university is “welcome tomorrow”. So, from the outset, it has aimed at being a driving force for Swiss industry, innovative products, and services.

ETH comprises two campuses; the Zentrum campus which initially established as an outside-city campus in 1858-1864 and now is located at the heart of the city because of urban expansion and it is well integrated with the city. Later, the shortage of available space in city core for expansion of ETH Zentrum resulted in the foundation of the second campus, Höggerberg, in 1961. Höggerberg campus is located on the hilltop at the northern outskirts of the city. Initially, Höggerberg campus was established as an enclave at the periphery of Zurich, separated from the urban fabric. It has embedded all the functions including educational, research, residential, recreational facilities, and spin-off activities. The redevelopment project of Science City was introduced in 2003 which won the European Cultural Award in 2010 for linking science, industry and the public. The project transformed the originally mono-functional campus to an urban district which functions as an interface between academia, industry, and the general public. The transformational project proposed by KCAP. The masterplan is very flexible with the capability to address the continuously changing needs of the science, economy, and university without destroying the cohesiveness of the campus. The framework mainly develops set rules as a means to control the development. The design concept is very minimal. There are faculty clusters which are merged by housing and create a mixed-use district. The residential, retail, sports facilities, business start-ups, and other services are arranged around diverse quarters. There is a conference center, library, and a multifunctional space for exhibitions and meetings that have been added to the campus in the development project. All of these functions are accessible to the public and create an inviting and liveable setting for studying, living, and working. To do so, masterplan applies a radical mix of uses with zones open to the public, and residential blocks in the proximity of laboratories and offices and sport recreational amenities. This fact enhances the interactions and exchanges of ideas.

Science City assists ETH to introduce itself as a paramount university in technology. The concept of Science City is well manifested in all of the layers of the university from didactic and research programs and third mission activities to physical organization. It influences all of the university's activities to interact and communicate with its hosting city and the broader world. Networking is at the core of the Science City concept. The ETH Science City concept praises integration and densification. It has a clear structure recalling the initial masterplan and is divided into four districts

and the new communication axis of Congress and Meeting Boulevard which is perpendicular to the original campus axis. The principle idea is the intermingling of built and open space and internal courtyards. The well-designed public spaces are enclosed by buildings which along with sightlines create a cohesive, legible and permeable setting. The spaces are connected to enhance connectivity in the campus tissue. There is a fluid transition between spaces which increases potentials of interactions. Therefore, these qualities result in the creation of an attractive science hub which is future-oriented and flourishing urban district.

6.2.4.2 Sustainability and urban outreach activities

Sustainability has a long tradition at ETH Zurich. ETH Zurich has a living commitment to sustainable development in its four core areas of activity – Research, Teaching, Campus, and Dialog with Society. Through its Research, ETH Zurich furnishes the technical and scientific know-how required for sustainable development. ETH Zurich also trains the next generation of scholars that advocates for sustainable development (Education). ETH Zurich reflects the principles of sustainability by integrating them into the administration and planning of its Campus. Finally, it informs the public about its latest research results (Dialog). ETH Zurich is thus contributing in many ways to achieving the United Nations’ sustainability goals (SDGs) of Agenda 2030. ETH Zurich has compiled all of its sustainability reports in accordance with the international Global Reporting Initiative (GRI) standard and taking into account the Sustainable Campus Charter of the International Sustainable Campus Network (ISCN).

6.2.4.3 The city

The city of Zurich is the largest in Switzerland with a population of 415,215 inhabitants and is located in the German-speaking part of the country. The city has a significant role in Swiss life by offering research and educational and cultural activities. It is also a prominent financial hub in the global context with a large number of leading banks. There are also numerous scientific institutions that change the city to a leading Science City.

6.2.5 Utrecht University

Typology: Attached Campus

University Name: Utrecht University
Campus Name: De Uithof
University Foundation: 1636
Campus Establishment Date: 1958, 1988 Redevelopment
Student Number (2014): 30,374
Plot Area: 273 hectares
Location: Utrecht, the Netherlands
City Population: 345,080
City Area: 99.21 km²



Figure 6.6 : Aerial view of Utrecht University (Url-10).

6.2.5.1 University campus development background

Utrecht University has been established in 1636 in Utrecht, the Netherlands and is one of the oldest universities of the country. It is one of the most influential institutions at the golden age of Dutch science. It has consisted of seven faculties, two of which have an inner-city position and five of them are located in De Uithof campus on the periphery of the city. De Uithof campus is located at the outskirts of the city in a greenfield site. It has been surrounded by a six-lane highway in two sides that restrict its connection with the adjacent city.

The primary edifices of the university have been founded in the urban center of Utrecht which now houses the Humanities and Law faculties. The historical buildings of the university, particularly the University Hall, are among the most admired places of the city. Later in 1960, the university expanded beyond its in-city site and two new campuses, the University College Utrecht and De Uithof, were established on the

outskirt of the city. Initially, it has the common characteristics of post-war universities such as ad-hoc planning, isolated and lifeless setting, and flavorless architecture. However, with the new phases of the redevelopment, it has been transformed into a very vibrant and award-winning university campus environment.

De Uithof campus has been developed in three phases. The primary phase took place between the 1960s and 1970s and mainly consisted of large Brutalist concrete buildings that were dispersed around the site and had a very low density.

The second phase of development last till the end of the 1980s and was mainly filling the spaces between the buildings in a piecemeal manner to respond the immediate needs. The aftermath of this period was fragmentation and a lack of consistency and harmony. The site was desolate and surrounded by a six-lane highway with no stimuli to live and work. The third phase of campus redevelopment carried out by OMA in 1988 that transformed the campus from an isolated commuter campus to a residential vibrant learning space. The new masterplan encouraged the merging of various functions to promote social interactions. The new redevelopment plan highlighted densification and clustering of buildings and programs and also reinforced the existing landscape of the setting.

It was emphasized on the common use of facilities such as laboratories and many communal functions were clustered. Educatorium (1997) is a shared facility and a hybrid structure embedding large examination and lecture halls, supermarket, cafeteria and restaurant which mainly act as a hub for social interaction of students and faculty.

The science park also is an important component of the campus which give space to spin-offs and industries. The regeneration of the campus to a vital academic hub was accredited with the transfer of the main library from the urban center to De Uithof campus in 2004. Moreover, the construction of student housing transformed it from a commuter campus to a vibrant residential campus. For instance, since 1992, residences for 3000 students were constructed.

The campus has a dense, heterogeneous, and polyvalent configuration with orthogonal grid movement network. There is a contrast between the dense cluster of buildings, which is named the "casbah" zone, and the open landscape of the site and the surrounding rural area. This issue gives a particular identity to the campus. The central

axis of the campus has been transformed into a very vibrant corridor that stimulates public life and also provides access for the vehicle movement.

Today, De Uithof campus is a hub for innovation and forward-thinking learning environment. It is a very good example of how location and campus planning strategies can create a desolate environment or a vibrant and liveable setting.

6.2.5.2 Sustainability and Urban Outreach Activities

Research on sustainability at Utrecht University is very significant and supports many diverse fields. Having the distinctive mix of high quality fundamental natural science research, modeling, and scholarship in innovation, transition, governance, and finance, Utrecht University, as a broad research university, is a leader of innovation in sustainability research. It focuses on recognizing and understanding transformative pathways in four hubs: Future food, Industry with negative emissions, Transforming infrastructures for sustainable cities, and Water, climate, and future deltas.

6.2.5.3 The city

The city of Utrecht with 345,000 populations and the area of 99 km² is one of the largest cities of the Netherlands. It has an atmosphere of a student town and the rural landscape. Its several canals and the picturesque downtown are key characteristics of the city.

6.2.6 University of California, Berkeley

Typology: Rurban Campus

University Name: University of California, Berkeley

Campus Name: UC Berkeley

University Foundation: 1868

Campus Establishment Date: 1873

Student Number (2017): 41,910

Plot Area: 72 hectares

Location: Berkeley, United States of America

City Population: 112,580

City Area: 45.82 km²



Figure 6.7 : Aerial view of U.C. Berkeley (Url-11).

6.2.6.1 University campus development background

The University of California is a public research university established in 1868 with the aim of “to contribute even more than California's gold to the glory and happiness of advancing generations.” UC Berkeley campus comprises about 499 hectares of land area which from that the main campus is 72 hectares and the large remaining area includes the facilities of science laboratories and research centers, Lawrence Berkeley National Laboratory, Lawrence Hall of Science, and University of California Botanical Garden. The campus of the University of California at Berkeley is one of the best instances of American campuses in the 19th century which attempted to create an identity for higher education in the United States. It signifies an emblem of European architecture and the spirit of the New World. California in those days was considered as the promised land of opportunities where its spectacular nature and existence of gold made it great economic power and an ideal place to live.

The main campus is now surrounded by scientific research centers and laboratories, upscale residential districts, student housing, Berkeley business downtown, and Clark Kerr campus. Going through its history, UC Berkeley was founded on a 30-acres land

purchased in an area close to San Francisco but far enough to enjoy its countryside position.

Campus design went through several phases of competitions and design proposals. South Hall, built in 1873, is the oldest edifice of the campus and the only building from the initial phase that survived. Finally, between 1902-1924, the master plan of campus was prepared which still forms the skeleton of the campus planning. The master plan considered two principles; Beaux-Arts tradition and valuing the metaphorical capability of built environment to convey the spirit of the new America and the aspirations of the university. The campus plan has a monumental classic architectural organization and was based on an east-west axial grid oriented towards the Golden Gate Bridge. Some of the axes of the grid were open-ended and some were closed but mainly each of disciplines was clustered in a specific zone of campus; east, core or west. However, all of the buildings were following a common architectural style in terms of scale and details that created a unified character and a cohesive atmosphere. The Doe Memorial Library, located on the main axis of “allee” was considered the most impressive edifice of the campus. Sather Gate, in 1908, was built as the main entrance of the campus at the end of the north-south axis which strengthened the axial configuration of the campus. Sather Tower, built in 1914, resembles the tower (campanile) of Piazza San Marco in Venice and has become the most noticeable and unifying landmark of the campus. The east-west oriented Campanile Way has been the main pedestrian path in the classical core of campus. This campus core has been praised and preserved and is still one of the most prominent Beaux-Arts campus plans in the United States. The further expansions of the campus due to growing student enrollment attempted to respect the primary design but it entered a new phase of development. Being encircled within the hills and the city (developed along with the university), there was a lack of land for large expansions. So doing, between the 1950s and 1970s, planners embraced the strategy of tall and infill structures.

Going through these phases, the UC Berkeley campus did a good job in preserving its sense of place and identity. It has a remarkable visual harmony and a well-defined layout due to the architectural style, placings, existence of landmarks and the grid system of axes. Its stunning natural landscape is and powerful component which through diversified formal and informal green spaces offer great potential for

socialization and recreational activities (Coulson et al. 2011; U.C. Berkeley Development Plan).

6.2.6.2 Sustainability and urban outreach activities

As one of the world's great research universities, UC Berkeley has a special obligation to serve as a model of how creative design can both minimize resource consumption and enhance environmental quality. Each new capital investment at UC Berkeley has the potential to advance the state of the art in responsible, sustainable design, and thereby contribute to our mission of public service.

In July 2003, the UC Regents adopted a university-wide Green Building Policy and Clean Energy Standard to reduce the consumption of non-renewable energy, through a combination of energy conservation measures, local renewable power measures for both existing and new facilities, and the purchase of energy derived from renewable sources. In support of this policy, UC Berkeley should develop a strategy for the campus that reflects the specific characteristics of its site, climate, and facility inventory.

Sustainability is a core value at UC Berkeley. The move toward more sustainable practices and environmental stewardship at UC Berkeley has grown markedly since the turn of the century. Berkeley's early efforts inspired campuses across the state to develop sustainability programs, influenced the UC Regents to make policy changes at the system-wide level. It has an established mission statement towards sustainability in the fields of energy consumption, carbon neutrality, zero waste, water usage, engagement. There are several projects launched in this regard including Team 2020 and Student Leadership for students' engagement in Sustainable Development Goals, Globalization, and The Environment, Carbon Neutrality Initiative, Solar Powering Cal, and so on.

UC Berkeley is one of eleven universities in the International Alliance of Research Universities (IARU). UC Berkeley in 2018 completed the self-reported STARS tool, or the Sustainability Tracking, Assessment and Rating System, and scored a Gold rating.

6.2.6.3 The city

Berkeley is located in California, on the east shore of San Francisco, USA. It borders the cities of Oakland, Emeryville, Albany, unincorporated community of Kensington. In the eastern side, it is limited with Contra Costa County generally follows the ridge of the Berkeley Hills. It is famous to be home to the University of California, Berkeley. Following the construction of the university, many new inhabitants moved to the town in the vicinity of the new campus and new settlements of residences and diverse industries were developed around it. Thus, due to the influence of the university, the urban development occurred. Considering the urban fabric, it has an orthogonal grid structure.

6.2.7 Stanford University

Typology: Rurban Campus

University Name: Stanford University

Campus Name: Stanford University

University Foundation: 1891

Campus Establishment Date: 1891

Student Number (2019): 16,424

Plot Area: 624 hectares

Location: Stanford, California, United States of America

City Population: 13,809

City Area: 7.190 km²



Figure 6.8 : Aerial view of Stanford University (Url-12).

6.2.7.1 University campus development background

Stanford University was established by Leland Stanford and his wife in the memory of their son to promote the welfare of the region. The university was founded in 8,180-acre farmland in Palo Alto, California, within a traditional territory. The university also contains Stanford University Medical Center, Stanford Research Park with the area of 280 hectares and Stanford Shopping Center with a space of 28 hectares, and an office park in Redwood City with an area of 14 hectares.

Stanford is a research university and from the outset, it intended to be coeducational and affordable and nurture cultured and qualified students. Stanford is located on the San Francisco Peninsula, in close proximity to the Silicon Valley on the northwest part of it. It is also one of the top fundraising institutions in the USA.

The innovative Stanford campus was designed by two well-known firms including Fredrick Law Olmsted. The masterplan conveyed a sense of unity, formality, ambition, and gravity. A north-south axis of palm trees has been proposed directing to a series of quadrangles. Outer Quad is situated at the core of the campus enclosed by low-rise buildings and allée (alley) is breaking it in the north side. The quad is surrounded by continuous courtyards of one-story height, known as Inner Quads. The second east-west axis passes through the quad and is surrounded by a sequence of courtyards, were added along with the university's growth. Being organized along these two axes creates a distinguishable distance from the American tradition of isolated buildings around a large open space. Olmsted designed a totality where each department and discipline was autonomous but linked to others. The series of quadrangles are connected by arcades that not only protect users from climate issues but also unites the whole fabric, directs the movements. The architecture of the campus by Olmsted intended to demonstrate the regional characteristics. It has a more expression of Mediterranean traces with columns and arches, stone walls, and one-story edifices with red-tile roofs.

The memorial church with glamorous decorations is one of the noticeable landmarks of the campus and is located on the south of the quadrangles at the end of the Palm axis.

The initial campus plan has not been completed and the vision changed after the death of Leland Stanford. The earthquake of 1906 also destroyed many buildings of the campus. It was an initiative for changes in the planning approach of Stanford. In this

phase of construction until WWII, massive constructions carried out. The quadrangles remained as the central conception of the campus plan. A new library quad, Physics, and Science building Tank were built. The new buildings interrupted the originally existing open vistas.

However, the original style of the campus plan was preserved. The arcades, red-tile roofs, and buff-colored walls are the most distinctive aspects of the Stanford campus are the uniting architectural characteristics. The iconic Hoover Tower with a height of 90 meters is the only and distinguishable vertical element of the precinct.

After 1945, the planning language of the campus is changed and got a more flavor of Modern architecture of the era. The red-tile roofs and arcades were abandoned in favor of modern structures which brought up a wide dissatisfaction. Doing so, the university authorities set in motion a couple of actions to unite the new constructions with the older quad buildings through the use of the traditional aesthetic references.

In the 1990s, a phase of renovation began with an emphasis on Stanford's architectural heritage. Many of the old buildings were restored and were seismically reinforced. The east-west axis was restored and pedestrianized. The expansion more concentrated on the west of the Main Quad and a hub of science were shaped there. The Near West Campus master plan has been responsible for the large-scale expansion of the campus. The masterplan clustered various academic disciplines to foster interdisciplinary interactions. The Clark Centre for Biosciences and Engineering has been designed as the "social magnet" of the campus, functioning as the gathering space for a variety of academics, researchers, and students from different fields.

One of the main initiatives of Stanford has been set a "green" agenda. It has aimed to largely reduce the energy and water consumption, use natural light and air conditioning, use solar panels, and stimulate recycling.

It is noticeable that from the initial point, the architectural language of the Stanford has been preserved. The red-tile roofs, arcades, sandstone-colored walls have been uniting elements of the Stanford through the generations of construction. These architectural and landscape elements express the Stanford identity and create a cohesive campus fabric. The arcades protect the campus residents from the weather conditions, connected various buildings, orders the circulation pattern, create a spot for informal encounters, and strengthen the sense of community. The landscape design

of the campus including urban plazas, gardens, meadows, and formal lawns, with native planting, contribute to a distinctive and memorable landscape of the campus. The Palm Drive axis is a monumental path that creates a unique arrival experience and directs between the oval, the Main Quad, and the Memorial Church. The sequential movement experience across the campus is another unique aspect of Stanford campus planning. It is reflected in axes, arcades, pathways, and the series of courtyards and unifies the entire campus fabric. The campus planning has been well responded to its location and has created an exclusive sense of place.

6.2.7.2 Sustainability and urban outreach activities

Stanford university is one of the most sustainable universities. From the outset, Stanford has been designed by Olmsted as a resource-conserving campus that would respond to its local climate and context to achieve beauty and functionality (<https://sustainable.stanford.edu>). It has been the vision of the university during its history and has been applied in new developments. New buildings in Stanford has been designed with high energy performance objectives. Stanford has a long history in energy and water conservation and efficiency. Reducing greenhouse gas emissions is one of its chief priorities. It is also highly committed to waste reduction and recycling program. R&DE's Sustainable Living and Sustainable Food Program help to embed sustainable behaviors and choices into the daily habits of students, provide sustainable, humane, and socially-responsible foods whenever possible, reduce waste in operations, and educate the community. Considering transportation, Stanford seeks to reduce transpiration-related pollution. It offers shuttle services and vanpools. It has several car-sharing and bile sharing services.

Considering the urban outreach and community service activities, through Cardinal Service, Stanford offers a wide variety of public and community service opportunities, ranging from on-campus courses to off-campus research to community-based leadership projects. The Haas Center for Public Service inspires Stanford University to realize a more just and sustainable world through service, scholarship, and community partnerships.

6.2.7.3 The city

Stanford is located in California and is the home of Stanford University. Its population was 13,809 at the 2010 census. It is close to the city of Palo Alto. It can be considered

a university town which most inhabitant population comprises of the residents of on-campus housing, including graduate student residences and single-family homes and condominiums owned by their faculty inhabitants but located on leased Stanford land. Considering the urban fabric, it is surrounded by an orthogonal urban pattern and in the southern part is limited to rural lands.

6.2.8 University of Virginia

Typology: Rurban Campus

University Name: University of Virginia

Campus Name: University of Virginia

Location: Charlottesville, Virginia, USA

University Foundation Date: 1817

Campus Foundation Date: 1817

Campus Area: 680 hectares

Student Number (2018): 24,360

City Population of Charlottesville: 43,475

City Area: 26.58 km²



Figure 6.9 : Aerial view of University of Virginia (Url-13).

6.2.8.1 University campus development background

The University of Virginia is a public research university in Charlottesville, Virginia. It is founded in 1819 by the third president of the United States, Thomas Jefferson and presents his notion of “Academic village”. The concept of the university as a community is well expressed in this campus. The university has been listed as the UNESCO Heritage Site.

With educated labor, and vicinity to Richmond and Washington, the territory carries affluence of economic and cultural liveliness. The University of Virginia provides education, cultural resources, and economic stability while acting as a catalyst for continued growth and progress.

Being an architect, Jefferson arranged all the items for a flagship university campus such as site location, campus layout, building designs, and academic programs. Any aspect of this leading university was expressing his striking pedagogic and social concept, “the Academic Village”. Through the academic vision and the architectural layout, it was intended to stimulate the intellectual dialogue between students and academics. The most promising aspect of this design is making a correlation between architectural design and academic philosophy.

Primarily, the University exhibited a village— an inward-looking, human-scaled, all-inclusive community, symbolizing Jefferson’s rural notions. This objective of autonomy intends to the selection of a site about one mile from Charlottesville, the closest city. The initial plan was constituted of a large open space, an open-ended quadrangle arrangement, with the line one or two-story buildings of pavilions organized around a lawn and campus green landscape. Each row of buildings consisted of five two-story pavilions which were linked by a row of one-story student accommodations. Enclosed garden and students’ residences and dining halls were situated behind the pavilions. The organization of the buildings was in a way that stimulates interactions between teachers and students, emphasizing on the uniting the social and academic life. This goal was to be addressed through the incorporation of education and living functions in the pavilions. The buildings were planned to facilitate the pedagogical function. Jefferson’s understanding of the classical patterns arranged the façades of the Pavilions and was envisioned to utilize the educational curriculum as a mean for architectural education.

The university was a secular institution. There was planned a monumental library, rather than a church, which was located at the top of the Lawn. The Rotunda, a domed structure of the library, was the symbolic climax of the lawn. This library is considered the intellectual core of the university. Jefferson believed that architecture and built space are meant to express the supreme aspirations of the new nation. Thus, the edifices were designed imitating the classic Roman style with Doric columns and Pantheon shape buildings. Jefferson employed a variety of architectural sources in form, decoration, and materials, creating diversity within a uniformity. The central Lawn with white trim, red-brick, and wooden buildings and the central green space characterizes itself as a human-scale totality. It sets a space for intellectual exchanges and social interaction, offering a sense of community. The campus layout is a rational manifestation of the collegiate archetype. Combining the academic pavilions and student dormitories, provides an environment for living, studying and enjoying.

With an increase in student enrollment, campus development was implemented in the 19th century. It was a shift from the classic plan of Jefferson to picturesque and eclectic planning. Curving routes were added to the campus border of the Lawn contrasting from the initial orthogonal plan. The new development intended to respond to the natural topography of the landscape and disrupted the grid geometry of Jefferson. With the beginning of the 20th century, the plan of Jefferson faces a complete revival. The Jeffersonian style seemed compatible with the needs of the new era confronted with mass migration and Communism and also was incongruence with the rising Beaux-Arts Movement. Thus, the new constructions with the Jeffersonian style were matching with the Academical Village.

With another boom in student enrollment in the 1950s, a new phase of development was initiated. For the growth, the university adopted two strategies of infill development and satellite campus. The North Grounds campus was established as a satellite campus but it suffered the lack of community and interaction because of the geographic sprawl. The infill development was more successful and the new buildings were added in a way that not disturbing the scale of the surrounding edifices. The growth of the late 20th and early 21st centuries concerned the unity of the landscape and the buildings of the inner area. It was also intended to foster the dialogue between the campus core and the distant precincts through directing the new developments including some student residences and informal classrooms in that direction. They

were perceived as new Academical Villages within the original complex. The mixed land use was emphasized in the new expansions.

Creating a link between original planning ideas and the new developments has been the principal aspect of campus expansions. The entire campus still expresses Jefferson's legacy. The continuity of the architectural language is manifested through the red brick, white trim, black shutters, white wooden balconies, and covered arcades.

The preserved tradition of materials generates an aesthetic harmony that unites the entire precincts and strengthens the history and permanence of the institution. In the same way, the landscape is also a pivotal component of this campus planning tradition. It portrays the experience of the Lawn as a distinct infinite experience in the social life of students. Distancing from this central green core, the other spaces steadily lead between arcades, from pavilions to gardens. The campus density is kept low. The central green space, the Lawn, the quadrangle of the library, and the gardens of pavilions are remarkable components in experiencing the campus setting.

Thomas Jefferson was not only the designer of the University of Virginia but also a significant character in the history of the territory. The two local sites of Monticello and the Academical Village, which are in the UNESCO World Heritage site, are traces of Jefferson's footprint in the region and on the nation. The University and its residing urban space have a large impact on each other and have been developed together.

6.2.8.2 Sustainability and urban outreach activities

The Office for Sustainability in UV aims to engage the communities, steward resources, and discover ways to improve Grounds and beyond for generations to come.

Its approaches comprise Advocacy, innovation and leadership, Academic and research integration, Environmental stewardship, Technical expertise, Outreach and engagement, Communication and knowledge management.

It provides various programs and services including:

1. Buildings and Operations:

- Greenhouse gas and nitrogen footprint tracking
- Metrics and data analysis - progress towards goals
- Delta Force - existing building sustainability engineering
- LEED-EBOM alignment for existing buildings

- Sustainability/energy project implementation project management/support
- Alternative energy research and implementation support
- Demand response support
- Annual steam trap surveys
- Owner's sustainability representation
- Drawing and spec reviews
- LEED-NC and LEED-CI certification support

2. Outreach, Engagement, and Communications:

- Sustainability Advocates (students)
- Student Employees – recycling, promotions, water, energy, and student outreach teams (students)
- Green Labs Program (students, staff, and faculty)
- Green Workplace Program (staff and faculty)
- Annual Events (i.e. Earth Week, U.Va. Sustainability Day, Game Day Challenge)
- Annual Competitions (i.e. Dorm Energy Race)
- Greening existing events (i.e. zero waste support)
- Community support (i.e. Georgetown University Energy Prize)
- Communications support - signage, website, social media, Sustainanewsletter, Green Tips

3. Recycling

Considering urban outreach activities, the University employs a model of providing academic outreach activities and programs which houses these activities within each of the eleven schools, the different centers and offices of the University. It collaborates with the private sector, and the state to advance education, health, and economic prosperity in Southwest Virginia. The Center for the Liberal Arts offers programs for public. Lifetime Learning offers over 120 faculty lectures annually in a variety of formats including extended learning programs, lectures, panel discussions and live streamed interviews. OpenGrounds (OG) a resource, and an opportunity; a network of collaboration, communication, and innovation. It connects the University, the Charlottesville community and global partners to develop the knowledge, tools, and behaviors that will shape the future. The Virginia Foundation for the Humanities (VFH) connects people and ideas to explore the human experience and inspire cultural engagement. The VFH promotes lifelong learning, literacy, and civil public debate, funds and produces exhibits, conferences and teachers' institutes; book discussion

series; film, video and radio programs; and other public programs that draw upon the humanities.

6.2.8.3 The City

The city of Charlottesville, Virginia is an independent city in Virginia. The University of Virginia established by Jefferson borders the city at the southern side and is the most important component of the city. Monticello, the primary plantation of Thomas Jefferson, at the southeastern part of the University is a significant tourist attraction element and is at UNESCO World Heritage Site. Stanford University plays a key role at regional, national, and international levels. The influence of the university on the city growth is noticeable which has created a university town. The urban fabric shows both organic and orthogonal grid shape.

6.2.9 Trinity College Dublin

Typology: Gated Campus

University Name: Trinity College, Dublin

Campus Name: Trinity College, Dublin

Location: Dublin, Ireland

University Foundation: 1592

Campus Foundation Date: 1592

Plot Area: 190,000 m²

Student Number (2019): 23,111

City Population of Dublin: 554,554

City Area: 114.99 km²



Figure 6.10 : Aerial view of Trinity College Dublin (Url-14).

6.2.9.1 University campus development background

Trinity College is located in the very center of the city of Dublin, Ireland. It was created in 1592. The primary site was situated near the small walled city which was far larger than the small community of fellows and students required. The organizational design of the university was affected by Cambridge and Oxford but it is an autonomous organization.

The primary development of the College Green site dates back to the former Priory of All Hallows of the medieval era in the 12th century. A red-brick quadrangle was shaping the basis of the site until the 18th century that the courtyard organization implemented as the basic planning principle of the university. The Library Square was planned in the late 17th century. In the 18th century, extensive constructions were conducted in the university setting such as the impressive new library, The Printing House, the West Front, the Dining Hall, and the Provost's House. During the second half of the century, Parliament Square gradually was developed, formed by the classical buildings of Public Theatre and the new Chapel.

The constructions did not follow any comprehensive master plan and many new individual buildings were erected in the 19th century such as the residential quadrangles. By the late 19th century the university a great part of the historical site was occupied with an agglomeration of academic structures, recreational facilities, museums and terraces of dormitories. In the 19th century landscape of the site changed strikingly. The west range of Library Square was destroyed and the new museum was built in the eastern side of the Library Square. A series of science buildings also were erected on the eastern part of the campus with a distinct character of the western side. Where the western part has a formal classical quadrangular organization, the eastern side has an informal dense arrangement. In the 20th century, the college witnessed a massive growth in student enrollment which triggered the physical layout of the campus as well. The Berkeley Library and Paul George Koralek's new library and new structures on Fellows Square, and the Art Block were constructed in this period. In late 20th century, the university started obtaining spaces outside its campus but in close vicinity for collegiate purposes and has also conducted many adaptive reuse projects in this regard such as St. James's Hospital and the new School of Nursing. Recent years have also seen many new developments within the campus boundaries. There has been an emphasis on the green open landscape, squares and plazas, courtyards, the

lawns and canopy of trees, and sculptures create a particular spatial and visual character and have been integral to the identity of the university setting. The campus has a significant place in the heart of Dublin and its historical buildings are among of the touristic attractions of the city. Recently, the well-defined boundary of the campus is blurring within the Dublin urban fabric. The site is walkable and pedestrian-friendly.

Ireland in the succeeding century witnessed a political stability because of the strong political monopoly and the College largely benefited from this state of affairs which can be seen in the scale and quality of its new edifices including massive new library (1712-32), the Printing House (1733-4), the West Front (1752-9), the Dining Hall (c.1760-65), and the Provost's House (1759-61). During the second half of the century, Parliament Square slowly emerged, shaped by the Public Theatre (1777-86) and the new Chapel (1787-98), which were designed from afar by George III's architect, Sir William Chambers. The great building drive was completed in the early nineteenth century by the residential quadrangles of Botany Bay and New Square.

During the 19th century, new expansions have been taking place which changed the campus landscape such as the Museum Building (1853-7). In the late 19th century the College setting changed again by filling the ancient site with a conglomeration of educational buildings and recreational facilities, museums and terraces of student dwellings.

During the wartime between British authorities and the Catholic hierarchy over higher education policy in Ireland, Trinity resisted to adjust itself to the changing situation. Thus, the university gradually re-located itself to become a non-denominational institution. However, despite this, the fractious struggle to retain the College's separate identity meant that when the battle over Irish higher education was finally resolved in 1908 with the creation of the federal National University, it left a difficult legacy for the defenders of the older institution.

Considering the physical development from 1950, the College contributed slightly to the growth of fine modernist architecture in Dublin but until 2000 the College expanded out of its initial campus site with a huge expansion of its off-campus dormitories. The most impressive development project was the Trinity Biomedical Sciences Institute in Pearse St (2008-11) that is considered the strongest physical

manifestation of the Colleges in its outward movement. This development embraces five educational schools, Academic Medical Centre.

6.2.9.2 Sustainability and urban outreach activities

Trinity is an important part of third level education and research in Ireland and is a recognized global leader in the area. University properties comprise a significant and integral part of the Dublin city. As an educational institution it has a role in and a responsibility to society to promote sustainability and sustainable development throughout all its activities both academic and institutional. This means that teaching, research, services, building development and administrative operations should be conducted in a manner that protects and enhances the environment, conserves and restores natural resources, reduces greenhouse gas emissions, and supports the community and society as a whole. This policy applies across all parts of the University and will be reviewed annually. Since achieving Green Flag status in 2013, Trinity has been working to deliver on its commitment to become a more sustainable university by 2020. Since 2012, we have delivered the following key highlights:

- 1) Energy, Climate Change & Greenhouse Gas Emissions: Increasing renewable energy generation by 2% per annum
- 2) Waste Management, Recycling & Litter Reduction: On schedule to reach our target of 50% recycling waste, Zero waste going to landfill, All users are within 100m of a litter bin
- 3) Water and Wastewater: Water usage reduced by 10%, Reduce wastewater release by 10%
- 4) Sustainable Transport: 90% of college users using sustainable transport - Increased bicycle usage by 10%
- 5) Resource Use & Sustainable Food: 50% of food being Fairtrade, locally produced, eco-sensitive or humane
- 6) Green Procurement: 100% of tenders requested to submit environmental information, 100% increase of construction tenders using green criteria
- 7) Education & Research: 100% of staff and students aware of Green pages, 10% increase in Sustainability Course Content
- 8) Communication, Student Involvement & Transparency: Met all requests for information on the environment Green Campus Committee Annual Report delivered on all environmental aspects

9) Trees & Biodiversity: Over 1,300 trees across University grounds. Increased green spaces and enhanced bio-diversity areas.

6.2.9.3 The City

The city of Dublin is the largest city and capital of Ireland with a population of 554,554 inhabitants. It is bordered by the Wicklow Mountains on the south and River Liffey passes through it. Dublin is a historical and contemporary center for education, the arts, administration, and industry. The urban fabric of the city shows both organic and grid form.

6.2.10 Bilgi University, Santralistanbul Campus

Typology: Gated Campus

University Name: Bilgi University

Campus Name: Santralistanbul Campus

Location: Istanbul, Turkey

University Foundation: 1994

Campus Foundation Date: 2007

Plot Area: 118,000 m²

Student Number (2017): 23,000

City Population of Istanbul: 15,067,724

City Area: 1,539 km²



Figure 6.11 : Aerial view of Bilgi University, Santralistanbul Campus (Url-15).

6.2.10.1 University campus development background

Bilgi University is a private university founded as the Bilgi Education and Culture Foundation in 1994 in Istanbul. The “learning not for school but for life” is the core mission of university which attempts to present a new vision to the Turkish higher education system. It ranks third place among private universities in Turkey.

Considering its motto, Bilgi is an in-city multi-site institution instead of having a large greenfield campus. Thus, it intended to form a web of knowledge agglomerations that can contribute to the socio-economic improvement of proximate urban areas while benefiting from the city’s facilities. It includes four campuses which are constructed in former industrial locations in central parts of Istanbul. The sites are mainly in deteriorated or underdeveloped districts that enable the university to have access to inexpensive land and meanwhile have access to the city’s amenities and various socio-cultural events due to their central position. Santralistanbul campus is the largest campus, spreading over a 118,000-square meter area. Santralistanbul campus was established in 2007 at the shores of Haliç, on a peninsula at Golden Horn in Alibeykoy district, a relatively poor region.

In its initial embodiment before restoration and conversion into Santralistanbul, the Silahtarağa Power Plant was the Ottoman Empire’s first urban-scale power plant and the facility went into service in 1911 on the Golden Horn, Istanbul’s oldest industrial area, and supplied the city with electricity until 1983. Regarding the power plant’s special position as a national unique industrial heritage site, between 1910 and 1950s, the regeneration project of Silahtarağa Electrical Central station was implemented by Bilgi University. It was a socio-cultural and educational project that involved the cooperation of public sector, private sector, and non-governmental organizations. The project aimed at transforming this urban-scale national capital to one of the most attractive and dynamic contemporary cultural centers of the city.

Santralistanbul campus is more oriented towards art and culture. Historical buildings are merged with modern and well-designed buildings that attempt to host a wide range of users of this cultural center alongside with the university students and faculty. It embeds Energy museum, Contemporary art museum, a public library, concert halls and amphitheater, residences for international guests, open-air recreation areas, cafés and restaurants, and spaces for modern cultural and artistic activities as well as educational units and faculties.

It can be considered as one of the most successful adaptive reuse, restoration, and renovation projects that attempted to create a modern art and cultural, recreational, and educational complex. The main principles in design project were understanding and re-using the layers of history of the Golden Horn area and the industrial architecture identity of the complex. The restoration and renovation project was designed by some of the most famous architects of Turkey. In this respect, considering the former function of the site, two buildings of the power station have been restored to the Contemporary Art Museum as a restoration project and attempted to conserve its historical architectural parameters. The buildings are linked to each other through a bridge and are lightened even at night hours that enhance the vitality of the environment and creates a state of outward-ness. The public library is designed as Adaptive reuse of one of the six historical power buildings while preserving the original façade voids and silos. The former energy turbine building has changed to an Energy Museum, using all of the elements of the old building. Educational buildings have designed as simple two or three-story buildings at the northern part of the campus, carrying the traces of old depots, residences, and workplaces.

Considering the morphology of the area, Santralistanbul is situated within a dense neighborhood with small structures. Thus, the campus has shaped an enclave form within its urban fabric. In spite of its initial intention to be an open university, Bilgi is not freely accessible to the public like many other Turkish universities. The main reason is the issue of security. However, Bilgi's catalytic enclosed campuses intend to form a stimulating city-wide knowledge network where the students participate in adjacent urban life and promote vitality.

6.2.10.2 Sustainability and urban outreach activities

It can be argued that all campuses of Bilgi university are an integral part of their urban space. Bilgi formerly has transformed squatter settlements of Kustepe and Dolapdere to establish its university campuses to alter the socio-demographic and cultural urban tissue of district. Santralistanbul attempts to become a “comprehensive, critical and interdisciplinary international platform with the purpose of contributing to urban revival within Istanbul” and aims at setting the ground for presenting art, culture, and education in a single stage with its new interdisciplinary vision. The main objective of the institution has been remarked as creating a network with other similar international institutions, contributing to the social sustainability of the historical and semi-

historical districts, creating a more vital work environment and addressing a wider mass of society.

In addition to being a prominent academic institution, Bilgi university provides knowledge for people, the society and the city. It creates a platform for meeting of entrepreneurial and open-minded individuals.

It has adopted a social responsibility as its core mission. Every year it organizes many conferences, seminars, and events on the social and environmental issues such as human right, labor rights, diversity, immigrants, sustainability, renewable energy. Furthermore, several courses and curricular activities have conducted in this regard. An interdisciplinary research center has developed within its research and administrative body with a focus on social responsibility and collaborates with NGOs, the UN, and other institutions.

Considering sustainability, Bilgi has initiatives to control waste, water consumption and energy consumption (cooling, heating, lighting) in educational buildings and of Santralistanbul campus. It offers free shuttle service and on-campus electric bicycles to promote sustainable transportation.

6.2.10.3 The city

Istanbul is the largest, most populous, and most dynamic city of Turkey and is the country's educational, economic, cultural and historic center. Istanbul is the transcontinental city in Eurasia. The Bosphorus (between the Sea of Marmara and the Black Sea) separates two continents. The historic area and commercial zone are mainly located on the European side. The city is the former capital of the Roman/Byzantine Empire and the Ottoman Empire. It is a cosmopolitan city with a rich character. The urban fabric is mainly organic.

6.2.11 Harvard University

Typology: Integrated Campus

University Name: Harvard University

Campus Name: Cambridge Campus

Location: Cambridge, Massachusetts, United States

University Foundation: 1636

Campus Foundation Date: 1636

Plot Area: 72 hectares

Student Number (2018): 36,012

Population of City of Cambridge: 105,162

City area: 18.47 km²



Figure 6.12 : Aerial view of Harvard University (Url-16).

6.2.11.1 University campus development background

Harvard University is a private research university and the first American university established in 1636. After the colonization of the United States, there was a strong belief that the New World required educated people for prosperity. So doing, Harvard College was founded on a one-acre piece of land in Newtown village –then changed its name to Cambridge. This piece of land now comprises the core of the campus, the Harvard Yard. The Harvard Hall I was the first purpose-built edifice of the campus located in Harvard Yard with an E-shape form. Indeed, design of the Harvard campus followed the ideals of the English Collegiate system and intended to shape a community for students to study, live and socialize. However, it rejected the inward-looking cloistered structures of English universities and instead outward-looking separated buildings were designed within a park-like landscape. This spatial arrangement was organized in a way to be open and accessible to serve the community. These ideals later became a prototype for American university campuses that continued within the centuries.

These early phase buildings were designed in red-brick and High Georgian style and this architectural style created unity and harmony within the Harvard Yard. Another major construction phase occurred between 1869 to 1909 that 35 new structures were erected and it was massive construction in comparison to earlier 34 buildings which were built within 233 years since the foundation of Harvard University. The structures of this latter period highly valued the functionality. They were designed with various architectural styles and were scattered around the Harvard Yard and the North Yard. Thus, there was not a unified architectural style nor an established development plan. In the period from 1909 to 1933, it was noticed that there was a need for a holistic plan for Harvard development to control the physical expansion and the architectural character. So, the Georgian Revival was chosen as the university's architectural style and a master plan was developed in 1910. The Second World War aftermath put its traces on Harvard University and caused transformations in its physical body. The International Style was practiced in the university's architecture and new materials, forms, scales were introduced into the Harvard campus. In spite of creating new radical transformations, it was intended to create a correlation between Harvard's historical character and the newly introduced forms. Within the chronology of Harvard development, from a Colonial, Colonial Revival, Georgian, Georgian Revival, Neo-Classical, Romantic Revival to Modernist, New Modernism, Post Modernism and New Historicism, an arrangement has been created that preserve the Harvard's unique spirit so vital and dynamic and align its physical growth to its academic objectives. The edifices are human-scale and in great harmony with the surrounding neighborhood. The campus is highly integrated to its hosting city through its green areas and open spaces.

Indeed, Harvard has had a decentralized planning tradition which has served for centuries. Within its long history, diversified buildings with different morphologies and architectural styles have emerged. Brick is not the only but the common material which has been used in different architectural styles and created a continuity across the campus.

Harvard yard has been considered as the "political, academic, and spiritual center of the Harvard". However, since the foundation of Allston Campus on the southern part of Charles River, the river has become the geographic locus of the university. The Charles River has a significant role in structuring the campus because of its particular

vistas and its clear directional quality. It also functions as a natural barrier and defines the edges. At the same time, the river offers potentials for connecting Harvard main campus to Harvard's other campuses and also adjacent universities.

Harvard is a single university composed of various institutes, faculties, and departments which function autonomously. This feature enhances its intellectual vibrancy and increases the diversity of physical environments. Harvard University has a decentralized characteristic. Being developed on a precinct basis, there is not a particular mechanism for sharing resources and growth of shared facilities. In addition, Harvard faces difficulties to be expanded within its dense urban fabric.

Harvard University has developed from a single building in a rural area to a large integral campus within a dense urban fabric. Harvard university is in close interaction with its hosting urban space. Its academic prosperity and economic growth have brought a responsibility to contribute to the improvement of its urban space by providing teaching and research facilities, laboratories, offices, and affordable housing. The high level of campus and urban land-use integration is mainly at the edge of campus where most of the residential and commercial uses are situated. diversified land-uses such as lecture halls, services, and residences are scattered around the campus and enhances the informal exchanges and vitality of the space. The diversity and balanced distribution of land-uses and activities increase the nightlife security due to the presence of 24-hour activities on the campus. There are residential areas, retail and commercial buildings, sports facilities, libraries that are active and open during the night hours. This issue increases the perceived safety not only inside the campus but also in the surrounding urban area. Providing housing is one of the core objectives of Harvard as an educational community and a residential college. There are a variety of residences available for students and faculty members. While the students' dormitories are mainly in proximity to academic buildings, the affiliates' housing is mostly located on campus boundaries. The existence of residential buildings enhances Harvard's campus liveability, informal interactions and the sense of community.

There are several facilities and services provided for Harvard students and faculty to boost their quality of life. Harvard Square can be considered the locus of many social, commercial and recreational activities. There are other activity zones forming corridors along the streets in campus edges.

Considering the greenness, approximately sixty percent of Harvard campus is devoted to open space which defines its structure and expresses its rich spatial quality. It is composed of diversified typologies of open spaces including courtyards, quadrangles, gardens, and paths which hierarchically forms a unique spatial experience for the users.

The campus edges have various forms of barriers including high and low walls, high and low fences, hedges and gates. Each type of boundary creates a different form of physical characteristics in terms of visibility and pedestrian and vehicular accessibility. In spite of containing various kinds of boundaries, it can be noted that Harvard campus merges with the surrounding urban space. It has a high level of public accessibility in different modes and conserves its public character.

Moreover, Harvard University offers a wide range of amenities to its urban context including cultural, athletic, religious facilities, museums, exhibition spaces. There are plenty of seminars, workshops, educational programs, art, and cultural events, theatre performances, sports games that are held in Harvard during the year which are accessible to the public.

6.2.11.2 Sustainability and urban outreach activities

Harvard University is among the most prestigious universities in teaching, research and developing leaders in various disciplines. Its core mission focuses on global challenges including sustainability. Harvard intends to translate the research into action. So doing, it uses its campuses as a living lab for directing and implementing solutions to contribute to sustainability and enhance the community's well-being.

Harvard implements a four-step plan for changing the culture towards sustainability. It educates and empowers students to use their sustainability knowledge. It translates education and research into real practice to create innovative answers. It institutionalized best practices in sustainable operations. It amplifies impacts by replicable models which can be applied inside and out of Harvard.

Harvard sustainability plan addresses the well-being of its academic community. It mainly has organized around five core dimensions; energy and emissions, campus operations, nature and ecosystems, health and wellness, and culture and learning. It aims to define objectives and normative guidelines in the path towards sustainability and resilient community.

In terms of community outreach, throughout its history, Harvard has been a very collaborative institution. Harvard has been an integral part of its region in Cambridge, Boston, and Massachusetts. It has been committed to creating life-long education and reinforcing the community.

Harvard's three core community engagement spotlights are housing, sustainability, and education. Through 200 projects, Harvard contributed to providing 7000 affordable housing in 30 neighborhoods in Boston and Cambridge. Harvard has committed to addresses sustainability goals in the region. Through various educational projects, Harvard addresses the local community across Boston and Cambridge.

Moreover, it is highly involved in creating partnerships with local organizations. It supports the regional economy by offering employment opportunities and attracting services and companies. It collaborates with non-profit organizations for public services.

It sets a platform for sharing ideas. It offers diversified programs, seminars, workshops. It provides a wide range of art and cultural activities and events for the public. Moreover, it shares many of its amenities with the public including museums, exhibition centers, religious and athletic facilities, hospital.

6.2.11.3 The city

Cambridge is a city in Middlesex County, Massachusetts, and part of the Boston metropolitan area. The metropolitan Boston houses 40 universities and colleges within its urban space. Among them, Harvard University, MIT and Boston University are located along the Charles River enjoying the availability of the vast affordable land at the time of their construction. The city is a balanced combination of educational spaces, residential and commercial districts, and high tech and industry zones. The urban fabric has a concentric arrangement with orthogonal grid shape.

