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Metamorphosis though Transition

The application of TOD as mobility / land-use model, and its applicability in the case of Tirana

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IDAUP Coordinator Prof. Roberto di Giulio

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ABSTRACT

The investigation of Transit Oriented Development as a growth paradigm in an attempt to become a catalyst in influencing city development is the primary emphasis of this research. Across the world, Transit-Oriented Development (TOD) has emerged as a viable strategy for integrating transportation with land use in mature and fast emerging cities alike. Is the emphasis on sustainable urban transportation a more tightly defined definition of sustainable transportation, or is the emphasis on transportation sustainability more broadly defined? Due to the impossibility of reaching a scientific consensus on what defines a truly sustainable transportation system, it is necessary to compile a complete list of all the definitions and characteristics that exist. It is important to identify the major aspects and components of TOD models by constructing a foundation and providing an alternative to the single standard model of planning that is currently used in growing cities such as Tirana, given that TOD is a concept that has been extensively researched. Tirana, the capital of Albania, is now confronted with tough issues as a result of a whole regime of transition and internal migration that began in the late 1990s and has continued to this day. In this context, the “Transit Oriented Development” can be seen as the core model to promote, guide and develop through transport and land-use. This study will include an overview on policies, land use changes and economic principles that combined with objectives from “Transit Oriented Development” will provide a guideline on sustainable urban growth. This research takes place under the assumption that creating a model for implementing Transit Oriented Development in the case of Tirana will guide future development without adding to urban sprawl.

Keywords: Transit Oriented Development, catalyst development, land-use development, sustainability, Model, urban Growth, resilience, Model builder, urban sprawl

ABSTRACT(ITA)

L'indagine sullo sviluppo orientato al transito come paradigma di crescita nel tentativo di diventare un catalizzatore nell'influenzare lo sviluppo della città è l'enfasi principale di questa ricerca. In tutto il mondo, il Transit-Oriented Development (TOD) è emerso come una strategia praticabile per integrare i trasporti con l'uso del territorio sia nelle città mature che in quelle in rapida espansione. L'enfasi sul trasporto urbano sostenibile è una definizione più strettamente definita di trasporto sostenibile o l'enfasi sulla sostenibilità dei trasporti è definita in modo più ampio? A causa dell'impossibilità di raggiungere un consenso scientifico su ciò che definisce un sistema di trasporto veramente sostenibile, è necessario compilare un elenco completo di tutte le definizioni e caratteristiche esistenti. È importante identificare gli aspetti e le componenti principali dei modelli TOD costruendo una base e fornendo un'alternativa al modello unico standard di pianificazione attualmente utilizzato in città in crescita come Tirana, dato che TOD è un concetto che è stato ampiamente studiato . Tirana, la capitale dell'Albania, si trova ora ad affrontare problemi difficili a causa di un intero regime di transizione e migrazione interna iniziato alla fine degli anni '90 e continuato fino ad oggi. In questo contesto, lo "Sviluppo orientato al transito" può essere visto come il modello centrale per promuovere, guidare e sviluppare attraverso i trasporti e l'uso del territorio. Questo studio includerà una panoramica sulle politiche, sui cambiamenti nell'uso del suolo e sui principi economici che, combinati con gli obiettivi dello "Sviluppo orientato al transito", forniranno una linea guida sulla crescita urbana sostenibile. Questa ricerca si svolge partendo dal presupposto che la creazione di un modello per l'attuazione dello sviluppo orientato al transito nel caso di Tirana guiderà lo sviluppo futuro senza aumentare lo sprawl urbano.