6.2.12 MIT (Massachusetts Institute of Technology)

Typology: Integrated Campus

University Name: Massachusetts Institute of Technology (MIT)

Campus Name: MIT

Location: Cambridge, Massachusetts, United States

University Foundation: 1861

Campus Establishment Date: 1916

Plot Area: 67 hectares

Student Number (2018): 11,466

Population of City of Cambridge: 105,162

City area: 18.47 km²



Figure 6.13 : Aerial view of MIT (Url-17).

6.2.12.1 University campus development background

MIT is a private university situated in Cambridge, Massachusetts. It was founded in 1861 as a part of the Morrill Land Grant Colleges Act. MIT is a private university and from the beginning, its funding was mainly supported by tuition rather than grants and donation where it mainly addressed the middle-class. It possesses all of its premises and also leases them to private companies.

Being established in the era of industrialization in the USA, MIT was stimulated by the notion of “learning by doing”. It reflected the German research university model and adopted the Polytechnic university concept of Europe and focused on applied science, technology and engineering. This is well presented in its motto; “Mind and hand”.

It primarily rented an area in the downtown of Boston till 1866 that its first building was constructed in the Back Bay of Boston. Back Bay campus was expanded quickly

till the end of the century with the building scattered around the area. In 1916, the Institute moved to a new campus in Cambridge along the Charles River and the New technology neoclassical campus was planned by William W. Bosworth.

MIT campus development can be explored in four phases: The Boston campus (1865-1910) which very few traces still exist from that campus, the new Cambridge campus before WWII (1910-1940), the Cold War development, and post-Cold War phase. In each period, a different architectural style was reflected in the campus buildings encompassing neoclassical, modernist, brutalist, and deconstructivist.

The Cambridge campus site was originally a brown field. The central agglomeration of interlinked buildings built in 1916 attempted to stimulate communication between departments. Two most outstanding edifices of the era of Beaux-Arts are Killian Court and the impressive entrance building. After WWII, some remarkable structures were designed by famous architects such as Eero Saarinen, I.M. Pei, and Alvar Alto. The masterplan for campus developed in 1960 that set principle rules for campus future developments. The fundamental issue was the aim to develop a “complete campus community” with educational, research, residential, and recreational areas.

It is located in vicinity to Boston Airport and benefits from the Boston transportation system and the Kendall Square subway which function as a commercial node for MIT and the adjacent community. MIT has a great location surrounded by industrial areas which enable the university to practice urban development projects in its proximate district. To do so, it has created a new identity for the deteriorated and deserted areas of Cambridge.

MIT is a compact urban campus in the distance of two kilometers from the center of Boston. The campus area is divided to two parts because of Massachusetts Avenue passing from and the Eastern side is allocated to academic zone and the Western part is the residential area, sports fields, and cultural and commercial activities. Some new edifices have been designed in the recent phase of campus development by prominent architects including Gehry, Maki, Holl, Correa which manifest university’s strategy on investing in star-architecture as a mean to create a distinctive campus. This strategy has a great impact on attracting students, faculty, and tourists.

It is located in vicinity to Boston Airport and benefits from the Boston transportation system and the Kendall Square subway which function as a commercial node for MIT

and the adjacent community. The campus has been developed along the main spine of 1916. It has been developed in a piecemeal manner. The campus setting of MIT is exceptionally diverse and portrayed by individual striking edifices with diverse architectural styles. However, through an emphasis on pedestrian pathways and public open spaces, it has attempted to create a continuity and coherence in university fabric.

6.2.12.2 Sustainability and urban outreach activities

MIT has a long-established history in contributing to sustainability initiatives. By using the campus as a testbed and incubator, it intends to change MIT into a strong model that creates new modes to address the sustainability challenges. MIT has earned several awards for its sustainability incentives including a STARS Gold rating in recognition of its sustainability achievements from the Association for the Advancement of Sustainability in Higher Education (AASHE). It is also a great contributor in terms of urban outreach activities.

6.2.12.3 The city

Cambridge is a city in Middlesex County, Massachusetts, and part of the Boston metropolitan area. The metropolitan Boston houses 40 universities and colleges within its urban space. Among them, Harvard University, MIT and Boston University are located along the Charles River enjoying availability of the vast affordable land at the time of their construction. The city is a balanced combination of educational spaces, residential and commercial districts, and high tech and industry zones. The urban fabric has a concentric arrangement with orthogonal grid shape.

6.2.13 Freire University Berlin (Freie Universität Berlin)

Typology: Integrated Campus

University Name: Free University Berlin

Campus Name: Freie Universität Berlin (FU)

Location: Berlin, Germany

University Foundation: 1948

Campus Foundation Date: 1950

Plot Area: 60 ha

Student Number (2017): 35,900

City Population of Berlin: 3,748,148

City Area: 891.1 km²



Figure 6.14 : Aerial view of Free University Berlin (Url-18).

6.2.13.1 University campus development background

Freie Universität Berlin is a research university founded in 1948 in Southwest of Berlin. The main facilities of the university are situated in the suburb of Dahlem which is surrounded by villas, parks and green fields. It is located within the urban fabric with an approximate distance of 10 km from the city center.

Its foundation history can be traced back to years following the Cold War. National Socialist regime had a great influence on academic education in Germany by limiting academic freedom. The years following the end of WWII was a beginning to a restructuring period in higher education of Germany. Free University Berlin was a symbol of the rebirth of liberal education in Berlin. At the time, when the scholars and students with political opinions were excluded by University Unter den Linden - a newly established university dominated by Soviet power – established the Freire University with support of the US allies and West Berlin Politicians. From the outset, it was a democratic institution with a high level of student participation and praised the Humboldt educational ideal model. The philosophy of freedom was demonstrated not only in the university mission but also in its physical space.

The campus planning forms a dense organization nestled within its low-density urban fabrics but still distinct from that. In spite of having a massive footprint, the complex has no specific identity, no iconic entrance or any particular façade. The most impressive component of the campus is Rost-und Silberlaube (rust and silver alcove) complex. It is modular, single mega-structure composed of two parts, the Rostlaube and Silberlaube. Its design was inspired by Le Corbusier's philosophy and the bazaar paths of Morocco. It can be considered as an ideal city designed according to the main ideas of interaction and growth. It is a low-rise edifice with a network of inner walkways that encompasses various disciplines and stimulates informal exchanges. The structure has zoned according to study, rest and activity. Activity areas are along the main pathways and include classrooms, lecture halls, and cafeterias. Research spaces and specialized zones are along the secondary pathways. Resting and social gatherings occur within the internal courtyards and roof terraces.

The university saw a phase of expansion in the 1970s and was spread within its surrounding urban context. Now, it owns 210 buildings scattered within a 1.5-kilometer radius area.

However, in practice, the complex could not completely address the main design principles and experienced a period of vandalism and deterioration. It went through a renovation phase in 2005 by Norman Foster and partners. The redevelopment project involved the restoration of the modernist buildings and designing a new library. It gave a new life to the complex while embracing the original design values. The nine separated departments were merged and the circulation system was organized according to better way-finding principles. In addition, a hemispherical massive library was designed at the center of the complex, containing the idea of communication and interdisciplinary connection. Thus, the Orchard Site is a cluster of interlinked buildings, connected inner pathways, courtyards in addition to a variety of extracurricular services. Sports facilities and the Collegium Musicum are situated in a distance from the main campus. The student residences are not anticipated in the main campus but are situated nearby. Moreover, the large Botanic garden of Free University is considered as one of the main attractions not only for the university but also in the city scale and even worldwide. In this sense, the whole complex aims to convey the notions of freedom, free social exchange, innovation, and flexibility.

6.2.13.2 Sustainability and urban outreach activities

Considering sustainability, Free University Berlin follows sustainable development guidelines. It has established an international alliance for sustainability with four international higher education institutions in Canada, Israel, China, and Russia.

There is an Energy Management Unit, established in 2015, that monitors and directs university's activities in terms of education, research, operations, and campus management. Freie Universität was the first university in the capital to conclude a climate protection agreement with the State of Berlin in 2011 in which it undertook to reduce its energy use by another ten percent by 2015 (compared to 2010). There are incentives to reduce energy consumption in buildings and in addition to the continuation of technical and structural optimizations, the main focus is on building a university-wide online energy monitoring system. For its commitment to climate protection and its incentive system for the economical use of energy, the university was awarded several prizes by the state initiative KlimaSchutzPartner Berlin and in the future competition of gas supplier GASAG: 2003, 2008, 2010 and 2012.

Considering urban outreach activities, FU Berlin is committed to social responsibilities dedicated to its society in the field of gender equality, being a family-friendly university, environmental issues, providing science and research for the public.

In addition to the university's academic programs, it offers a wide range of events, lectures, conferences annually for the public. Many lectures on a variety of topics, as well as courses in the Guest Card Program, are open to the public. Researchers at Freie Universität Berlin regularly open their institutes, laboratories, and libraries to the public, for example, during the Long Night of the Sciences or open house days. The Center for Cooperation with Schools organizes various activities open to schoolchildren.

6.2.13.3 The city

Berlin is the capital city of Germany and is its largest city with a population of 3,748,148 inhabitants. It is the gateway between East and West. It has a remarkable history and a political center in Europe. It is a vibrant city with an inspiring cultural heritage and a center of research and scientific institutions.

6.2.14 University of Bologna

Typology: Scattered Campus

University Name: University of Bologna

Campus Name: UniBo

Location: Bologna, Italy

University Foundation: 1088

Campus Foundation Date: Varied

Plot Area: 15 hectares

Student Number (2017): 82,363

Population of City of Bologna: 389,261

City area: 140.86 km²



Figure 6.15 : Aerial view of University of Bologna (Url-19).

6.2.14.1 University campus development background

University of Bologna is the world oldest university founded in 1088 in Bologna, Italy. This date is considered as the time when the free teaching, independently from the cleric school, started in Bologna. In 1158, Frederick I Barbarossa publicized a *Constitutio Habita*, which made every school to be founded as a “*societas di socii*” (group of students) supervised by a master (*dominus*) salaried by the money paid by students. The Empire assumed to defend scholars travelling with the aim of study from the interruption of political powers. It was a critical time in the history of European university where the University was legally acknowledged as a place where research could develop independently from any other power. After Barbarossa passed away, the University of Bologna faced many difficulties. The 13th century confronted many

contrasts. Among many difficulties of the time, the University struggled for its autonomy, while the political authorities wanted to use it as a mean for their reputation. In this period there were more than two thousand students in Bologna. In the 14th century, the schools of jurists established beside the so-called “artists”, academics of Medicine, Philosophy, Arithmetic, Astronomy, Logic, Rhetoric and Grammar. The teaching of Theology was introduced in 1364. In the 15th century Greek and Hebrew studies were inaugurated, and in the 16th century, the “natural magic”, experimental science, was established. By the 16th and 17th century, the University’s reputation had known throughout Europe and Bologna became a target destination for many scholars. Alongside with the Industrial Revolution in the 18th century, the University disseminated scientific and technological development and after the foundation of the United Italian State, the University of Bologna witnessed a great prosperity. In 1888 the eighth centennial of the University was celebrated, with a grand ceremony to admire the mother of all universities. Within the two World War period, the University preserved its chief position within the global knowledge culture, when other universities evolved in teaching and research. The University attempted to cooperate with other worldwide higher education institutions, to modernize and develop its activities.

Nowadays, the University has a multi-campus structure and is composed of several edifices scattered around the city as well as its other campuses in proximate areas including Rimini, Cesena, Forli, and Ravenna. The oldest site of the university embeds the foundation Alma Mater and museums which is situated in a one-kilometer distance from the city center. Other sites and departments are sprawled around the city and a new precinct has been established near the botanical garden. All the premises of the university, which are scattered around the urban fabric, function as landmarks. They have a significant role in the identity of city and also act as tourist attractions. They have been evolved with the residing urban space with similar morphological and architectural characteristics.

6.2.14.2 Sustainability and urban outreach activities

University of Bologna has acquired an Environmental Sustainability Plan 2013-2016. The two dimensions of sustainability – environmental and social – embrace the idea of cherishing the land, so that natural resources are protected and replenished, and the ability of the people involved to act in an effective concerted manner, facilitated by

coordination among the various institutional echelons. The central focus is on new methodological models geared to measuring results and monitoring the various management processes. In the current Plan, these figure as a schedule of measures to be implemented over the three-year span covered.

6.2.14.3 The city

The city of Bologna is the seventh most populous city in Italy with a population of 389,261 inhabitants. The city has been an urban center for centuries and embeds the world's oldest university, University of Bologna. It is well-known for several architectural heritages such as churches, towers, and lengthy porticoes. It has a well-preserved historic core. It is a significant agricultural, financial, industrial, and transport hub. The city has a large student population well.

6.2.15 Uppsala University

Typology: Scattered Campus

University Name: Uppsala University

Campus Name: Uppsala University

Location: Uppsala, Sweden

University Foundation Date: 1477

Campus Foundation Date: Varied

Campus Area: - hectares

Number of Students (2019): 42,559

Population of City of Uppsala: 168,096

City Area: 48.77 km²



Figure 6.16 : Aerial view of Uppsala University (Url-20).

6.2.15.1 University campus development background

Uppsala University, established in 1447 in Uppsala, Sweden is the oldest university in Sweden and all Nordic countries. It has been founded along with other impressive institutions including castles and churches in the era when Sweden had its golden age after the late Middle Age. It has been founded in stone-houses, in the proximity of the Cathedral, in the heart of the town and was an integral part of its urban setting. Though it has been expanded and sprawled within 500 years of its history, it is still integrated into the urban life of the city. In the 17th century, the university buildings expanded with an attempt to revive the city. University's buildings with large distinguished shape express distinctiveness in the silhouette of the city. In the 18th century, various laboratories established in the body of the university around the town core that contributed to the flourishing of the science. In the 19th century, new phases of physical growth occurred with the construction of the library and Main Building, which along with the Gustavianum are the main landmarks of the town. In the 20th century, more sympathetic buildings were erected that replicate the continual expansion as the characteristics of any research library. A park naming the English Park is also founded behind the library. In the early 20th century, numerous buildings were erected at the western side of the English Park. It was aimed at creating a science precinct and altered the image of the university. Alongside with the higher education boom in the Post-WWII, the number of students increased significantly and the

university needed to be expanded largely. This issue altered the spatial organization of the university. The biological science campus was established as a satellite campus in a distance from the city center. In the late 20th century, the science complex was expanded in the university's southern area creating another sub-precinct.

The University of Uppsala has continued the long legacy of the city in conserving the informal green parklands. Thus, the science buildings have been situated in rolling green setting and are known as a desirable site by citizens.

A key issue that changed the organization of the university happened in 1993. Before that, all the real estate of higher education was managed by the National Board of Public Buildings, leasing the buildings to universities. With the new regulation in 1993, universities were allowed to own lands and premises. This was a new phase in the development of Uppsala University. In 1995, the new masterplan for the entire university was arranged and numerous new projects were initiated. This fact, widely transformed the spatial organization of the university. The science complex changed to the campus of humanities that enabled the agglomeration of many institutes in a mono-site and stimulated the interdisciplinary collaborations. The new master plan also re-organized the orientation of the layout, entrances, and the definition of the green space.

However, the tradition of leasing the buildings has a great impact on the coherence and characteristics of the university. Thus, the buildings do not express a uniformity for instance in the English Park, a wide range of architectural styles and material have been placed in a sole setting beside each other. The construction of the development of the late 20th century, do not follow a specific planning concept. The new constructions of the last fifty years are very unpretentious and ordinary. They are mainly erected for the sake of the function. However, the historical amalgamation, with the prominent heritage, is a key characteristic of the university. The Main Building, Carolina Redivivia, and Gustavianum, the informal green filed are the main landmarks of the university and the city. The identity of the university and the city are correlated with each other. In spite of continuous centrifugal developments towards the outskirts, the university has preserved its identity within the city.

6.2.15.2 Sustainability and urban outreach activities

Uppsala University Sustainability Initiative (UUSI) has been launched to strengthen research at the University that can further society's transition towards sustainability. Currently, the work is focused on two thematic areas or initiatives:

- Climate change leadership
- Sustainable urban development

Another two or three initiatives may be launched in 2019.

The goals of UUSI:

- Develop tools for effective multi- and interdisciplinary research collaboration.
- Communicate and give visibility to the activities and results of the research initiatives, within Uppsala University and to the external community.
- Initiate and develop multi- and interdisciplinary research initiatives in the area of sustainability.
- Support collaboration between the disciplinary domains and external actors within the initiatives.

6.2.15.3 The city

Uppsala is Sweden's fourth largest city. Since the Viking Age it has been one of the main cultural centers in Sweden. It is growing very fast which is becoming gradually integrated into the wider Stockholm region. Meanwhile, Uppsala has preserved its small-town characteristics which offers the possibility of accessing many destinations within a convenient cycling distance. The city center is compact and encompasses the Cathedral, the River Fyris, and several small squares, parks, cafés, restaurants, and historic buildings which shape the city's unique identity.

6.3 Discussion and Developing an Illustrative Index

6.3.1 Liveability

Liveability criteria consider the level of vibrancy and vitality of the campus. It describes to what extent a campus can offer a safe and liveable atmosphere that stimulates social interactions and enhances the sense of community and collegiality. Liveability of the campus is largely dependent on the extent of mixing various uses (mixed land-use), availability of on-campus housing for students and faculty, availability of well-designed and inspiring open spaces and green spaces, existence,

and distribution of extracurricular activities for students and staff, and availability of various retail services.

Referring to the examined case studies, Simon Fraser University and Universiti Teknologi Petronas belong to the typology of Detached campuses. They show a high level of liveability. This indicates that being designed as isolated and remote campuses, they embrace various facilities and services including on-campus residences, retail services, and various extracurricular activities. Both of the universities have been awarded for their campus master planning. One of their key campus plan strategies is mixed land-use which enhances collaborations and interactions. EPFL, ETH, and Utrecht University are Attached campuses and are located in the peripheries of their bordering cities. Similar to detached campuses, these precincts express a high level of liveability. They embed diversified facilities, services, and activity opportunities as well as on-campus residences which enrich the vitality of the environment. The campuses are green and also being surrounded by greenfield, they enjoy the high level of greenness that enhances the precincts attractiveness and sustainability. The ETH and Utrecht University campuses have been redeveloped. In their redevelopment plan, it has been emphasized on mixing land-uses and interdisciplinary cooperation. They have quasi well-designed and well-distributed open spaces. U.C. Berkeley, Stanford University and the University of Virginia represent the typology of Rurban campuses. They are significant elements of the development of their surrounding urban context. In this sense, from the beginning, they have provided an environment which offers various facilities and services to their academic body and hosting towns. They have emphasized the notion of community and collegiality, particularly, the University of Virginia which is the birthplace and the best expression of the concept of “Academical Village”. Thus, the sense of community and collegiality are very high on these campuses. They all have a well-designed and well-preserved historical core which set a ground for gatherings and communications. They all have a large ratio of green spaces. Although by the sprawl of their residing urban context, they have a central urban position, they offer varied types of housing for their students. Trinity College Dublin and Santralistanbul, Bilgi University belong to Gated campus typology. They both have a very central position in their host urban spaces. They have a mixed land-use plan. They have an average level of designed open spaces. Trinity College Dublin is largely covered by green spaces while

Santralistanbul, Bilgi University has a medium level of greenness. Trinity College offers diverse types of housing while Santralistanbul campus has little opportunities for on-campus residences and is mainly dependent on the city. They offer different types of activities for students and also embody various retail services for their academic body. Considering all of the factors, they present a high level of liveability.

Harvard University, MIT, and Free University Berlin are the representatives of Integrated campus typology. They all present a very high level of liveability. They have an urban position and well-integrated into their urban space. They all offer a wide range of extracurricular activity opportunities and diversified retail services within their setting. They have well-designed open space and encompasses the mid-high ratio of green spaces. Harvard University and MIT provide their student with various housing types within their setting while Free University Berlin offers residences outside its precinct but in close proximity. They have a high level of mixed land-uses and a high level of collegiality and vitality. University of Bologna and Uppsala University belong to the typology of Scattered campuses. They express a low level of liveability. Being composed of individual buildings or very small precincts, they do not contain large open spaces and greenfield. They are dependent on their hosting cities to provide facilities and retail services. They do not offer student housing. In addition, they cannot provide an interdisciplinary collaboration and mixed land-use spaces. As a result, the level of liveability and collegiality is very low on these campuses.

6.3.2 Legibility

Legibility criteria indicate that different components of the campus are organized in a coherent pattern and create an imageable and ineligible setting. A legible campus provides a memorable and beautiful environment and reinforces the identity and unique character of the setting as a constantly evolving environment and meanwhile values the history of the university. It offers an appealing space that enhances the daily experience of students. A legible campus urban space has a unique character in terms of the natural and built landscape. It has a good system of orientation and a hierarchy of spaces and routes. The existence of historical heritage, landmarks, and focal points at the end of axes and corridors enhance legibility. The homogeneity of architectural style and unity of architectural language is also a key aspect.

In the Detached campus typology, Simon Fraser University demonstrates a high level of legibility of campus layout. Although it is a modern university without any historical buildings, it has a well-designed plan with a hierarchy of open and built spaces. The architectural style is coherent in the entire campus and there are two main plazas for gatherings which also act as landmarks. Universiti Teknologi Petronas is a newly founded university and shows an average level of legibility. The main campus core has a very distinctive form and character and acts as the focal point. The rest of the campus is organized with some deviations from the main core characteristics, especially at the residential village part. EPFL, ETH, and Utrecht University, as Attached campuses, all demonstrate high levels of legibility. They are newly established and redeveloped universities and do not embrace historical heritages. They have consistency and harmony in their architectural styles. Their layouts are highly legible with good distribution and connection of open and built spaces, focal points and axes for orientation. U.C. Berkeley, Stanford University and the University of Virginia, as Rurban campuses, all present high levels of legibility. They have strong historical cores. It has been attempted to preserve the relationship between historical core and new developments and it was quasi-successful considering the large precinct areas and several phases of development. They have a quasi-consistent and legible character in the entire campuses considering their unique architectural and landscaping elements but their campus cores express a unique sense of identity. Trinity College Dublin shows an average level of legibility. There exists a very strong architectural character in the campus core. But new establishments have a different character. The historical core has a unique character. There are several landmarks and the university, itself, act as a landmark on the city scale. Santralistanbul, Bilgi University shows a high level of legibility. It is a historical industrial site that its heritage buildings are well-preserved in its renewal plan. The newly established buildings and the renovated historical buildings are incongruences. There are several landmarks in the settings. Harvard University, MIT, and Free University Berlin, as Integrated campuses, present mid to high level of legibility. Harvard University has a historical core with a very strong identity and character with several landmarks and focal points. Its architectural language has been repeated in the entire precinct. MIT and Free University Berlin are more recent campuses and do not include historical cores. MIT has a particular character coming from its strategy of starchitecture individual edifices. It includes artistic individual buildings and artworks which act as landmarks and focal points. It

has a medium level legible campus. Free University Berlin is a modern campus. It has a unique architectural style on the entire campus. The buildings of the campus have a specific architectural style and the newly designed buildings have designed concerning the main design principles. Considering the Scattered campus typology, University of Bologna express a high level of legibility. It is composed of heritages and historical buildings and it is highly legible and homogenous. It is the oldest university in the world and is one of the main tourist attractions in the local and national level. Uppsala University shows a low level of legibility. The university has been developed within the centuries in the leased buildings and sites and there is not any homogeneity in the material and architectural style.

6.3.3 Cohesion

A cohesive campus conveys a comprehensive idea and plan where all components of the setting cooperate to express an identity and a sense of place. A cohesive campus has a well-designed layout as the campus has a designed spin and open spaces are well-designed and defined by built spaces. Meanwhile, there is a spatial consistency between the campus and the surrounding urban fabric.

Simon Fraser University and Universiti Teknologi Petronas, Detached campuses, display an average and low level of cohesion, respectively. Being isolated from the urban fabric, they do not have consistency and homogeneity with their urban context. However, Simon Fraser University has a well-designed setting and is organized along the main spine with plazas, integral courtyards, etc. with very well-connected spaces. Concerning Universiti Teknologi Petronas, the precinct has a well-designed core with a distinctive shape and with a radial arrangement and the rest of the campus has a different spatial organization. Considering the Attached campus typology, EPFL, ETH, and Utrecht University show a high level of cohesion. They have well-organized campus spaces with a hierarchy between open space and built spaces. Being located in the city outskirts, they follow the spatial structure of the proximate city but have a medium level of consistency and homogeneity. In the Rurban campus category, Stanford University and the University of Virginia have quasi-well-organized campus settings. They have a very well-designed campus core but considering their large setting and several development phases, the same homogeneity is not followed in the entire campus. They have a medium level of homogeneity with their surroundings. U.C. Berkeley has a well-designed campus space in most of the areas and has a mid-

high level of homogeneity with the surrounding urban fabric. So, it displays a high level of cohesion. Considering Gated campus category, Trinity College Dublin has a high level of cohesion. It has a well-organized campus core and a semi-well-organized overall spatial configuration but it is highly in harmony with its surrounding urban fabric. Santralistanbul, Bilgi University shows an average level of cohesion. It has a well-organized spatial configuration but it has a very low level of spatial consistency with its surrounding urban tissue. In the Integrated campus typology, Harvard University has a high level of cohesion. It has a very well-organized spatial layout and the fact that campus and hosting town evolved together creates a high level of consistency. MIT and Free University present an average level of cohesion. They have a quasi-well-organized spatial layout. They have a mid-low level of spatial homogeneity with their residing urban context. In the Scattered campus typology, University of Bologna has a high level of cohesion. It has a well-organized layout and being inserted within the urban fabric as a part of its historical heritage, has a very high spatial consistency with its surrounding. Uppsala University shows an average level of cohesion. It does not include any precinct with an organized spatial layout but it is an integral part of its urban fabric.

6.3.4 Compactness

Compactness signifies compact urban form and also refers to contiguity and connectivity. It indicates the density of the campus setting and the proximity of the built forms.

Considering the Detached campus typology, Simon Fraser University displays a high level of compactness. It has one large campus with the concentration of constructions in the center of the campus to prevent sprawl and preserve the surrounding greenfield. Universiti Teknologi Petronas shows an average level of compactness. It obtains one large campus with a mid-high density in the campus core and low density in the rest of the area. It also attempts to preserve the surrounding rural land. Referring to the Attached campus typology, EPFL, ETH, and Utrecht University, all demonstrate a high level of compactness. They include one mid-size and compact campus with mid-high density. In the Rurban campus category, U.C. Berkeley, Stanford University and the University of Virginia, all present a high level of compactness. They include one large compact campus. A large portion of their campus area is covered by greenfield which if it is not included in counting the precinct density, they have a mid-high

density in their built areas. Considering Gated campus category, Trinity College Dublin and Santralistanbul, Bilgi University, both exhibit an average level of compactness. They acquire one compact mid-size precinct with the mid-low level of density. Concerning the Integrated campus typology, Harvard University and Free University Berlin have more than one smaller diffused precincts which reduce their compactness. The level of their density is high. Instead, MIT shows a high level of compactness, having one compact campus with high density. In the Scattered campus typology, University of Bologna and Uppsala University present an average level of compactness. They have been scattered within the urban context acquiring several individual buildings. They show a mid-high density similar to their urban fabric.

6.3.5 Walkability

It refers to the movement network within the precinct and underlines the capability of the campus to provide a safe, attractive, and intelligible moving experience. Walking and cycling are two environmentally-friendly modes of commuting that support social interactions and fosters liveability. It also necessitates the managing of the vehicle movement and arranging the parking areas in the campus in a manner that could be safe and functional without disturbing the pedestrian movement and ruining the campus vitality. Bike-sharing and carpooling is a sustainable mode of transportation that can decrease the need to automobile usage.

Considering the Detached campus typology, Simon Fraser University shows a high level of walkability. It has well-connected, weather-protected pedestrian walkways which facilitate reaching various destinations in campus within a 15-minute walking distance. Bike trails and car roads are well-organized. There is the availability of carpooling and electronic cars. In addition to parking structures, the open parking areas are small and mid-size and well-distributed. Universiti Teknologi Petronas express an average level of walkability. The core precinct area is accessible within a 15-minute walking distance. Pedestrian paths are organized and covered to be protected against the local heavy rains. There is a well-organized system of car roads, mainly located at the periphery of the campus center. There are mid-size and well-distributed parking areas. It does not offer biking, bike-sharing and carpooling opportunity. Concerning the Attached campus typology, EPFL, ETH, and Utrecht University, all demonstrate a high level of walkability. All of the three precincts are accessible within a 15-minute walking distance. They include well-designed and connected pedestrian paths at the

entire campus. The paths are mainly arranged orthogonally. They offer an orthogonal road network inside the campuses (except the campus core) that serve all the buildings without disturbing the campus homogeneity. There are small parking areas distributed around the site. They have bike routes inside and around campus. They also have bike-sharing and carpooling opportunities. Referring to the Rurban campus category, U.C. Berkeley, Stanford University and the University of Virginia, all present a high level of walkability. The car accesses are mainly on the peripheries and around the campus core and to main buildings without disturbing the campus core. There are small and mid-size parking lots and parking structures distributed around campus and outside campus in the vicinity. In the case of Stanford University, there are concentrated large parking lots in the western part of the campus, moving towards campus core and other parts of the campus, the parking areas are smaller and more distributed. In all the three campuses, there are bike routes inside the campus and in the vicinity. There is also the possibility of using bike-sharing and carpooling. Pedestrian paths are organic, and orthogonal in the campus core and well-connected. But considering the large size of the campuses, they are not reachable within a 15-minute walk to entire campuses. Considering Gated campus category, Trinity College Dublin and Santralistanbul, Bilgi University displays a high level of walkability. They have mid-size accessible parking areas in campus peripheries. Car roads are well-distributed around the campus core without disturbing it and also in campus boundaries. Pathways are organized and the precincts are reachable within 15-minutes walking distance. There are bike routes. Trinity College Dublin benefits from the bike-sharing system of the city. Concerning the Integrated campus typology, Harvard University, MIT, and Free University Berlin all exhibit a high level of walkability. The precincts are highly walkable with well-organized and connected pathways. The pathways also continue in the indoor spaces. The car roads are well-distributed without disturbing the campus cores. The parking areas are mid-size and well-distributed. There are well-connected bike routes inside precincts and also in the campus vicinities. There are opportunities for bike-sharing and car-pooling. Considering the Scattered campus typology, University of Bologna express an average level of walkability. It is mainly because of the sprawled status of the precincts that in spite of using the well-connected pathways of the city, it is not so convenient to reach various buildings in a short time. There are small-size parking areas but many university buildings use the parking areas of the city. For car roads and bike routes and bike-sharing, the campuses are dependent on the hosting city facilities.

6.3.6 Accessibility

Accessibility is a critical dimension and is highly dependent on the campus located within the urban fabric. In this research, accessibility concerns two issues. The first one is the ease of access and arrival to the precinct by walking, bicycling or using various transportation means. The other implies the level of permeability and porosity of the campus boundary.

Simon Fraser University and Universiti Teknologi Petronas, Detached campuses, both show a low level of accessibility. They are to some extent accessible by public transportation means but still, the need for car usage is high. Their boundaries are not physically closed but are restricted by natural barriers like forest and hills. Referring to the Attached campus typology, EPFL, ETH, and Utrecht University display a high level of accessibility. They are well-connected to various public transportation means. They have several entrances. Their boundaries are visually and physically permeable with no physical barrier except for highways. In the Rurban campus category, U.C. Berkeley and the University of Virginia exhibit a high level of accessibility. They are served with various public transportation means. They have several entrances. Stanford University has an average level of accessibility. It provides a shuttle service to the city center. It has several entrances but mainly for vehicle access. Considering Gated campus category, Trinity College Dublin and Santralistanbul, Bilgi University exhibits an average level of accessibility. They are located in central positions within the hosting cities and are served by various public transportation means. But they have physical barriers around their precincts that limit the free access to the setting. Harvard University, MIT, and Free University Berlin in the Integrated campus typology, and University of Bologna and Uppsala University, in the Scattered campus typology, demonstrate a high level of accessibility. They are situated within the urban fabric and have access to various public transportation means. Their boundaries are permeable with several access points.

6.3.7 Connectivity

It indicates the extent of connectivity of movement network between inside campus and its surrounding urban context. Connectivity is to some extent related to accessibility and points out to the level of permeability of campus boundary and also the availability of transitional spaces such as cafés and shops in the campus-city

interfaces which enable the connectivity between interior and exterior space of the campus.

Simon Fraser University and Universiti Teknologi Petronas, Detached campuses, both show a low level of connectivity. Their boundaries are limited by natural barriers. Being isolated from the urban context, there is no circulation network connectivity nor transitional spaces. EPFL, ETH, and Utrecht University, as Attached campuses, all represent a low level of connectivity. Their boundaries are permeable. They have no transitional spaces in their campus interface and there is no connectivity in circulation network around campuses. In the Rurban campus typology, U.C. Berkeley shows a high level of connectivity. The circulation network between campus and surrounding is connected. There are transitional spaces in campus boundary. Its boundary is a preamble. Stanford University and the University of Virginia display an average level of connectivity. They are restricted by natural barriers in parts of their boundary which influence negatively their permeability. They have no or few transitional spaces in their interfaces. Being restricted by natural barriers, the circulation connectivity between campus and surrounding is just happening in some parts of the precincts. Considering Gated campus category, Trinity College Dublin expresses a high level of connectivity. The campus boundary is visually permeable with several gates. There are shops, cafés, and restaurants in campus interface space. There is a high level of connectivity between campus and surrounding with several intersections. Santralistanbul, Bilgi University shows a low level of connectivity. Its boundary is impermeable with no transitional spaces in the interface area. There is not any circulation network connectivity as the result of being surrounded by the natural barrier, the water. Harvard University, MIT, and Free University Berlin in the Integrated campus typology, exhibit a high level of connectivity. The street network is highly connected. Their boundaries are highly permeable with several transitional spaces in their interface spaces. Considering the Scattered campus typology, University of Bologna and Uppsala University present a high level of connectivity. Their boundaries are highly permeable with many transitional spaces. The circulation network connectivity is in the nature of being an integral part of the urban context.

6.3.8 Integration

Integration in one hand implies the physical connection between campus and the surrounding urban context and is highly dependent on the location of campus within

its urban fabric. But on the hand, and much more related to the purpose of this research, is related to the social interactions and the outreach activities of the university towards its community. It is related to the extent of activities and services that campus offers to the surrounding community and the facilities that it shares with the public.

In Detached campuses category, Simon Fraser University displays an average level of integration. It is separated from the urban context. It offers many public educational programs, cultural activities, exhibitions, seminars, etc. Its amenities are shared by adjacent UniverCity community residents. Universiti Teknologi Petronas shows a low level of integration. It is isolated from the urban environment and the campus facilities are mainly serving the campus body. However, UTP is a university with the main mission of collaborating with industry through cutting-edge knowledge and expertise transfer. It has a Center of Excellence that works in this regard. Considering the Attached campus typology, EPFL, ETH, and Utrecht University exhibit a high level of integration. They are inserted in the city outskirts with a low level of spatial connectivity but they offer many services and programs to their adjacent urban space and shares their facilities like hospital, museum, library, etc. Referring to the Rurban campus category, U.C. Berkeley, Stanford University and the University of Virginia, all present a high level of integration. They are within the urban fabric. They share many amenities with the public such as hospital, museums, and sports facilities. They offer a wide variety of public and community service opportunities, ranging from on-campus courses to off-campus research to community, exhibitions, seminars, etc. Considering Gated campus category, Trinity College Dublin and Santralistanbul, Bilgi University displays a high level of integration. They are in central positions within their urban fabric. They offer many services to the community such as educational programs, seminars, art, and cultural events, etc. They share their facilities with the public such as the library, museum, etc. Harvard University, MIT, and Free University Berlin in the Integrated campus typology, all exhibit a high level of integration. They are in central locations and as an integral part of their urban contexts. They provide many services to the community and share their facilities with their surrounding community. Considering the Scattered campus typology, University of Bologna and Uppsala University express a high level of integration. They are spatially very integrated into the urban fabric. They share their facilities as well as offering several services to their urban community.

6.3.9 Sustainability

It mainly considers the sustainability incentives of the university. Considering the urban form, it relates to planning and constructing in a sustainable way. Concerning the university's third mission, it also encompasses all the university's endeavor to progress in the sustainable pathways. In all the categories, the campuses exhibit a high level of sustainability except University of Bologna and Santralistanbul, Bilgi University which newly has established their agenda in the sustainability pathway.

6.3.10 The illustrative index

The performance level of the set of criteria has been demonstrated in Figure 6.17. In this figure, the rows of the table show the list of fifteen campuses from the six campus typologies. The nine criteria are illustrated in the columns of the table. The vertical columns exhibit the level of performance of each university campus corresponding to one of the criteria related to sustainability and liveability of campus form. Each criterion for each case study has been portrayed in one of the colors ranging from green (the highest level), yellow (the average level), to red (the lowest level).

This illustrative figure provides the opportunity to make a comparison between performance level of each university campus according to each campus form criterion.



Figure 6.17 : The Figure illustrates the level of performance of case study university campuses according to the set of criteria.

6.4 The Campus Form Morphology Atlas

Based on the produced campus analytical maps, A Campus Form Morphology Atlas was developed. The Campus Form Morphology Atlas is a model to illustrate the types of morphological dimensions concerning campus typology. The developed model reveals that how different morphological attributes differ in different campus typologies. This Atlas is a matrix in which the first column demonstrates the fifteen case studies for the identified six typologies of the campuses and the first row exhibits the defined campus morphological dimensions (Figure 6.18).

Some morphological attributes are mostly related to campus internal organization while some concern the campus location and its relationship with the surrounding urban context. Though being inserted within the urban setting provides a higher possibility of integration between campus and the adjacent urban space, the campus internal layout has a critical role in strengthening the university-city interaction.

The morphology of urban context is a significant factor in the association between campus and the adjacent urban space. The high level of morphological similarity enhances campus-city connectivity. The issue is more comprehensible in Scattered, Integrated, and Rurban campuses. The land-use organization is highly related to the campus planning principles. However, a type of planning which emphasizes the interactions and exchanges, attempt to create more mixed-use and interchange spaces particularly in campus-city interface areas. In this sense, Detached, Attached and Gated campuses are to a large extent incapable of addressing the issue and contrariwise, Scattered, Integrated and Rurban campuses have more potentials to provide a transitional interface space. Considering the green space, Detached, Attached and Rurban campuses contain larger green spaces. The spatial structure of the campus is more dependent on the type of campus internal organization and less related to the campus-city relationship. However, the higher degree of homogeneity between campus and the surrounding urban context increases the level of their connection. The type of campus boundary and its permeability is an important determinant in creating an interaction between campus and the immediate urban space. A campus with permeable boundary and a larger number of entrances is more connected to its urban context. In this sense, Scattered and Integrated campuses display a high level of permeability. Though vehicle and pedestrian circulation network are more related to campus internal arrangement, it is a critical factor in creating a

connection between campus and the surrounding urban context. The circulation network may have diversified types including organic, grid, orthogonal, or radial system. The higher degree of internal and external circulation network continuity enhances the campus-city connection. The campus organization axis also is the issue more related to campus spatial layout and its historical development phases. However, it may carry some traces from the surrounding urban space development as well. For instance, in Rurban and Integrated campuses which have been developed along with their surrounding urban context, it can be in accordance with the urban space development grids.

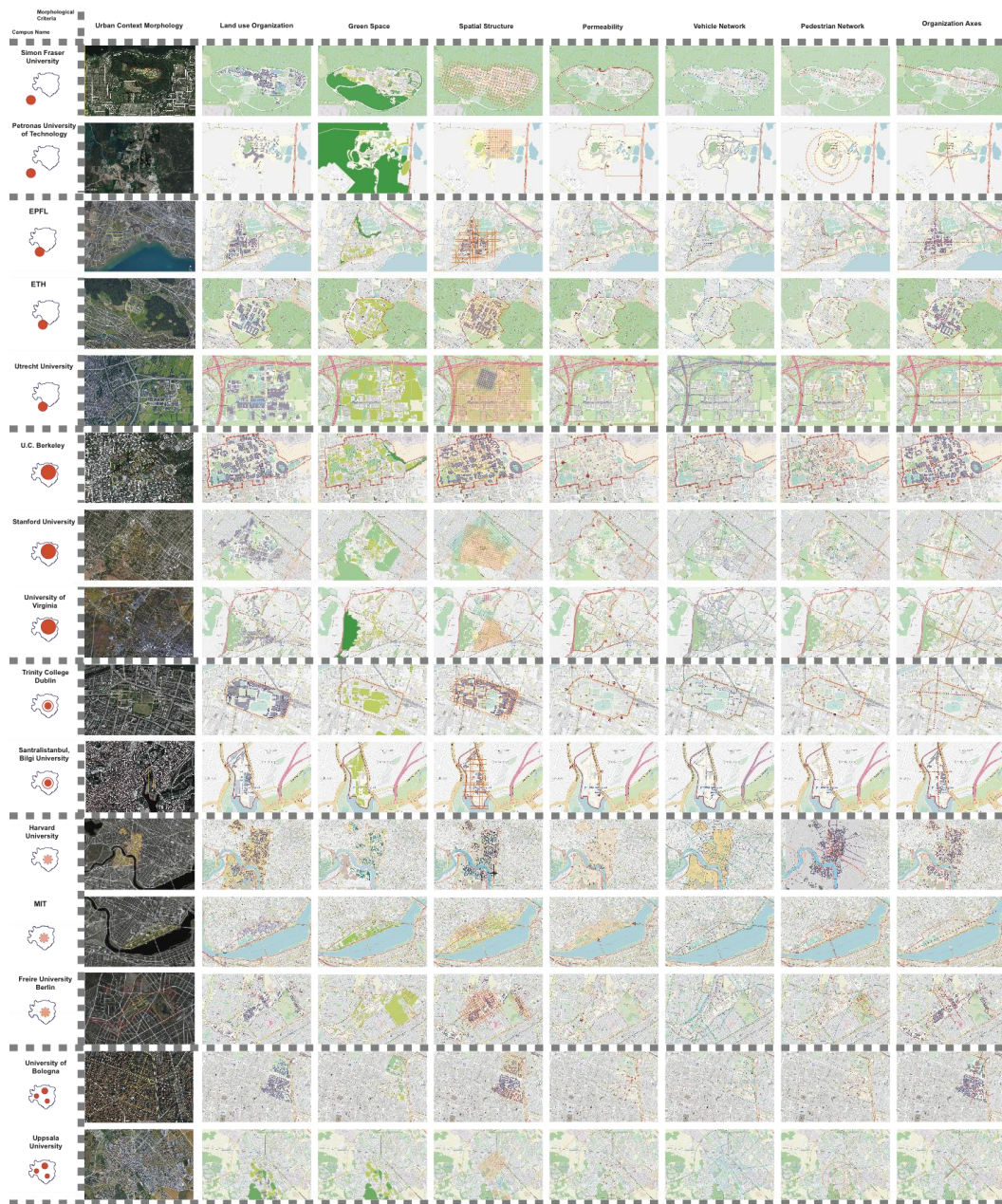


Figure 6.18 : Campus Form Morphological Atlas.

7. SUMMARY AND PERSPECTIVES

7.1 Final Remarks

Universities are place-bound entities and their mission is tightly linked to their physical form. However, the physical form and mission of universities have largely changed within centuries. Early universities in Europe were located within the urban context. Their primary mission was educating and nurturing the elite group of society. The knowledge production was preserved to the mono-functional, gated spaces separated from the mainstream of the society. Within the long history of higher education, they gradually moved outside of their enclaves and became more integrated into their societies. Recently, the global transformations have made a radical shift in the mission and consequently on the physical space of universities. Today, universities are among the main drivers of economic development and contributors to social life. They partake new responsibilities for the economic, social, cultural, environmental, and spatial development of their regions. They are key generators of knowledge and technology, supporters of new businesses and industries, and engines of economic growth. They are the originators of many new ideas and cultural trends and enrich the socio-cultural reputation of the society through providing several educational programs and cultural events. They are large institutions with large physical properties that influence the spatial condition of their hosting urban fabric. They are key agents in the regeneration and transformation of the urban areas and spatial development of the hosting cities in collaboration with external stakeholders. In this regard, the third mission of universities is to some extent dedicated to urban outreach activities and addresses economic, socio-cultural, spatial, and environmental challenges of the societies (Razavivand Fard et al., 2017). Accepting these new roles, universities have become more collaborative and integrated institutions in their societies.

The mission of a university is the basis of the institution's strategies and actions and is directly linked to the university's vision and general philosophy. The educational programs, university's built-space, the social dimension of the university, and its connection with the broader society is grounded on the institutional values. In this respect, the campus physical environment plays a fundamental role in the realization

of the objectives and core values of the institution (Kenney et al., 2005). As Chapman (2006) argues, “the institutional story is told through the campus . . . The campus is an unalloyed account of what the institution is all about.”

Clearly, the edifices of universities, the open spaces between the buildings, and the space surrounding them which constitute the physical form of universities are not a blank canvas that institutional, academic and daily life of university body was portrayed. They extremely influence what is happening inside their boundaries and also outside in their proximate urban context and even in a broader sense, they have a global influence. One important concern is that once a university is founded it is rarely possible to be re-located (Temple, 2014). Another important issue to consider is that the university shapes and is shaped by its surrounding urban space. Thus, the location of a university and its physical features play a profound role in fostering synergies and enhancing the interaction between the campus and its surrounding environment.

The location of a university campus, the physical features of the setting, its spatial configuration and morphological characteristics have large impacts on the quality of academic and social life of a university (Caldenby, 2009). Campus physical space is not just the means to facilitate learning but it has a larger influence on the educational, social, cultural, economic life of the academic community and the broader society. A university campus with a high-quality urban space can reinforce a higher quality research and education, attract and nurture high quality human capital, assure the presence of people and support diversified activities, stimulate the flow of synergy, foster social and economic well-being, and consequently contribute to vibrancy, liveability and sustainability of campus space, and promote prosperity of the hosting neighborhood, city, and region.

In literature related to urban form, notions of “sustainability” and “liveability” are correlated. Accordingly, sustainability endorses a better quality of life and a more liveable urban environment. University is a microcosm of a city. Considering the large dimension and the diversity of functions, the university campus has many common attributes of an urban space including built space, open space, circulation networks, and also the spatial configuration and the relationships between these components. Therefore, the design principles that are applied to urban space can be applicable to a university campus, considering the specific function of the university. Building on this, the sustainability and liveability factors which are related to an urban form can be

referred to the campus form. Developing a sustainable urban environment signifies to set a group of morphological strategies and relationships through arranging the components of urban form. These principles ultimately intend to diminish the urban sprawl, increase compactness, decrease commuting distances, reduce energy consumption, CO₂ emissions and pollutions. Liveability and the concept of liveable urban space are very much related to the notion of quality of life while it is associated with the vitality and congeniality of urban space. Thus, a liveable urban space indicates an inspiring quality of life conditions with attractive public space, social activities, sense of community, environmental resiliency and economic vigor.

In this context, universities because of their educational mission, their large size, and impact on their societies are key agents in directing the society, forming its future and the transition towards a liveable and sustainable environment. Universities are among chief organizations in the society that comprise infrastructure, facilities, land, human and economic capital, and function as large urban enterprises. So, sustainability initiatives can be incorporated into their research and educational agendas as well as their operations and should be manifested in their physical setting. To do so, universities have considered the fact that they need strategies that profit students, staff and also the broader community. Today, many universities improve their facilities in accordance with the concepts of sustainability and liveability and attempt to be more connected, coherent, green, pedestrian-friendly and more importantly try to be an integral part of their surrounding urban context. It can be admitted that there is a correlation between the spatial quality of university space and the quality of academic and urban life. Physical attributes of a campus setting can be well portrayed by a comprehensive campus plan. Campus layout outlines the institutional objectives of the university including attracting prospective students and faculty, promoting the quality of life, improving the academic atmosphere, contributing to sustainability goals, and improving the quality of proximate urban space.

Considering this background, this research has been initiated with the primary aim of exploring the relationship between universities and their residing urban context. Its main objective is to explore:

- How physical features and morphological characteristics of universities and their third mission objectives in terms of urban outreach activities influence the

sustainability and liveability of university campus urban space and the surrounding urban space.

And it continues with the sub-questions as:

- What are the main criteria that influence the sustainability and liveability of university campus space and the surrounding urban space?
- To what extent does the impact of these criteria vary in different typologies of university campuses?

The research has investigated the social and spatial evolution of universities within the course of centuries, their new responsibilities in the ever-changing context of the global world, and their third mission and urban outreach activities. It has explored the morphological and spatial relationship that universities create with their surrounding urban context. Considering universities' spatial attributes and their urban location, this research has identified six typologies of universities campuses as (1) Detached campuses, (2) Attached campuses, (3) Rurban campuses, (4) Gated campuses, (5) Integrated campuses, and (6) Scattered campuses. The attributes of each typology have been described in chapter three. These typologies present different morphological attributes and spatial patterns that a campus create in relation to its adjacent urban fabric.

As described before, then the research has focused on the factors that influence the liveability and sustainability of university campuses concerning the campus form. In this respect, the literature related to the concepts of urban form, campus form, sustainability, liveability, and campus design principles has been reviewed. Through a comprehensive literature review and Content Analysis of university campus masterplans, the main criteria which affect the liveability and sustainability of university campus form have been defined. This set of criteria consist of nine main criteria and twenty-eight sub-criteria. The multi-criteria set comprises liveability, legibility, cohesion, compactness, walkability, accessibility, connectivity, integration, and sustainability. The defined set of criteria embraces spatial and morphological attributes of a campus setting such as a campus spatial organization, greenness, compactness, density, legibility, as well as the dimensions concerning the urban

outreach activities of the university which is related to campus physical space such as shared facilities, provided services, and sustainability initiatives.

The set of criteria has been applied to fifteen university campuses which have been selected as case studies and represent the defined six university campus typologies. The selected universities are among the best representatives of their typology. They are among the highest-ranking universities in terms of academic performance. They have been developed according to very well-designed or redeveloped campus masterplans which many of them have been achieved prestigious architectural awards. Acquiring these criteria facilitates the comparisons between campus spatial organizations and make it possible to generalize the findings.

The selected university campuses have been analyzed in-depth according to their history, campus development process, and their spatial and morphological attributes. Analytical maps have been produced for each case study. The developed set of criteria has been applied to each campus and a descriptive table has been developed for each case study explaining its specific characteristics concerning the set of criteria.

The case study analysis makes it possible to have a better understanding of how each campus typology performs regarding the defined set of criteria in terms of sustainability and liveability aspects. Based on the findings of Multiple-case study analysis it can be noted:

The criterion of “Liveability” is a qualitative dimension and to some extent is related to the perception of users towards space. This perception is interwoven with the spatial qualities of place. It is more dependent on the internal structure and spatial configuration of the campus setting rather than its location. The existence of diverse and mixed land-uses and opportunities for participating in diversified activities increase the presence of students and their involvement in the potential activities and enhance the sense of community and collegiality. Well-designed and well-connected opens spaces and the existence of green spaces attract more people to spend time in the setting, increase the social interactions and informal knowledge exchange, and enhances the quality of place. Availability of various retail services such as cafés and restaurants and extracurricular activities including exhibitions, student union spaces, athletic facilities and sports fields, and their fair distribution within the setting in a walkable distance increase the engagement of students and their socialization. In

addition, providing on-campus housing in a mixed-use manner is a key issue that guarantees the presence of people in the day and night hours and weekends which reinforces vitality and safety of the campus environment.

Thus, liveability is highly related to campus spatial layout and its spatial qualities and the location of the campus has an indirect impact. Being inserted within an urban fabric can encourage the presence of students and their willingness to be involved in the campus setting activities beyond their mandatory academic programs. However, it needs more research to be validated and requires other methods including questionnaires and interviews to understand the space-use patterns of students.

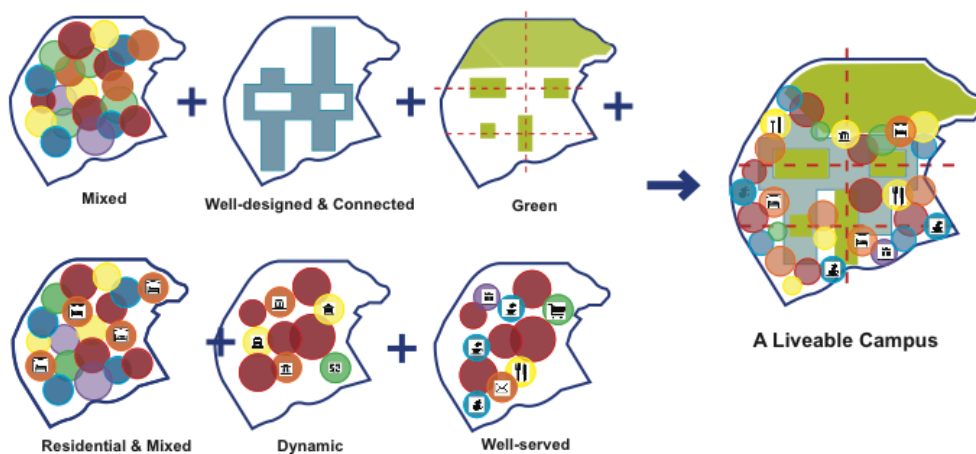


Figure 7.1 : A Liveable Campus Scheme.

The criterion of “Legibility” is related to the spatial layout of the precinct and the experience and perception of users of its spatial qualities. When different components of a campus setting including built forms, open spaces, landmarks, movement networks are organized in an identifiable pattern, they create a legible space. A legible campus space reinforces wayfinding and facilitates creating a mental image of the space. Existence of historical buildings strengthens the identity of the campus and contributes to the sense of place. Designing landmarks at focal points, intersections, end of the axes and pathways create a high level of imageability and intelligibility. Existence of a distinctive and unique architectural style, architectural material, and a common landscaping element forms a more united and identifiable campus setting. According to the findings of the case study analysis, legibility is more related to the internal spatial configuration and architectural attributes of the campus. In this sense, the location of the campus plays a smaller role in its legibility. However, it can be

observed that the precincts which have been inserted within the urban tissue embody more landmarks or themselves are the landmarks for the hosting urban context. For instance, Harvard University and the University of Bologna are considered historical heritage and act as landmarks and attractive places for visitors in the local and national scale.

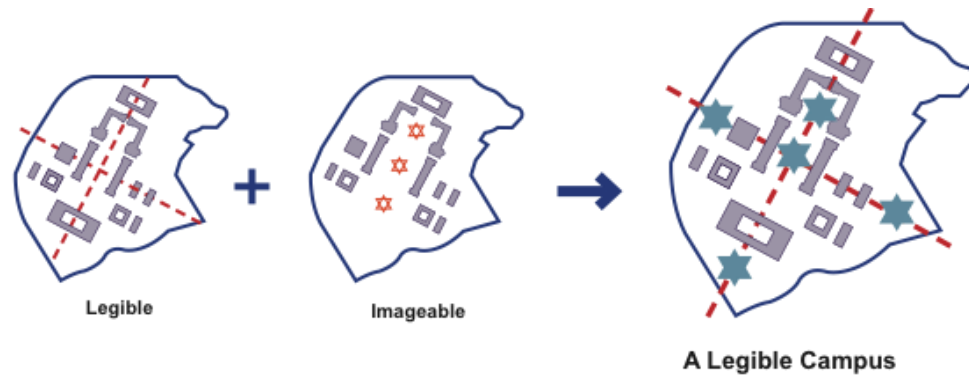


Figure 7.2 : A Legible Campus Scheme.

The criterion of “Cohesion” is related to the spatial layout of the campus. The built space and landscaping elements of the campus need to be arranged in a coherent manner. The whole campus should have a well-designed layout. It can be designed along with the main spin where open spaces are well-designed and defined by built spaces. Different spaces are connected through a hierarchy of spaces including main corridors, courtyards. The campus has a core space with a defined open space or plaza with landmarks, enclosed open spaces, designed landscape elements, and the entire master plan is relatively symmetric and geometric. The entire campus is designed as a unity and express a unique identity. Moreover, the precinct forms a consistency with its adjacent urban space. In one hand, cohesion is related to the internal spatial configuration of the campus to form a coherent and united setting and on the other hand, it is related to the relationship between campus spatial layout and the spatial structure of the surrounding urban fabric.

Referring to the findings of the case study analysis, it is noticeable that Detached campuses and Attached campuses such as Simon Fraser University, EPFL, ETH, and Utrecht University in spite of having a high level of internal spatial organization cohesiveness, demonstrate a low level of consistency with their surrounding urban context. The University of Bologna and Harvard University which are integrated into the urban fabric exhibit a high level of cohesion. There is a consistency between

campus form and the approximate urban form. They are making a unity which enhances the flow of synergies. Thus, the location of the campus influences its cohesion dimension.

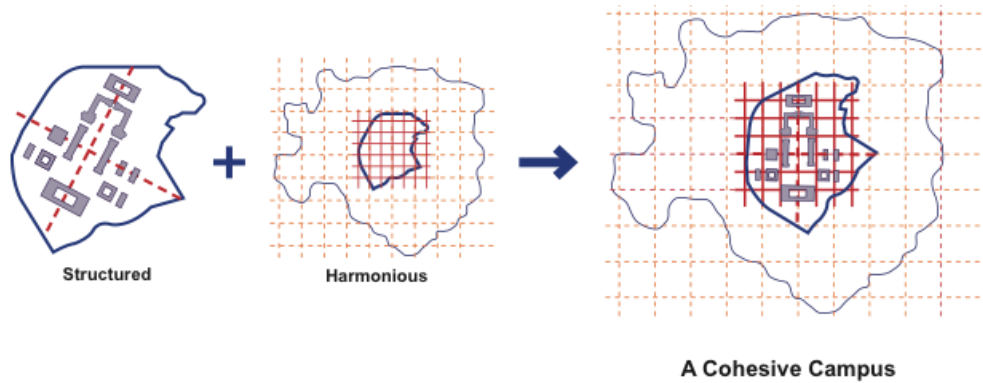


Figure 7.3 : A Cohesive Campus Scheme.

The criterion of “Compactness” refers to the density of the precinct and the proximity of built-forms inside the campus and examines if a campus is composed of a solo-precinct or includes several and scattered smaller precincts. Compactness and density are directly related to liveability, walkability, and sustainability. A denser and compact precinct promotes interactions which enhance liveability. It facilitates movement between different nodes and within the entire campus and promotes walkability. It also creates a higher level of sustainability through reducing the needs for travel, decreasing energy consumption and restricting the urban sprawls and land uses. However, density can be a relative issue. For instance, the existence of a high ratio of green spaces within the setting is a positive dimension which can enhance the liveability and sustainability but oppositely decrease the density and compactness. Compactness is related to the campus form and its internal spatial organization as well as its form within urban tissue. In this sense, scattered campuses have the lowest performance, being sprawled around the urban space. The Detached campuses, Attached campuses, and Rurban campuses mostly include a single medium or large-size compact campus with lower density. Gated, Integrated, and Scattered campuses comprise denser and less compact precincts. It can be noticed that most of the campuses which have been evolved with their surrounding urban context show similar densities.

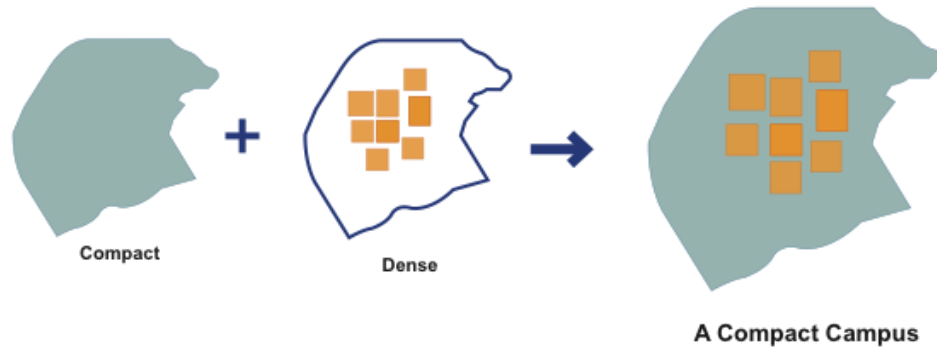


Figure 7.4 : A Compact Campus Scheme.

The criterion of “Walkability” refers to the ease of movement within the precinct and highlights the importance of creating an effective, secure, and intelligible circulation network. It considers the pedestrian pathways, bike routes, and vehicle roads which need to be designed in a way that be connected and homogenous and facilitate the movement within the campus. The priority needs to be given to the pedestrian walkways which consequently promotes the existence of people in the campus outdoor spaces and stimulates the interactions. Biking is a safe and sustainable mode of commuting which requires well-designed and connected routes and needs to be connected to the bicycling network of the surrounding urban space. Organizing the vehicle roads is more challenging and needs to be designed in a way that does not disturb the pedestrian movement within the campus and particularly in the campus core. It is more appropriate to arrange the car roads in the campus edges while creating service access to the main buildings. Parking areas follow the automobile roads network. It is more appropriate to organize them mainly in the campus peripheries with a fair distance to most of the facilities. Small and medium-size parking is more acceptable than large size parking lots which create fragmentation in the campus setting.

A key issue that affects the walkability of a campus setting is the layout of the campus and the placement of different functions. If various facilities and uses are located in proximity, it can be reachable by walking or biking. If a campus is very large, walking to all areas may not be realistic. However, increasing density, creating a mixed-use model and providing diverse on-site services can enhance the walkability. Existence of on-campus housing also promotes the potential of walking and bicycling.

Walkability to a great extent is related to the internal campus spatial layout and less is related to the location of precinct within the hosting city. The findings of the case studies do not indicate a correlation between walkability and campus urban location.

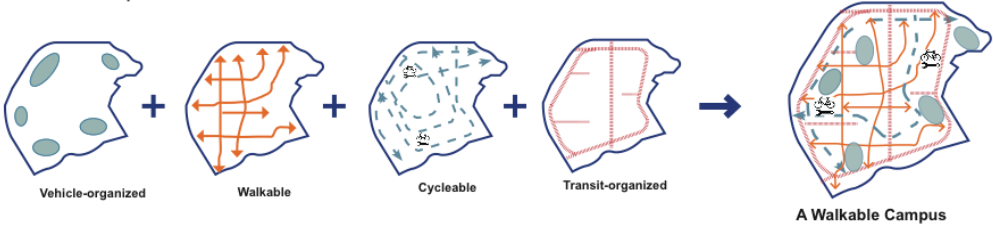


Figure 7.5 : A Walkable Campus Scheme.

The criterion of “Accessibility” relies on the precinct location, the type of its boundary, and availability of various transportation means. It is related to proximity and possibility of commuting between campus and mainly the city center. According to the findings of the case study analysis, the Detached campuses demonstrate the lowest level of accessibility. Attached campuses which have been analyzed in this research have operationalized high-quality sustainable transport including biking, bike-sharing, and carpooling and are served by a highly effective public transportation system which increases their accessibility level. Gated campuses have the opportunity of being accessed easily by various modes of transportation but their boundary type and their enclosed system decrease the level of accessibility. Rurban campuses also are accessible concerning their urban location but the campus boundary permeability should be considered. Scattered campuses and Integrated campuses exhibit the highest level of accessibility as the result of being located in urban centers and being integrated into the urban fabric through very porous boundaries.

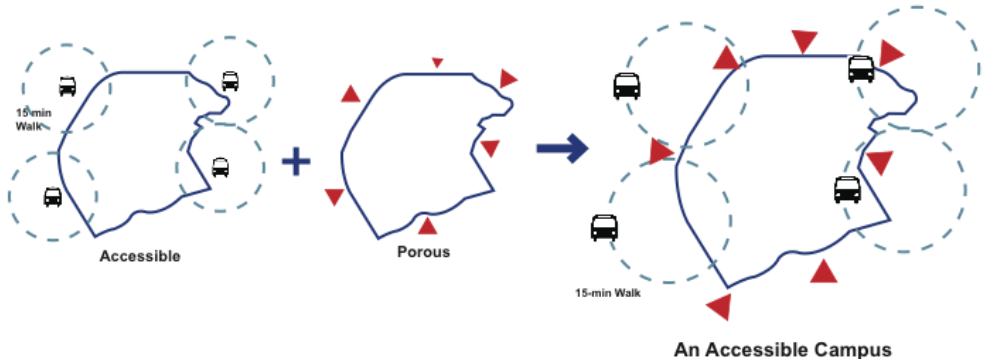


Figure 7.6 : An Accessible Campus Scheme.

The criterion of “Connectivity” is dependent on the availability of transitional spaces in the campus interface space, the permeability of campus boundary, and the continuity of the city circulation network within the campus setting. Campus boundary type has an important role in this regard. Impervious boundaries restrict the accessibility to the precinct and limit the free movements. They also restrict the flows and continuity between campus and proximate urban fabric which consequently reduce the vitality of the urban context. In this sense, the campus location and the state of being inserted with an urban fabric or being isolated play a key role. Findings of the case studies express that the Detached campuses and Attached campuses present the lowest level of connectivity and Rurban campuses demonstrate an average level of connectivity. The Gated, Integrated and Scattered campus typologies which are inserted within the urban tissue demonstrate a high level of connectivity.

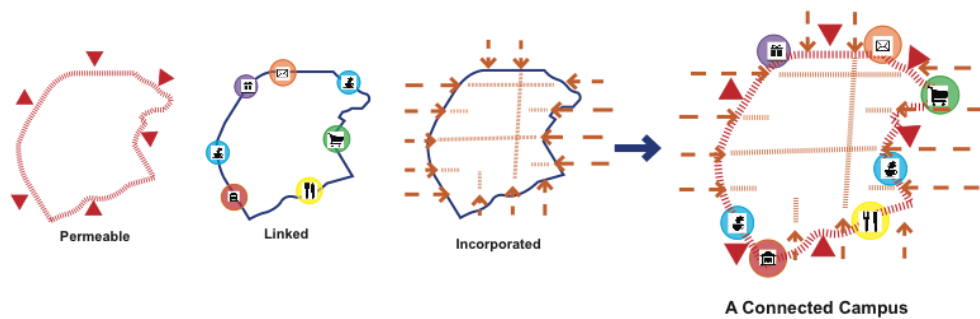
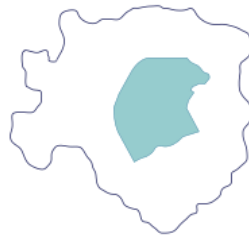


Figure 7.7 : A Connected Campus Scheme.

The criterion of “Integration” implies the physical connection between campus and the surrounding urban context in one hand and considers the centrality of the campus location within city urban space. On the other hand, to a large extent is related to university outreach activities towards its community. It considers the availability of shared facilities with the community such as museums, library, sports facilities, open spaces and recreation areas, etc. and the availability of annual outreach activities and events such as courses, seminars, exhibitions, art, and cultural events, tours, etc. provided by the university for the public. Moreover, the existence of public spaces, plazas, and courtyards of the campus which are accessible to the public enhances the level of integration between them.

Thus, integration is largely related to the university’s third mission and urban outreach activities and the service that provides for the public and less is materialized in the campus physical form and its urban location. However, it can be claimed that a campus

which is inserted in the urban fabric and enjoys a high level of accessibility and centrality can attract more people to attend the organized events.



An Integrated Campus

Figure 7.8 : An Integrated Campus Scheme.

The criterion of “Sustainability”, generally encompasses all of the mentioned criteria. There is a direct correlation between the extent of the walkability, accessibility, liveability, and compactness of the campus and its sustainability. However, in this analysis, the dimension as a single criterion mainly refers to the university’s physical space, its outreach activities, and its sustainability initiatives. In this sense, it is not possible to directly correlate this dimension with the campus form and location.

It is noticeable that some of the criteria are correlated. As such, a very compact campus is more walkable and a highly walkable campus is more liveable. The high degree of sustainability is associated with a high level of compactness, walkability, and liveability.

Overall, the developed set of criteria and the proposed campus typologies make it possible to propose a well-performing university campus model. This university campus model can assist university campus designers, decision-makers, and university authorities to better understand the relationship between their campus typology and campus form with the associated sustainability and liveability outcomes. It also provides an opportunity to explore the relationship between campus form and the mission and vision of the university.

One of the most significant contributions of this research is developing a theoretical framework for a sustainable and liveable campus form. However, it should be noted that each campus is, and need to be, a unique entity considering its history, culture, philosophy, mission, and context. Thus, in addition to implementing the generic

schemes, the universities should attempt to create their particular identity and character.

7.2 Limits of Research

One of the most challenging sides of this research was data availability. Although the information about the general institutional features is approximately accessible, there is not adequate available data on the built form attributes of the university campuses. Moreover, considering the variety of case studies and their geographical locations, it was a challenging issue to conduct an in-situ observation for all the cases. In this respect, it was attempted to use alternative methods for data collection such as informal skype interviews with students of the campuses, using several online videos demonstrating the campus space and campus life, university websites and photo galleries, and Google Maps Street-view option. In spite of the shortages, the research attempted to provide a rich database for the selected case studies and utilize it for producing the analytical maps.

Another issue to be considered is that the criteria were applied and tested on the selected case studies and were assessed according to the developed Histology Atlas of Campus Form for the reliability but without in-situ observation of the precincts, for some qualitative aspects the possibility of subjective evaluation mistakes is likely.

7.3 Future Studies

This study is focused on the subjects of university campus form and university-city relationship, aiming at exploring the sustainability and liveability parameters in relation to the campus form. The research intends to provide a theoretical scheme to evaluate physical attributes and morphological characteristics of campus form which influence sustainability and liveability of campus setting and the surrounding urban context. In this respect, it develops a methodological framework which is twofold: hypnotizing cycle and theorizing cycle and totally is composed of seven steps. The proposed methodological framework identifies six typologies of university campuses concerning their urban location and develops a multi-criteria set to evaluate university campus physical and morphological characteristics in terms of sustainability and liveability and then, it has applied the criteria set on the selected university campuses from the different campus typologies.

The proposed methodology is applicable to other function typologies and mid or large-scale institutions such as commercial and recreational spaces, research centers, hospitals, etc. and examine their spatial impact in terms of sustainability and liveability.

Furthermore, the proposed set of criteria can be applied to a larger number of case studies. It will make possible the generalizations and achieving stronger results. The case studies can be selected from a specific region to assess a regional or national performance or can be selected throughout the globe.

Moreover, other criteria concerning the characteristics of the interior spaces such as classrooms as the cells of university space can be included.

In this research, the study on the impact of the university on the surrounding urban context is limited to the morphological characteristics and universities' third mission in terms of urban outreach activities. It can be investigated in more detail considering each of the economic, social, and environmental impacts. It may also consider the university's influence at a short, medium and long-term ranges, evaluating the transformations in the urban space in terms land-uses changes, offered new jobs and services, real-estate prices, housing and accommodation conditions, and gentrification and spatial development.

Another possibility is examining the relationship between campus form criteria and academic performance of universities. It will make it possible to analytically evaluate the correlation between campus space qualities and the academic performance of the institution and students' outcome.

Grounded in the findings of the theorizing cycle, one Index of campus sustainability and liveability evaluation criteria and one extensive Campus Form Morphological Atlas have been developed. The relation between these two frameworks can be explored in further researches.

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APPENDICES

APPENDIX A: List of the Examined Master Plans for Content Analysis

APPENDIX B: Case Study Analysis

APPENDIX A: List of the Examined Master Plans for Content Analysis

1. University of York: Heslington East Campus, Ireland.
2. Trinity College Dublin, Ireland.
3. Bilgi University, Turkey.
4. ETH Zurich, Switzerland.
5. Universiti Teknologi Petronas.
6. Simon Fraser University, Canada.
7. Free University Berlin, Germany.
8. Politecnico di Torino, Italy.
9. University of Kent, England.
10. The University of Sheffield, England.
11. Lancaster University, England.
12. University of Exeter, England.
13. University College Dublin, Belfield Campus, Ireland.
14. Western University, Canada.
15. University of Wollongong, England.
16. University of Queensland, Australia.
17. Australian National University, Australia.
18. University of Toronto, Mississauga Campus, Canada.
19. University of Leeds, England.
20. University of Hong Kong, China.
21. Vancouver Island University, Nanaimo Campus, Canada.
22. University of the Fraser Valley, Canada.
23. University of Ottawa, Canada.
24. University of Waterloo, Canada.
25. University of Lethbridge, Canada.
26. Griffith University, Nathan Campus, Australia.
27. University of Melbourne, Australia.
28. Makerere University, Uganda.
29. MacEwan University, Canada.
30. Nagoya University, Japan.
31. University of Glasgow, The UK.
32. Chinese University of Hong Kong, China.
33. University of the West of England, Frenchay Campus, England.
34. University of Manitoba, Canada.
35. Glasgow Caledonian University, England.
36. University of Sunderland, England.
37. Monash University, Clayton campus, Australia.
38. Monash University, Caulfield Campus, Australia.
39. Utrecht University, the Netherlands.
40. Brandon University, Canada.

APPENDIX B: Case Study Analysis

B.1 Simon Fraser University, Burnaby, Canada

B.1.1 Spatial analysis maps



Figure B.0.1 : Campus Location Analysis Map of Simon Fraser University.



Figure B.0.2 : Campus Land-use Analysis Map of Simon Fraser University.

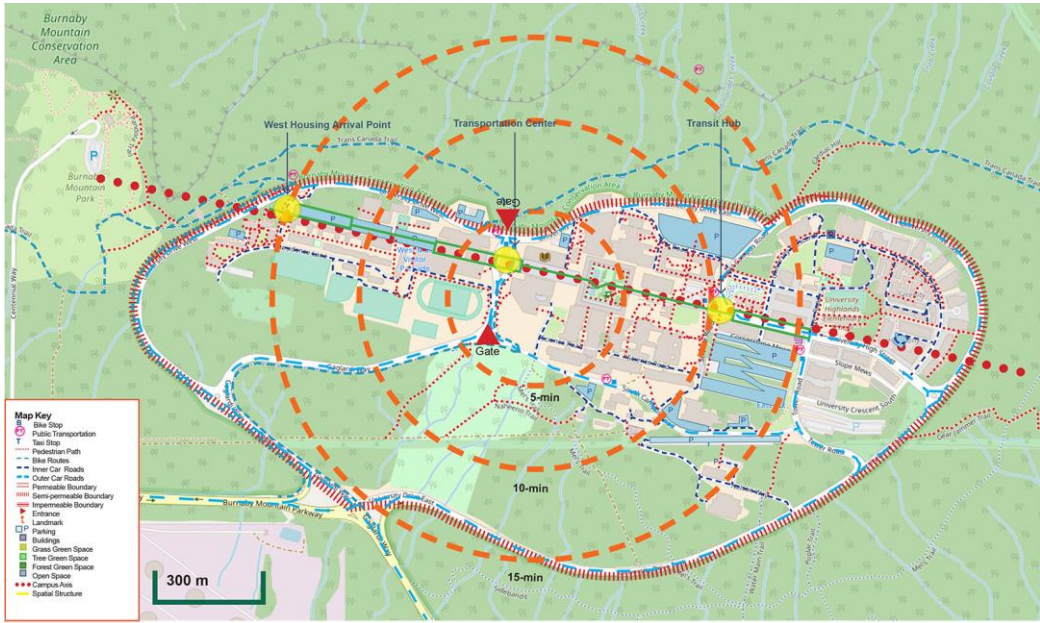




Figure B.0.5 : Campus Compactness Analysis Map of Simon Fraser University.



Figure B.0.6 : Campus Urban Context Morphology Analysis Map of Simon Fraser University.

B.1.2 Multi-criteria analysis table

Table B.1 : Liveability and sustainability multi-criteria assessment table of Simon Fraser University.

<i>Simon Fraser University</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	A Mixed zoning of spaces according to <i>Use</i> and not to departments, an <i>Interdisciplinary</i> work availability.	3	
	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.	Well-designed plazas and courtyards (considering the climate conditions)	2	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	Existence of Forest areas, Integral courtyards, grass fields and Meadows, ...	3	

Table B.1 (Continued) : Liveability and sustainability multi-criteria assessment table of Simon Fraser University.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	Availability of low to mid rise Student housing in western and eastern side of campus	3	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces, considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is no extracurricular activities.	Sport field, covered gyms, recreation areas, galleries, museum, ...	3	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided in surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services.	Available.	3	
Legibility	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space e.g. existence of unique character like natural and built landscape, historical heritage, availability of focal points at the end of streets for orientation, hierarchy of spaces and routes, from 3 to 1.3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	It is a well-designed campus with a coherent architectural style.	3	

Table B.1 (Continued) : Liveability and sustainability multi-criteria assessment table of Simon Fraser University.

	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	Concrete as the main material, a common modern architectural style repeated all around the campus.	3	
	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and clock towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark exist.	Plazas, courtyards and art works	2	
<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout that campus has a designed spin and open spaces are well-designed and defined by built spaces. Different space are connected by hierarchy of spaces including corridor, courtyard. Campus has a core space with a defined open space or plaza with land marks, enclosed open spaces, designed landscape elements and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	It is a well-designed campus (Architectural Awards)/ Organized along a main Spine with plazas, integral courtyards, ... Very well-connected spaces.	3	

Table B.1 (Continued) : Liveability and sustainability multi-criteria assessment table of Simon Fraser University.

	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban space with no morphological consistency.	Considering being a Detached campus, it is not connected to urban fabric. Although it follows the grid planning system like the nearest city but it is surrounded immediately with a large green space that creates a fragmentation between campus and the city.	1	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying adaptive reuse infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	Compact and clustered in the core of the campus. Preserving the surrounding landscape.	2	
	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	Designed as a High dense cluster in the core of the campus and expanding outward.	3	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilitates or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	Indoor and Outdoor parking availability for SFU members and visitors	2	

Table B.1 (Continued) : Liveability and sustainability multi-criteria assessment table of Simon Fraser University.

	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	Well-connected, Weather protected pedestrian walkways	3	
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	Bike trails.	3	
	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	Vehicular roads, Electronic car availability.	3	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	Availability of Car sharing, Car pooling, Electric Vehicles	3	
<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	Four Bus route	2	

Table B.1 (Continued) : Liveability and sustainability multi-criteria assessment table of Simon Fraser University.

	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	There is no artificial borders. There is forest around the campus as a Natural barrier. And there is one entrance to the campus.	1	
<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1.3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	It has located within a forest area, accessible by car. Being located on the Hilltop, it has a great vista.	2	
	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, etc., from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	Isolated from city and is surrounded by forest area.	1	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	Connected within campus but it is separated from the surrounding.	1	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	It is a Detached campus, 8-km far from Burnaby center and 20-km to Vancouver center	1	

Table B.1 (Continued) : Liveability and sustainability multi-criteria assessment table of Simon Fraser University.

	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	All the amenities are shared by UniverCity community residents.	3	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Many public educational programs, cultural activities, exhibitions, seminars,	3	
<i>Sustainability</i>	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Highly Available	3	
	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	Got several Sustainability Awards, AASHE member, Sustainability Office, Energy efficient Buildings, Sustainable, Transportation, sustainability educational programs	3	

B.2 Universiti Teknologi Petronas, Perak, Malaysia

B.2.1 Spatial analysis maps



Figure B.0.7 : Campus Location Analysis Map of Universiti Teknologi Petronas.

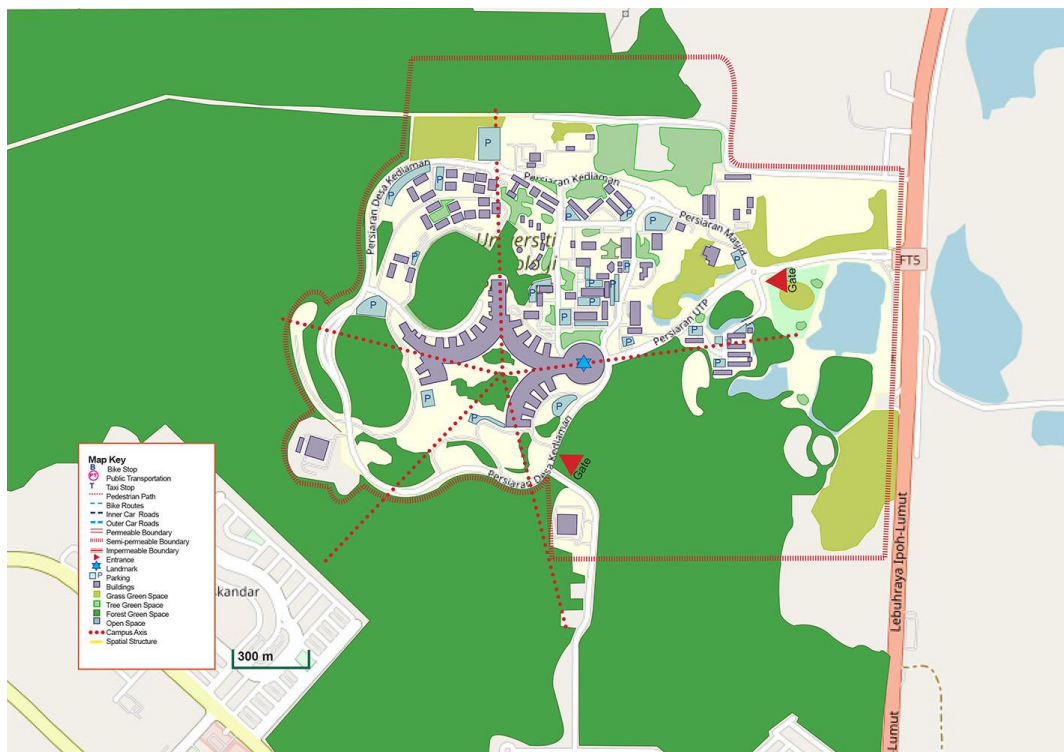


Figure B.0.8 : Campus Land-use Analysis Map of Universiti Teknologi Petronas.

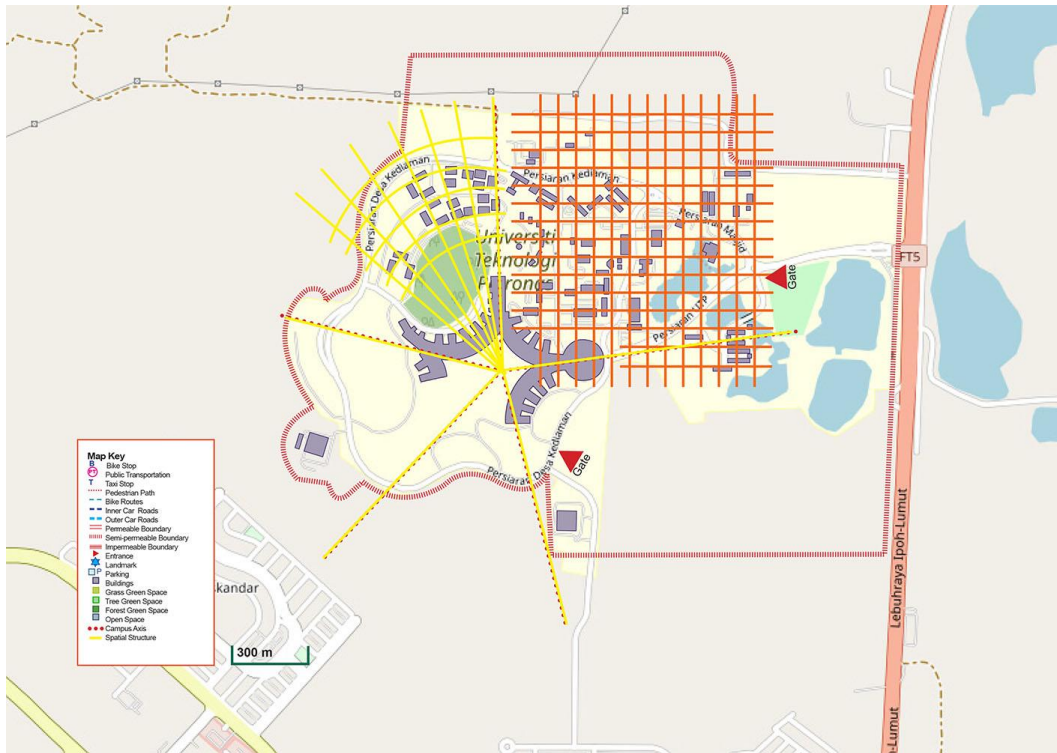


Figure B.0.9 : Campus Spatial Configuration Analysis Map of Universiti Teknologi Petronas.

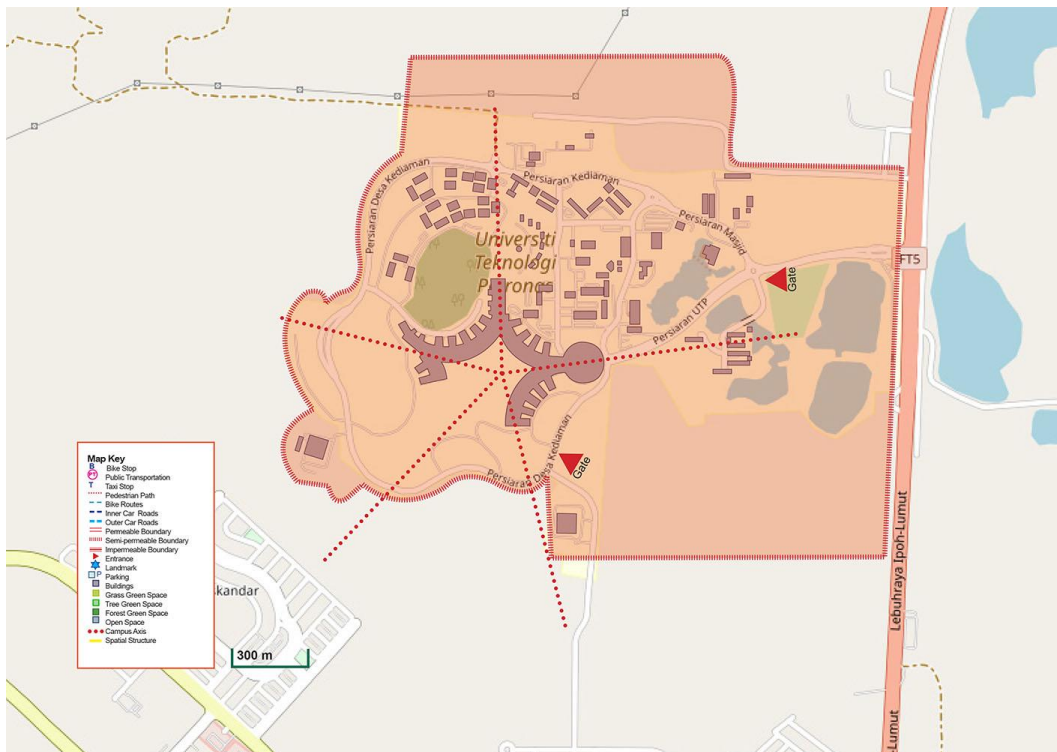


Figure B.0.10 : Campus Compactness Analysis Map of Universiti Teknologi Petronas.

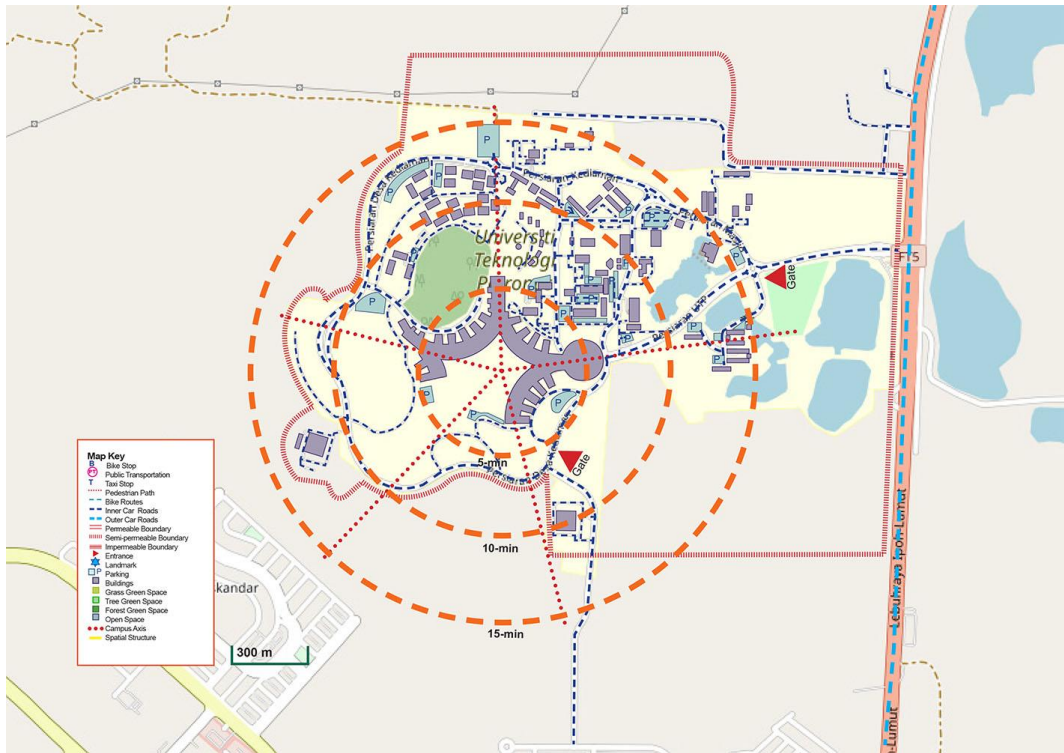


Figure B.0.11 : Campus Movement Network Analysis Map of Universiti Teknologi Petronas.

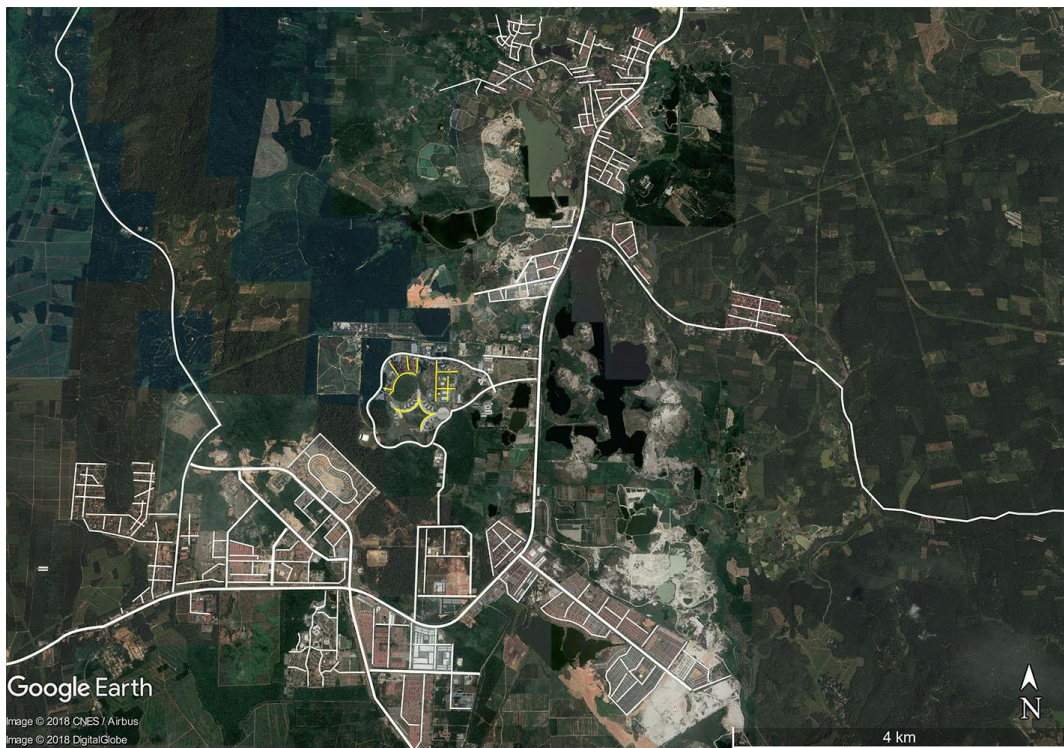


Figure B.0.12 : Campus Urban Context Morphology Analysis Map of Universiti Teknologi Petronas.