Parole chiave: sviluppo orientato al transito, sviluppo catalizzatore, sviluppo dell'uso del suolo, sostenibilità, modello, crescita urbana, resilienza, costruttore di modelli, espansione urbana

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ABBREVIATIONS

TOD	Transit Oriented Development
SD	Sustainable Development
GIS	Geographic Informational Systems
SUD	Sustainable Urban Development
SMCA	Spatial Multi Criteria Analysis
IMM	Integrated Modification Methodology
USAID	The United States Agency for International Development

1 CHAPTER ONE | A SIMPLE INTRODUCTION

1.1 Background

The complexity of dealing with the Transit Oriented Development as a theoretical notion and later on as model of development, requires attention on both Transport planning and policymaking. It is necessary to pay close attention to both transportation planning and policymaking while dealing with Transit Oriented Development, first as a theoretical idea and then as a development model, because of the difficulty of dealing with it. For the purpose of dealing with the theoretical dimensions, components, and applications of transit-oriented development, a multidisciplinary approach is required that includes complementary disciplines such as urban development, history, transportation planning and the cognitive process of decision-making. The purpose of this study is to provide an in-depth literature review of the concept of TOD, its application, and how the definitions and case studies present the components of TOD as a way of implementing this theory from a concept to an urban development model that influences today's transportation. It is expected that the first part of this research will help to theory formation and evolution of the idea through a review of relevant literature, comparison models, and the identification of common components (principles).

This research will make extensive use of Geographic Information Systems to construct a framework for the development of Tirana through the collection of data from orthophotos, mapping materials from previous studies, reports and various publications with the goal of measuring some of the physical components of development for the territory. An important part of this research will be the use of Geographic Information Systems to construct a framework for the development of Tirana. The last section will try to design a toolbox for implementation as well as the optimum development scenario

for this model in developing nations, based on the findings of the research and case studies conducted so far. This research intends to
contribute to diversification of a modern classic urban planning approach of TOD. With the implementation of this concept, it is hoped that the future growth of the transportation planning would be enhanced. The thesis concludes with the creation of a model in GIS, which allows for the components to be measured, adapted and fitted into different urban context. Transit Oriented Development as a concept came as a result of a number of failed attempts to revitalize metropolitan areas, illustrated into our case studies. As previously said, there is no "recipe" to follow in order to be successful. The evolution occurred in the adaptation of this notion to distinct situations of development while taking the unique environment into consideration. The Life and Death of Great American Cities by Jane Jacobs (Jacobs, 1961) and Ebenezer Howard's Garden Cities of Tomorrow (Ebenezer Howard, 1902) both highlight the components of this paradigm, which must be recognized as such when they are being translated and updated in future applications. This notion has been partially or completely realized, but the creation of a toolkit that is tailored to the individual has made all the difference. A neo-traditional guide to sustainable community design and transportation, TOD is viewed as a step forward from the past.

1.2 Research Hypothesis

This research will focus on the exploration of “Transit Oriented development” as a model, in an attempt to identify the criteria and indicators in influencing cities development.
The process of Identifying the key factors and guidelines for “Transit Oriented development” by establishing a base and creating a non-single standard method of application is interrelated to the deconstruction of the theory’s components. A TOD is often distinguished from conventional developments because of its atypical development characteristics, such as high quality of transit service, pedestrian and cycling facilities, higher density, moderated private vehicle infrastructure, improved accessibility to and mixes of land uses.

The concept of Transit oriented development and its components constantly find their way into plans we would mention here Vienna “step Plan 2030” (Vienna, 2014) and Barcelona “Superblocks” (Commission for Ecology, 2016).

The scope of this research will focus on understanding the components of the theory by case study analyses and using these findings (or components) to measure the possibility of TOD application. The importance of TOD is present in new planning attempts and “newly” introduced concepts as well, we could mention here the 15 min cities a concept by Carlos Moreno, which embraces the same components as the concepts of Transit Oriented Development, promoting wellbeing in a bottom-up way (Pozoukidou G, 2021).

The focus on transport is not something new for cities, however the combination of components such as density, diversity, design in the case of TOD is giving a renascence to this concept. But with an abundance of plans pursuing sustainable development were does TOD prevail?

The following research questions are formulated and should be answered to complete this research:

Our two main Research Questions and sub questions:

Research Question 1:

- How are the criteria and indicators for TOD conceptualized in the planning?

Sub-question:

- Is it translatable into a Model?
- The TOD theory is positioned as a narrative model or doctrine?