B.2.2 Multi-criteria analysis table

Table B.2 : Liveability and sustainability multi-criteria assessment table of Universiti Teknologi Petronas.

<i>Universiti Teknologi Petronas</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	It has mixed-use campus organization. there are several medium-scale buildings: four-storey blocks for teaching and research, cafes and communal facilities, and a drum-like building containing a library and 3'000-seat multipurpose hall.	3	
	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.	There are designed open spaces in average ratio. The main hub of the campus is the semi-closed public plaza in the Chancellor Complex. Large part of the campus is covered with greenery.	3	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	275 hectares of 400 hectares area of the campus comprises tropical jungles with hills and valleys.	3	

Table B.2 (Continued) : Liveability and sustainability multi-criteria assessment table of Universiti Teknologi Petronas.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	There are on-campus residences in walking distance of the campus core.	3	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces, etc. considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is not any extracurricular activities on campus.	There are sport and athletic facilities, library, and museum, and so forth.	3	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided within surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services on campus.	There are café and restaurants, bank, post,...	2	

Table B.2 (Continued) : Liveability and sustainability multi-criteria assessment table of Universiti Teknologi Petronas.

<i>Legibility</i>	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space for instance existence of unique character in terms of natural and built landscape, historical heritage, availability of focal points at the end of streets for orientation, hierarchy of spaces and routes, from 3 to 1. 3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	Campus space is legible. The form of the main campus core construction is very distinctive that act as the focal point. There are well-organized pedestrian pathways. The rest of the campus is still organized but does not express the same strength of the core.	2	
	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	The main campus core has a very distinctive form and character and act as the focal point. The rest of the campus is organized with some deviances from the main core characteristics specially at the residential village part.	2	
	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and clock towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark exist.	Campus is a newly established precinct and does not include any historical edifices. But the academic core is composed of a distinctive form of five crescents. This structure act as a focal point and a hub.	2	

Table B.2 (Continued) : Liveability and sustainability multi-criteria assessment table of Universiti Teknologi Petronas.

<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout that campus has a designed spin and open spaces are well-designed and defined by built spaces. Different spaces are connected by hierarchy of spaces including main corridors, courtyards. Campus has a core space with a defined open space or plaza with long land marks, enclosed open spaces, designed landscape elements and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	Campus has a well-designed core of a distinctive shape and with radial arrangement that embodies the main functions. The rest of the campus are still organized and have a grid spatial structure different from the main core. A large area of the campus is the greenery and planted area.	2	
	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban space with no morphological consistency.	Being located outside of the urban space, there is no consistency and homogeneity.	1	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying adaptive reuse infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	If a large campus all concentrated in one precinct.	3	

Table B.2 (Continued) : Liveability and sustainability multi-criteria assessment table of Universiti Teknologi Petronas.

	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and the new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	The campus core has a mid-high density but the rest of the area has a low density and very large portion of the campus land is covered by forest.	1	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilities or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	There are mid-side and well distributes parking areas.	3	
	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	There are pedestrian routes that are protected by the soaring crescent-shaped roofs from the wind, sun, and heavy rains.	3	
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	No cycling routes detected.	1	

Table B.2 (Continued) : Liveability and sustainability multi-criteria assessment table of Universiti Teknologi Petronas.

	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	There is a well-organized system of car roads, mainly located at the periphery of the campus center.	3	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	No car-sharing or bike sharing system detected.	1	
<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	It is a detached campus. It is accessible by car, taxi, bus, and electric train service.	2	
	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	There is not a physical barrier but there are natural barriers at the periphery of campus.	1	
<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	There is not a physical barrier but there are natural barriers at the periphery of campus. It is still visually permeable.	2	

Table B.2 (Continued) : Liveability and sustainability multi-criteria assessment table of Universiti Teknologi Petronas.

	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, etc., from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	There is no transitional space in the campus boundary.	1	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	There is no connectivity between campus and surrounding.	1	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	Being a detached campus, it is separated from the urban space.	1	
	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Being a detached campus, it is separated from the urban space and the campus facilities are mainly serving the campus body.	1	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	UTP is a university with the main mission of collaborating with industry through cutting-edge knowledge and expertise transfer. It has a Center of Excellence that works in this regard.	3	

Table B.2 (Continued) : Liveability and sustainability multi-criteria assessment table of Universiti Teknologi Petronas.

<i>Sustainability</i>	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	The university structures have been design according to green infrastructures and compatible with the local climate.	3	
	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	There are some projects that university try to contribute to three pillars of sustainability.	2	

B.3 EPFL (École Polytechnique Fédérale de Lausanne), Lausanne, Switzerland

B.3.1 Spatial analysis maps



Figure B.0.13 : Campus Location Analysis Map of EPFL.



Figure B.0.14 : Campus Land-use Analysis Map of EPFL.

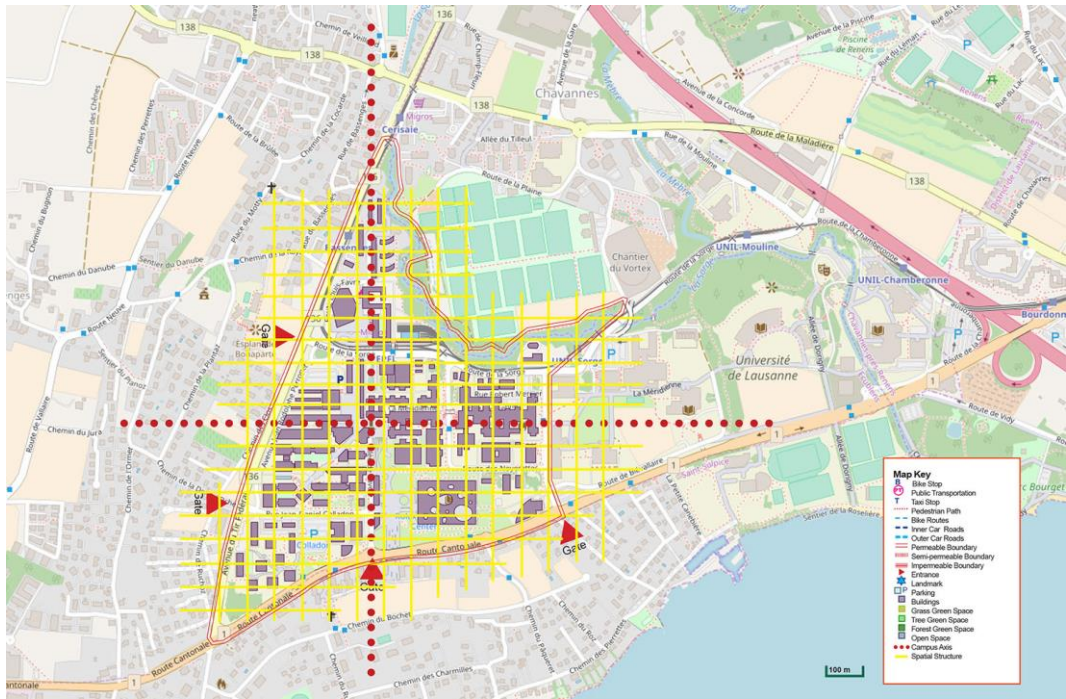


Figure B.0.15 : Campus Spatial Configuration Analysis Map of EPFL.

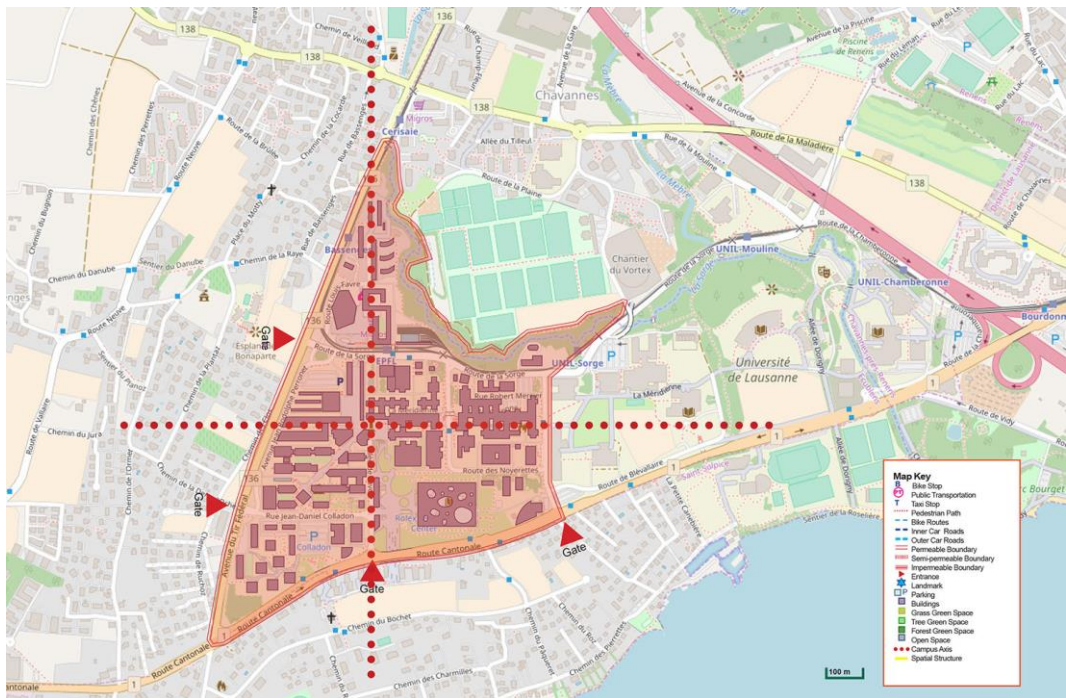


Figure B.0.16 : Campus Compactness Analysis Map of EPFL.

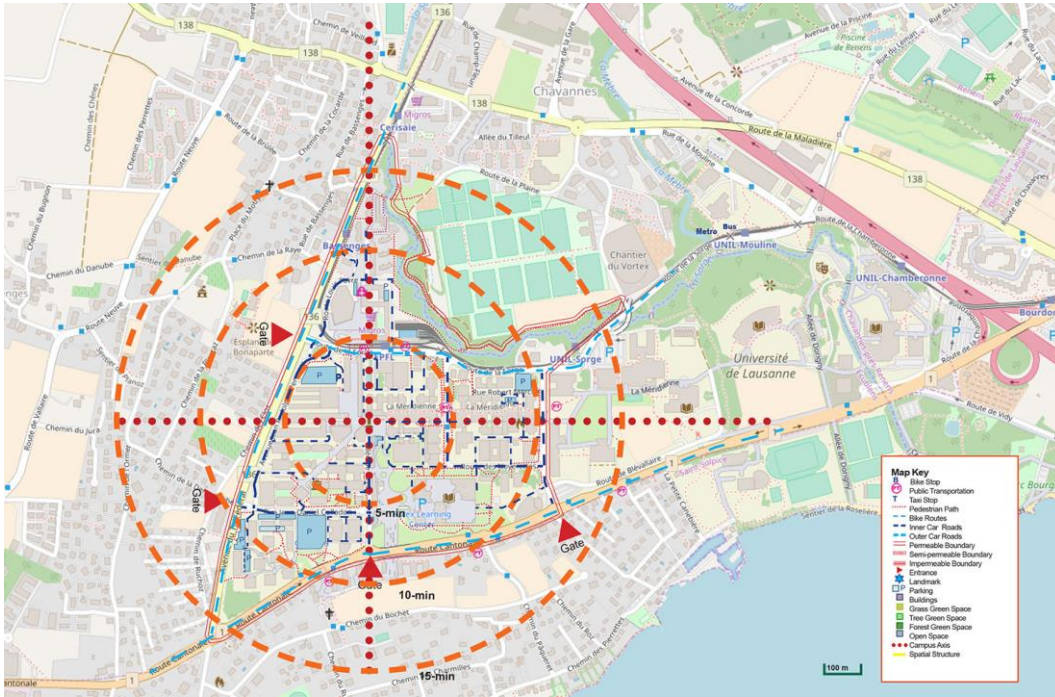


Figure B.0.17 : Campus Movement Network Analysis Map of EPFL.

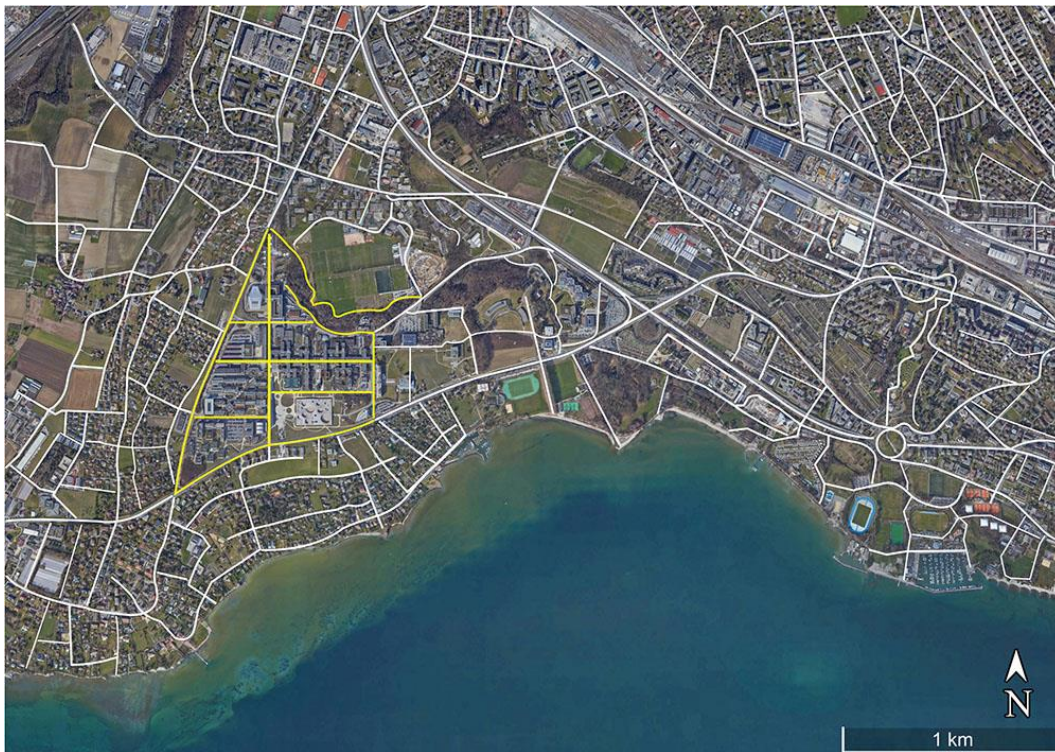


Figure B.0.18 : Campus Urban Context Morphology Analysis Map of EPFL.

B.3.2 Multi-criteria analysis table

Table B.3 : Liveability and sustainability multi-criteria assessment table of EPFL.

<i>EPFL</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	The uses are mixed at entire campus. Educational, recreational, art and cultural activities are well mixed. The Rolex center at the core of the campus is also a multi-purpose space for different activities. The EPFL and the University of Lausanne also share an active sports center five minutes away from EPFL, on the shores of Lake Geneva	3	
	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.	There are well-designed and well-connected open spaces at entire campus and particularly at the core around Rolex center.	3	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	The un-built spaces of campus are mainly covered by grass fields. There is also a forest-like space on the north of campus.	3	

Table B.3 (Continued) : Liveability and sustainability multi-criteria assessment table of EPFL.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	There are various housing options (which are managed by independent organizations) with an average commuting time of 30 min from your housing to EPFL. There are On-campus student housing at Quartier Nord (Atrium) and Les Estudiantines.	3	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces, etc. considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is not any extracurricular activities on campus.	<ul style="list-style-type: none"> - The SwissTech Convention Center: that accommodate different activities like shops, ... - The Artlab - Conference centre: the SwissTech Convention Center - Museums: Musée Bolo and Archizoom - Radio: Fréquence Banane (student radio) - Libraries: the Learning Center - Sport facilities outside campus in a close proximity. 	3	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided within surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services on campus.	<ul style="list-style-type: none"> - Restaurants: Le Copernic and La Table de Vallotton - Cafeterias: La Coupole, Le Corbusier, Le Parmentier, Le Vinci, BMX (Bâtiment des matériaux), BC (Bâtiment des communications), L'Arcadie, Le Hodler, Le Klee, L'Ornithorynque - Bar: Satellite - Travel agencies: Swiss Federal Railways and STA Travel - Banks: Credit Suisse and PostFinance - Childcare. 	3	

Table B.3 (Continued) : Liveability and sustainability multi-criteria assessment table of EPFL.

<i>Legibility</i>	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space for instance existence of unique character in terms of natural and built landscape, historical heritage, availability of focal points at the end of streets for orientation, hierarchy of spaces and routes, from 3 to 1. 3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	There is a consistency in campus design. There is a good orientation and legibility because of the well-designed movement system and availability of focal points.	3	
	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	Although the campus has been evolved within several phases but there is a high architectural homogeneity at the entire campus.	3	
	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and clock towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark exist.	There are monumental buildings designed by famous architects including Mechanics Hall (2016) by Dominique Perrault, SwissTech Convention Center (2014) by Richter Dahl Rocha & Associés and Rolex Learning Center (2010) by SANAA that act as focal points.	3	

Table B.3 (Continued) : Liveability and sustainability multi-criteria assessment table of EPFL.

<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout in a way that campus has a designed spin and open spaces are well-designed and defined by built spaces. Different spaces connected through a hierarchy of spaces including main corridors, courtyards. Campus has a core space with a defined open space or plaza with long land marks, enclosed open space, designed landscape and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned in the mentioned way nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	The campus plan is well-designed as a mix of open and built spaces. It has a bi-directional organization and is arranged along two main axes with a grid structure. There are well-designed plazas and open spaces that function as public spaces. There is a hierarchy between open space and built spaces (open, semi-open, closed). There are designed connected pathways between different buildings.	3	
	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with a complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban with no morphological consistency.	Inserted in the outskirts of the city of Lausanne as a detached campus with few similarity to surrounding context.	1	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within surrounding urban fabric, from 3 to 1. 3= Occupying one distinct site with high density or applying adaptive reuse infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	EPFL is composed of one average size campus and is quite dense and compact. All the functions are well distributed within a close proximity.	3	

Table B.3 (Continued) : Liveability and sustainability multi-criteria assessment table of EPFL.

	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and the new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	It is a quite dense campus without any high-rise building, spread horizontally within the site.	3	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilitates or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	There are parking for EPFL body and visitors. There are small parking areas distributed in the site also a large parking under the SwissTech Convention Centre.	3	
	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	There are well-designed and connected pedestrian paths at the entire campus. The paths are mainly arranged orthogonally. There are bridges (that passes above the car roads) and covered pathways that connect different buildings.	3	
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	There are bike routes inside and around campus. There are bike parking areas. There is also a bike repair shop inside campus.	3	

Table B.3 (Continued) : Liveability and sustainability multi-criteria assessment table of EPFL.

	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	There is an orthogonal road network inside campus (except the campus core) that serve all the buildings without disturbing the campus homogeneity.	3	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	There is the shared electric “cargobikes” system for bike sharing. The EPFL campus has become a testing ground for the mobility of tomorrow. In the past, students and staff have been able to experiment with autonomous shuttles and self-service bicycles. Today, EPFL Sustainable Campus is joining forces with the Biel-based start-up ENUU to set up a pilot project for free-floating electric vehicles.	3	
<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	Campus is accessible by Train (M1 and M2 metro lines), By Bus (MBC bus 701, MBC bus 705, TL bus 31), and by Car. There are stations inside campus.	3	
	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	There are four main entrances to the campus. But there is not an artificial boundary like wall or fence around campus.	3	

Table B.3 (Continued) : Liveability and sustainability multi-criteria assessment table of EPFL.

<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	There is not an artificial barrier like wall or fence around campus but existence of large avenues at western and southern side act as barrier and disconnects campus.	2	
	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, etc., from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	Not being located within urban context, there is no transitional space serving both city and university.	1	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	Being a detached campus and surrounded by large roads, there are not high number of intersections with surrounding context (8 main intersections on the campus boundary). But there are streets that continue from outside campus to inside.	1	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	EPFL is situated in the outskirts of the city of Lausanne with a 6 km distance to the city center.	2	

Table B.3 (Continued) : Liveability and sustainability multi-criteria assessment table of EPFL.

	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	The EPFL Library, located at the Rolex Learning Center, is accessible by public. The Artlab was opened in November 2016; it includes three spaces opened to the public. The first one hosts archives from the Montreux Jazz Festival; the second is a space for museum experimentations. The third space, named DataSquare, hosts an exposition on Big data, illustrated by two scientific projects from EPFL: the Human Brain Project and the Venice Time Machine.	3	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	There are Exhibition venues, student initiatives, concerts and performances. - The Artlab which share facilities with public. There are diversified types of events such as - EPFL Music Festivals are so famous like the Balélec Festival.	3	
<i>Sustainability</i>	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Flagship projects on campus: - Complete renovation of the Heating Plant for 100% renewable energy in 2021 - Largest urban solar park in Switzerland	3	

Table B.3 (Continued) : Liveability and sustainability multi-criteria assessment table of EPFL.

	<p>28. Sustainability initiatives</p>	<p>Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative</p>	<p>EPFL Sustainable Campus was created in 2007 to support EPFL's strong growth and strengthen the culture of strong sustainability within the university. EPFL management has relaunched an ambitious 2017-2020 strategy based on 3 pillars: 1) Towards CO2 neutrality in 2020. 2) Strong and integrated sustainability. 3) Special projects. Three major exemplary projects on emerging issues: ACT FOR CHANGE LAB, RESILIENT CAMPUS, URBAN FARMING.</p> <p>Flagship projects on campus: - Complete renovation of the Heating Plant for 100% renewable energy in 2021 - Largest urban solar park in Switzerland - Exemplary commuting and business mobility plans - Deployment of washable dishes throughout the campus - Biodiversity-certified outdoor landscaping - An active community within the Act for Change programme and concrete projects in Act for Change Lab.</p> <p>Living Lab: EPFL is becoming a living laboratory for social and environmental transition.</p>	<p>3</p>	
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B.4 ETH (Eidgenössische Technische Hochschule), Zurich, Switzerland

B.4.1 Spatial analysis maps

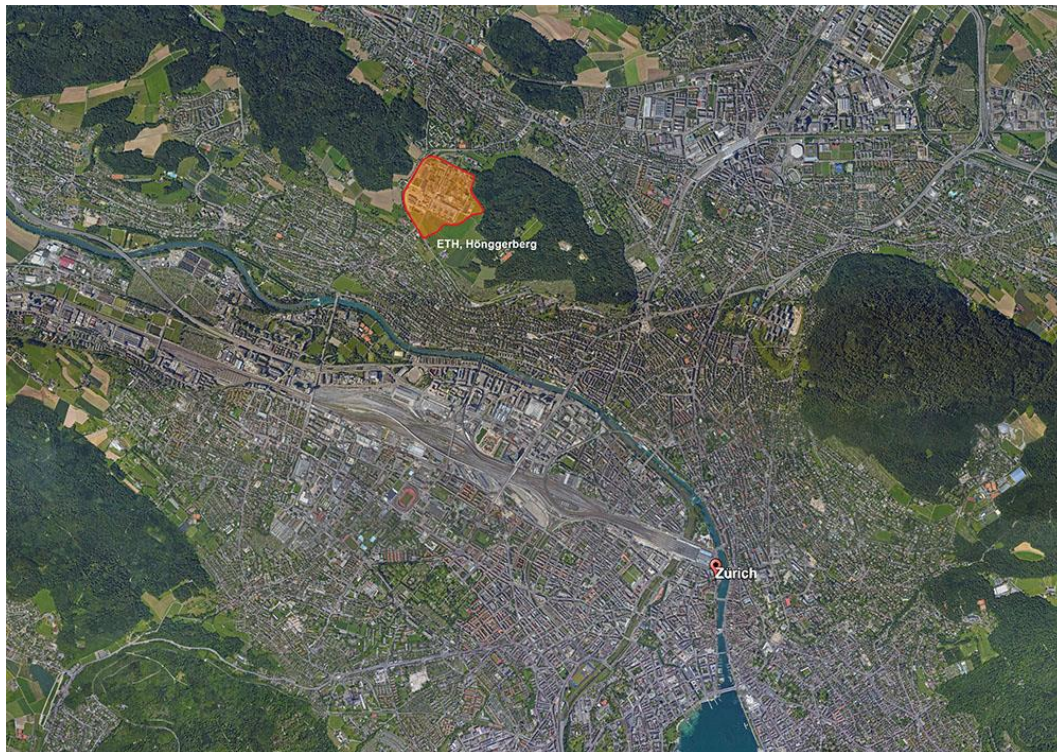


Figure B.0.19 : Campus Location Analysis Map of ETH.



Figure B.0.20 : Campus Land-use Analysis Map of ETH.

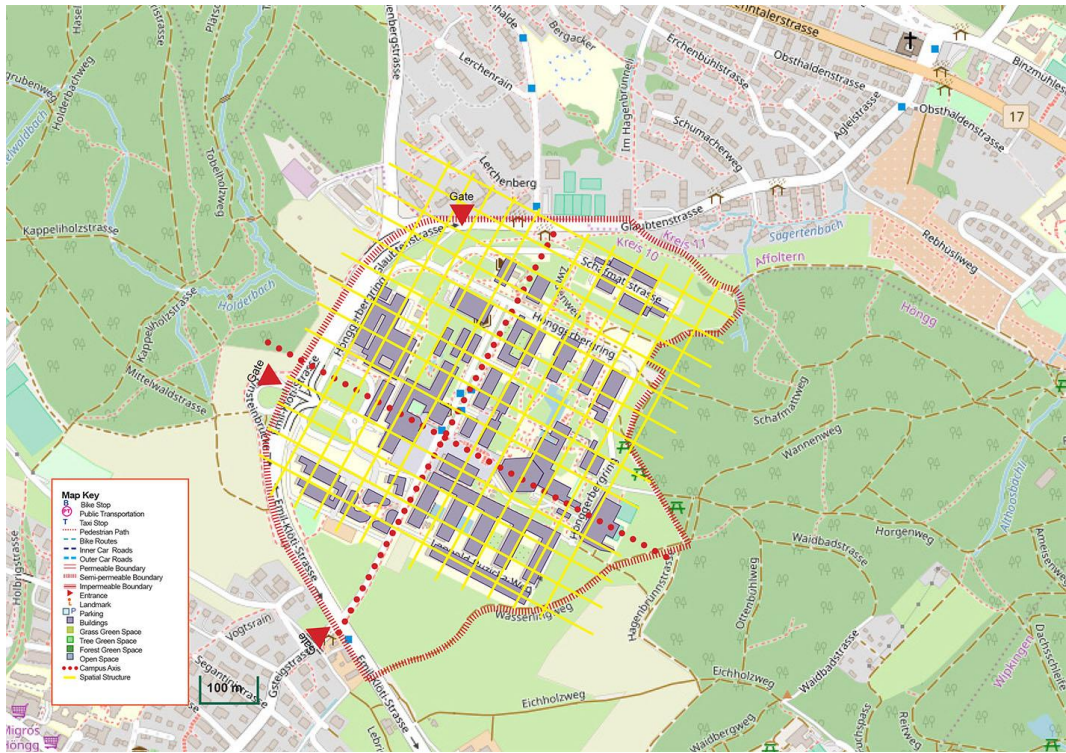


Figure B.021 : Campus Cohesion Analysis Map of ETH.

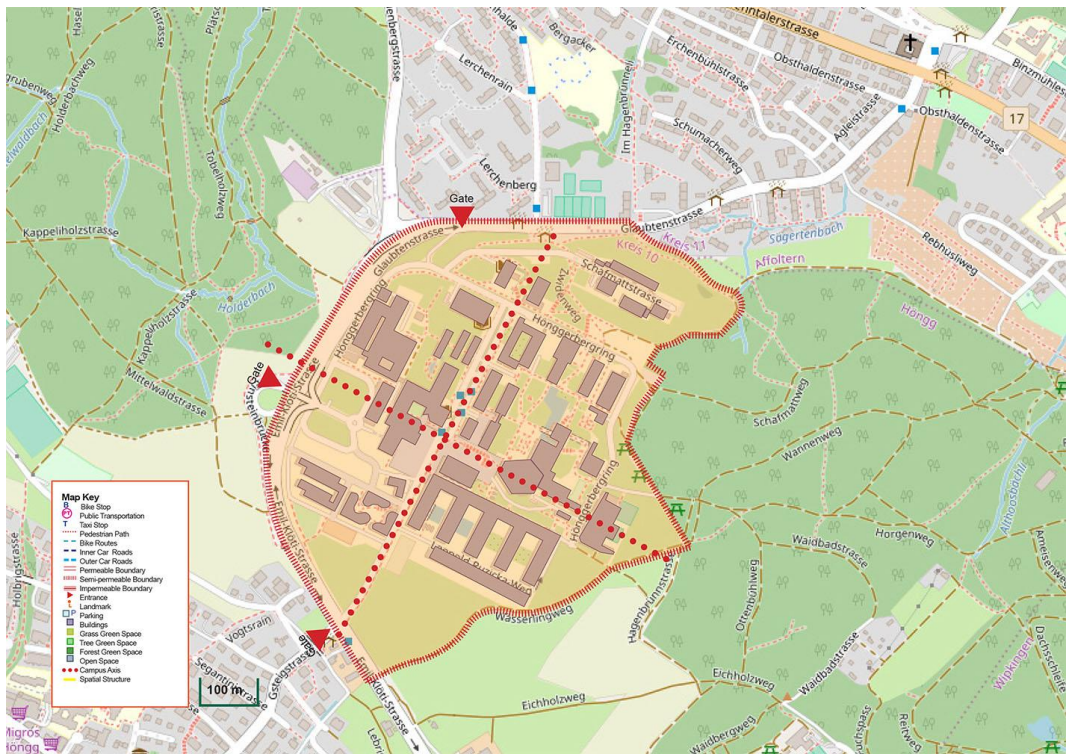


Figure B.022 : Campus Compactness Analysis Map of ETH.

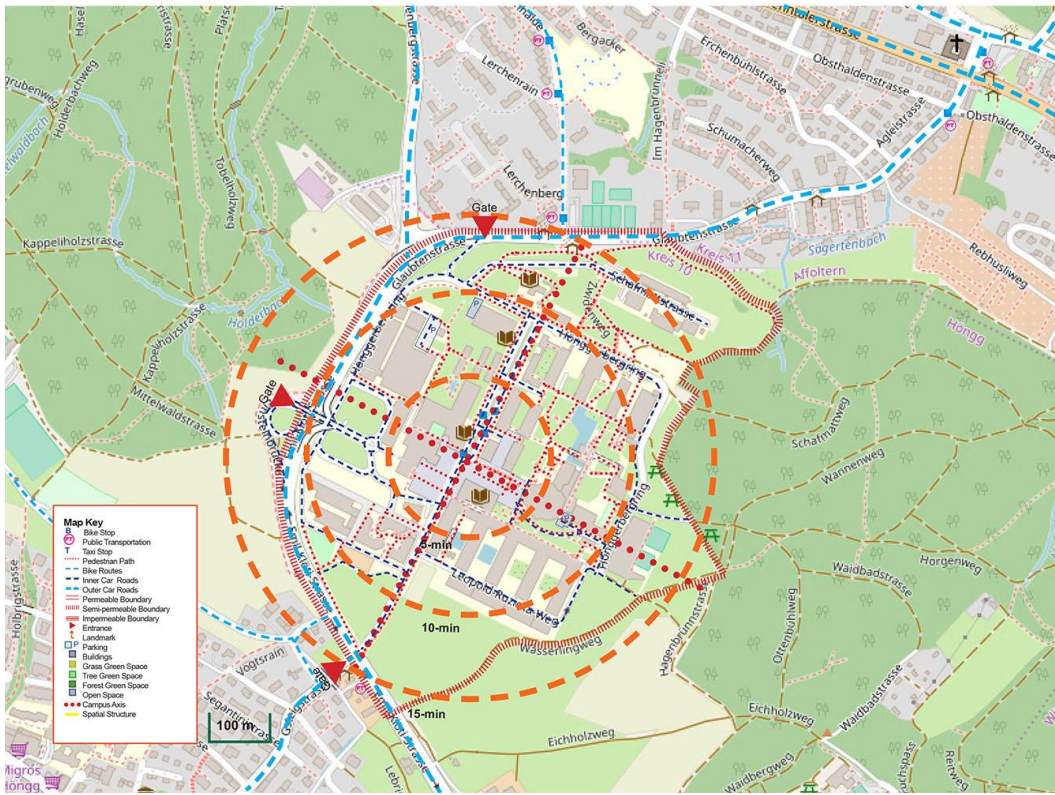


Figure B.0.23 : Campus Movement Network Analysis Map of ETH.

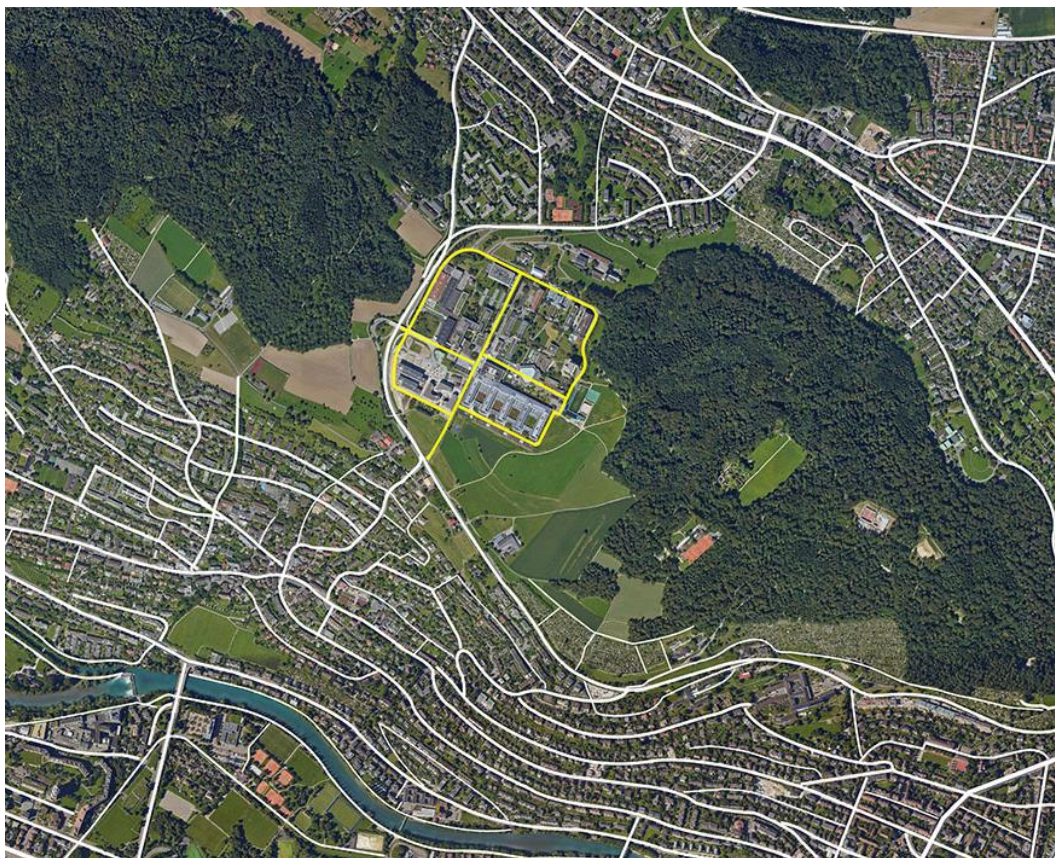


Figure B.0.24 : Campus Urban Context Morphology Analysis Map of ETH.

B.4.2 Multi-criteria analysis table

Table B.4 : Liveability and sustainability multi-criteria assessment table of ETH.

<i>ETH</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	The re-development project of Science City has created a mix-use districts of office, laboratories, educational spaces, spin-offs, residences, cultural, recreational, and sport facilities.	3	
	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.	There are well-designed open spaces which are enclosed by built spaces. There are transitional spaces. The open space and built space are interlinked.	3	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	Being originally located in suburban greenfield, there is a high ratio of green space within campus including lawns and grass fields and in surrounding area including forest-like area.	3	

Table B.4 (Continued) : Liveability and sustainability multi-criteria assessment table of ETH.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	There has been provided on-campus housing since the initial phase and it has been developed by the re-development project.	3	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces. considering total number of students, from 3 to 1. 3= Diverse activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is no extracurricular activities.	There are diversified activities including sport, cultural, exhibitions.	3	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided in surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services on campus.	There are various retail services including cafes, shops, supermarket, restaurants.	3	
<i>Legibility</i>	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space for instance existence of unique character like natural and built landscape, historical heritage, availability of focal points at end of streets for orientation, hierarchy of spaces and routes, from 3 to 1. 3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	The campus is highly legible with a good distribution and connection of open and built spaces, focal points and axis.	3	

Table B.4 (Continued) : Liveability and sustainability multi-criteria assessment table of ETH.

	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	There is a consistency and harmony in architectural style.	3	
	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and clock towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark exist.	There is not any historical building or city landmarks but there are a few buildings as landmarks.	2	
<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout that campus has designed spin and open spaces are well-designed and defined by built spaces. Different spaces are connected through hierarchy of space including main corridors, courtyards. Campus has a core space with a defined open space or plaza with long land marks, enclosed open space, designed landscape, entire masterplan is relatively symmetric and geometric. 2= The campus has neither planned nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	The spatial layout is well-defined along two orthogonal axes. important buildings are located along these axes. There is hierarchy and connection between different open and built spaces with transitional areas.	3	

Table B.4 (Continued) : Liveability and sustainability multi-criteria assessment table of ETH.

	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban with no morphological consistency.	Being located in city outskirts, there is not homogeneity between campus space and surrounding.	1	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying adaptive reuse infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	Campus space is a one medium-size compact campus.	3	
	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and the new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	The density is mid-low.	2	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilitates or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	There are well-distributed small-medium size parking around the campus.	3	

Table B.4 (Continued) : Liveability and sustainability multi-criteria assessment table of ETH.

	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	Pathways are mostly orthogonal and connected.	3	
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	There is a well-connected bike route within and around the campus.	3	
	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	The roads are well-connected mainly at campus boundary and main spine with access to inner functions.	3	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	Available	3	
<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	There is a very good public transportation system	3	

Table B.4 (Continued) : Liveability and sustainability multi-criteria assessment table of ETH.

	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	The campus boundary is permeable with no physical barrier. There are three main entrances. But being located in the suburban area, it is surrounded by natural landscape.	2	
<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	The boundary is physically and visually permeable.	3	
	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book store, exhibition library, etc., from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	No transitional space.	1	
	23. Circulation network connectivity	Rating the continuity of street networks in campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with more intersections campus is completely integrated with the surrounding 2=Average continuity with average intersections 1=No continuity	To some extent it is connected but the continuity is low.	1	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	Inserted in suburban area.	2	

Table B.4 (Continued) : Liveability and sustainability multi-criteria assessment table of ETH.

	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Campus is highly open to public with many shared facilities.	3	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Highly available	3	
<i>Sustainability</i>	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	A very sustainable campus	3	
	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	An established sustainability initiatives.	3	

B.5 Utrecht University, Utrecht, Netherlands

B.5.1 Spatial analysis maps



Figure B.0.25 : Campus Location Analysis Map of Utrecht University.

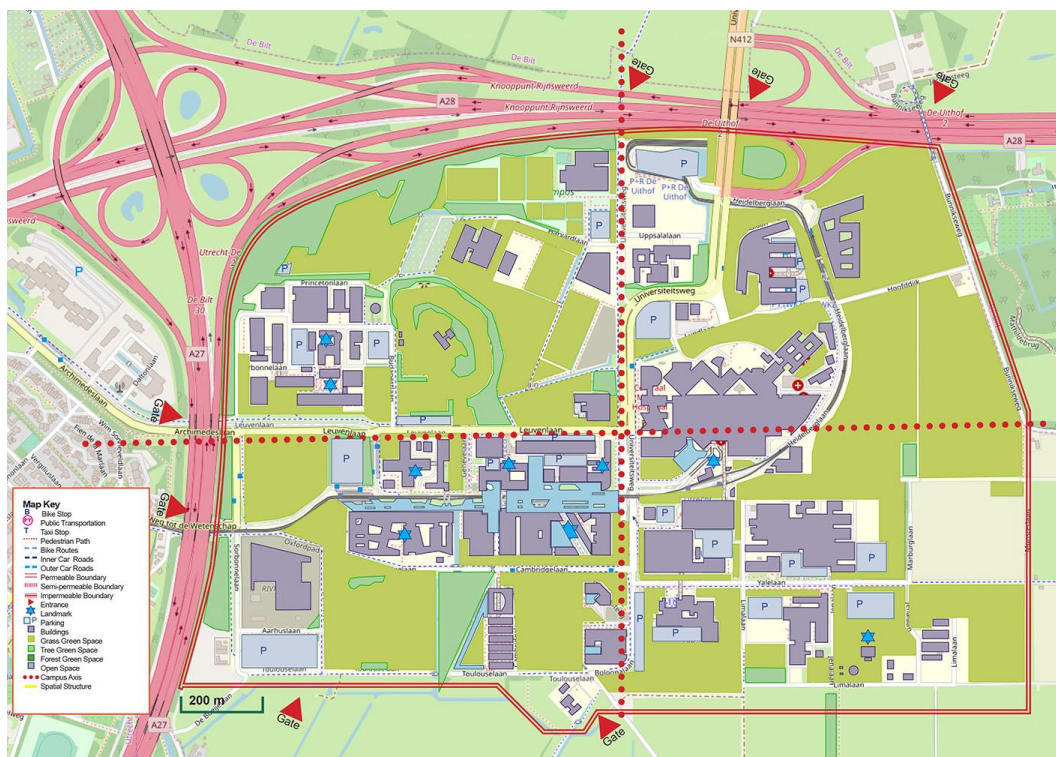


Figure B.0.26 : Campus Land-use Analysis Map of Utrecht University.

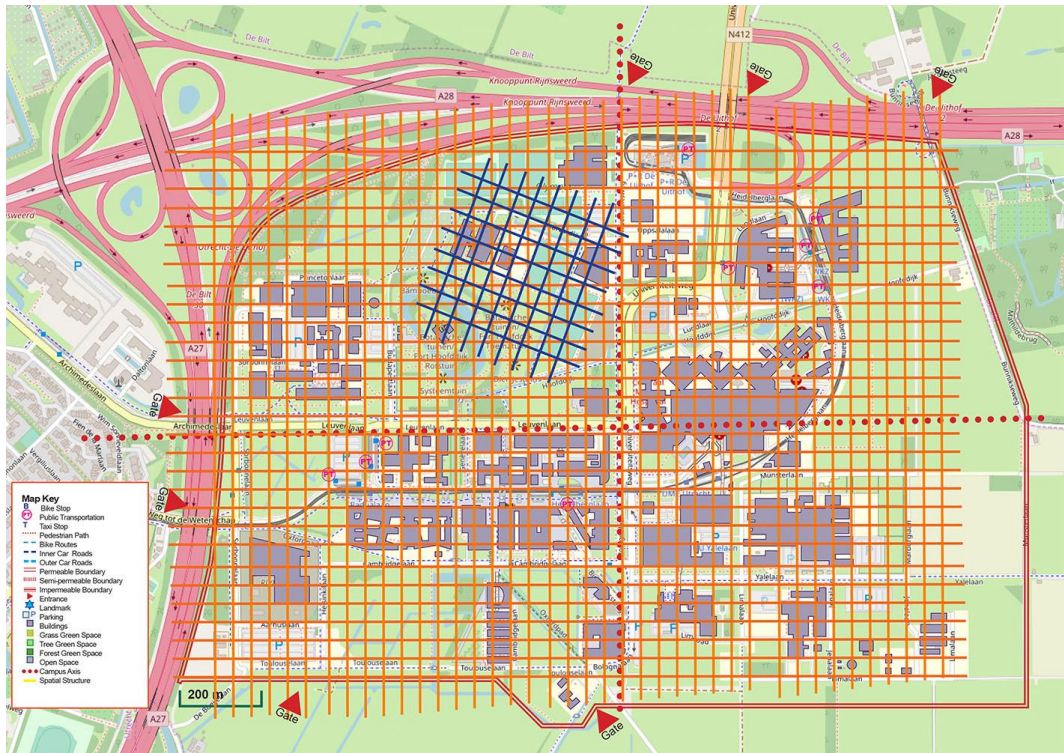


Figure B.0.27 : Campus Spatial Configuration Analysis Map of Utrecht University.

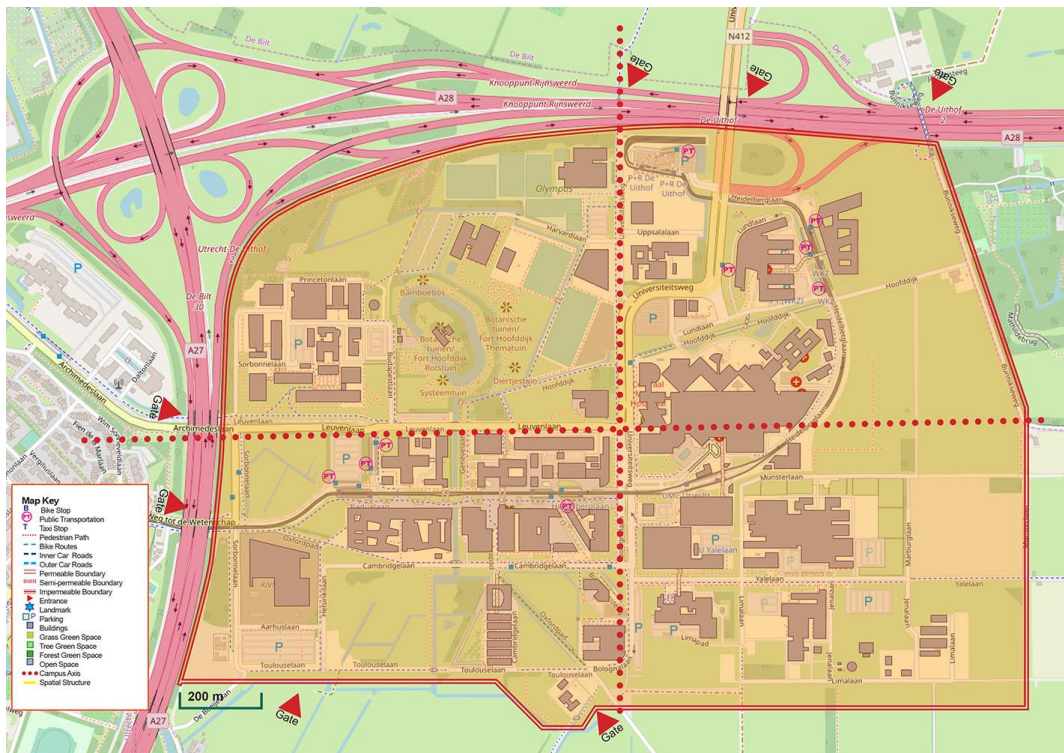


Figure B.0.28 : Campus Compactness Analysis Map of Utrecht University.

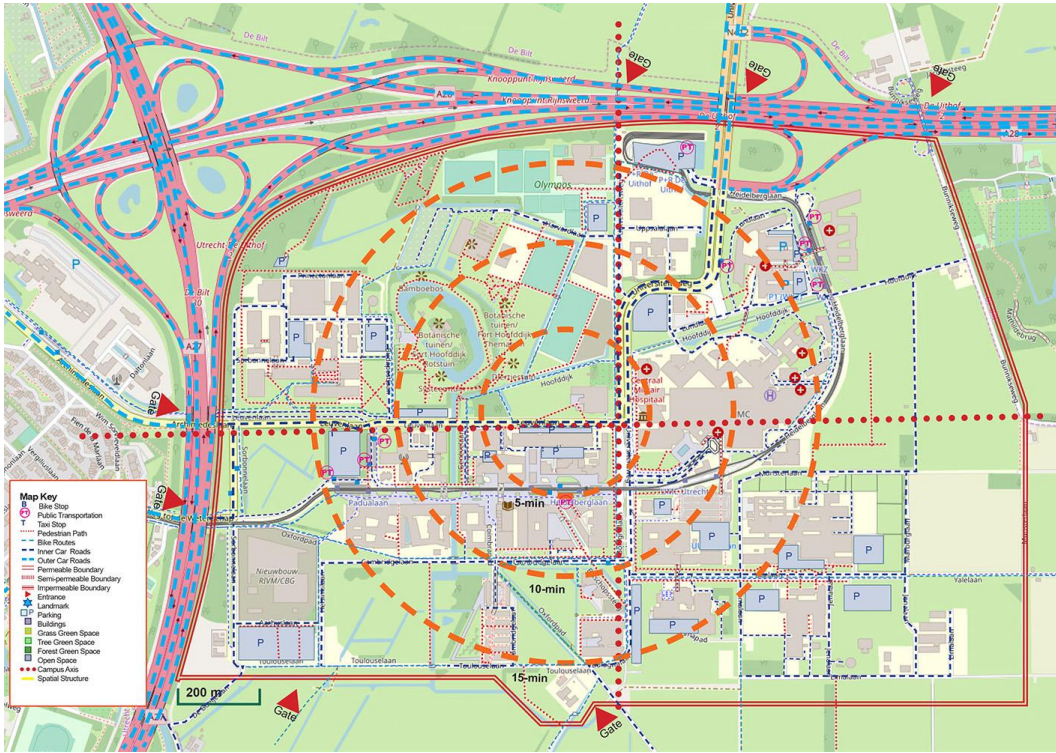


Figure B.0.29 : Campus Accessibility Analysis Map of Utrecht University.



Figure B.0.30 : Campus Urban Context Morphology Analysis Map of Utrecht University.

B.5.2 Multi-criteria analysis table

Table B.5 : Liveability and sustainability multi-criteria assessment table of Utrecht University.

<i>Utrecht University</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	In the redevelopment plan of the campus, it has been emphasized on the clustering of buildings and programs. The student housing has been added to the campus and integrated with other functions.	3	
	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.	There are quasi well-designed and well-distributed open spaces in addition to a botanic park, and the great landscape of the site.	3	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	Being a greenfield site, the entire campus is a park-like setting with buildings located in between, and a large botanical park.	3	

Table B.5. (Continued) : Liveability and sustainability multi-criteria assessment table of Utrecht University.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	There are on-campus residences with are integrated with other functions in a walking distance.	3	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces. considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is no extracurricular activities on campus.	There some amenities including sport facilities.	2	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided in surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services on campus.	There are several retail services including café, restaurant, hairdresser, shops, post office, nursery and childcare and so on which are well distributed within the campus.	3	
Legibility	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space for instance existence of unique character like natural & built landscape, historical heritage, availability of focal points at end of streets, hierarchy of spaces and routes, from 3 to 1. 3=There is a consistent and legible character in entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	Being a new campus, there is no historical buildings but the campus structure follows a modern style which creates a specific identity.	3	

Table B.5. (Continued) : Liveability and sustainability multi-criteria assessment table of Utrecht University.

	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	The entire campus has a cohesive modern architectural style.	3	
	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale, remarkable landmarks such as special buildings, plazas, monuments, and clock towers, well-designedly. 2=Existence of landmark, art works around campus 1=No landmark exists.	The campus has several landmarks mainly in the central area and western part.	2	
<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout in a way that campus has designed spin and open spaces are well-designed and defined by built spaces. Different space are connected through hierarchy of spaces including main corridors, courtyards. Campus has a core space with a defined open space or plaza with long landmarks, enclosed open space, designed landscape and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1= campus has an unplanned layout.	The campus is organized along a main axis. It has an orthogonal grid system which ease the wayfinding. There are well-designed open spaces. The campus green is well-organized and covers the whole setting. The campus core is very vibrant.	3	

Table B.5. (Continued) : Liveability and sustainability multi-criteria assessment table of Utrecht University.

	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban space with no morphological consistency.	Being located in city outskirts, there are few consistencies with urban space. Just, the campus green landscape continues and integrates with the greenery of the surrounding environment.	1	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying adaptive reuse infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	It is an almost large precinct which are located in one setting.	3	
	13. Density	Rating the mass density of campus considering the building footprint in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	The campus density is almost high in the built spaces but a big part of the campus is covered with green space.	3	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilitates or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	There are well-distributed mid/small size parking around the campus which are covered by green space.	3	

Table B.5. (Continued) : Liveability and sustainability multi-criteria assessment table of Utrecht University.

	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	There are well-designed and connected pedestrian walkways around the campus.	3	
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	There are well-designed and connected bike routes inside and in the surrounding of the precinct. There is also bicycle repair shop inside campus.	3	
	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	The car roads follow the grid system. The main axis is the main spine of the movement that provides access to all facilities. They continue also in the campus core.	2	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	There is a car sharing StudentCar. There is also rental car service. There is also e-bike system.	3	
Accessibility	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	It is accessible by car, bus, bike and train.	3	

Table B.5. (Continued) : Liveability and sustainability multi-criteria assessment table of Utrecht University.

	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	There are several entrances to the campus. But being surrounded by highways in two side restrict the permeability and ease of access.	2	
<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	The campus boundary is physically and visually permeable but it has surrounded by highways in two sides which are considered barriers.	2	
	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition, from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	There is no transitional activity spaces along the campus boundary.	1	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	Being surrounded by highways in two sides and green lands on the other sides, there is few connectivity and continuity with surrounding.	1	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	It is inserted in city outskirts.	2	

Table B.5. (Continued) : Liveability and sustainability multi-criteria assessment table of Utrecht University.

	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	The university hospital is the main facility shared with public.	3	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Functioning as a science park, the campus has a high level of engagement with industries and spin-offs. It is active in knowledge transfer. It also offers several courses, seminars, educational programs, lectures, and exhibitions.	3	
	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability		3	
<i>Sustainability</i>	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	There is an established Green Office that addresses: -Sustainability in education -Contribution to science and knowledge transfer. This subject falls under the strategic research theme of Sustainability -The impact of Utrecht University as a client -The impact of Utrecht University as one of the largest employers in the region	3	

B.6 University of California, Berkeley, USA

B.6.1 Spatial analysis maps

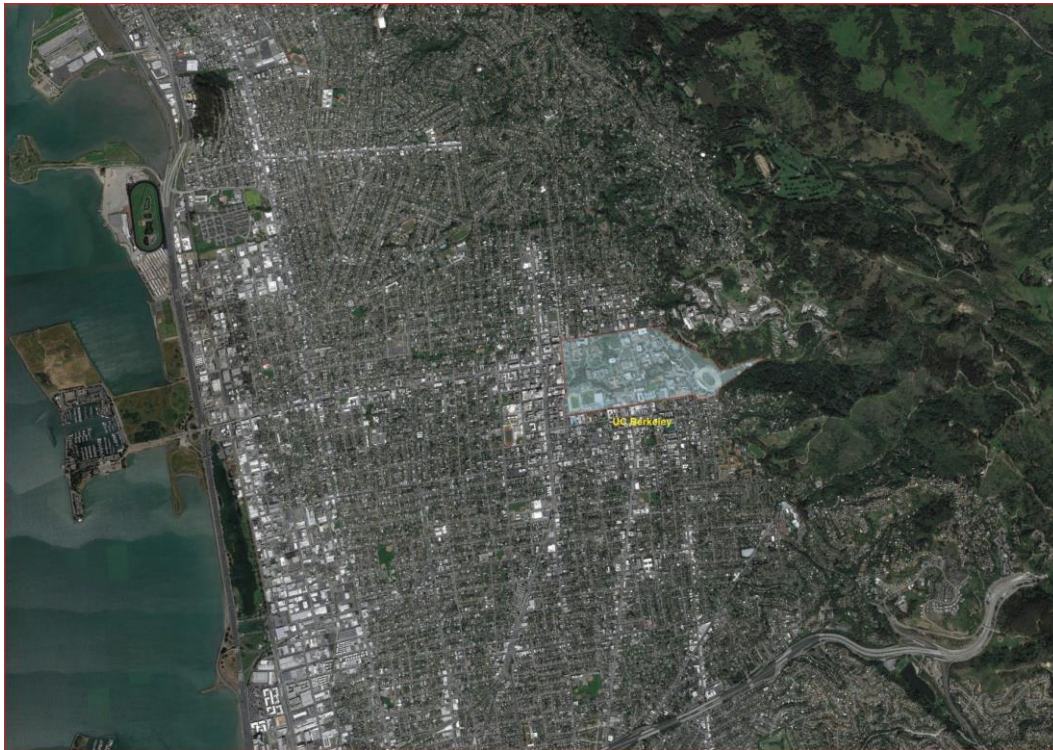


Figure B.0.31 : Campus Location Analysis Map of UC Berkeley.

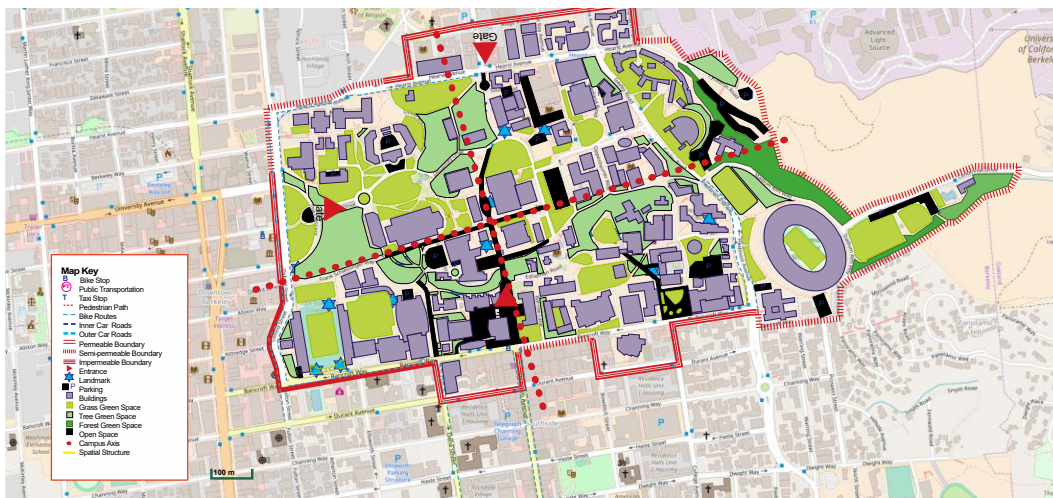


Figure B.0.32 : Campus Land-use Analysis Map of UC Berkeley.

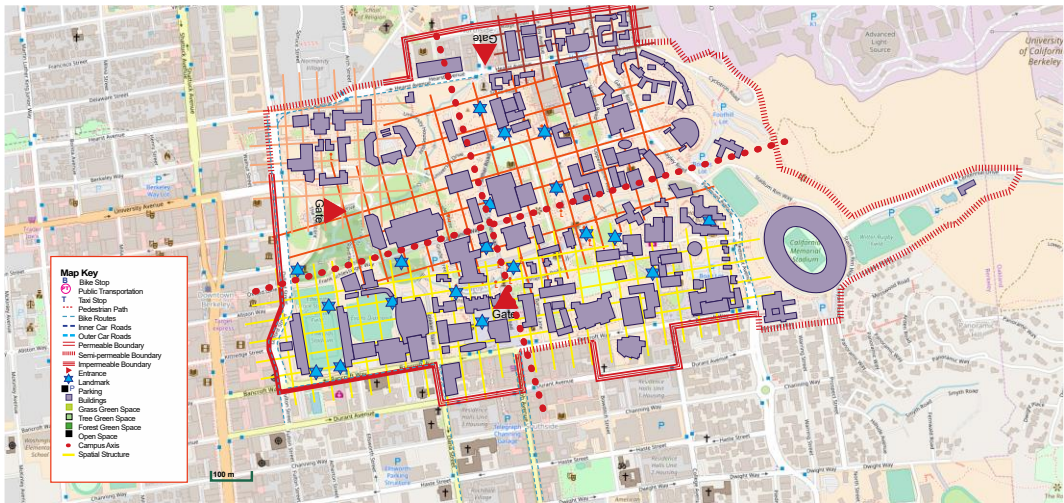


Figure B.0.33 : Campus Cohesion Analysis Map of UC Berkeley.

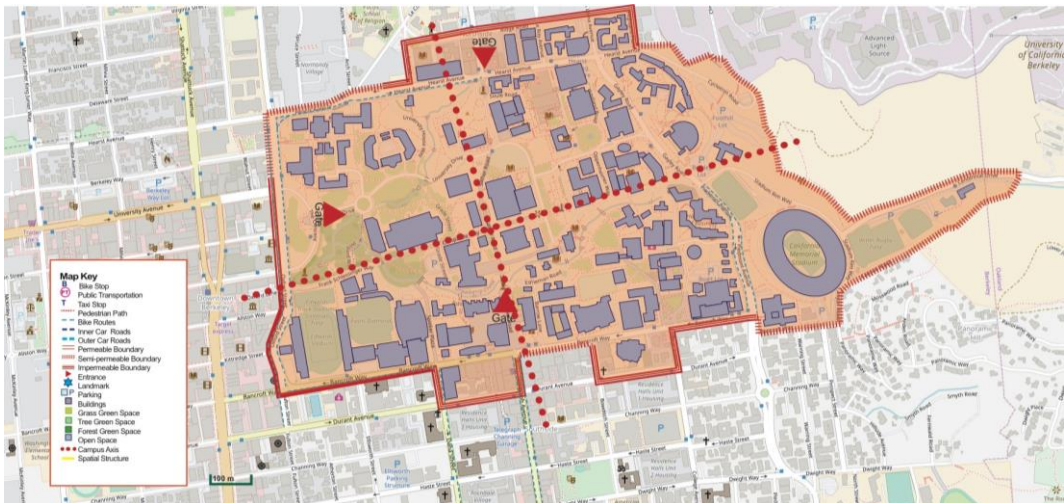


Figure B.0.34 : Campus Compactness Analysis Map of UC Berkeley.

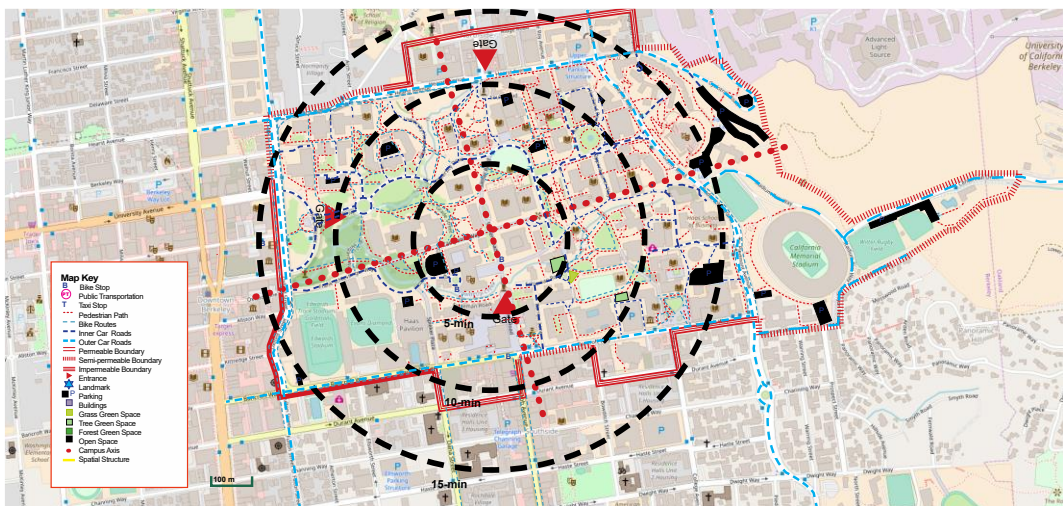


Figure B.0.35 : Campus Accessibility Analysis Map of UC Berkeley.

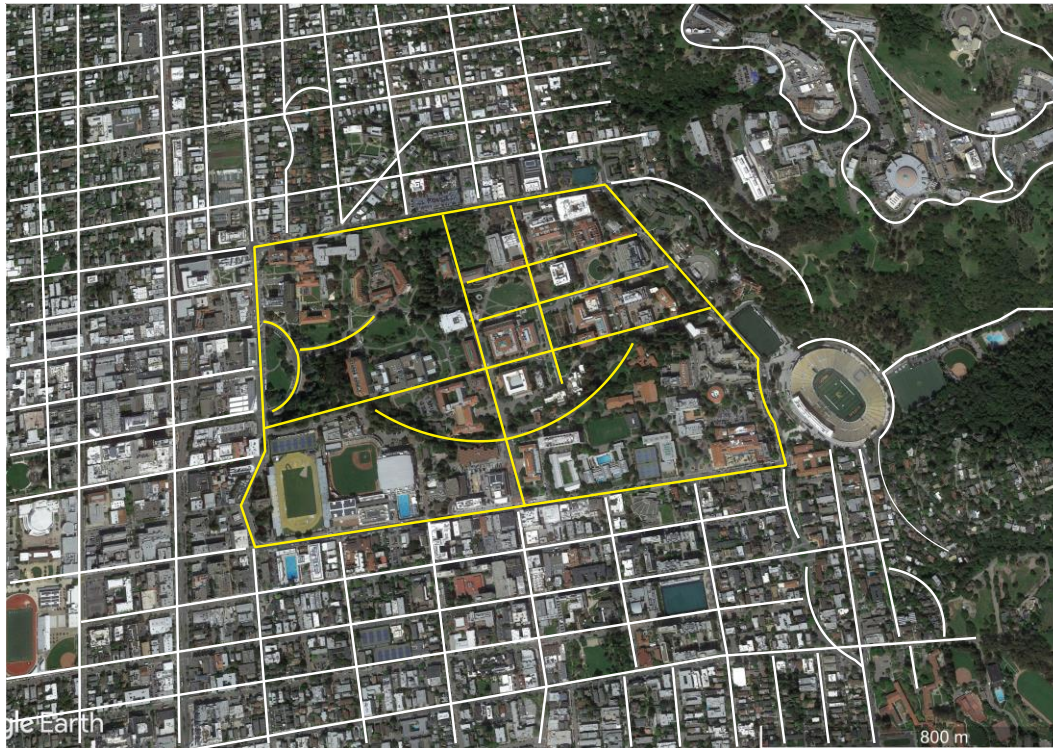


Figure B.0.36 : Campus Urban Context Morphology Analysis Map of UC Berkeley.

B.6.2 Multi-criteria analysis table

Table B.6 : Liveability and sustainability multi-criteria assessment table of U.C. Berkeley.

<i>UC Berkeley</i>					
	Criteria	Scale	Description	Value	Color
<i>Livability</i>	1. Mixed land use	<p>Rating land use organization on campus, from 3 to 1.</p> <p>3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.)</p> <p>2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center.</p> <p>1=Different uses are not mixed and campus has isolated areas far from the campus central space.</p>	<p>The land organization is in a way that mainly each of disciplines were clustered in a specific zone of campus; east, core or west.</p> <p>As university land is both scarce and finite at Campus Park, land use is prioritized for programs that engage students and promote student-faculty interaction. The large remaining area (Out of campus main space of 72 ha) includes the facilities of science laboratories, research centers, Lawrence Berkeley National Laboratory, Lawrence Hall of Science, University of California Botanical Garden..</p>	3	

Table B.6 (Continued) : Liveability and sustainability multi-criteria assessment table of U.C. Berkeley.

	<p>2. Open spaces</p>	<p>Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.</p>	<p>Open spaces for both quiet contemplation and active recreation have always been an integral part of the campus. The most important such area on the Campus Park is the classical core, which contains the ensemble of neoclassical buildings designed primarily by John Galen Howard. The classical core represents a unique cultural resource, in terms of both its architectural merit and the open spaces its buildings frame and design. There are several Campus Park open spaces as 'places of interaction', because they are located on major pedestrian routes and/or because they are framed by multiple buildings housing a variety of academic programs.</p>	<p>3</p>	
	<p>3. Green spaces</p>	<p>Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces</p>	<p>The natural landscape of the Campus Park provides a wide variety of experiences, from the shady, peaceful glens and rustic woodlands along Strawberry Creek, to the broad open lawns of the Central Glades. Located within the densely urbanized eastbay, the Campus Park is a precious resource for both the university and the city around it.</p>	<p>3</p>	

Table B.6 (Continued) : Liveability and sustainability multi-criteria assessment table of U.C. Berkeley.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	UC Berkeley offers housing to fit every type of need for Undergraduate, Graduate Students, for Families, Visiting Scholars, Faculty, Staff. They are mainly located in a close proximity to campus.	2	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces, etc. considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is not any extracurricular activities on campus.	There are Student Center, Durham Studio Theatre, Golden Bear Recreation Center, Hearst Greek Theatre, Hearst Memorial Gymnasium, Stadium and sport fields and Old Art GalleryBerkeley Art Museum within campus.	3	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided within surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services on campus.	There are several café and restaurants. But being located in urban fabric of city, it uses many facilities of the city.	3	

Table B.6 (Continued) : Liveability and sustainability multi-criteria assessment table of U.C. Berkeley.

<i>Legibility</i>	7. Campus space legibility	<p>Rating the extent of homogeneity and legibility of campus urban space for instance existence of unique character in terms of natural and built landscape, historical heritage, availability of focal points at the end of streets for orientation, hierarchy of spaces and routes, from 3 to 1.</p> <p>3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.</p>	<p>The heart of UC Berkeley is often described as a ‘university in a park’, and it is this parklike character that unifies its disparate buildings and diverse academic functions, and imparts a unique and memorable identity to the campus.</p> <p>Although intensively developed, the Campus Park (campus core) today retains a magnificent legacy of natural and formal open spaces, as well as numerous historic buildings and ensembles.</p> <p>The Campus Park is an intensively developed environment, laced with an intricate web of circulation systems that are complex and often confusing in their purpose, hierarchy, and linkages. There is a lack of signage leading to the campus, and a lack of a legible wayfinding system within it. Moreover, although the campus continues to implement a multiyear program of universal access improvements, some routes of travel on campus include segments that are not yet accessible for those with impaired mobility.</p>	3	
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Table B.6 (Continued) : Liveability and sustainability multi-criteria assessment table of U.C. Berkeley.

	<p>8. Architectural character</p>	<p>Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.</p>	<p>While the campus does not have a single, coherent architectural vocabulary, it does have many buildings of great distinction, and the best of these comprise the 'classical core': the beaux-arts ensemble designed primarily by John Galen Howard, the first campus architect. Classical symmetry of these buildings, and their common palette of granite facades, tile roofs, and copper trim, impart a sense of unity and dignity to the heart of campus. The campus identity is shaped by another, more subtle ensemble: the variety of picturesque buildings, mostly located along the forks of Strawberry Creek, which also include a number of historic structures. In contrast to the formality of the classical core, these picturesque buildings are designed as informal, articulated volumes that respond to the natural contours of the site.</p>	<p>3</p>	
	<p>9. Landmarks as focal points</p>	<p>Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and clock towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark exist.</p>	<p>UC Berkeley includes 52 sites, structures, and features on the National Register of Historic Places. The majority are neoclassical buildings located primarily within the classical core, while the balance is comprised of picturesque buildings located primarily along the historic route of Strawberry Creek.</p> <p>Of the most well-known landmarks is the Campanile, Sather Tower.</p>	<p>3</p>	

Table B.6 (Continued) : Liveability and sustainability multi-criteria assessment table of U.C. Berkeley.

<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout that campus has designed spin and open spaces are well-designed and defined by built spaces. Different spaces are connected through hierarchy of spaces including main corridors, courtyards. Campus has a core space with a defined open space or plaza with long land marks, enclosed open spaces, designed landscape elements and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	The campus plan has a monumental classic architectural organization and was based on an east-west axial grid oriented towards the Golden Gate Bridge. One of the most memorable features of the Berkeley campus is the way the organic, picturesque landscape contrasts with the formal, axial order of the neoclassical ensemble. Campus compose new buildings primarily of orthogonal forms with orthogonal relationships to neighboring buildings.	3	
	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted in urban fabric with complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban with no morphological consistency.	Situated within urban fabric with an orthogonal distribution that resembles the grid structure of its adjacent urban context. Being situated in the edge of the city, in eastern side, it has surrounded with large green space.	3	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying adaptive reuse infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	It is single large compact campus with some single properties within its adjacent urban context.	3	

Table B.6 (Continued) : Liveability and sustainability multi-criteria assessment table of U.C. Berkeley.

	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and the new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	Campus has a quite dense space but it has lower construction density than its adjoining urban context. Campus development between 1950s and 1970s embraced the strategy of tall and infill structures.	2	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilities or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	There are small-mid size parking and parking structures distributed around campus and outside campus in vicinity.	3	
	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	While the Campus Park is often described as a 'pedestrian' environment, many of vehicles enter the campus on a typical workday: not just campus vehicles, but service, maintenance trucks, service vans, construction vehicles and private cars. Not only do they pose a hazard to pedestrians, particularly on busy routes such as Sather Road and Campanile Way, they also cause paving and landscape damage. As the campus becomes congested due to both growth, construction activity, unregulated flow of private vehicles through the Campus Park must be managed more assertively.	3	

Table B.6 (Continued) : Liveability and sustainability multi-criteria assessment table of U.C. Berkeley.

	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	Available.	3	
	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	The car access is mainly around the campus core and to main buildings.	3	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	Ford GoBike Car-pooling	3	
<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	Campus shuttles, Car-sharing Bus Electric Vehicles	3	
	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	There are three main entrances to campus.	3	

Table B.6 (Continued) : Liveability and sustainability multi-criteria assessment table of U.C. Berkeley.

<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	It has a permeable boundary with visibility to inside campus. It is highly accessible.	3	
	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, etc., from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	There are some transitional spaces in campus interface including museum, Cal student store, cafes.	3	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	It is highly connected to urban circulation network.	3	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	It has been developed as an out-city campus but now is surrounded by urban space. The campus is situated 1.5 km east from the city center of Berkeley.	2	
	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	University shares its facilities such as museums, libraries, ...	3	

Table B.6 (Continued) : Liveability and sustainability multi-criteria assessment table of U.C. Berkeley.

	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	There are many exhibitions, seminars, ...	3	
<i>Sustainability</i>	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	It has green infrastructure including buildings, solar panels, ...	3	
	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	University has the established sustainability initiatives since 2003. It has the gold ranking in STAR assessment system.	3	

B.7 Stanford University, Stanford, California, USA

B.7.1 Spatial analysis maps

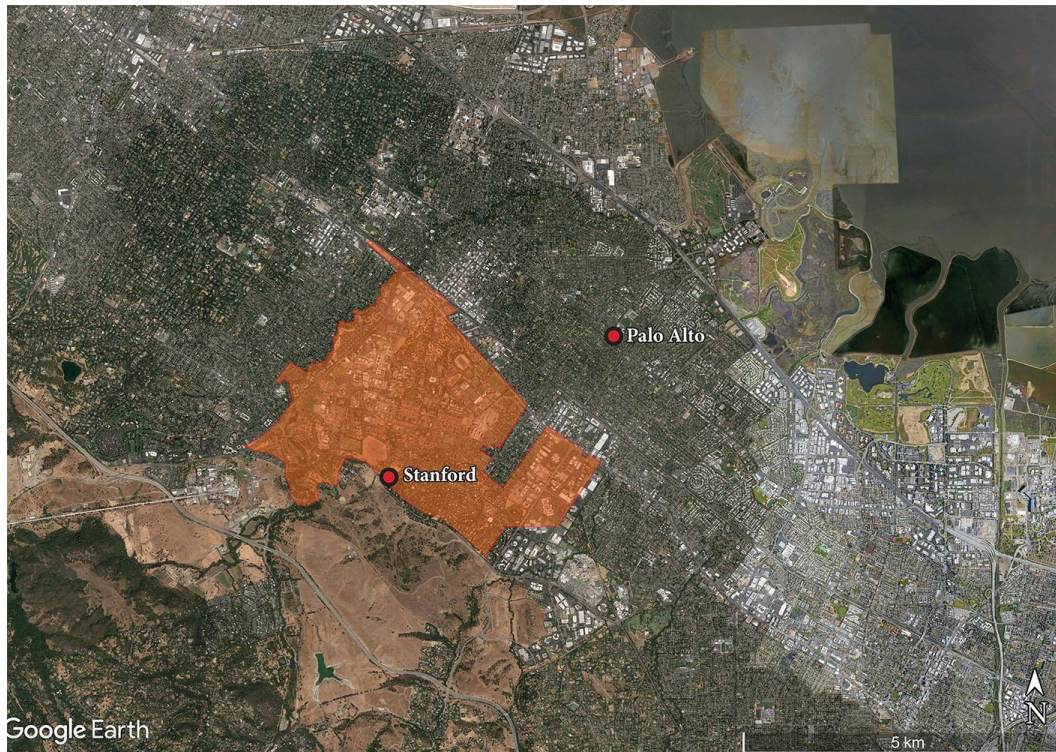


Figure B.0.37 : Campus Location Analysis Map of Stanford University.



Figure B.0.38 : Campus Land-use Analysis Map of Stanford University.

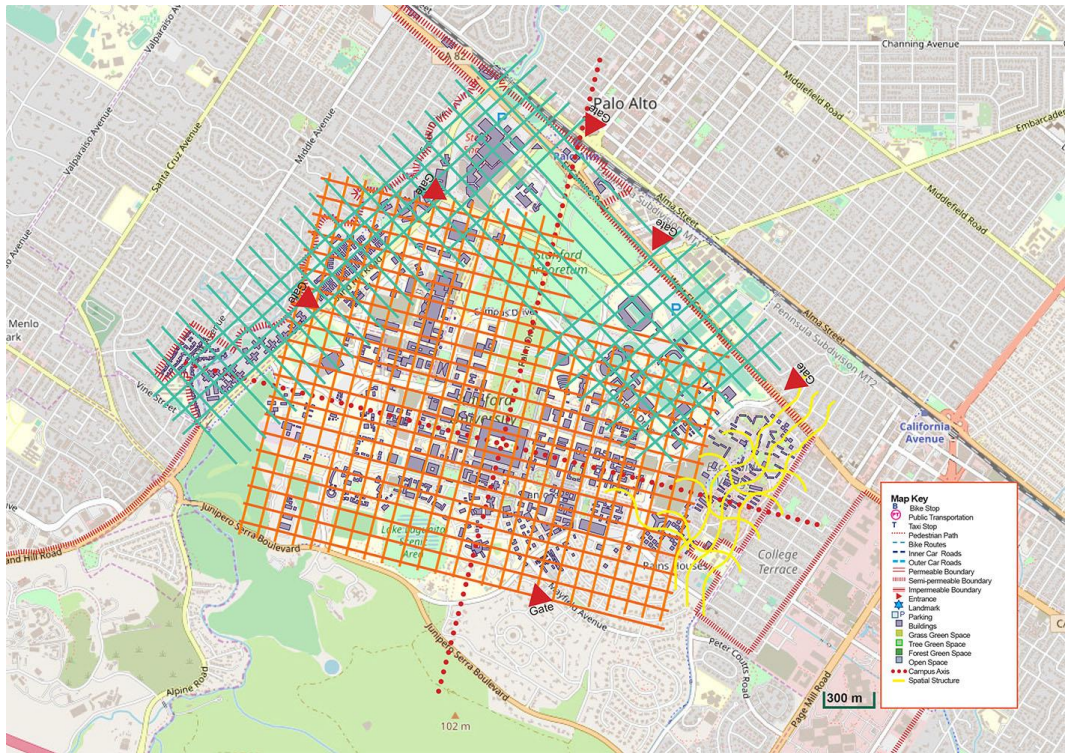


Figure B.0.39 : Campus Spatial Configuration Analysis Map of Stanford University.

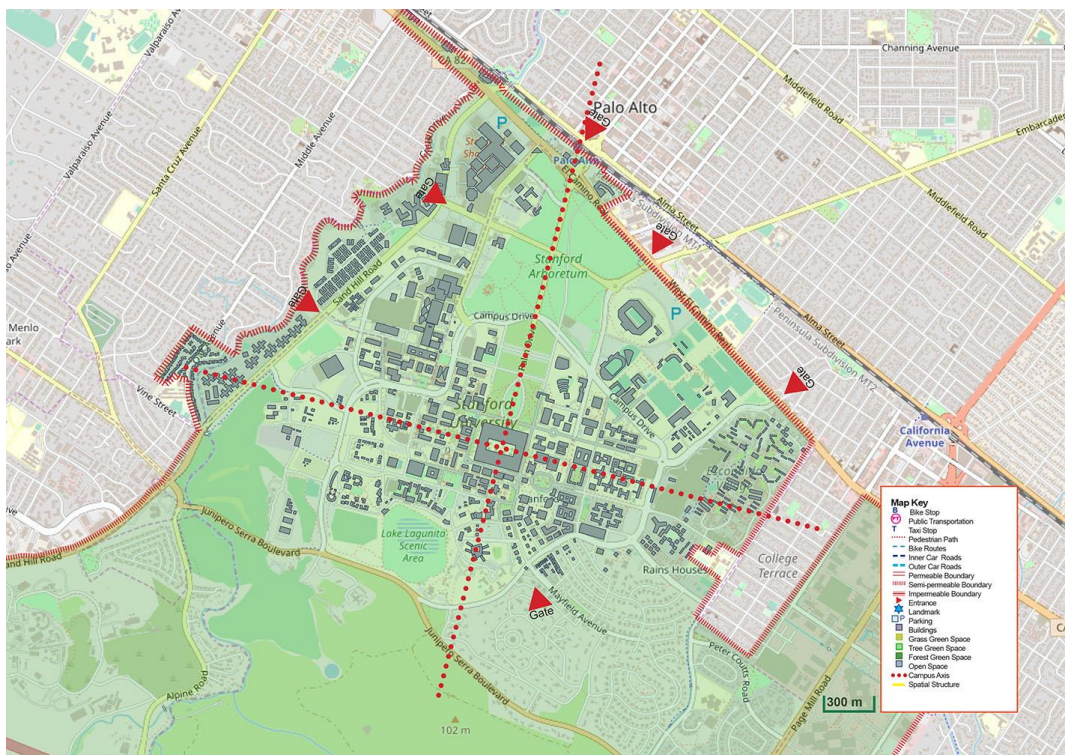


Figure B.0.40 : Campus Compactness Analysis Map of Stanford University.

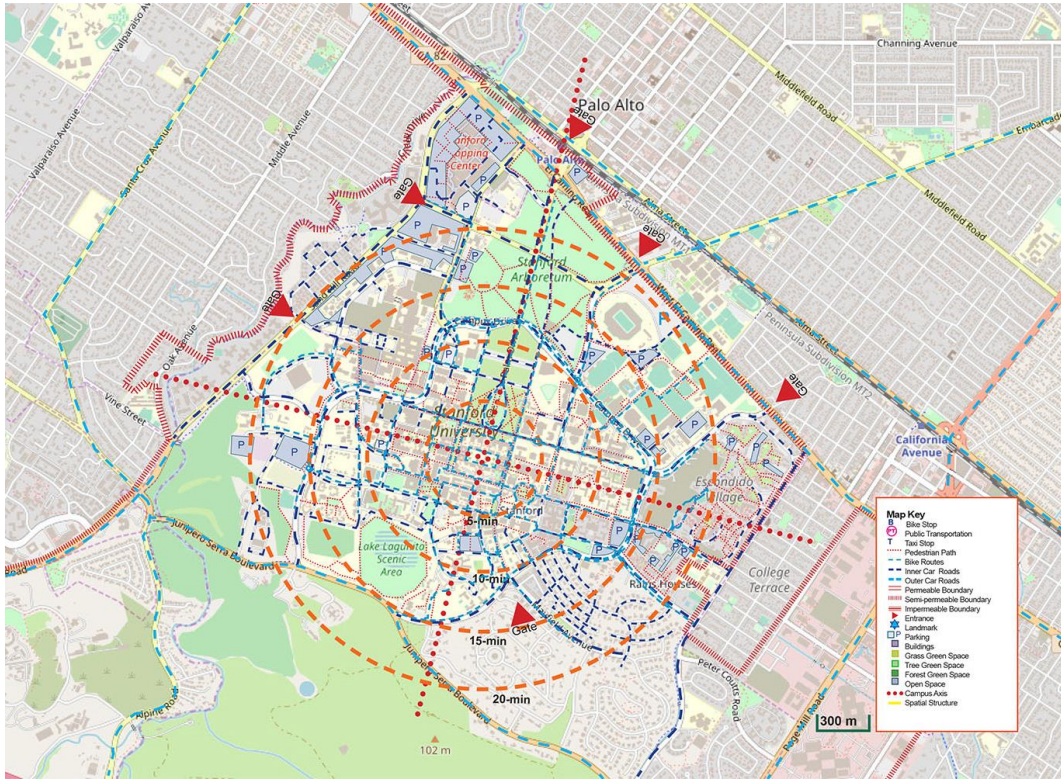


Figure B.0.41 : Campus Accessibility Analysis Map of Stanford University.



Figure B.0.42 : Campus Urban Context Morphology Analysis Map of Stanford University.

B.7.2 Multi-criteria analysis table

Table B.7 : Liveability and sustainability multi-criteria assessment table of Stanford University.

<i>Stanford University</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	From the first master plan of Olmsted till now it was aimed at mixing the disciplines. The land-use is mixed. There are several café and restaurants and various activities that enhance the livability. It is a thriving residential campus and community. The sport fields and facilities are located in north-eastern part of campus, still in a walking distance.	3	
	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=There are not any designed open spaces, and many spaces are abandoned without possibility to use.	Stanford is like a small city with well-designed sequence of courtyards in the campus core, many inviting plazas and public spaces.	3	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	Stanford is a highly green campus, with vast grass fields, lawns, tree lines.	3	

Table B.7 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	From beginning, the Stanford envisioned a residential university housing its students and faculty. There are 81 different housing option inside campus on the eastern and western part as well as more central part on the south-east of Main Quad.	3	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces, etc. considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is not any extracurricular activities on campus.	There are more than 625 organized student groups in campus. There are several museums, art exhibitions, performing arts, athletic and recreational activities	3	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided within surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services on campus.	There are several types of retail services. There are numerous café and restaurants. There is also a shopping center within the maximum of 20-min walk distance from the center.	3	

Table B.7 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

Legibility	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space for instance existence of unique character in terms of natural and built landscape, historical heritage, availability of focal points at the end of streets for orientation, hierarchy of spaces and routes, from 3 to 1. 3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	There is a consistent and legible character in the entire campus which is the result of its unique architectural and landscaping elements including the red-tile roofs, sandstone-colored walls, and arcades. The arcades not only protect from the weather conditions but also direct the users within the campus and connect different disciplines. The link between original campus development and new constructions is preserved through usage of the uniting stylistic language.	3	
	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	There is a distinctive architectural design in the entire campus answering to the local character of campus. The red-tile roofs, sandstone-colored walls, and arcades create the unique architectural character of the campus.	3	
	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and clock towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark exist.	There are several historical buildings and landscape elements as heritages including Memorial Church, Memorial Court, Main Quad, Palm Drive Axis, and landmarks including Hoover Tower, Memorial Arch. The campus itself is a landmark and tourist destination in the area.	3	

Table B.7 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout that campus has a designed spin and open spaces are well-designed and defined by built spaces. Different spaces are connected through hierarchy of spaces including main corridors, courtyards. Campus has a core space with a defined open space or plaza with long land marks, enclosed open spaces, designed landscape elements and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned in the mentioned way nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	The most part of the campus is well-designed. There are two main axes from the initial phase of development that campus has designed along them. There is a sequence of connected courtyards enclosed by low-rise buildings. But there are undeveloped parts as well.	2	
	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with a complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban space with no morphological consistency.	Campus is located to some extent within the urban fabric. It has a grid spatial structure in most parts, similar to its surrounding, that create morphological cohesion and consistency with surrounding. Large parts of southern, northern and western parts are undeveloped lands and surrounded by rural landscape.	2	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	Stanford is compact occupying one large campus.	3	

Table B.7 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and the new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	Campus core has a high density with low-rise buildings. The southern, northern and western part and surrounding areas of the campus have very low densities.	2	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilitates or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	There are concentrated large parking lots in western part of the campus. Moving towards campus core and other parts of the campus, the parking areas are smaller and more distributed all around the campus excluding the campus core.	2	
	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	The paths are organic and orthogonal and irregularly distributed. The campus core is pedestrian zone and car free except for restricted service vehicles. It is possible to reach most parts of the campus between 3 to 20 min walk.	3	
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	There is a well-designed bike route inside campus and in campus core. This route extend to the surrounding of the campus.	3	

Table B.7 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	The campus core is pedestrianized and has a restricted access only for service vehicles. The rest of campus has are accessible by car and there is a car road on the campus periphery.	3	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	It has several car-sharing and bike-sharing services and carpooling and shuttles.	3	
<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	There is a very well-operated campus shuttle system.	2	
	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	There are several entrance which are mainly for car access rather than pedestrian.	2	
<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	The boundary is highly visually permeable. There are physical and natural barriers around the campus.	2	

Table B.7 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, etc., from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	There is not activity and transitional spaces along the campus boundary. It is accessible by car rather than pedestrian.	1	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	In the sides of the campus which is surrounded by urban space, there are levels of connectivity. In the sides like southern part which is adjacent to rural landscape, there is no connectivity.	2	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	It is a Rurban/developer campus which is quasi surrounded by urban space in three sides.	2	
	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Stanford shares many of its facilities with public such as hospital, museums, and sport facilities.	3	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Through Cardinal Service, Stanford offers you a wide variety of public and community service opportunities, ranging from on-campus courses to off-campus research to community-based leadership projects.	3	

Table B.7 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

<i>Sustainability</i>	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	University has invested on being a green campus from the outset. It is very green. It is one of the best universities in reducing energy and water consumption. It has solar panels and natural air conditioning system. It highly conduct recycling.	3	
	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	From the outset, Stanford has been designed by Olmsted as a resource-conserving campus. It has implemented several projects for reducing waste, water, and energy consumption. It has several sustainable transportation options. It has well-established Living Labs and sustainability monitoring teams.	3	

B.8 University of Virginia, Stanford, California, USA

B.8.1 Spatial analysis maps

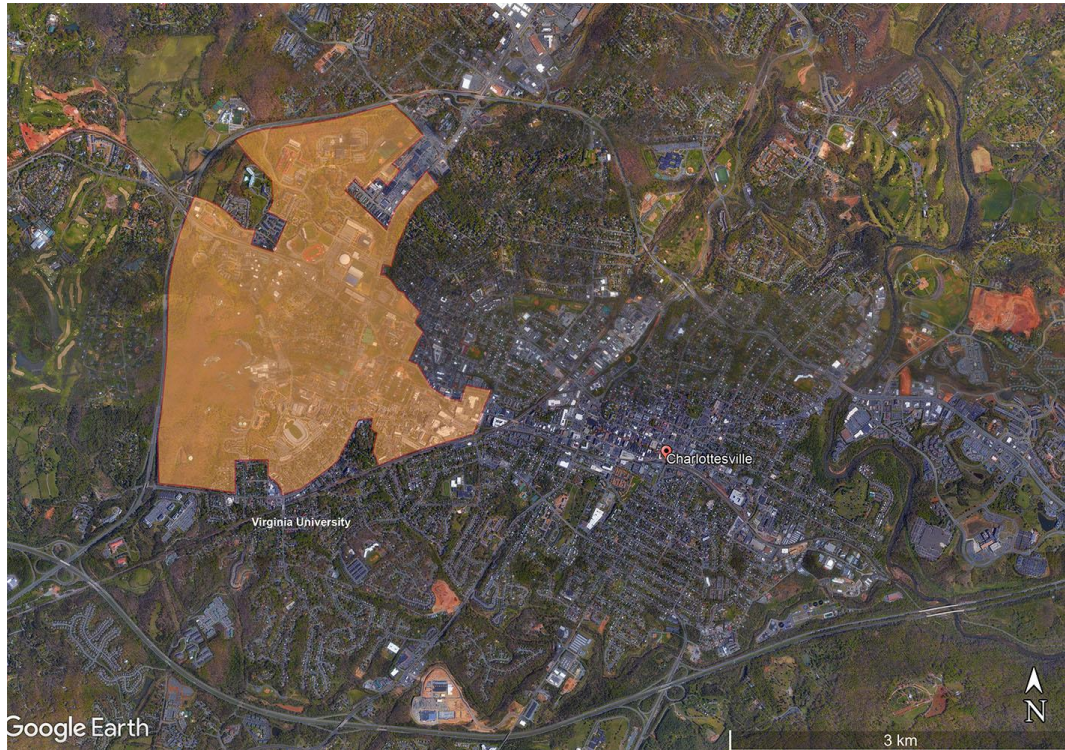


Figure B.0.43 : Campus Location Analysis Map of University of Virginia.