Research Question 2:

- What is the link between TOD and Mobility?

Sub-question:

- How do TOD Indicator influence the urban transit Planning process and influence the urban environment?

1.3 Objectives

Due to the complexity of this topic, it requires both transportation planning and policymaking attention. An interdisciplinary strategy that incorporates complementary disciplines such as urban development, history, transportation planning, and decision-making cognition. This section will contribute to the theory's growth and evolution

through a survey of the literature, comparative models, and an emphasis on common components (principles). A significant component of this research will be the use of Geographic Information Systems to develop a framework for Tirana's development through the collection of data from orthophotos, mapping materials from previous studies, reports, and various publications aimed at quantifying various physical and theoretical (policies) components of the territory. The last section will seek to construct an application toolbox and the optimal development scenario for this model in developing nations, based on analysis and case studies. This is to allow for future urban planning and transportation growth using this measurement method. Build up an understanding of the concept of TOD and various aspects related to it through gaining a detailed knowledge of TOD components. During the course of this research the objectives are clear and defined as:

- Exploring “Transit Oriented development” as a model, in an attempt to become a catalyst in influencing cities development.
- Help determine Urban transformations that require to develop a TOD
- Evaluate the transport impacts of TODs from a case studies perspective by comparing the results with characteristics of conventional development similarly located in the urban fabric.

1.4 Scope of the Research

This research will focus on the exploration of “Transit Oriented development” as a model, in an attempt to become a catalyst in influencing cities development. Transit-oriented development (TOD) is a viable model for transportation and land use integration in many developed and rapidly developing cities of the world. The significance of this research is in identifying the critical characteristics and rules for "rapidly emerging cities" by constructing a foundation and designing a non-standard planning model for developing cities such as Tirana. Tirana is Albania's capital and is presently confronted with significant issues as a result of a comprehensive regime transition and internal migration that began in the late 1990s. In this perspective, "Transit-Oriented Development" may be viewed as the foundational paradigm for promoting, guiding, and developing via transportation. This research will present an overview of policies, land-use adjustments, and economic concepts that, when coupled

with the goals of "Transit-oriented development," will result in an improvement in policies promoting sustainable urban growth. This research is conducted on the concept that developing a model for implementing transit-oriented development in the context of Tirana will increase city competitiveness, guide feature development, and prevent sprawl.

1.5 The motivation behind this research

Transit-Oriented Development (TOD) as a strategy for creating sustainable communities has become increasingly prevalent in urban development. The notion is seeing a rebirth, as planners and cities strive to incorporate TOD concepts into their plans and goals (Curtis, 2009).

This process is illustrated by the presence of TOD development concepts in planning practices. Keeping in mind that the concept of applicability is intrinsically tied to the sustainable development of cities, their inherent complexity, and the need for more context-sensitive planning approaches.

The use of TOD as a catalyst is contingent upon its application finding benefit and resulting in innovations, reforms, and a shift in planning strategy.

The inclusion of TOD development principles in planning techniques exemplifies this process. Keeping in mind that applicability is inextricably linked to the sustainable development of cities, their inherent complexity, and the requirement for more context-sensitive planning techniques.

TOD's employment as a catalyst is conditional on its implementation demonstrating value and resulting in innovations, reforms, and a shift in planning approach.

1.6 Thesis outline

Each chapter is divided into smaller sections that slowly contribute to the unraveling of the Topic, at the end of each section creating a bridge over the next theoretical discussion will be some conclusions and lessons learned from the previous sections.
The overall organization is reflected into the **first chapter** where the objectives, introductions and research problematics are introduced.
The second chapter is focused into the literature exploration of the main concepts of this topic, starting from cities and the challenges they face, how and why these challenges should be addressed.
The third Chapter is dedicated to complexity of the urban context and how we understand complexity in planning.
The fourth chapter explores the birth and evolving into deep exploration of the concept of TOD.
The fifth chapter is a road map into the selected methodological approach used to explore the concept of TOD in relation to its application context and future possible adaptation.
The Sixth chapter will consider the case studies as a benchmark into the contextual understanding of TOD. This chapter will categorize and define the data collection process, indirect data and GIS instruments that will provide the basis of critical comparative data.
The seventh chapter will draw focus into the case studies of Tirana and provide an understanding of the selective context.
The eighth Chapter will focus on the Comparative data conclusion and findings defining the impact of such findings into the overall objective of this research, the conclusions and overall conclusions will provide the findings of the research but also gap and continuity of this research in the future.
The Nineth and ten chapter will focus into the common findings and provide a clear view on our research data, bibliography and literature considered during this research.

2 SECOND CHAPTER | THE URBAN DILEMA

2.1 The Urban Challenge

> "***The world breaks everyone, some get stronger at the broken place***"
> (Hemingway, 1995).

The city is there; it already exists in an over changing context. Development models have a multidimensional meaning, defining city models or cities is no easy task. The Webster's dictionary defines cities as a complex relation between socio-economic relationships within a space and time.

One of the corner stones of cities radical change was the Neolithic revolution with the division of labor, much like the industrial revolution that starts in the industrial city, with incompatible uses and high complexity. These cities called for the deep understanding of its problems in order to be planned. In the post-industrial world however, the reconfiguration of space, economy and place is radically changed by only random movement of people. Michael Storper (2013) argues that cities must be treated more than an "urban playground for only a few1" but as a living workshop for cultivation talent, culture, creativity and sociability for people. (Storper, 2013)

According to Le Gates and Stout (1996), city life and growth bolster the city's complex systems, economics, and social environment.

The fact that cities are multifaceted and complicated is a common denominator, making identifying the difficulty that cities confront difficult. However, while the city as a physical

1 For Planners to test theories and policy, applicability: https://doi.org/10.11120/jebe.2009.04020029

entity covers just 2% of the earth's surface, 60% of the world's population lives in cities. This figure is predicted to increase to 65 percent by 2030[2]. The massive urbanization of cities is a worldwide phenomenon, that is increasing the land-consumption, sprawl, pollution, economic and social inequalities, traffic congestion, cities footprint growth, are only some of these challenges[3] (Habitat, 2020). Cities are dealing with these challenges on a daily basis, interdisciplinary studies work continuously to find solutions and to mitigate these challenges. Cities all over the world are trying to implement planning solutions that help and guide cities to turn problems into opportunities (J. M. Barrionuevo, 2012).

The Eco-City is a concept born during the 60's mid and 70's. This concept was born as controversy of the deterioration of natural resources. Richard Register first coined the term in 1975' in his book *"Eco Cities: Rebuilding Cities in Balance with Nature".* As a positive approach into understanding and meeting cities challenges, eco-cities take us on a journey to the future city, where development occurs within the means of our environment[4] In the book the city is treated like an organism and should be built as such. Many eco-cities have the overall goal of removing emissions, generating electricity exclusively from green sources and incorporating the nature into the city; however, eco-cities are also designed to promote economic growth, minimize poverty, structure cities with higher population densities, higher productivity, and enhance health. Transport and development are an essential part of this theory with a focus of developing for people, with high density and walkable centers, the theory enhances the reversing of the role transport plays in the city. The challenge in building dense, vibrant, green, secure, friendly and essential mixed-use communities near transit nodes and other transport services, by revising land-use goals. Based on design principles that use transportation and mobility to increase accessibility. The concept sees resources, ecological linkage, culture, quality of life as an essential part of urban economy, bringing together the evolving city and natural capacities. (Register, 2006) Some of the

[2] *UN Habitat World Cities Report 2020, prediction.*

[3] *Simin Davoud also highlighted these challenges during the 2017 Helsinki AESOP conference.*

[4] *Talking about the elephant in the room: Climate change, sprawl, transportation, food ect./* "Eco Cities: Rebuilding Cities in Balance with Nature" (1975). Xxxx make it correct

design principles with a focus on transport, brought forwards by Richard Register in his books are illustrated below.