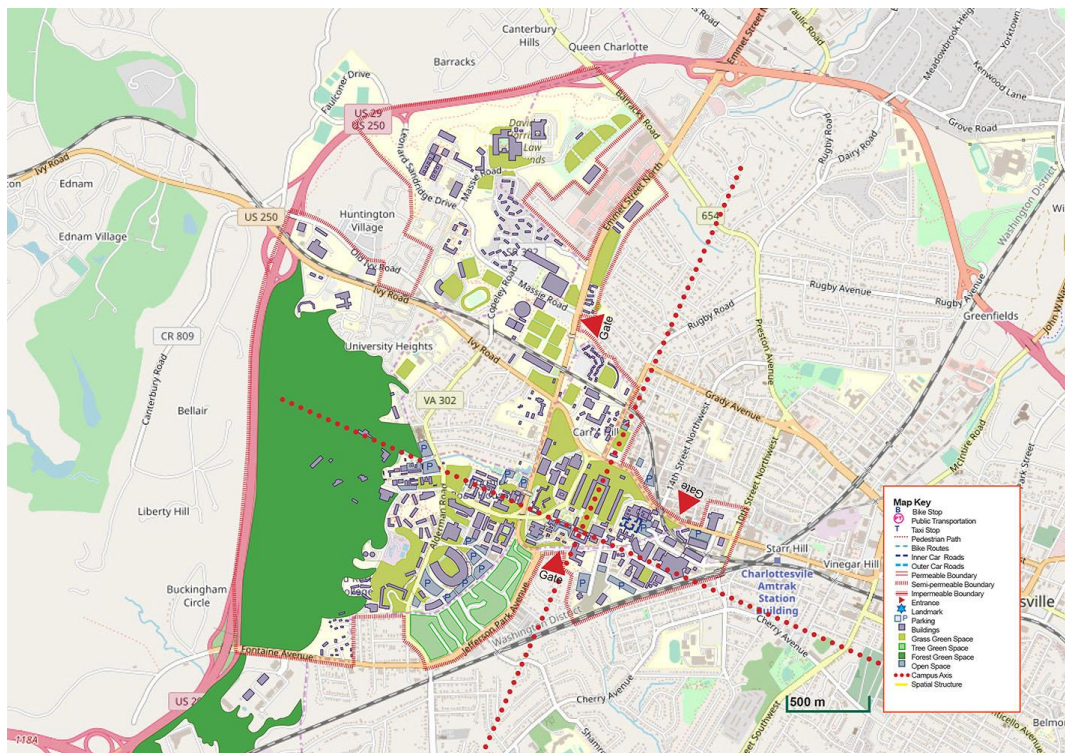


Figure B.0.44 : Campus Land-use Analysis Map of University of Virginia.



Figure B.0.45 : Campus Compactness Analysis Map of University of Virginia.

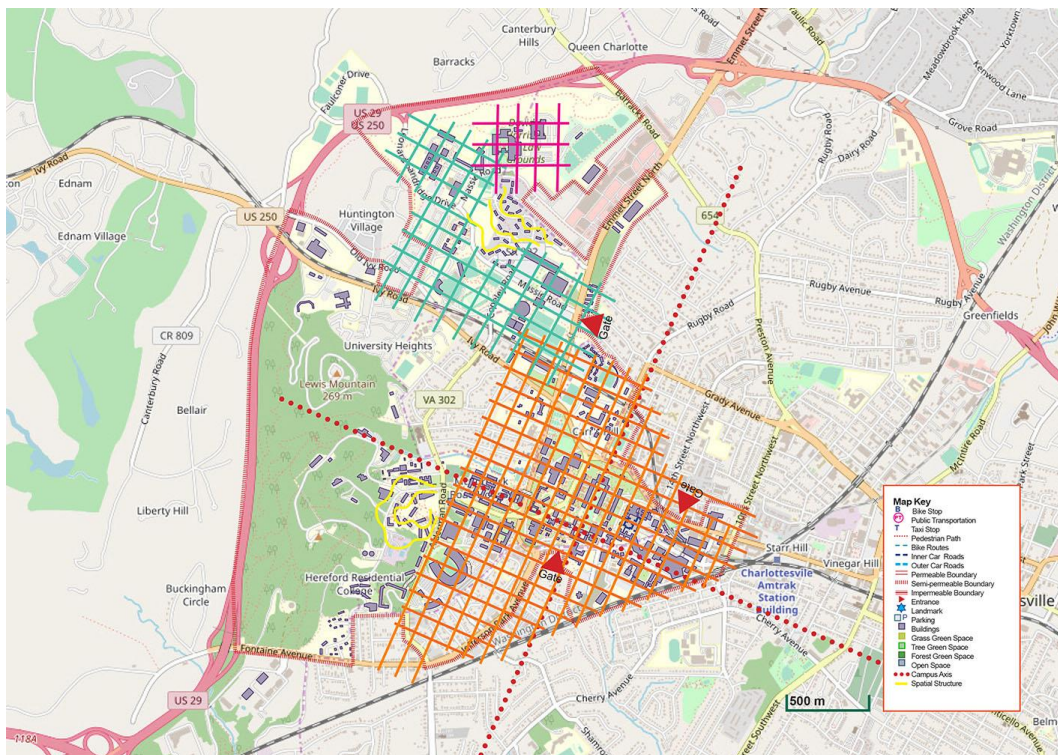


Figure B.0.46 : Campus Cohesion Analysis Map of University of Virginia.

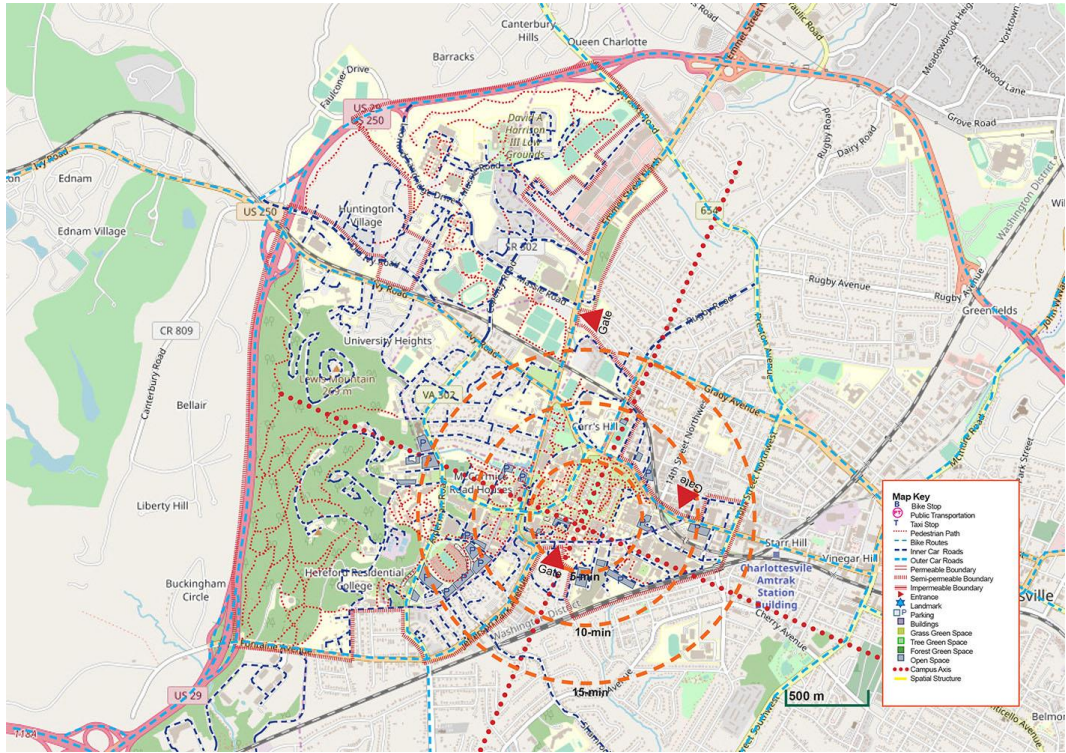


Figure B.0.47 : Campus Accessibility Analysis Map of University of Virginia.



Figure B.0.48 : Campus Urban Context Morphology Analysis Map of University of Virginia.

B.8.1 Multi-criteria analysis table

Table B.8 : Liveability and sustainability multi-criteria assessment table of University of Virginia.

<i>University of Virginia</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Liveability</i>	1. Mixed land use	<p>Rating land use organization on campus, from 3 to 1.</p> <p>3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.)</p> <p>2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center.</p> <p>1=Different uses are not mixed and campus has isolated areas far from the campus central space.</p>	<p>The core of Central Grounds possesses a world-class inventory of historic buildings and landscapes that create a unique identity and serve as a model of the living-learning environment central to the vision of the Academical Village. The diversity of academic pursuits, persistence of personal freedom, and importance of social responsibility within the University community are among the defining qualities of the institution.</p> <p>The plan is the contiguous series of multi-functional facilities and green spaces linked by a network of natural and man-made systems.</p> <p>The University and the adjacent City and County areas together have a pattern of mixed land use, including academic and administrative buildings, offices, commercial uses and residences. Within the Grounds, the mixed use pattern established by the Academical Village continues to some degree, providing a combination of residential, academic, administrative, cultural and social spaces, just as Jefferson intended.</p>	3	

Table B.8 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

	2. Open spaces	<p>Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1.</p> <p>3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities.</p> <p>2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities.</p> <p>1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.</p>	<p>Green space and landscape on Grounds take many forms, including tree-lined fields and pathways, terraced amphitheaters, quadrangles, and courtyards. They provide an equal diversity of uses, ranging from passive recreation to athletics for informal and formal assembly. These open spaces and the buildings that surround them in the core of Central Grounds create higher quality outdoor spaces that are more likely to be used than those on the periphery of Grounds.</p> <p>There is a well-deigned campus core with the principles of Academical Village intended for social interactions. There is a continuity of spaces between closed to semi-closed, and open spaces.</p> <p>The Redevelopment Zones provide for the inclusion of green space with a system of “places and links”, destination green spaces and the connecting elements that work together to compose a comprehensive green space system linking uses throughout the Grounds.</p>	3	
	3. Green spaces	<p>Rating the availability and quality of green spaces, from 3 to 1.</p> <p>3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces.</p> <p>2=Medium ratio like tree lines</p> <p>1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces</p>	<p>There is a high ratio of green spaces ranging from forest-like areas to lawns and grass fields.</p>	3	

Table B.8 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	The residential/mixed use accommodate University housing ranging from residential halls to family housing and related facilities such as dining halls.	3	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces, etc. considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is not any extracurricular activities on campus.		3	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided within surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services on campus.	There are several well-distributed retail services around the campus ground.	3	

Table B.8 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

<i>Legibility</i>	7. Campus space legibility	<p>Rating the extent of homogeneity and legibility of campus urban space for instance existence of unique character in terms of natural and built landscape, historical heritage, availability of focal points at the end of streets for orientation, hierarchy of spaces and routes, from 3 to 1.</p> <p>3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.</p>	<p>The University appreciate its special character and sense of place derive not just from Jefferson’s buildings, but from the ensemble of buildings and settings which forms the current Grounds.</p> <p>The spatial order of the Academical Village is based on the interrelated design of site; buildings and landscape, characterized by a thoughtful, balanced, and continuous sequence of structures and outdoor rooms. Moving from the Lawn, beneath the Colonnades, and into the gardens beyond, one experiences a rich spectrum from public to semiprivate spaces. The success of this assembly of building, landscape and movement is found elsewhere on Grounds; however, there are also many places where the scale and continuity of space is less thoughtfully conceived. Responding to changing demands of growth and transportation, UVa development since Jefferson’s time has shifted to common urban and suburban patterns/ practices, unable to hold to the intimate relationship of the original campus. As a result, it is difficult today to experience the overall cohesiveness and clarity- of-place so evident in the early campus.</p>	3	
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Table B.8 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	The continuity of the architectural language is manifested through the red brick, white trim, black shutters, white wooden balconies, and covered arcades. The preserved tradition of materials generates an aesthetic harmony that unites the entire precincts and strengthens the history and permanency of the institution.	3	
	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and clock towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark exist.	University of Virginia is the World Heritage site of the Academical Village, designed and built by Thomas Jefferson	3	
<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout that campus has designed spin and open spaces are well-designed and defined by built spaces. Spaces are connected by corridors, courtyards. Campus has a core space with a defined open space or plaza with landmarks, enclosed open spaces, designed landscape elements and entire master plan is relatively symmetric and geometric. 2= The campus has neither planned nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in landscaped ground. 1 = Campus has an unplanned layout.	Most buildings in the Central Grounds are oriented to orthogonal axes established by the Academical Village, while those in West and North Grounds are oriented to topography or along curving roads, a few of which predate the Jeffersonian grid. Several building sites actually employ both organizational schemes. Campus has experienced various development phases. The central core has an orthogonal arrangement organized along two axes. The other zones have different organizations but there is still a good hierarchy of spaces.	2	

Table B.8 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with a complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban space with no morphological consistency.	Campus has been established in greenfield but with the urban development, now it is within the urban space. There is an average level of homogeneity with precinct and the surrounding. It has a similar density considering the adjacent urban space. It has diffuse but perceptible limits.	2	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying adaptive reuse infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	The campus is a single large precinct. The development boundary designed to emphasize compact growth through infill and redevelopment.	3	
	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and the new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	Precinct has a mid-low density. It has a low density within the campus but in comparison with surrounding it shows a higher density.	2	

Table B.8 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

<i>Walkability</i>	14. Parking area	<p>Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilities or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)</p>	<p>There are several parking areas around the campus, mainly out of the campus core. Parking on Grounds includes surface and structured, with the majority of spaces located at garages near the periphery of Grounds, requiring a transfer to transit or a five to ten minute walk to reach destinations. While parking supply in the core areas of Grounds is heavily used, the overall parking supply accommodates all needs. Many parking areas serve multiple functions at different times of day or night, making the available parking supply more efficient. With the exception of meters and attended lots, all University parking requires the use of a paid permit.</p>	3	
	15. Pedestrian paths	<p>Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.</p>	<p>Paths are heterogeneous but connected. Considering the large green areas, few paths are developed in these parts. For bicycles and pedestrians, circulation within Grounds occurs along roadways designed primarily for vehicular use and a complex web of pathways. Adequate bike lanes, sidewalks are found along much of the road network, and in some cases, overpasses provide pedestrian and bicycle access across busy streets. In many locations bicycle and pedestrian network is incomplete, presenting safety issues and other challenges, particularly for the elderly and those with disabilities.</p>	2	

Table B.8 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	For bicycles and pedestrians, circulation within Grounds occurs along roadways designed primarily for vehicular use and a complex web of pathways. Adequate bike lanes, sidewalks and crosswalks are found along much of the road network, and in some cases, overpasses provide pedestrian and bicycle access across busy streets. However, in many locations the bicycle and pedestrian network is incomplete, presenting safety issues and other challenges, particularly for the elderly and those with disabilities.	3	
	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	Circulation network is heterogeneous. It is designed primarily for vehicular. In addition to providing access to various destinations throughout the University, the roads, along with two active rail lines, also bisect and separate parts of the Grounds.	2	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	There is a new bike-sharing program called U Bike. There are also ZIMRIDE, ZIPCAR, CAVPOOL and VANPOOL car sharing services.	3	

Table B.8 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	The University has comprehensive transit service provided by University Transit Service (UTS) and Charlottesville Transit Service (CTS), offering multiple bus routes to and through the Grounds. In addition to moving people between residential and academic areas, UTS provides service to and from several University parking garages, allowing commuters to leave their cars at the periphery of Grounds and travel to their final destination by transit. UTS also offers on demand service for passengers with disabilities, along all of the routes. CTS provides transportation services to the University, City and parts of the County, including a free bus trolley between the University and Charlottesville's downtown shopping and business district.	3	
	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	There are several entrances but the campus area is very large and in large areas it is covered with green areas and natural barriers.	2	

Table B.8 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	At points along the border between Grounds and neighboring Charlottesville and Albemarle, gateways into the University community represent important transitions, require appropriately scaled entrances. In other cases, the transition between the University and its adjacent neighborhood is subtle and traditionally treated with low walls constructed of brick and/or stone.	2	
	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	There are few transitional spaces such as cafes in eastern side.	2	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with surrounding 2=Average continuity with average number of intersections 1=No continuity	In western side, campus is surrounded by large green areas and two highways in northern and southern part separate campus from the surrounding. It is in eastern side that campus encounters the adjacent urban area. There is a medium level of street continuity in this side.	2	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	It is an attached campus in one side surrounded by urban fabric and in some parts by green areas.	2	

Table B.8 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	It largely shares its open grounds and facilities with community.	3	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	The University employs a model of providing academic outreach activities and programs houses these activities within each of the eleven schools, the different centers and offices. It collaborates with the private sector, and the state to advance education, health, and economic prosperity in Southwest Virginia. The Center for the Liberal Arts offers programs for public. Lifetime Learning offers over 120 faculty lectures annually in a variety of formats including extended learning programs, lectures, discussions and live streamed interviews. OpenGrounds (OG) a resource, and an opportunity; a network of collaboration, communication, and innovation. It connects the University, the Charlottesville community and global partners to develop the knowledge, tools, and behaviors that will shape the future. The Virginia Foundation for the Humanities connects people and ideas to explore the human experience and inspire cultural engagement. The VFH promotes lifelong learning, and civil public debate, funds, produces exhibits, conferences and teachers' institutes; book discussion series; film, video and radio programs; other public programs that draw upon the humanities.	3	

Table B.8 (Continued) : Liveability and sustainability multi-criteria assessment table of Stanford University.

<i>Sustainability</i>	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability		3	
	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	The Office for Sustainability offers several programs and services: 1. Buildings and Operations: -Greenhouse gas and nitrogen footprint tracking -Metrics and data analysis - progress towards goals -Delta Force - existing building sustainability engineering -LEED-EBOM alignment for existing buildings -Sustainability/energy project implementation project management/support -Alternative energy research and implementation support -Demand response support -Annual steam trap surveys -Owner’s sustainability representation -Drawing and spec reviews - LEED-NC and LEED-CI certification support 2. Outreach, Engagement -Sustainability Advocates (students) -Student Employees – recycling, promotions, water, energy, and student outreach teams (students) -Green Labs Program (students, staff, and faculty) -Green Workplace Program (staff and faculty) -Annual Events (i.e. Earth Week, U.Va. Sustainability Day, Game Day Challenge) 3. Recycling	3	

B.9 Trinity College, Dublin, Ireland

B.9.1 Spatial analysis maps



Figure B.049 : Campus Location Analysis Map of Trinity College Dublin.

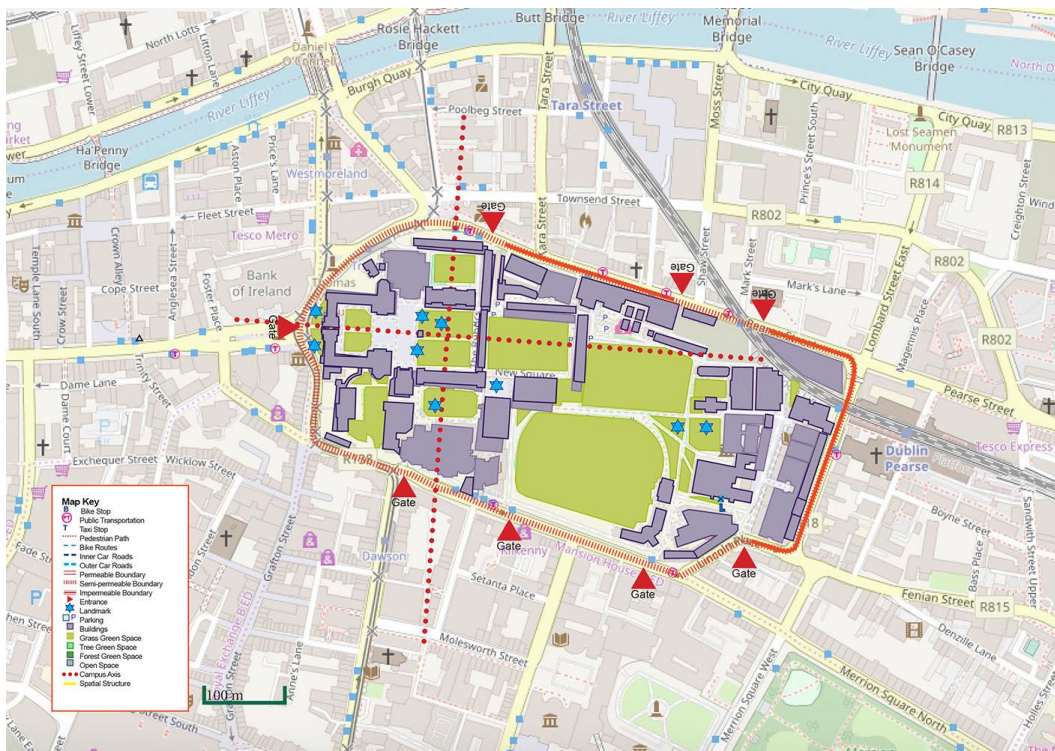


Figure B.050 : Campus Land-use Analysis Map of Trinity College Dublin.

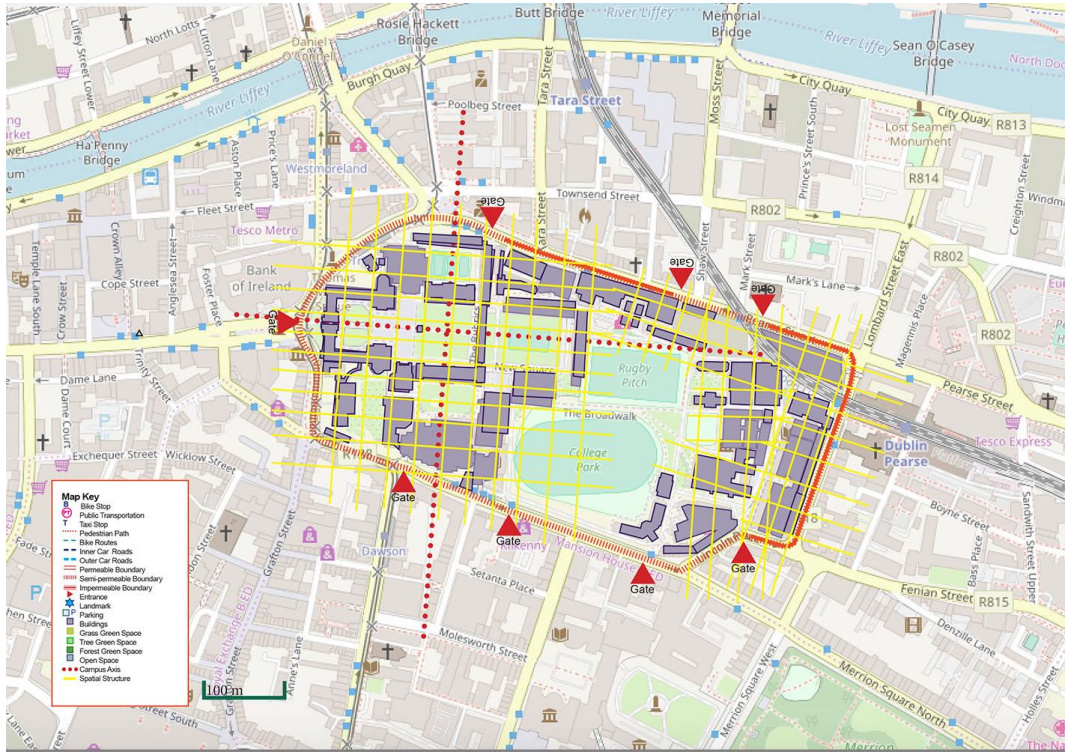


Figure B.051 : Campus Cohesion Analysis Map of Trinity College Dublin.

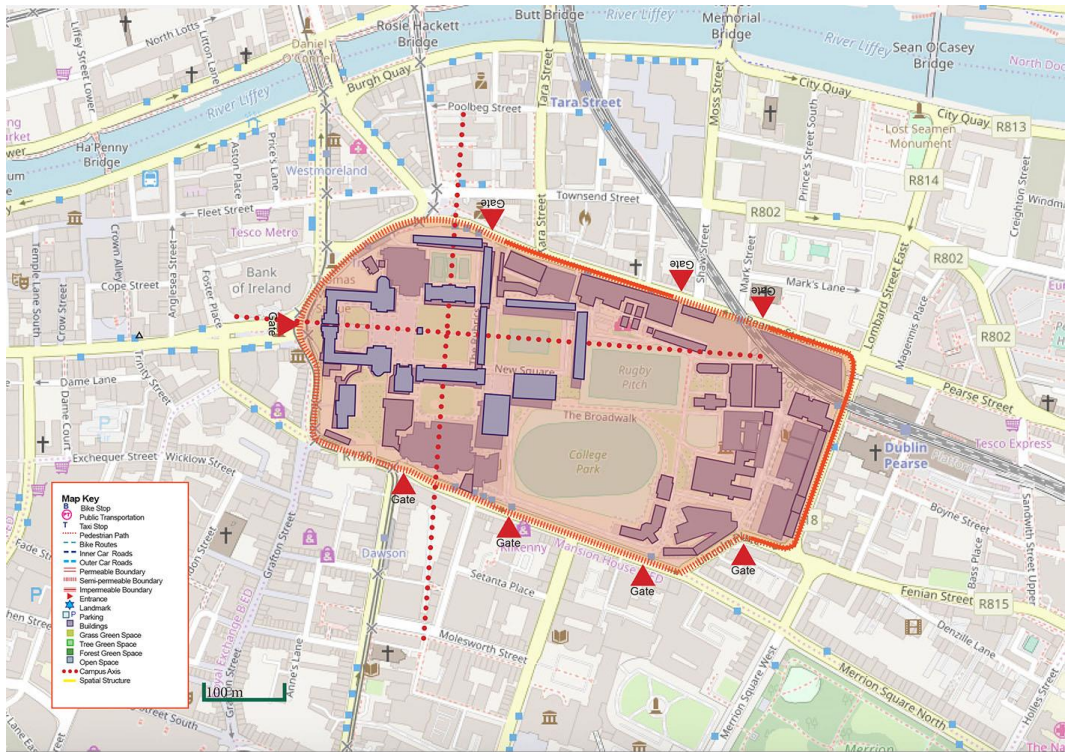


Figure B.052 : Campus Compactness Analysis Map of Trinity College Dublin.

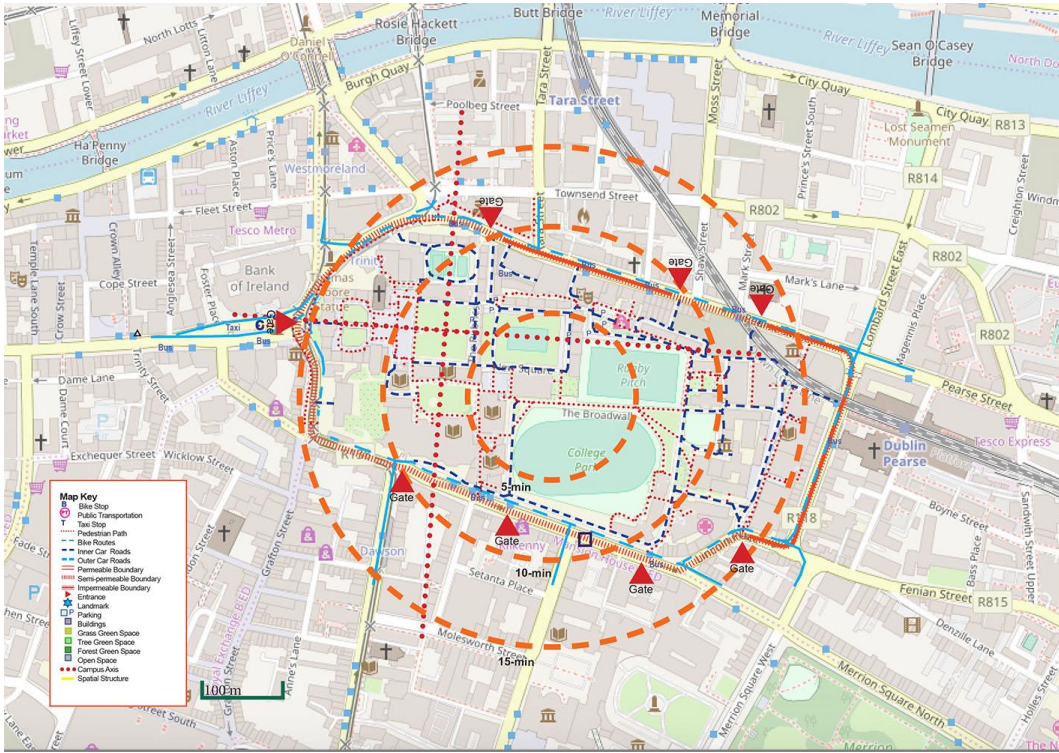


Figure B.0.53 : Campus Accessibility Analysis Map of Trinity College Dublin.

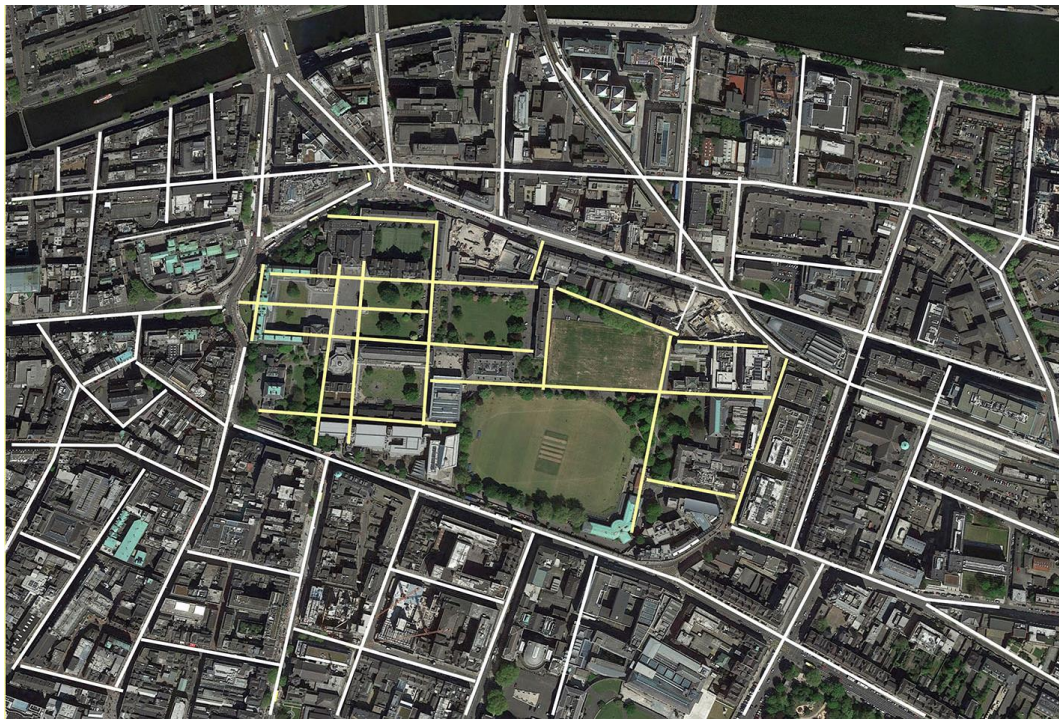


Figure B.0.54 : Campus Urban Context Morphology Analysis Map of Trinity College Dublin.

B.9.2 Multi-criteria analysis table

Table B.9 : Liveability and sustainability multi-criteria assessment table of Trinity College Dublin.

<i>Trinity College Dublin</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	It has a mixed land use with on-campus residences. The sport facilities are located on campus northern edge.	3	
	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.	There is a beautiful well-designed open space in campus core.	2	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	A large part of campus is covered by green fields and lawns.	3	

Table B.9 (Continued) : Liveability and sustainability multi-criteria assessment table of Trinity College Dublin.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	On-campus: in historical buildings or in new buildings + outside campus	3	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces. considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is not extracurricular activities on campus.	There are different spaces for activities such museum, sport fields, ...	3	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided in surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services on campus.	There are some café and restaurants inside campus buildings.	2	
<i>Legibility</i>	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space e.g. existence of unique character like natural and built landscape, historical heritage, availability of focal points at the end of streets, hierarchy of spaces and routes, from 3 to 1. 3=There is a consistent and legible character in entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	It is a mix of historical buildings and new establishments.	2	

Table B.9 (Continued) : Liveability and sustainability multi-criteria assessment table of Trinity College Dublin.

	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space e.g. existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	There is a very strong architectural character in campus core. But new establishments have a different character.	2	
	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark.	The university itself is a landmark and tourist attraction in the city scale. Inside campus, the historical buildings and towers are functioning as landmarks.	3	
<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout that campus has a designed spin and open spaces are well-designed and defined by built spaces. Different spaces are connected through hierarchy of spaces including main corridors, courtyards. Campus has a core space with a defined open space or plaza with long land marks, enclosed open spaces, designed landscape elements and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	The historical core has an orthogonal grid structure but the new establishments has different structure.	2	

Table B.9 (Continued) : Liveability and sustainability multi-criteria assessment table of Trinity College Dublin.

	11. Spatial homogeneity with surrounding	Rating spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with complete distinguished morphological attributes or in peripheries. 1= Campus is detached from urban space with no morphological consistency.	There is a consistency between campus and surrounding in terms of scale of buildings and layout excluding the large green fields.	3	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	Campus is a medium-size compact precinct but due to the shortage of land for expansion, university has acquired other piece of lands in vicinity for its functions.	2	
	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and the new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	It has a medium-low level of density	2	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilitates or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	Mainly as linear along the buildings but accessible for different functions. It is not disturbing the campus core.	2	

Table B.9 (Continued) : Liveability and sustainability multi-criteria assessment table of Trinity College Dublin.

	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	Pathways are organized	3	
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	There is bike routes and bike stations.	3	
	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	Car roads are well-distributed around the campus core without disturbing it and also in campus boundary.	3	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	There is Dublin Bikes offered by the city and Bleeper Bike available on campus.	2	
<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	There are taxi station and several bus stops along the campus boundary.	3	

Table B.9 (Continued) : Liveability and sustainability multi-criteria assessment table of Trinity College Dublin.

	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	Campus has a physical boundary around itself but it has several entrances	1	
<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	It is a mix of fences and Walls around the campus perimeter.it is visually quasi-permeable.	2	
	22.Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	There are shops, cafes and restaurants in campus interface space.	3	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	There is a high level of connectivity between campus and surrounding with several intersections.	3	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	It has a very central location within urban fabric if Dublin.	3	

Table B.9 (Continued) : Liveability and sustainability multi-criteria assessment table of Trinity College Dublin.

	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	It shares its museums, libraries and sport facilities.	3	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Seminars, interactive program of development research, public events, etc.	3	
<i>Sustainability</i>	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Available	2	
	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	It Has achieved Green Flag status in 2013. It is very active in sustainable development.	3	

B.10 Bilgi University, Santralistanbul Campus, Istanbul, Turkey

B.10.1 Spatial analysis maps

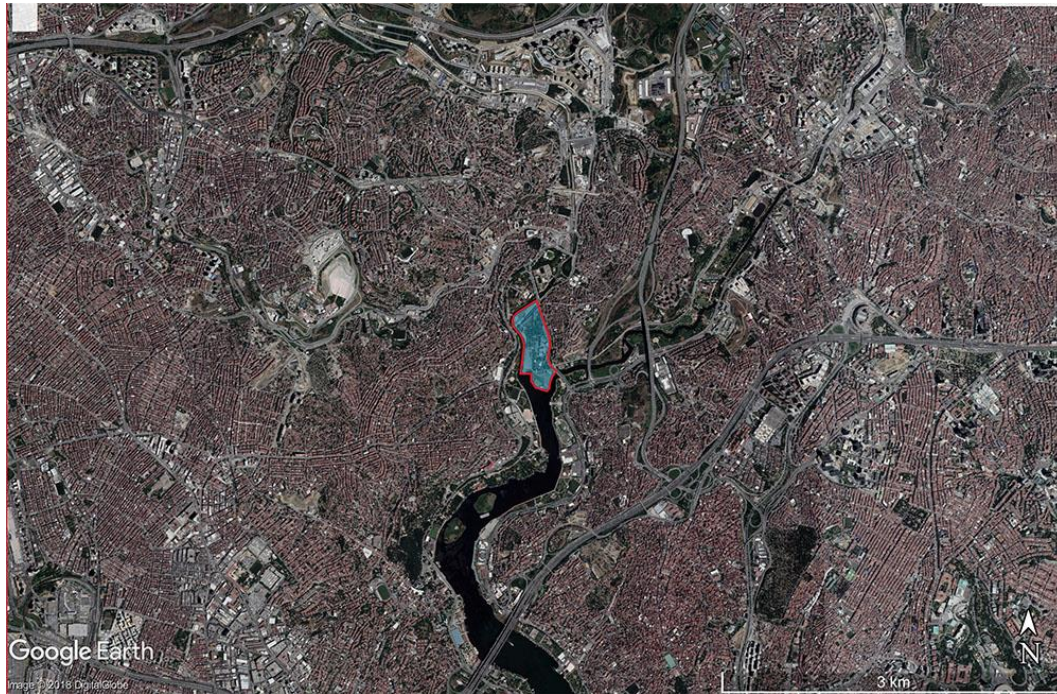


Figure B.055 : Campus Location Analysis Map of Bilgi University.

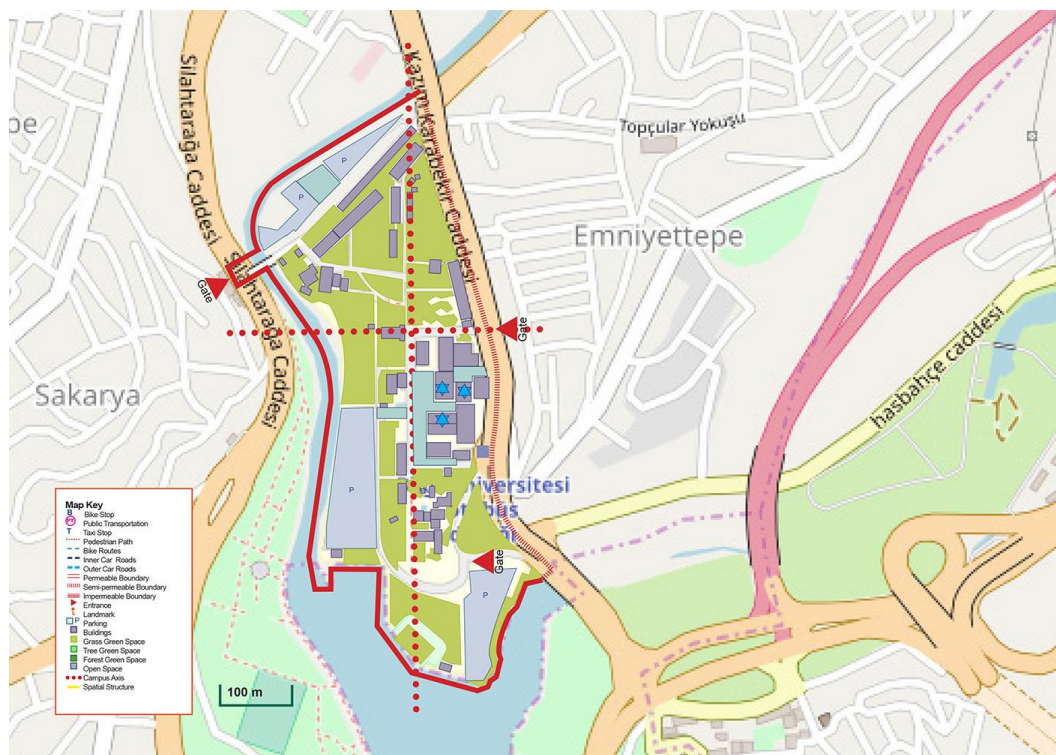


Figure B.056 : Campus Land-use Analysis Map of Bilgi University.

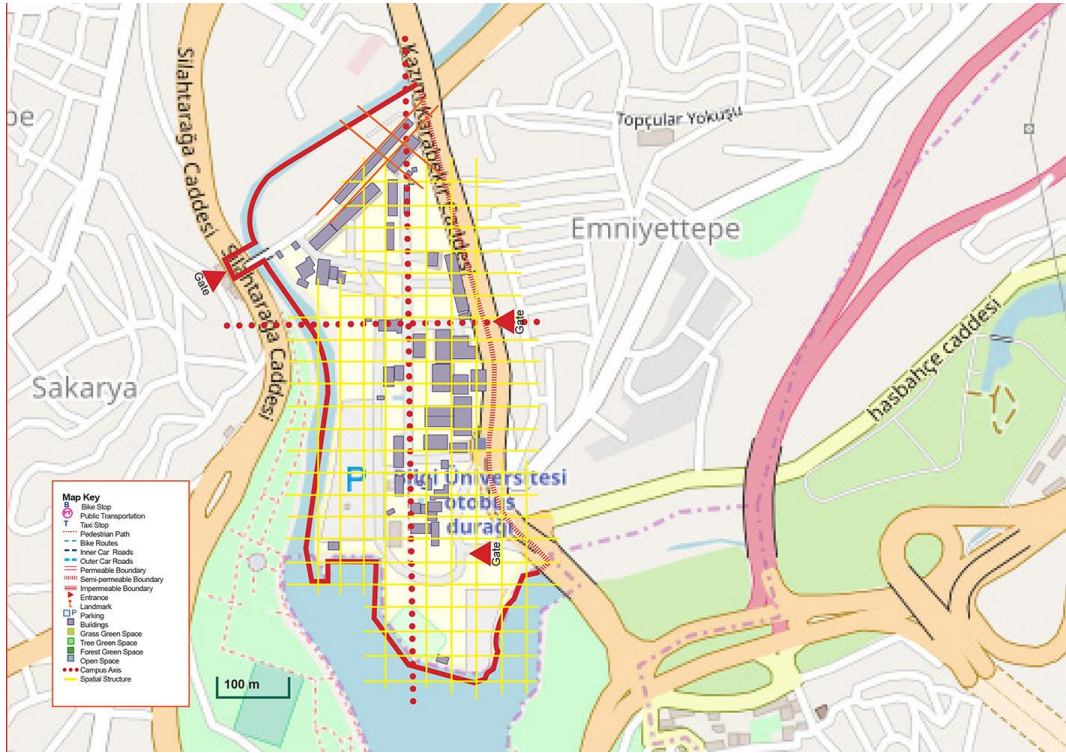


Figure B.0.57 : Campus Cohesion Analysis Map of Bilgi University.

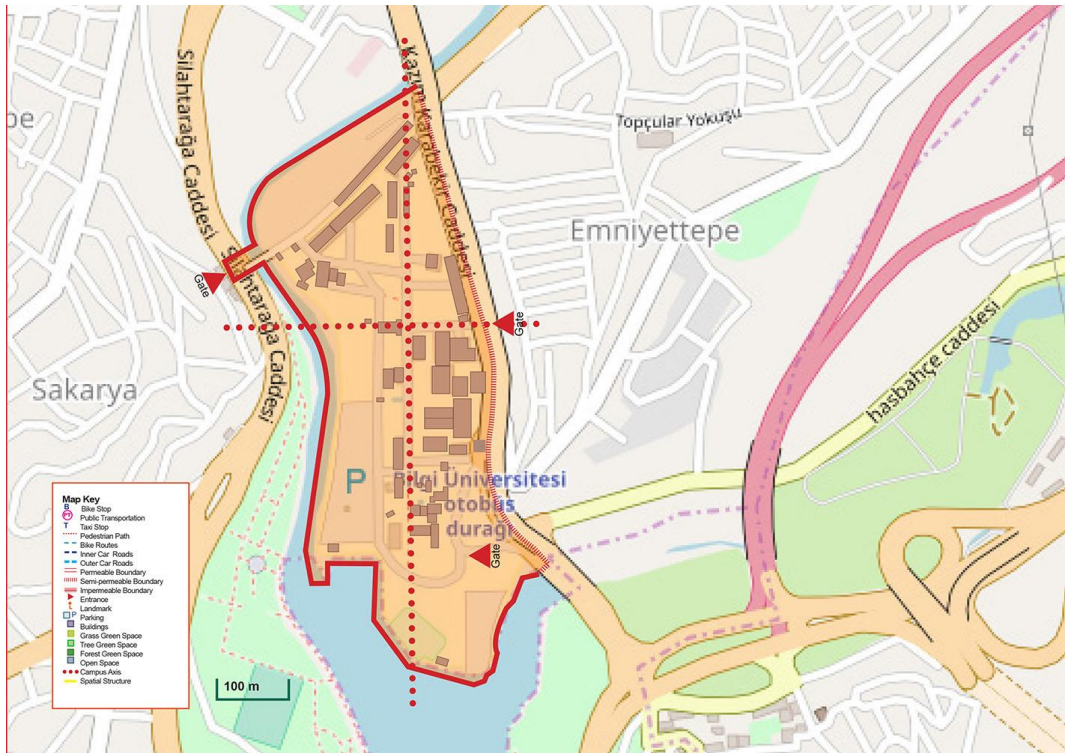


Figure B.0.58 : Campus Compactness Analysis Map of Bilgi University.

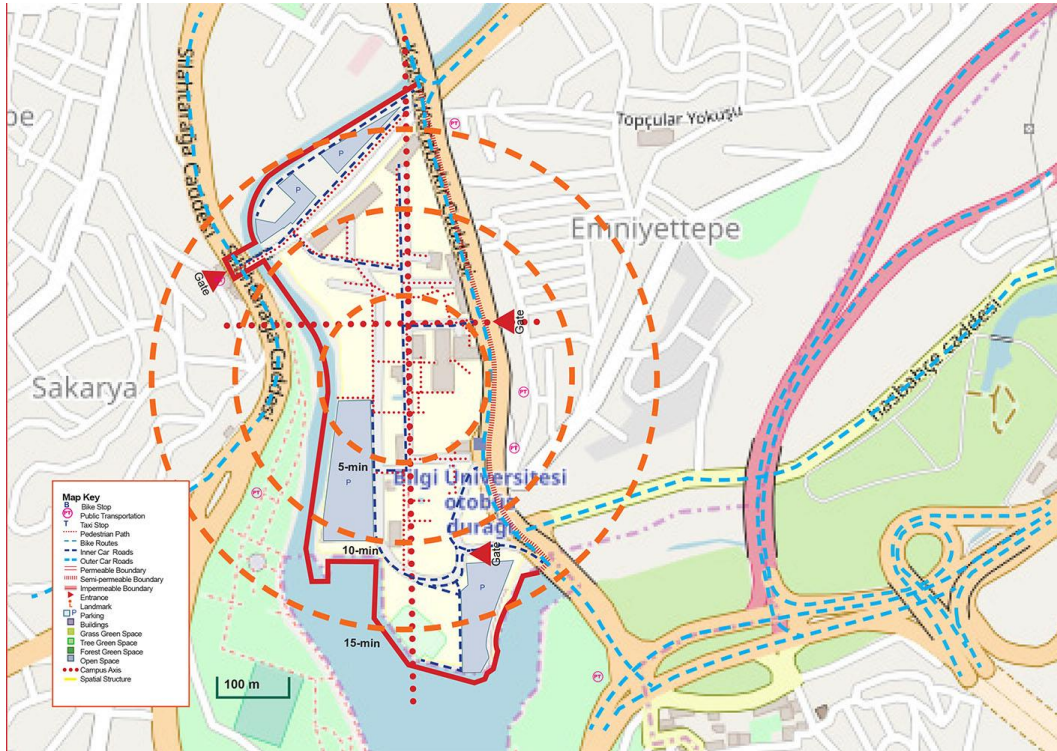


Figure B.0.59 : Campus Accessibility Analysis Map of Bilgi University.



Figure B.0.60 : Campus Urban Context Morphology Analysis Map of Bilgi University.

B.10.2 Multi-criteria analysis table

Table B.10 : Liveability and sustainability multi-criteria assessment table of Bilgi University.

<i>Bilgi University-Santralistanbul Campus</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	Diversified uses including academic, residential, social, and recreational are situated homogeneously within campus area.	3	
	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.	There are designed open spaces with artistic elements and gathering points mainly along the main axis of campus.	3	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	Grass fields and tree lines.	2	

Table B.10 (Continued) : Liveability and sustainability multi-criteria assessment table of Bilgi University.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	There are residences for guests and artists not for students.	2	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces, considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is no extracurricular activities on campus.	Santral Istanbul campus intends to be a site for art and cultural activities.	3	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided in surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services on campus.	They are well-distributed around the campus.	3	
<i>Legibility</i>	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space e.g. existence of unique character in terms of natural and built landscape, historical heritage, availability of focal points at the end of streets for orientation, hierarchy of spaces and routes, from 3 to 1. 3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	It is an industrial site that the historical buildings are well-preserved.	3	

Table B.10 (Continued) : Liveability and sustainability multi-criteria assessment table of Bilgi University.

	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	There are art works and historical buildings as landmarks.	3	
	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark.	The historical buildings of the campus have a specific architectural style and the newly designed buildings have designed with respect to that style.	3	
<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout that campus has a designed spin and open spaces are well-designed and defined by built spaces. Different spaces are connected through a hierarchy of spaces including corridors, courtyards. Campus has a core space with a defined open space or plaza with long land marks, enclosed open spaces, designed landscape elements and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	The historical part of the campus has organized along a main axis with a grid system and the educational buildings on the northern part do not follow that grid system but are organized around a large green space.	2	

Table B.10 (Continued) : Liveability and sustainability multi-criteria assessment table of Bilgi University.

	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban space with no morphological consistency.	Inserted in urban fabric with distinguished morphological attributes.	2	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying adaptive reuse infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	Santral Istanbul campus is a clustered site.	3	
	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and the new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	The density of campus is very low in comparison with its dense surrounding urban fabric.	1	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilitates or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	Average parking areas distributed at the periphery of campus and highly accessible from all parts of campus.	3	

Table B.10 (Continued) : Liveability and sustainability multi-criteria assessment table of Bilgi University.

	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	Pedestrian paths are connected and well accessible.	3	
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	There is on-campus electric bicycle system.	3	
	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	Different buildings are accessible by car for services and parking are well distributed which reduces the car roads inside campus.	3	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	Not available	1	
<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	There are campus shuttles beside various public transportation means.	3	

Table B.10 (Continued) : Liveability and sustainability multi-criteria assessment table of Bilgi University.

	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	Closed with physical barriers including fences and buildings, and also surrounded by water as a natural barrier. There are two entrances to the campus,	1	
<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	Closed with physical barriers including fences and buildings, and also surrounded by water as a natural barrier. Visually permeable.	2	
	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	No transitional spaces.	1	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	No continuity	1	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	At a central position of city, in historical peninsula.	3	

Table B.10 (Continued) : Liveability and sustainability multi-criteria assessment table of Bilgi University.

	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	A public library, Museums and sport facilities.	3	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	They are well-distributed around the campus.	3	
<i>Sustainability</i>	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Not available	1	
	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	It has initiatives for controlling waste, water and energy consumption. Offers sustainable transportation.	2	

B.11 Harvard University, Cambridge, Massachusetts, USA

B.11.1 Spatial analysis maps

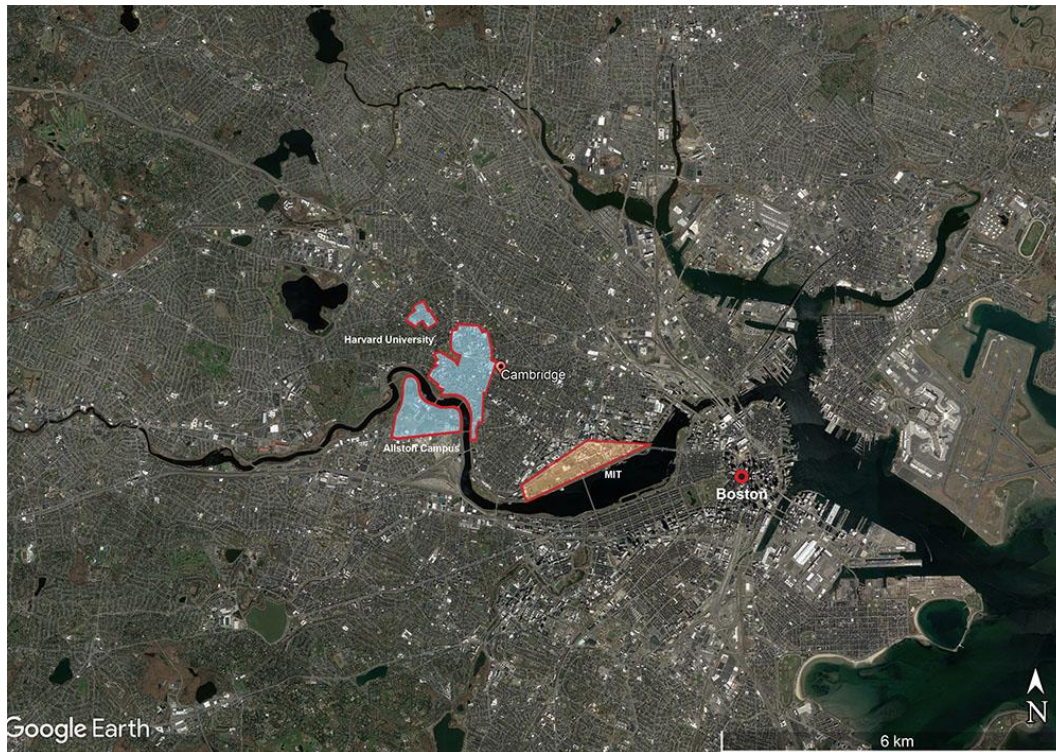


Figure B.0.61 : Campus Location Analysis Map of Harvard University.

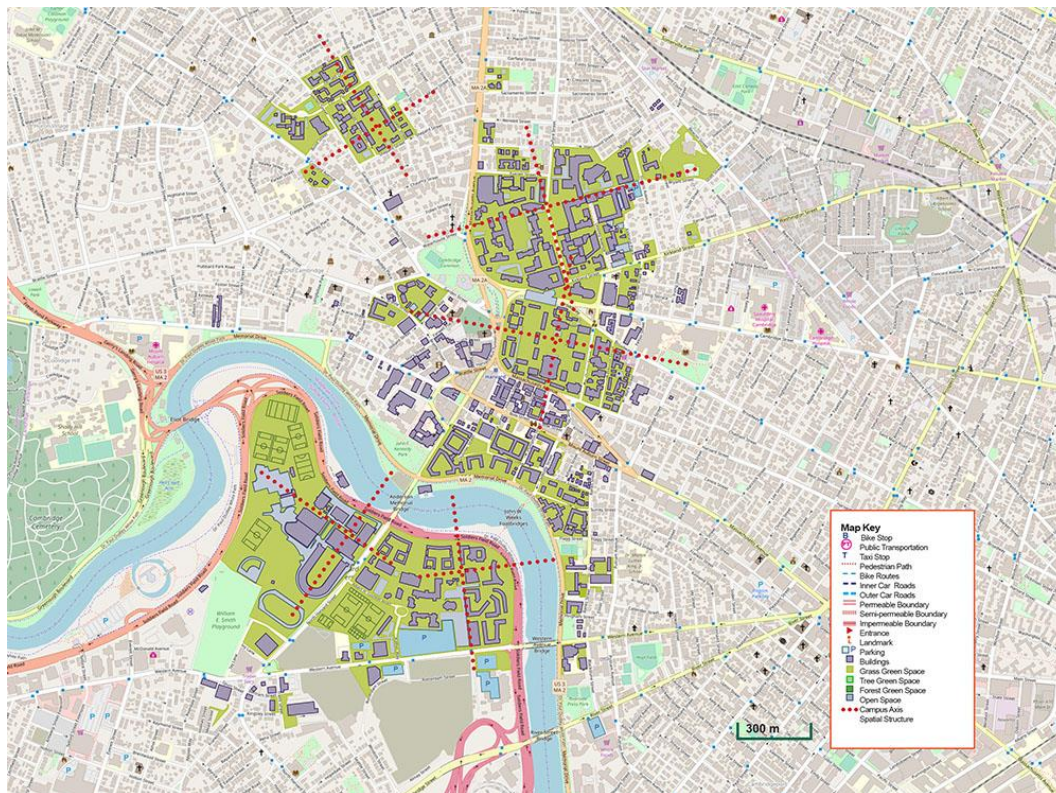


Figure B.0.62 : Campus Land-use Analysis Map of Harvard University.

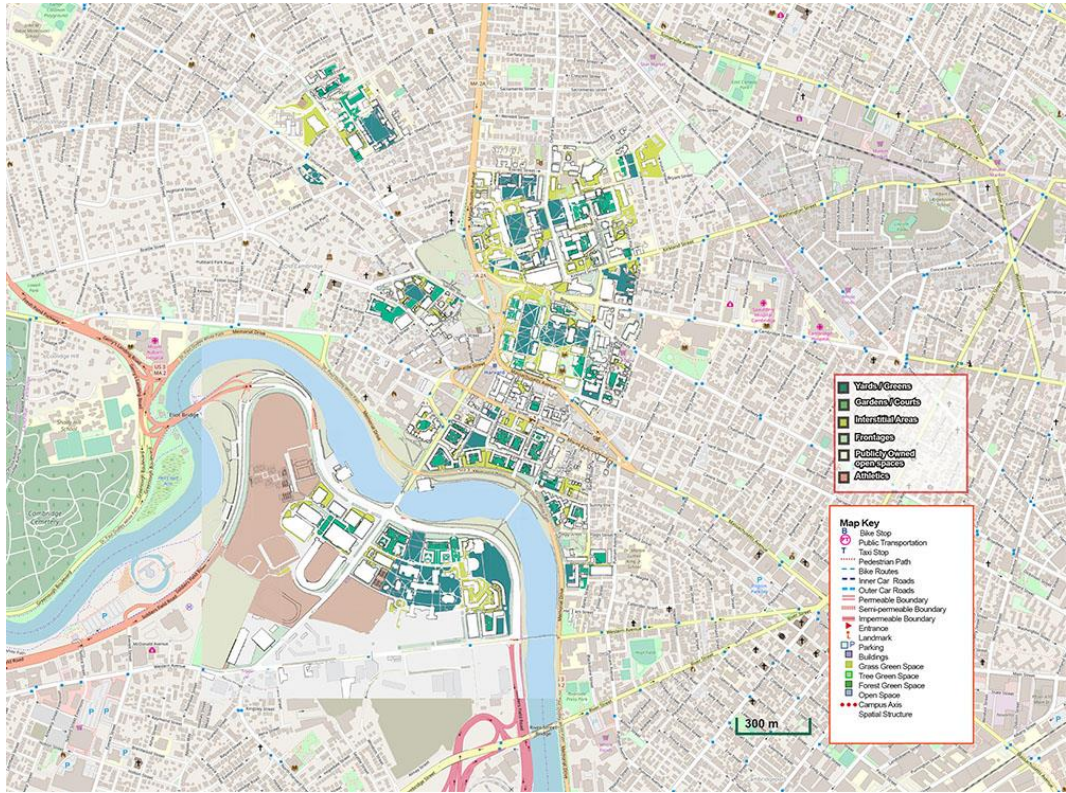


Figure B.0.63 : Campus Green Space Analysis Map of Harvard University.

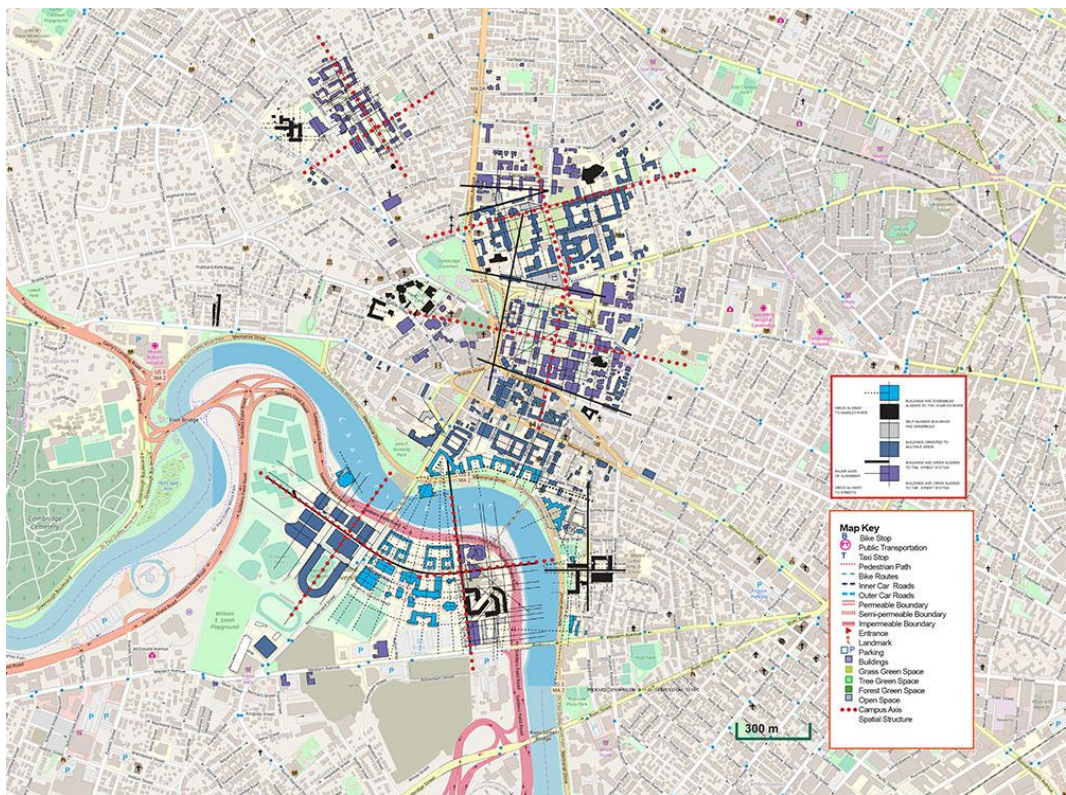


Figure B.0.64 : Campus Spatial Configuration Analysis Map of Harvard University.

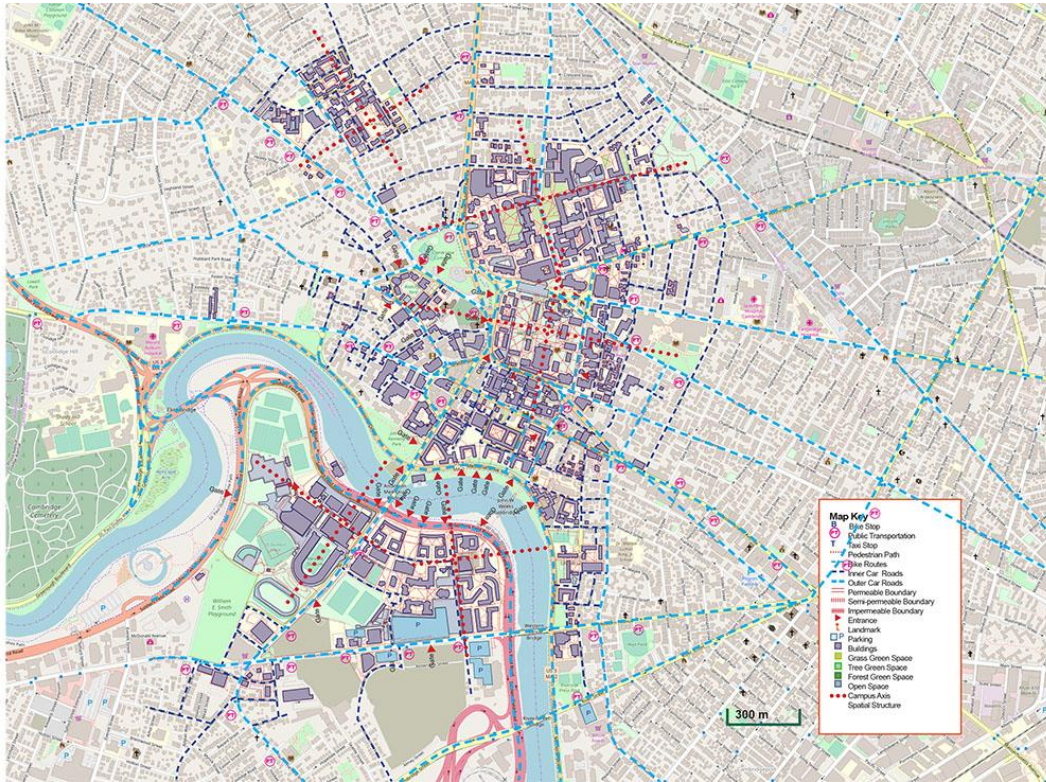


Figure B.0.65 : Campus Accessibility Analysis Map of Harvard University.

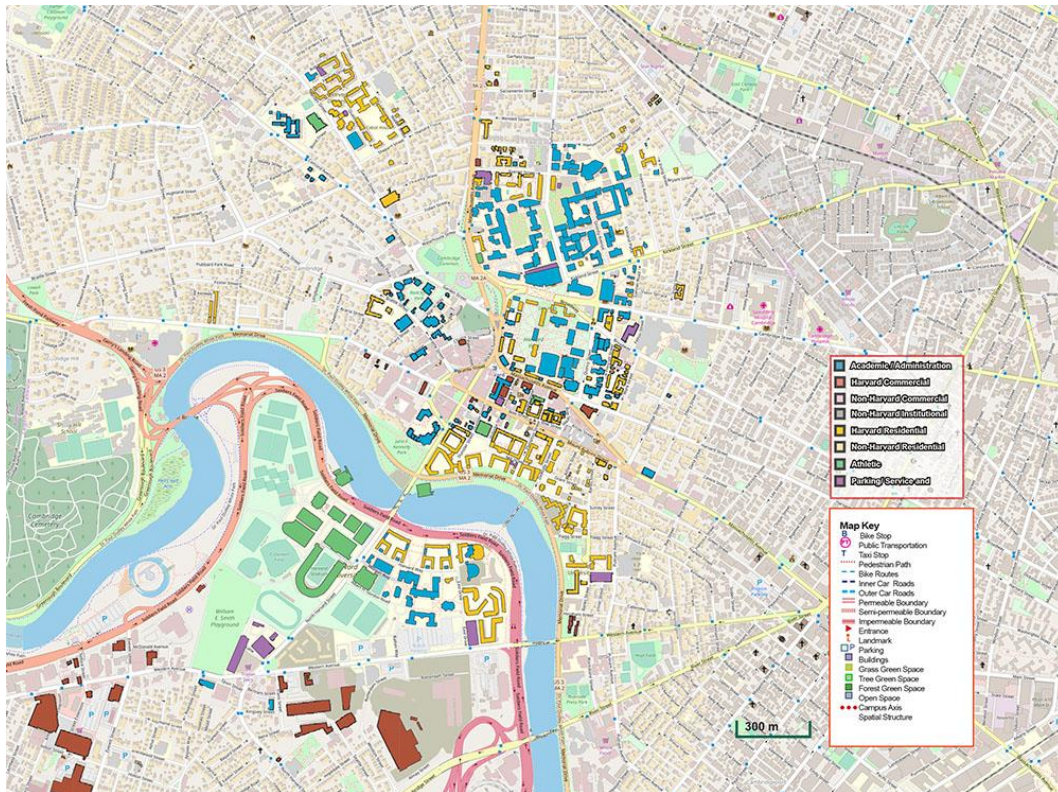


Figure B.0.66 : Campus Land Use Analysis Map of Harvard University.

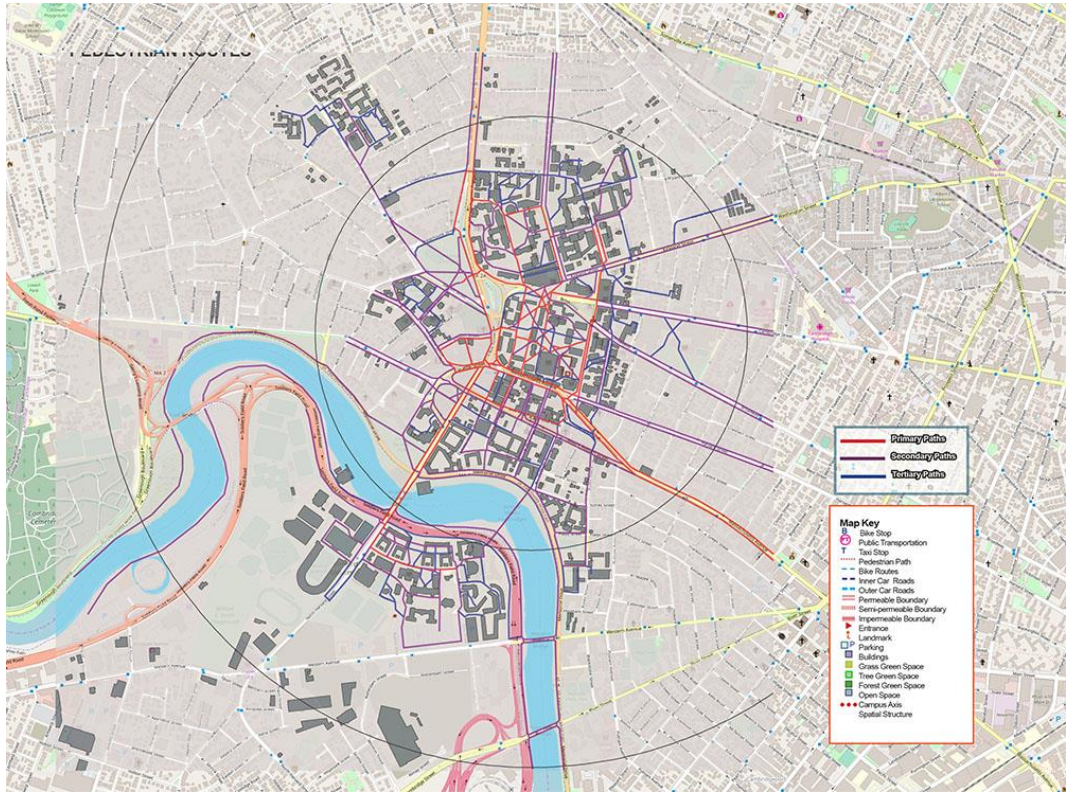


Figure B.0.67 : Campus Paths Analysis Map of Harvard University.

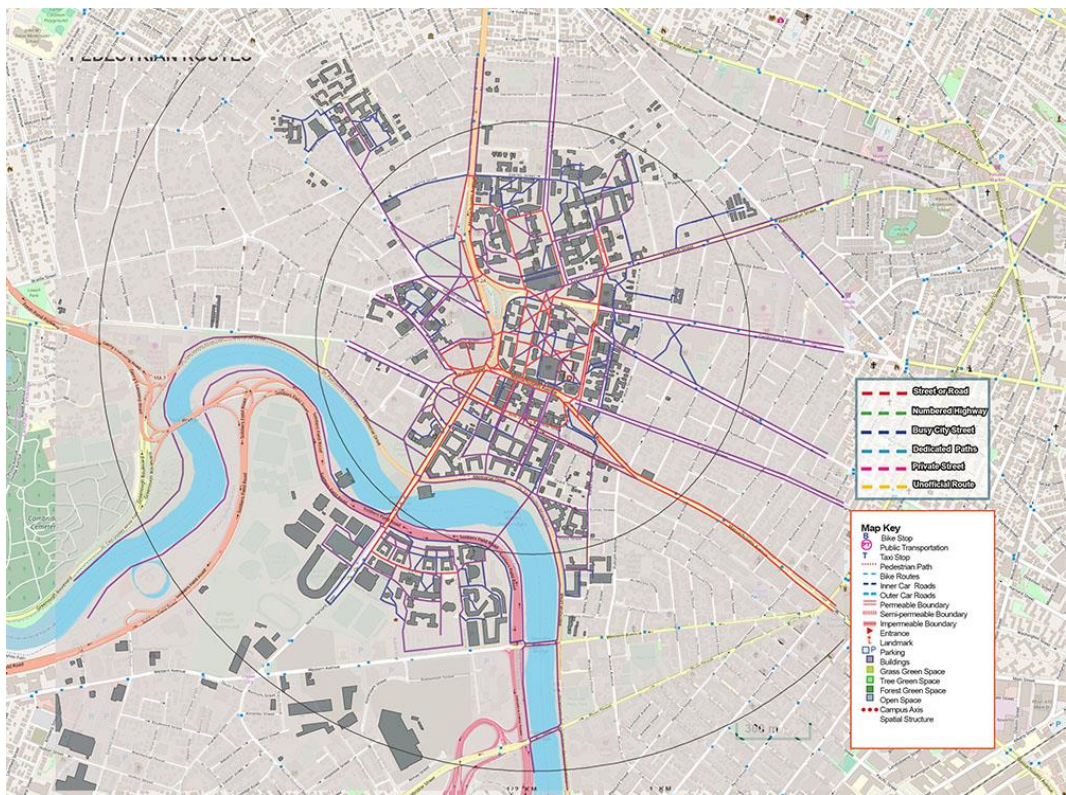


Figure B.0.68 : Campus Movement Network Analysis Map of Harvard University.



Figure B.0.69 : Campus Urban Morphology Analysis Map of Harvard University.

B.11.2 Multi-criteria analysis table

Table B.11 : Liveability and sustainability multi-criteria assessment table of Harvard University.

<i>Harvard University</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	The institution is organized according to departments and faculties and all uses are scattered around the campus in a balanced way.	3	

Table B.11 (Continued) : Liveability and sustainability multi-criteria assessment table of Harvard University.

	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.	There are well-designed plazas and courtyards around the campus.	3	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	All the campus is like a park-like landscape with diversified green spaces.	3	
	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	Availability of dormitory for students inside the campus and accessible and also residences for faculty members mainly in the periphery	3	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces, etc. considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is not any extracurricular activities on campus.	Sport filed, covered gyms (In Allston campus), recreation areas, galleries, museum, ...	3	

Table B.11 (Continued) : Liveability and sustainability multi-criteria assessment table of Harvard University.

	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided within surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services on campus.	Highly available and accessible, mainly in urban surrounding space.	3	
<i>Legibility</i>	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space for instance existence of unique character in terms of natural and built landscape, historical heritage, availability of focal points at the end of streets for orientation, hierarchy of spaces and routes, from 3 to 1. 3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	Most of the buildings are historical.	3	
	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	Buildings, Yards, Plazas, art works	3	

Table B.11 (Continued) : Liveability and sustainability multi-criteria assessment table of Harvard University.

	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and clock towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark exist.	There are different architectural styles. Red brick is the common material. There is an overall architectural style homogeneity.	3	
<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout in a way that campus has a designed spin and open spaces are well-designed and defined by built spaces. Different spaces are connected through a hierarchy of spaces including main corridors, courtyards. Campus has a core space with a defined open space or plaza with long land marks, enclosed open spaces, designed landscape elements and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned in the mentioned way nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	In spite of not being organized according a development plan, campus is generally well organized and there is a consistency and harmony, “a Harvard spirit”.	3	

Table B.11 (Continued) : Liveability and sustainability multi-criteria assessment table of Harvard University.

	11. Spatial homogeneity with surrounding	Rating the spatial consistency between campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted in the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban with no morphological consistency.	Campus and city has evolved together.	3	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying adaptive reuse infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	It is scattered within its urban fabric.	1	
	13. Density	Rating the mass density of campus considering the building footprint in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development that buildings are small/mid-size and new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	It has a mid-high density in comparison with surrounding urban space.	3	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilitates or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	Small parking areas	2	

Table B.11 (Continued) : Liveability and sustainability multi-criteria assessment table of Harvard University.

	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	Well-connected pedestrian paths.	3	
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	Well-connected bike routes.	3	
	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	Different types of car roads.	3	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	Availability of Car sharing, Car pooling, Electric Vehicles	3	
Accessibility	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	Availability of various kinds of public transportation.	3	

Table B.11 (Continued) : Liveability and sustainability multi-criteria assessment table of Harvard University.

	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	There are different kinds of boundaries, but campus is highly accessible.	3	
<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	Inserted in the urban fabric and integrated with that.	3	
	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	Being inserted in the urban fabric, there are various shared land uses on the campus edges.	3	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	Well-connected	3	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	Inserted in the urban context	3	

Table B.11 (Continued) : Liveability and sustainability multi-criteria assessment table of Harvard University.

	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Most of the amenities are shared by public such as cultural, religious, athletic facilities, museums, exhibition centers, hospital, post-secondary education.	3	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Many public educational programs, cultural activities, exhibitions, seminars, ...	3	
	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability		3	
<i>Sustainability</i>	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	It is among the highest rank of sustainable universities got several Sustainability Awards. It has a LEED certificate. Harvard has a sustainability plan started from 1990 and organized around the five core topics of Emissions and Energy, Campus Operations, Nature and Ecosystems, Health and Well-Being, and Culture and Learning.	3	

B.12 MIT (Massachusetts Institute of Technology), Cambridge, Massachusetts, USA

B.12.1 Spatial analysis maps

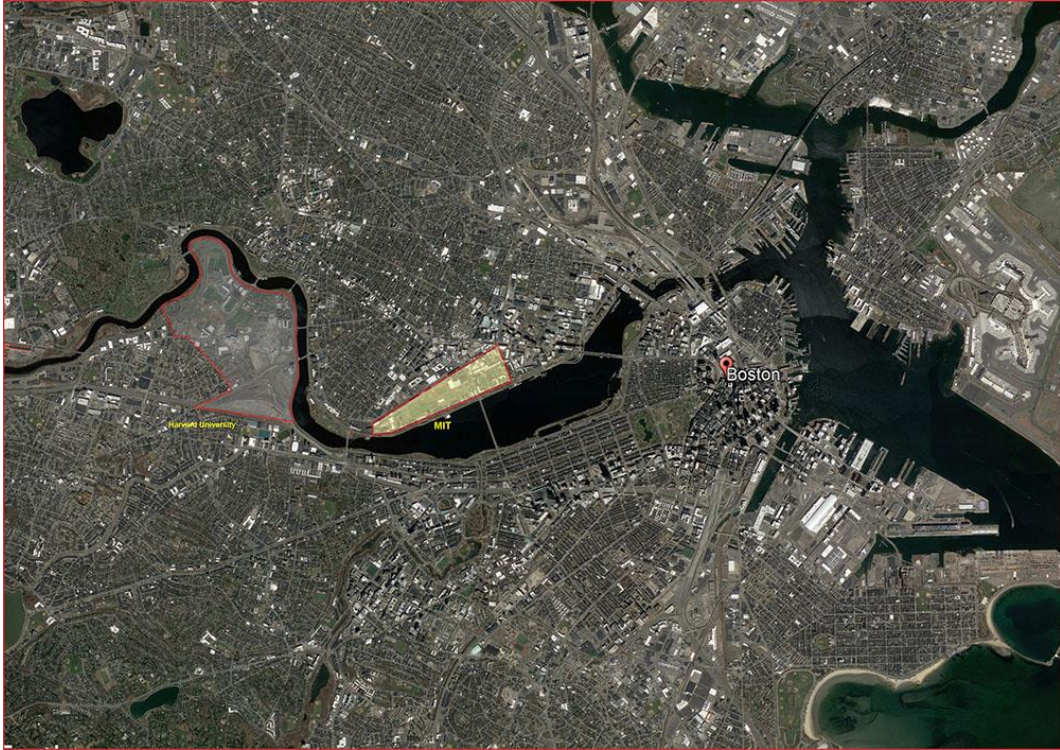


Figure B.0.70 : Campus Location Analysis Map of MIT.



Figure B.0.71 : Campus Land-use Analysis Map of MIT.

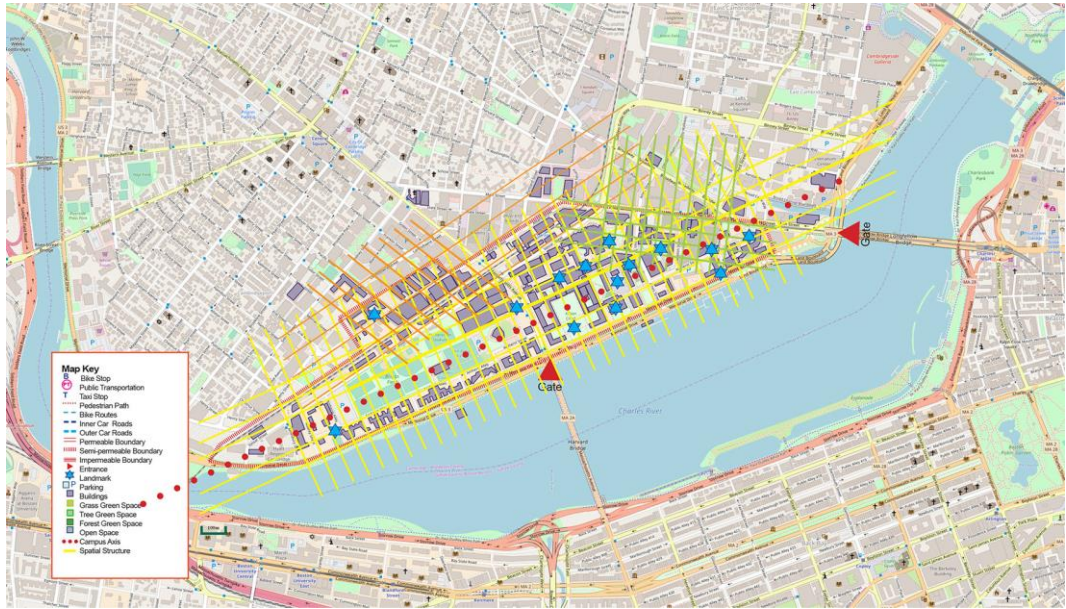


Figure B.0.72 : Campus Spatial Configuration Analysis Map of MIT.

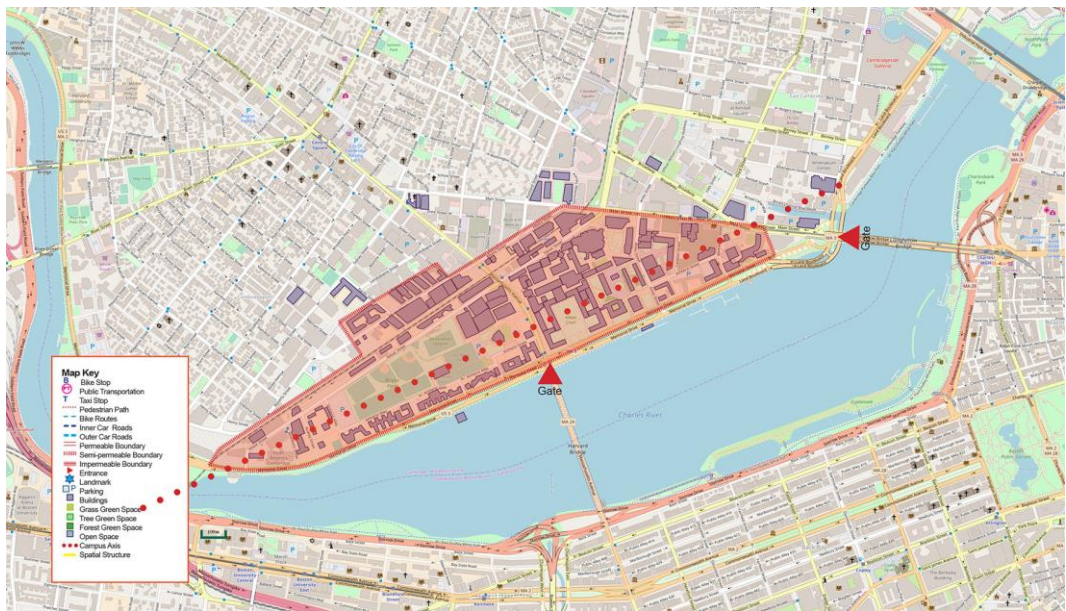


Figure B.0.73 : Campus Compactness Analysis Map of MIT.

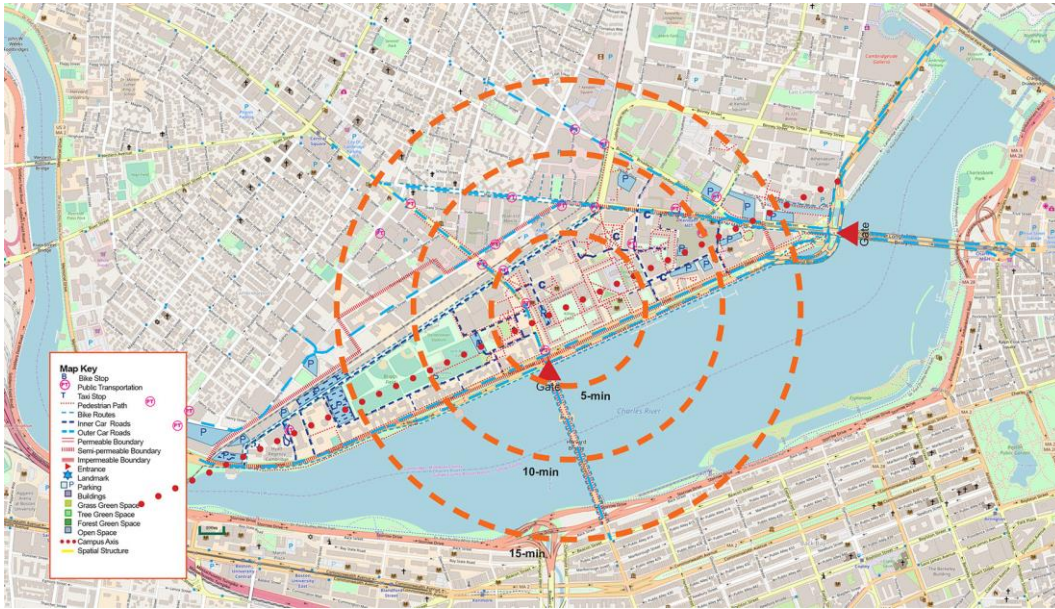


Figure B.0.74 : Campus Movement Network Analysis Map of MIT.



Figure B.0.75 : Campus Urban Morphology Analysis Map of MIT.

B.12.2 Multi-criteria analysis table

Table B.12 : Liveability and sustainability multi-criteria assessment table of MIT.

<i>MIT</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	From the beginning, it was aimed at creating the interdisciplinary collaborative and interconnected setting within mixing functions and connecting departments	3	
	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.	The open spaces are not elaborately designed but they are well-arranged and surrounded by Star buildings. It is emphasized on creating open spaces for communications. Open spaces are very human-scale.	3	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	Average ration of grass fields.	2	

Table B.12 (Continued) : Liveability and sustainability multi-criteria assessment table of MIT.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	There are several dormitories on campus.	3	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces, considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is no extracurricular activities on campus.	Several types of curricular activity including sport, exhibitions, ...	3	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided in surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services.	There are several café, restaurants, bookstores, bank, and other services.	3	
<i>Legibility</i>	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space e.g. existence of unique character like natural and built landscape, historical heritage, availability of focal points at the end of streets for orientation, hierarchy of spaces and routes, from 3 to 1. 3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive e.g. the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	The campus has been developed in a piecemeal manner. Campus does not have a specific character and it has composed of individual star architecture buildings which has created a distinctive identity for campus. They act as focal points.	2	

Table B.12 (Continued) : Liveability and sustainability multi-criteria assessment table of MIT.

	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	Campus does not have a specific architectural style and it has composed of individual star architecture buildings	2	
	9. Landmarks as focal points	Rating the imageability of campus e.g. existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark.	Individual buildings and artworks act as landmarks and focal points.	3	
<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout in a way that campus has a designed spin and open spaces are well-designed and defined by built spaces. Different spaces are connected by hierarchy of spaces including corridors, courtyards. Campus has a core space with a defined open space or plaza with long land marks, enclosed open spaces, designed landscape elements and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	The campus is organized along one axis, parallel to the river. It has been organized in a piecemeal manner and with emphasis on individual buildings rather than space. There is still a good level of continuity between open and built spaces.	2	

Table B.12 (Continued) : Liveability and sustainability multi-criteria assessment table of MIT.

	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban space with no morphological consistency.	Campus is inserted within urban fabric. It has mid-high density but lower than surrounding urban fabric. The campus spatial configuration is not much in contrast with surrounding.	2	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	It is compact campus with one mid-size campus.	3	
	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and the new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	It has mid-high density but lower than surrounding urban fabric.	3	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilitates or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	There are several mid-size parking areas.	3?	

Table B.12 (Continued) : Liveability and sustainability multi-criteria assessment table of MIT.

	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	The paths are well-distributes and organized orthogonally but is some areas, it is complex. The pathways also continue inside of some buildings as student streets.	3	
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	There are well-designed by routes. There are also bicycle cages and bike repairing places.	3	
	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	Considering its linear form. the car roads are mainly in campus boundary which not disturbing the campus vitality.	3	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	Highly available inside campus and in surrounding area including Bluebikes. There are car sharing services such as Carpooling, Zipcar, Commute with Enterprise	3	
<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	It is well connected to the airport. It benefits from the urban transportation. It can be arrived there by car, taxi, subway, bus.	3	

Table B.12 (Continued) : Liveability and sustainability multi-criteria assessment table of MIT.

	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	There is no barrier and it is highly accessible.	3	
<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	It has a highly permeable boundary with no physical barrier and highly accessible.	3	
	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, etc., from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	It is integrated with the surrounding and many university buildings facing the street and are directly accessible. There are some cafes and stores in the interface space.	3	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	Campus has several intersections with surrounding fabric.	3	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	It is in very central position and integrated to surrounding.	3	

Table B.12 (Continued) : Liveability and sustainability multi-criteria assessment table of MIT.

	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Majority of university facilities are highly accessible by public.	3	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Highly available	3	
	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Highly available	3	
Sustainability	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	MIT is one the most sustainable universities and has awarded several prizes. Its mission is to transform MIT into a powerful model that generates new and proven ways of responding to the unprecedented challenges of a changing planet via operational excellence, education, research and innovation on its campus.	3	

B.13 Freire University Berlin (Freie Universität Berlin)

B.13.1 Spatial analysis maps

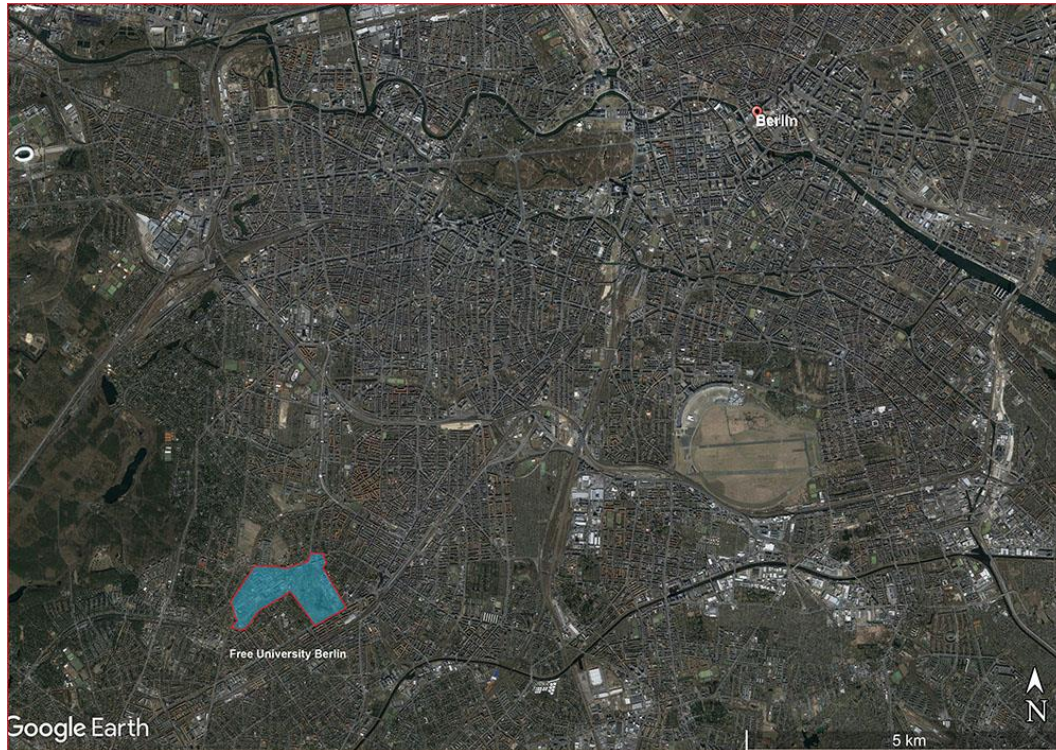


Figure B.0.76 : Campus Location Analysis Map of Free University Berlin.