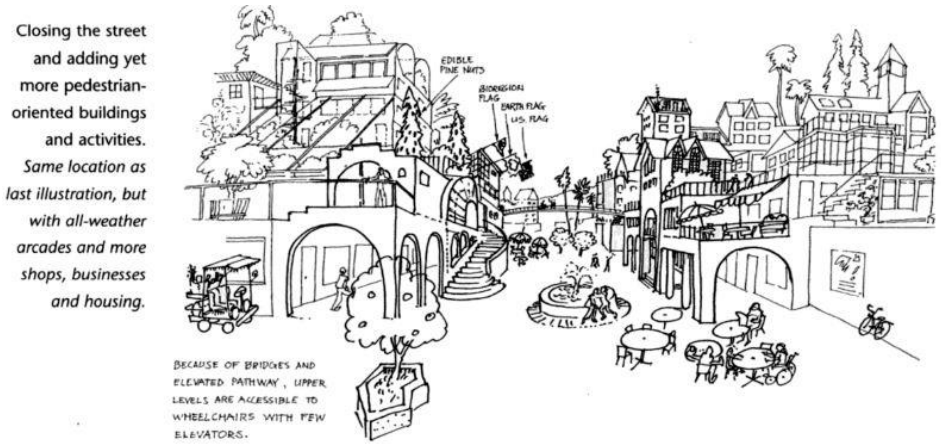


Figure 1 Register, R. (2006). Eco Cities: Rebuilding Cities in Balance with Nature (Revised Edition). New Society Publishing (Page 23)

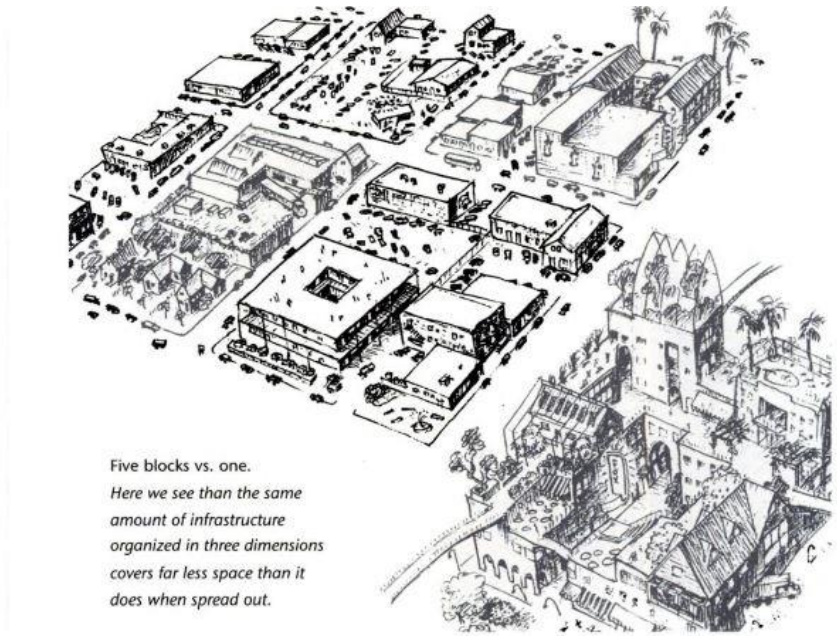


Figure 2 Register, R. (2006). Eco Cities: Rebuilding Cities in Balance with Nature (Revised Edition). New Society Publishing (Page 77)

Smart Cities was a term that made an appearance in the 1990's, the term itself is not at all new, starting as movement that advocated new policies in cooperation with technological advancement, inter-connectivity, safe and attractive urban development. The concept is derived from the smart growth movement in the early 90's (Bollier, 1998).The concept has since evolved into any technology-based approach to planning or development (Bakıcı, 2013). It offers the possibility to utilize technological

advancement into the planning process and to improve management and decision-making. Cities' metabolisms are often characterized by the entry of products and the outflow of debris, both of which have constant negative externalities that exacerbate social and economic difficulties. Cities rely on an excessive number of external resources and, in reality, they are (and will likely always be) resource consumers. In the subject of urban planning, the phrase "smart city" is frequently interpreted as an ideological component, with smarter implying strategic orientations.