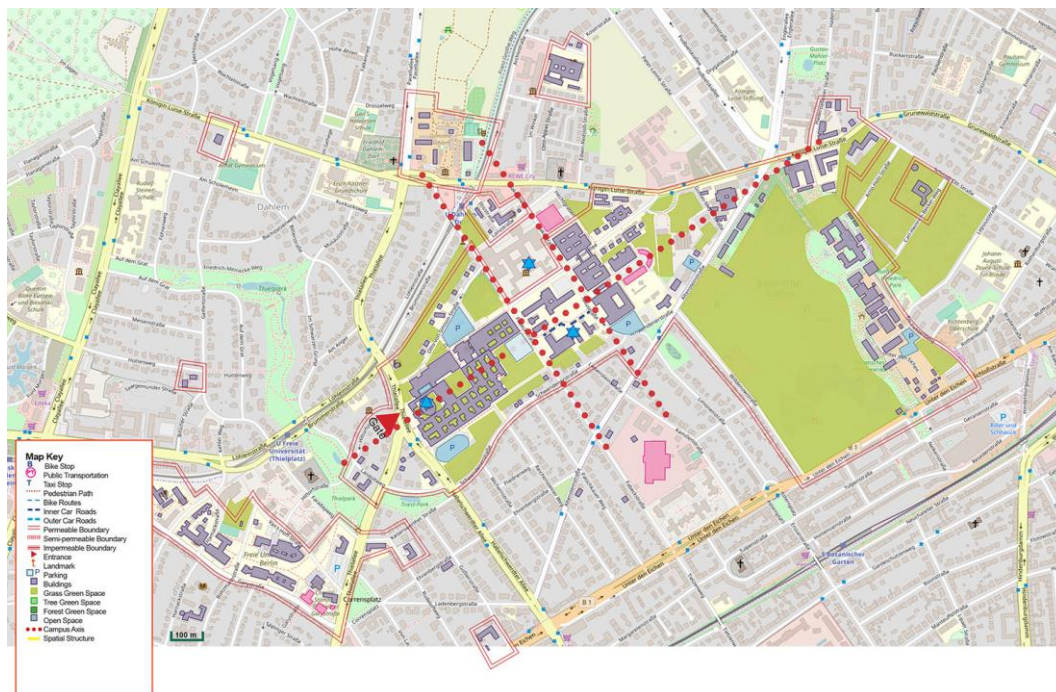


Figure B.0.77 : Campus Land-use Analysis Map of Free University Berlin.

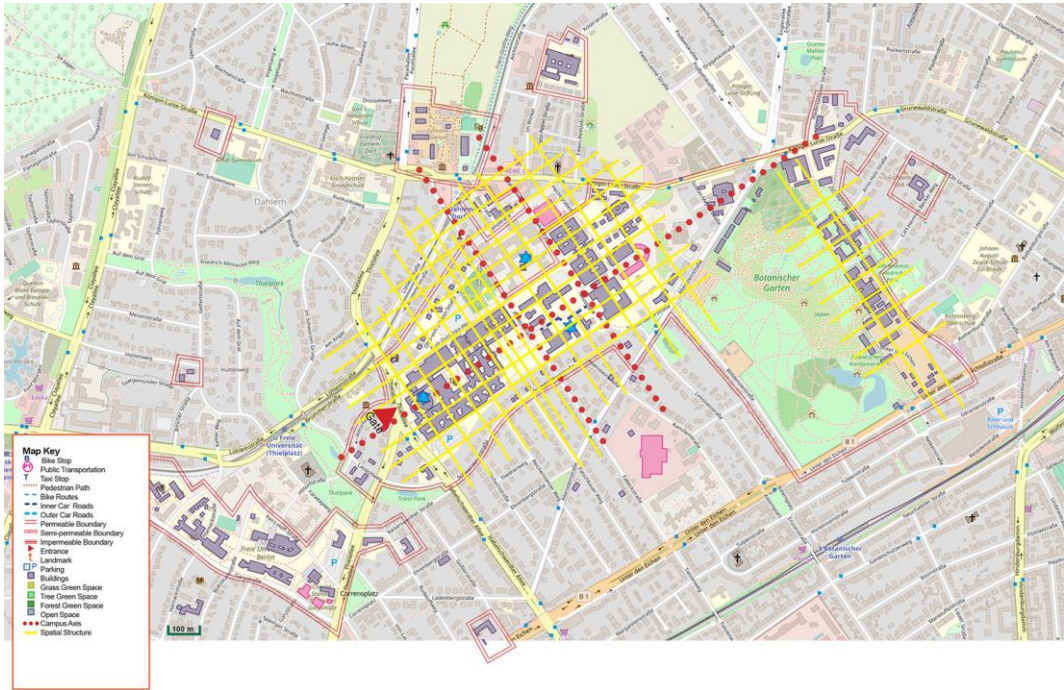


Figure B.0.78 : Campus Spatial Configuration Analysis Map of Free University Berlin.

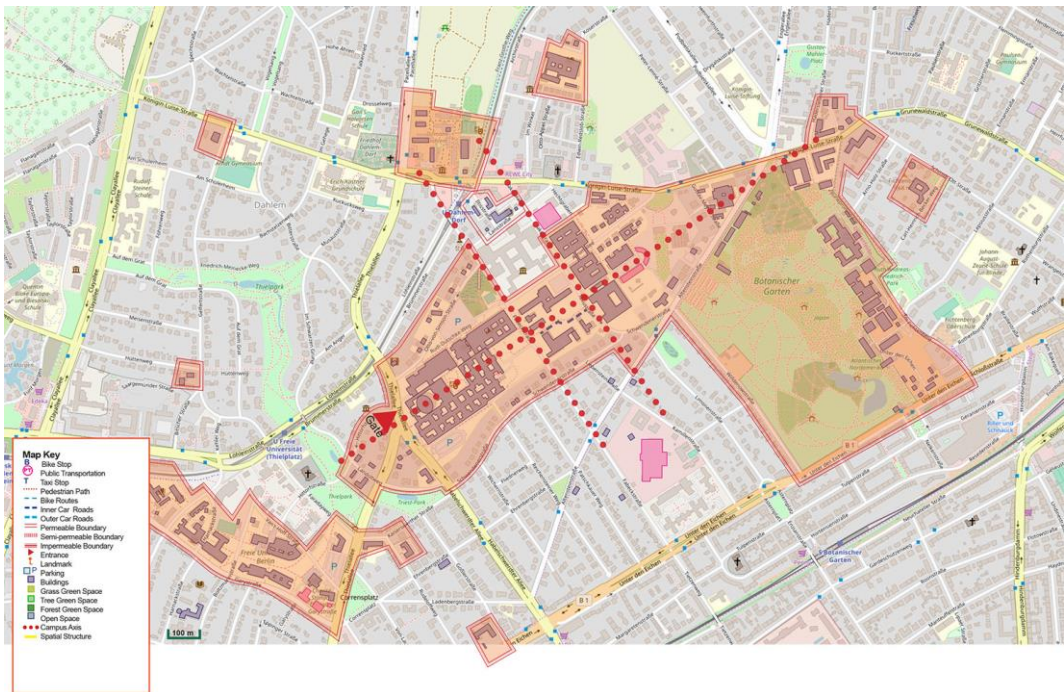


Figure B.0.79 : Campus Compactness Analysis Map of Free University Berlin.



Figure B.0.80 : Campus Movement Network Analysis Map of Free University Berlin.



Figure B.0.81 : Campus Urban Context Morphology Analysis Map of Free University Berlin.

B.13.2 Multi-criteria analysis table

Table B.13 : Liveability and sustainability multi-criteria assessment table of Free University Berlin.

<i>Free University Berlin</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	Diversified uses including academic, residential, social, and recreational are interwoven and mainly are located in Rost-und Silberlaube.	3	
	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.	There are designed open spaces with artistic elements and courtyards and Roof terraces for social gatherings.	3	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	There are Grass fields, Tree lines, Courtyards and Green roof Terraces.	2	

Table B.13 (Continued) : Liveability and sustainability multi-criteria assessment table of Free University Berlin.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	There are no on-campus residences but there are residences in close proximity.	2	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, cultural spaces, considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is no extracurricular activities.	There are several sport, social and leisure activities for students.	3	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided in surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services.	They are well-designed and distributed along the main axes and in the area.	3	
<i>Legibility</i>	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space e.g. existence of unique character like natural and built landscape, historical heritage, availability of focal points at the end of street hierarchy of spaces and routes, from 3 to 1. 3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	Rost-und Silberlaube is not an old building but can be considered a historical one and a focal point	3	

Table B.13 (Continued) : Liveability and sustainability multi-criteria assessment table of Free University Berlin.

	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	There are art works and Rost-und Silberlaube building as focal point.	3	
	9. Landmarks as focal points	Rating the imageability of campus e.g. existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark.	The buildings of the campus have a specific architectural style and the newly designed buildings have designed with respect to the main design principles.	3	
<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout in a way that campus has a designed spin and open spaces are well-designed and defined by built spaces. Different spaces are connected by hierarchy of spaces including corridors, courtyards. Campus has a core space with a defined open space or plaza with long land marks, enclosed open spaces, designed landscape elements and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned in the mentioned way nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	The main space campus is well organized along a main axis with a grid system and there are designed courtyards and open spaces. There are also other buildings that do not follow this grid organization.	2	

Table B.13 (Continued) : Liveability and sustainability multi-criteria assessment table of Free University Berlin.

	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with a complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban space with no morphological consistency.	No morphological similarity. Campus is like a highly dense cluster within villas of the surrounding neighborhood.	1	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying adaptive reuse infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	It has a high density main campus in addition to several small sites and scattered buildings mainly at the small neighborhood .	1	
	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	The density of campus is very high in comparison with its low-density surrounding urban fabric.	3	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilitates or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	Medium and small size parking areas distributed at the periphery of main campus and within the surrounding neighborhood.	2	

Table B.13 (Continued) : Liveability and sustainability multi-criteria assessment table of Free University Berlin.

	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	Pedestrian paths are connected and well accessible.	3	
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	There is on-campus and also outside of campus bike routes.	3	
	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	Buildings are accessible by car for services and parking are distributed which reduces the car roads inside campus.	2	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	Available inside and in surrounding	3	
<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	There are several public transportation means around campus in the area.	3	

Table B.13 (Continued) : Liveability and sustainability multi-criteria assessment table of Free University Berlin.

	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	Open campus with no physical barrier and highly accessible.	3	
<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	Physically and visually permeable.	3	
	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	There are several transitional spaces including cafeterias, book stores, etc.	3	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	High connectivity	3	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	At the southwest of Berlin, in a suburban area but still within urban fabric of city and highly accessible.	2	

Table B.13 (Continued) : Liveability and sustainability multi-criteria assessment table of Free University Berlin.

	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	FU Berlin shares its facilities such as Museums, Botanic Garden and library with public.	3	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	There are many annual seminars, lectures, events for public.	3	
<i>Sustainability</i>	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability		3	
	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	It is committed to sustainability principle. It has alliances with international partners. It has an Energy Management Unit to direct sustainability strategies. It has been awarded several prizes. It also supports biodiversity issue.	3	

B.14 University of Bologna, Bologna, Italy

B.14.1 Spatial analysis maps

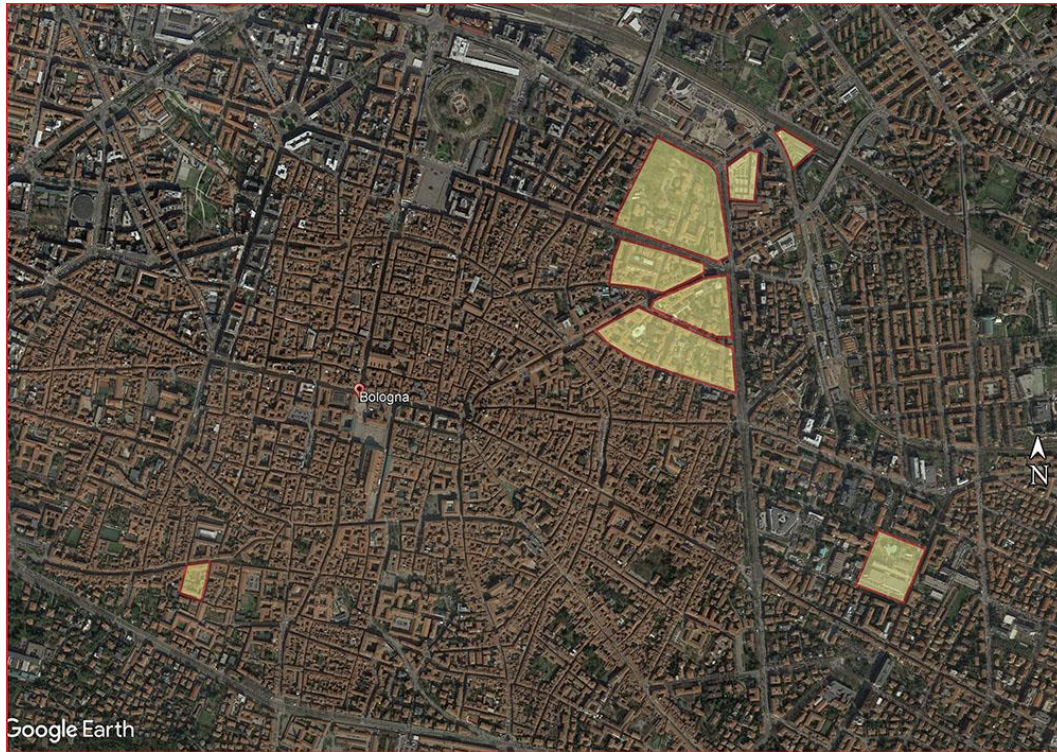


Figure B.0.82 : Campus Location Analysis Map of University of Bologna.



Figure B.0.83 : Campus Land-use Analysis Map of University of Bologna.

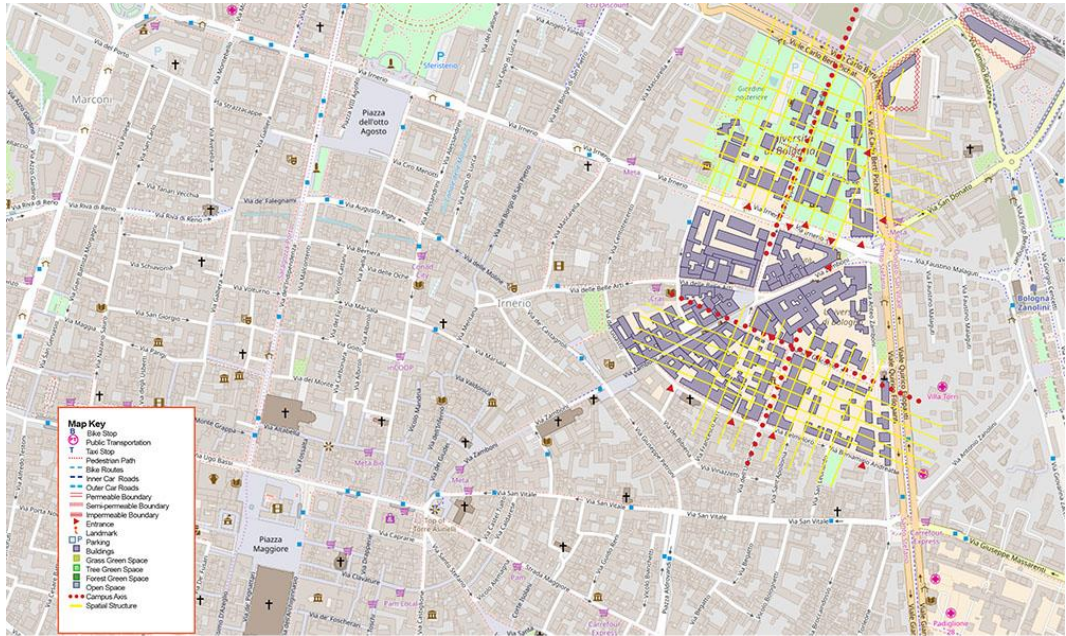


Figure B.0.84 : Campus Spatial Configuration Analysis Map of University of Bologna.

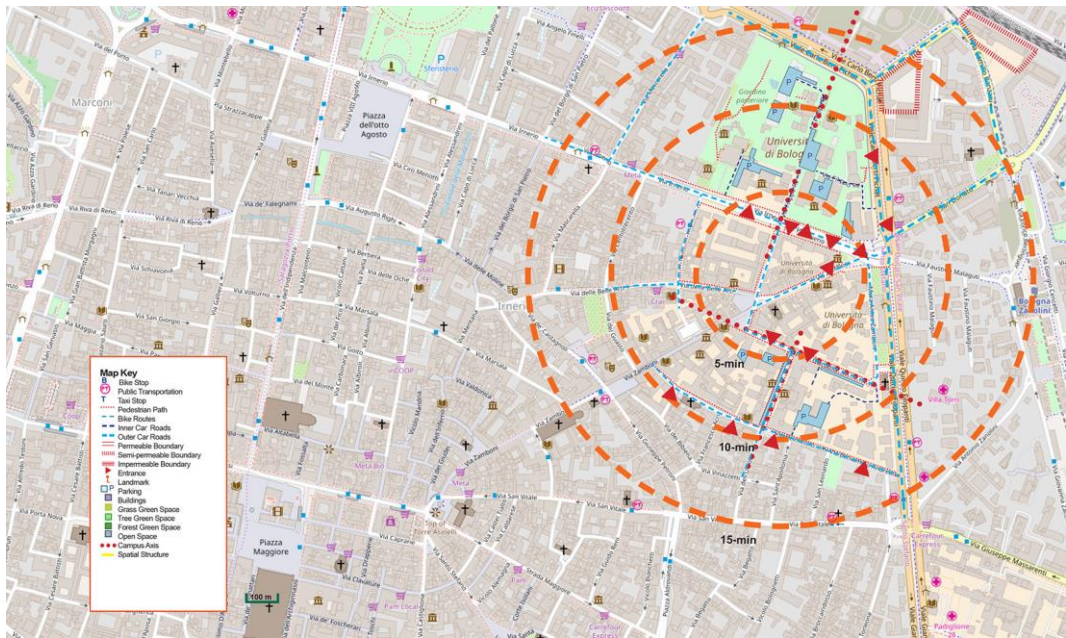


Figure B.0.85 : Campus Movement Network Analysis Map of University of Bologna.



Figure B.0.86 : Campus Urban Morphology Analysis Map of University of Bologna.

B.14.2 Multi-criteria analysis table

Table B.14 : Liveability and sustainability multi-criteria assessment table of University of Bologna.

<i>University of Bologna</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	Being scattered around the urban space, it is neither mixed nor segregated. But still there is a distance between different types of activity zones.	2	

Table B.14 (Continued) : Liveability and sustainability multi-criteria assessment table of University of Bologna.

	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.	Being composed of single buildings, there is not a noticeable open space designed as a campus space except the courtyards. The city public spaces are considered as the places for interactions.	2	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	The is very few green spaces inside university precincts' boundary.	1	
	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	There is no on-campus housing. The Regional Authority for the Right to Higher Education (ER-GO) manages a number of university halls of residence available to students at a preferential rate. Students need to look for their accommodation within the city resources.	1	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces, etc. considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is not any extracurricular activities on campus.	It is served by the city for leisure and permanence areas, not offering relevant public spaces. Some of the buildings of university are functioning as museums and exhibitions.	1	

Table B.14 (Continued) : Liveability and sustainability multi-criteria assessment table of University of Bologna.

	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided within surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services on campus.	Dependent on city amenities.	1	
<i>Legibility</i>	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space for instance existence of unique character in terms of natural and built landscape, historical heritage, availability of focal points at the end of streets for orientation, hierarchy of spaces and routes, from 3 to 1. 3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	Being composed of heritages and historical buildings and it is highly legible and homogenous.	3	
	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	Highly homogenous. The character is reinforced by tradition and history of the urban space.	3	

Table B.14 (Continued) : Liveability and sustainability multi-criteria assessment table of University of Bologna.

	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark.	The historical buildings of university are considered as the major landmarks and tourist attractions of the city.	3	
<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout that campus has a designed spin and open spaces are well-designed and defined by built spaces. Different spaces are connected by hierarchy of space including corridors, courtyards. Campus has a core space with a defined open space or plaza with land marks, enclosed open spaces, designed landscape and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	The precincts have a grid- like structure, arranged along orthogonal axes. They are quadrangle edifices that organized around courtyards.	3	
	11. Spatial homogeneity with surrounding	Rating spatial consistency between campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with high morphological cohesion and consistency with surrounding. 2=Campus is inserted within urban fabric with complete distinguished morphological attributes or in peripheries. 1= Campus is detached from context with no morphological consistency.	Inserted within the urban fabric with a high morphological cohesion with surrounding	3	

Table B.14 (Continued) : Liveability and sustainability multi-criteria assessment table of University of Bologna.

<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying adaptive reuse infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	Being composed of several small precincts, the level of compactness is low.	1	
	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and the new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	High density	3	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilitates or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	There are few parking spaces inside the larger precinct. Other university buildings are dependent on parking areas of the city.	2	
	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	Paths are homogenously distributed. Highly walkable.	3	

Table B.14 (Continued) : Liveability and sustainability multi-criteria assessment table of University of Bologna.

	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	Dependent on city for bike routes.	1	
	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	Dependent on city for auto circulation.	2	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability	Dependent on city for bike-sharing or car-sharing. The Mobike project has recently lunched as the bike-sharing system of Bologna. Bologna city rewards those using bike-sharing with free beer and ice cream!	3	
<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	Public transportation provided by city. Highly accessible.	3	
	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	The precincts are highly permeable (physically and visually). The precinct near Botanical garden to some extent has the green space as a barrier. There are entrances for each building.	3	

Table B.14 (Continued) : Liveability and sustainability multi-criteria assessment table of University of Bologna.

<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	No barrier. The precincts are highly permeable (physically and visually). City and university are indistinguishable.	3	
	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, etc., from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	The precincts and city are interwoven. The concept of Archiginnasio	3	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	High continuity and high number of intersections.	3	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	University has several precincts in bologna and near towns. The precincts in Bologna are scattered within urban fabric and the oldest ones are at the core of the city with 1km distance from center.	3	
	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Sharing museums, library, ... and the buildings itself.	3	

Table B.14 (Continued) : Liveability and sustainability multi-criteria assessment table of University of Bologna.

	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	Public seminars, workshops, degree programs, tours, exhibitions.	2	
<i>Sustainability</i>	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	No availability	1	
	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	There is an Environmental Sustainability Plan 2013-2016 in process.	2	

B.15 Uppsala University, Uppsala, Sweden

B.15.1 Spatial analysis maps



Figure B.0.87 : Campus Location Analysis Map of Uppsala University.

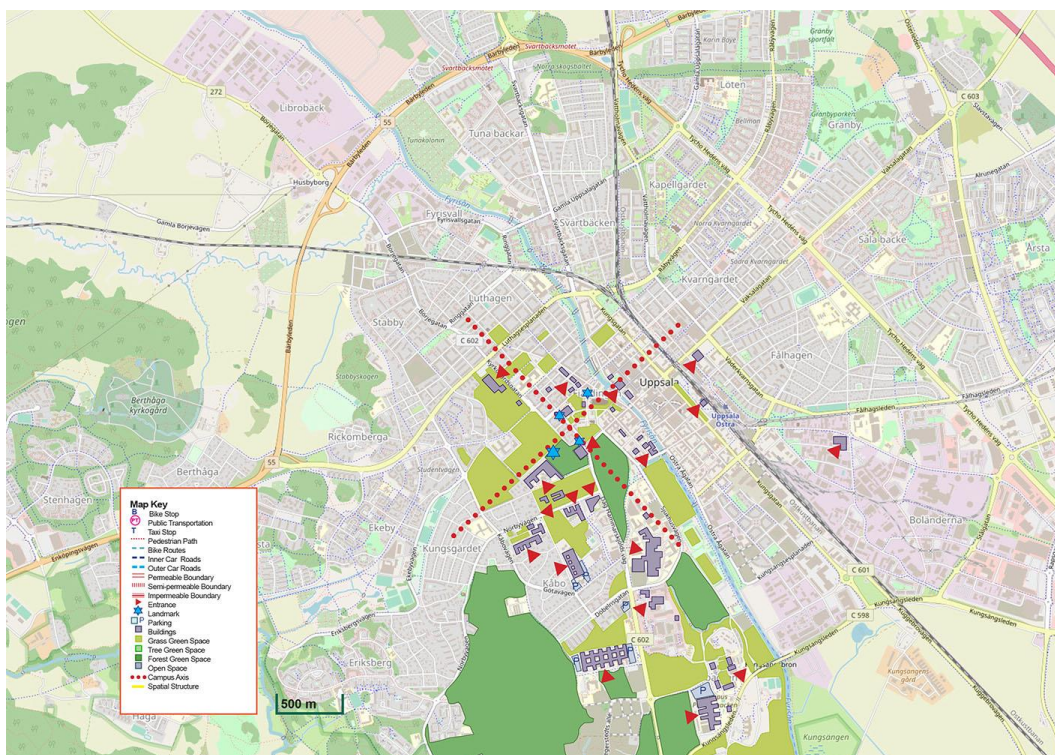


Figure B.0.88 : Campus Land-use Analysis Map of Uppsala University.

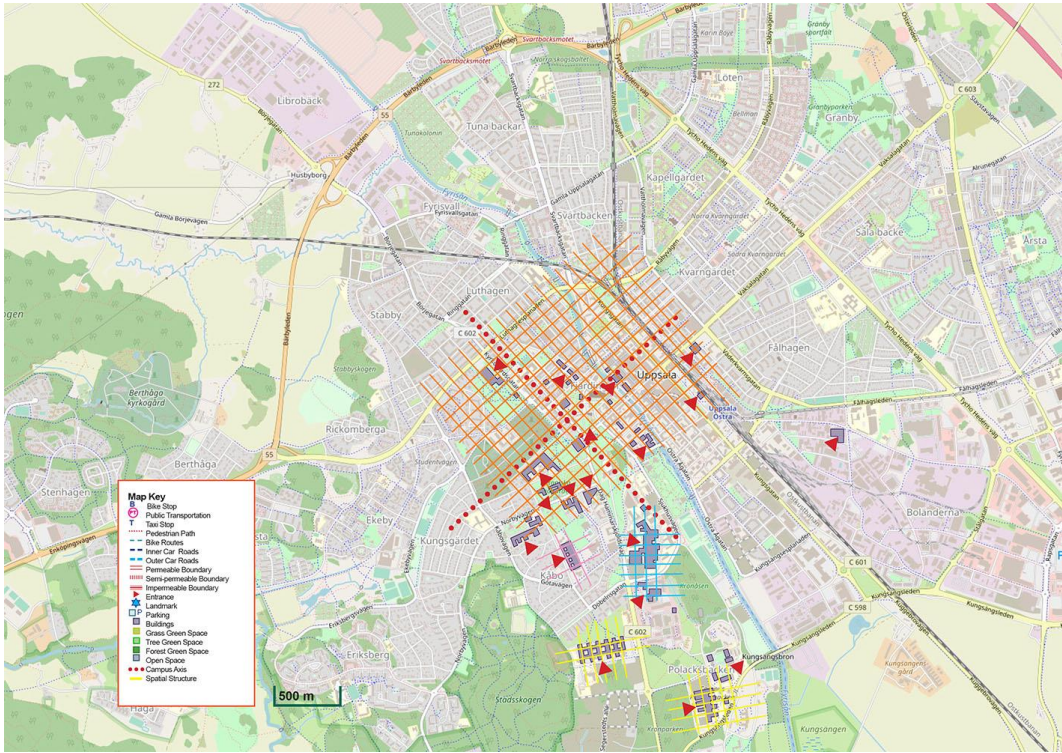


Figure B.0.89 : Campus Cohesion Analysis Map of Uppsala University.

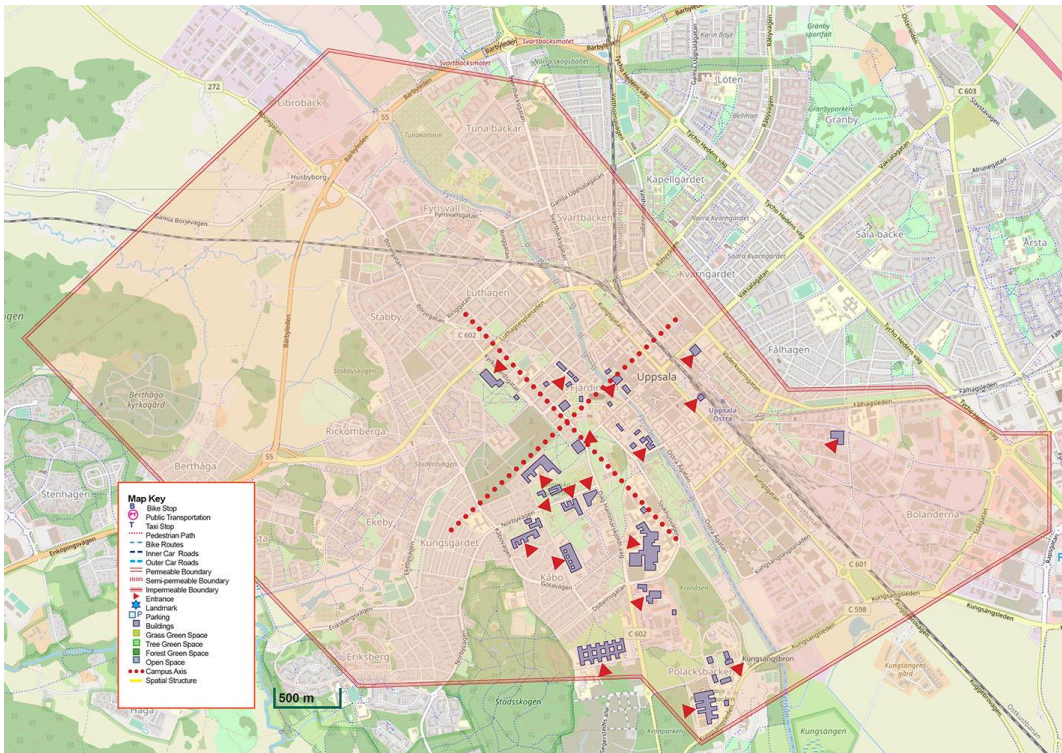


Figure B.0.90 : Campus Compactness Analysis Map of Uppsala University.

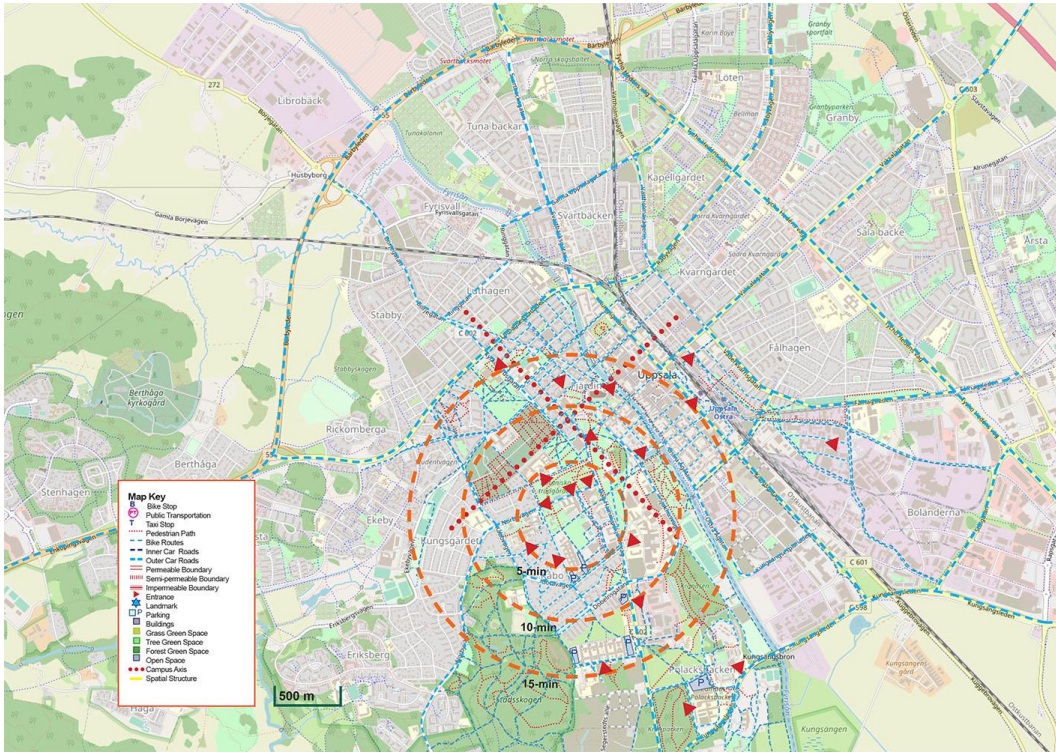


Figure B.0.91 : Campus Movement Network Analysis Map of Uppsala University.



Figure B.0.92 : Campus Urban Context Morphology Analysis Map of Uppsala University.

B.15.2 Multi-criteria analysis table

Table B.15 : Liveability and sustainability multi-criteria assessment table of Uppsala University.

<i>Uppsala University</i>					
	Criteria	Scale	Description	Value	Color Value
<i>Livability</i>	1. Mixed land use	Rating land use organization on campus, from 3 to 1. 3=Land uses are mixed and there are interdisciplinary spaces. (Uses like large sport facilities, stadium, greenhouse, amphitheater, surface parking areas, etc. are not situated at the campus core.) 2=Land use is neither mixed nor isolated. For instance, dormitories are located far from the campus core, but other educational, research and recreational uses are mixed and located in the campus center. 1=Different uses are not mixed and campus has isolated areas far from the campus central space.	The university edifices have been developed as a piecemeal growth and scattered around the town in leased lands and buildings. After the proposed masterplan, it was aimed at creating an interdisciplinary collaboration in some parts.	1	
	2. Open spaces	Rating the availability of designed open spaces for social interactions and other activities, from 3 to 1. 3=There are high level of well-designed and well-distributed open spaces (particularly in campus core) that encourage interactions and occurrence of different activities. 2=There are an average amount of open spaces (considering the whole campus area) that can be used for socialization and diversified activities. 1=The are not any designed open spaces, and many spaces are abandoned without possibility to use.	Being a scattered campus, there is not much designed open spaces.	1	
	3. Green spaces	Rating the availability and quality of green spaces, from 3 to 1. 3=High to mid-high ratio like forest and grass fields, lawns, park-like spaces. 2=Medium ratio like tree lines 1= Low-medium ratio like vegetation, shrubs, bushes or empty spaces	Being situated at the heart of Uppsala city, the university is served by the green spaces of the city. The English park is also an important component of the Uppsala university.	2	

Table B.15 (Continued) : Liveability and sustainability multi-criteria assessment table of Uppsala University.

	4. On-campus residences	Rating availability and quality of residences inside campus and the appropriate distribution of dormitories within the campus space, from 3 to 1. 3= There are on-campus residences that distributed like mixed used within a short distance to other uses. 2=There are on-campus residences located in campus peripheries or in a separated area with lower access to other uses. 1= No student housing.	In Sweden universities are not allowed by law to have housing. The university does not include on-campus student housing. The shortage of housing is a major problem but it has been improved with the many new housing projects after 2010.	1	
	5. Extra-curricular activity facilities for academic body	Rating availability of extra-curricular activity such as recreation facilities, athletic fields, exhibitions, art and cultural spaces, etc. considering the total number of students, from 3 to 1. 3= Diverse facilities and activities with a high accessibility 2= Average level of facilities and their accessibility 1= There is not any extracurricular activities on campus.	The university does not have a large campus but it consist of several sites and buildings around the town including Museum Evolution, Botanical Garden, Theatrum, Observatory Park, and etc. The university includes the Royal Academic Orchestra. Sport has a small role in the university system. But still university includes the swimming, fencing, riding, gymnastic clubs.	2	
	6. On-campus retail services	Rating the availability and equal distribution of retail services such as catering, café, restaurants, shops, etc. inside campus, from 3 to 1. (If they are not available inside campus, there should be provided within surrounding urban space in a very close proximity.) 3= High and well distributed 2=Average and concentrated 1=Not available retail services on campus.	Being a scattered campus, there is not any retail service in campus body.	1	

Table B.15 (Continued) : Liveability and sustainability multi-criteria assessment table of Uppsala University.

<i>Legibility</i>	7. Campus space legibility	Rating the extent of homogeneity and legibility of campus urban space for instance existence of unique character in terms of natural and built landscape, historical heritage, availability of focal points at the end of streets for orientation, hierarchy of spaces and routes, from 3 to 1. 3=There is a consistent and legible character in the entire campus 2=Campus space is quasi legible and cohesive for example the main core has a unique character but the rest of space does not have that unique identity 1=There is not a cohesion in entire campus space.	The university has been developed within the centuries in leased buildings and sites. Thus, it does not have a high level of legibility but the historical buildings are main component of the university edifices.	1	
	8. Architectural character	Rating the extent of homogeneity and legibility of architectural elements inside campus urban space for instance existence of a homogeneous specific architectural style and material all around the campus, from 3 to 1. 3=There is a distinctive architectural design in the entire campus 2=Campus space is quasi identifiable 1=There is not a cohesion in campus architectural design.	There is not any specific architectural style and material.	1	
	9. Landmarks as focal points	Rating the imageability of campus for example existence of well-preserved historical buildings as heritages, landmarks and art works in the campus urban space as focal points at end of the axes or in the plazas and nodes, from 3 to 1. 3=Existence of historical heritages, large-scale and remarkable landmarks such as special buildings, plazas, monuments, and clock towers in a well-designed way. 2=Existence of landmarks and art works around the campus 1=No landmark exists.	University historical buildings including the Main Building, Carolina Redivivia and Gustavianum, and the English park are the main landmarks of the university and also the city.	2	

Table B.15 (Continued) : Liveability and sustainability multi-criteria assessment table of Uppsala University.

<i>Cohesion</i>	10. Spatial layout	Rating the type of campus spatial layout, from 3 to 1. 3= The whole campus has a well-designed layout in a way that campus has a designed spin and open spaces are well-designed and defined by built spaces. Different spaces are connected by hierarchy of spaces including corridors, courtyards. Campus has a core space with a defined open space or plaza with long land marks, enclosed open spaces, designed landscape elements and the entire master plan is relatively symmetric and geometric. 2= The campus has neither planned in the mentioned way nor unplanned organization. For example, the historical part or campus core has a well-defined spatial layout, but the rest of the campus has different styles or composed of free-standing buildings in open, landscaped ground. 1 = the campus has an unplanned layout.	Being a scattered campus, there is not any organized campus layout.	1	
	11. Spatial homogeneity with surrounding	Rating the spatial consistency between the campus and surrounding urban fabric, from 3 to 1. 3= Campus is inserted within the urban fabric with a high morphological cohesion and consistency with the surrounding. 2=Campus is inserted within urban fabric with complete distinguished morphological attributes or in peripheries. 1= Campus is detached from the urban space with no morphological consistency.	Being an integral part of urban space in the town center, university has a high homogeneity with surrounding.	3	
<i>Compactness</i>	12. Compactness	Rating the compactness of campus within the surrounding urban fabric, from 3 to 1. 3= Occupying one clearly distinct site with high density or applying infill development strategy. 2= Occupying more than one site in a very close vicinity that can function together. 1=Occupying smaller and highly sprawled sites within the urban fabric far from each other.	University includes several individual buildings and sprawled sites around the town.	1	

Table B.15 (Continued) : Liveability and sustainability multi-criteria assessment table of Uppsala University.

	13. Density	Rating the mass density of campus considering the building footprints in campus space and also the ratio of balance between built space and open space, from 3 to 1. 3= High density development in a way that the buildings are small/mid-size and the new constructions are mainly located within the existing developed areas. 3= Medium density 1= Low density	It has a mid-high density similar to its urban fabric.	3	
<i>Walkability</i>	14. Parking area	Rating the availability and distribution of parking area within campus, from 3 to 1. 3= The parking areas are distributed around the campus edge or main road in a fair distance to all of facilities 2=The large parking areas are located in the campus periphery without fair distribution distance to all facilitates or smaller parking inside campus 1=There is not any available parking area. (Parking structures are not considered.)	There are few small parking areas and university is mainly dependent on the city for parking spaces.	1	
	15. Pedestrian paths	Rating the availability of well-designed paths such as designed circular, linear, orthogonal paths and also continuity of pedestrian paths inside campus, from 3 to 1. 3=Well-designed paths (circular, linear, orthogonal distribution of paths) in a highly connected way that stimulate interactions 2=Average continuity and organic distribution of paths 1=Low continuity and not designed paths.	There is not a system of well-designed paths but being a urban campus it follows the pedestrian routes of the city.	2	
	16. Bike Routes	Rating the availability of designed bike routes inside campus, from 3 to 1. 3=There are high level of designed bike routes and also services related to bikes including stations, repair shop, and etc. 2=Medium availability 1=No bike routes	There is a good network of bike routes mainly provided by the city.	2	

Table B.15 (Continued) : Liveability and sustainability multi-criteria assessment table of Uppsala University.

	17. Car roads	Rating availability and distribution of car roads inside campus, from 3 to 1. 3= The main service roads are well-defined and distributed in campus edge and also as a main road that give a high access to different land uses in a way that does not disturb the vitality of campus core open space 2=Medium accessibility and distribution within campus space 1=Low accessibility and distribution	University structures are accessible by the city automobile network.	2	
	18. Bike-sharing or Car-sharing	Rating availability of bike sharing or car-sharing inside campus or in close proximity, from 3 to 1. 3=Available inside campus 2=Available in campus vicinity 1=No availability		3	
<i>Accessibility</i>	19. Public transportation mean	Rating availability of public transportation mean inside campus or in close proximity (within a 15-minute walking distance), from 3 to 1. 3=High availability in a short walking distance 2=Medium availability and 1=Low availability	Being an integrated to urban space, it uses the public transportation of the city.	3	
	20. Campus entrances	Rating the number and distribution of campus gateways, considering the campus boundary length, from 3 to 1. 3=There is not any physical barrier or there are several gateways around the campus boundary in a way that campus is highly accessible 2=Medium accessibility 1=Low accessibility.	There is no physical barrier. There are several entrance for the sites and for each building.	3	
<i>Connectivity</i>	21. Boundary Permeability	Rating the permeability of campus within its surrounding space, from 3 to 1. 3= Highly physical permeability without a physical 2=Semi-closed boundary and medium visual/physical permeability 1=Closed boundaries and impervious	University is highly permeable with no boundary.	3	

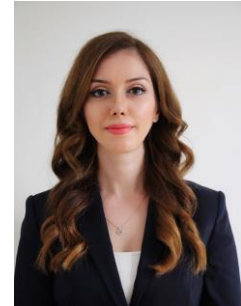
Table B.15 (Continued) : Liveability and sustainability multi-criteria assessment table of Uppsala University.

	22. Transitional or Mixed-use spaces along the campus boundary	Rating the availability of diverse transitional activity spaces along the campus boundary that create a connection between inside and outside campus such as book stores, library, exhibition centers, etc., from 3 to 1. 3= High availability 2=Medium availability 1= No transitional spaces	Campus is highly integrated with the city and shares the facilities like library and museum with no boundary.	3	
	23. Circulation network connectivity	Rating the continuity of street networks within campus and surrounding area and the number of intersection in campus boundary (considering the size of campus plot and boundary perimeter length), from 3 to 1. 3=High continuity with high number of intersections campus is completely integrated with the surrounding 2=Average continuity with average number of intersections 1=No continuity	Campus is highly integrated with the city.	3	
<i>Integration</i>	24. Campus centrality regarding the surrounding urban space	Rating the extent of centrality of the campus location within city urban space, from 3 to 1. 3= Highly central or within urban context but not very central position 2= Still surrounded by urban space but very far from urban core or outside city but attached to it (in the city periphery) 1= Outside the city and completely detached.	University structures are located in the central areas of the city.	3	
	25. Shared facilities with public	Rating the availability of shared facilities with public such as museums, library, sport facilities, open spaces and recreation areas, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	University shares many facilities like library, museum, botanical garden, and the hospital with the public.	3	
	26. On-campus Outreach activities for public	Rating the availability of annual outreach activities and events such as courses, seminars, exhibitions, art and cultural events, tours, etc. provided by university for public, from 3 to 1. 3=Highly available 2= Medium availability 1= No availability	University offers many educational programs, seminars, exhibitions, ...	3	

Table B.15 (Continued) : Liveability and sustainability multi-criteria assessment table of Uppsala University.

<i>Sustainability</i>	27. Green infrastructure	Rating availability of green infrastructure including green buildings, renewal energy resources, passive strategies, etc., from 3 to 1. 3=Highly available 2= Medium availability 1= No availability		2	
	28. Sustainability initiatives	Rating the availability of sustainability initiatives, programed by university such as participating in sustainability assessment networks or providing individual sustainability framework such as establishment of living lab or green team office, from 3 to 1. 3= In implementation process 2= In programming process 1= No initiative	University has a well-established sustainability initiative, green office, and on-going projects. It has the 2030 Agenda for Sustainable Development which addresses education and research, health and equity, energy consumption, etc.	3	

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PUBLICATIONS, PRESENTATIONS AND PATENTS ON THE THESIS:

- **Razavivand Fard, H.**, Demir, Y., and Trisciuglio, M. 2019. The Histology Atlas of Campus Form: A Framework to Explore Liveability and Sustainability in University Campuses, *A|Z ITU Journal of the Faculty of Architecture*, Vol 16 No 3, November 2019 • 87-102.
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OTHER PUBLICATIONS, PRESENTATIONS AND PATENTS:

- **Razavivand Fard, H.**, Demir, Y., and Trisciuglio, M. 2019. University and the City: From the Past to Present. In progress.
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