Governments and international agencies at all levels are adopting the concept of smartness to differentiate their policies and programs aimed at fostering sustainable development, economic growth, improving residents' quality of life, and fostering happiness (Chen, 2010).

The smart city puts a spatial focus on sustainability, the quality of life, urbanization and smartness. “A city is smart when investments in human and social capital and traditional(transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.” (Caragliu, 2011)

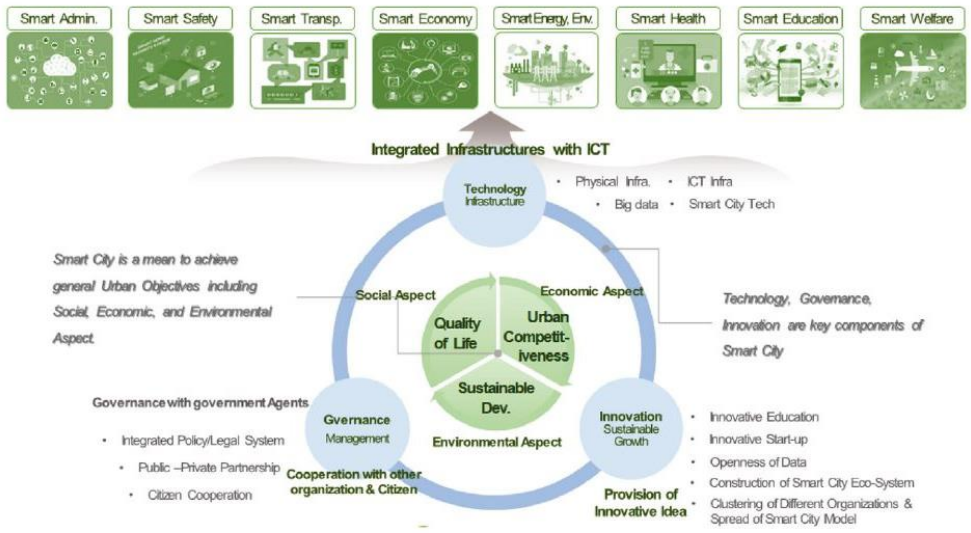


Figure 3 The smart city concept / (Lee, J. Y. (2018). Catalyzing the evolution of ICT based growth ecosystems in cities.

Resilient Cities is a relatively new term for cities. In the context of cities, resilience refers to an urban system's capacity to absorb, adapt to, and respond to change. However, it is stated in this article that resilience has a great deal in common with other critical modern urban goals such as sustainability (K. C. Desouza, 2013). The term speaks of a hidden opportunity for cities, to revive and reduce their vulnerability. Resilient cities

can be applied to respond to crises, adapt and change for the future. As we explore the core of resilience, the quicker the system returns to its natural state the greater the resilience of this system (K. C. Desouza, 2013). However, resilience is mostly used in ecology to describe the level of disturbance a system can endure before its changes structure. (V. Raj Sharma, 2019). As a system-based, complex, and dynamic process, resilience offers the required context for understanding the risk and vulnerability that this system faces. “Resilient cities” have gained popularity as a way to encourage communities to reduce their risk and prepare for natural, anthropogenic, and economic catastrophes.

“Although cities have been destroyed throughout history—sacked, shaken, burned, bombed, flooded, starved, irradiated, and poisoned—they have, in almost every case, risen again like the mythic phoenix.” (Vale, 2005)

Resilience is a rather old concept; in the 17th century, Samuel Grot used the term to refer to physical counter-reactions and reversion to their earlier state. "Resilience," according to Robert Greene, was the balance of forces operating on a body as push forces for expansion. (R.Greene, 1727) Crawford Stanley Holling first focused on the concept transferred from physics, applied mechanics, psychology, and ecology in population balance, establishing the first distinction between resilience in other disciplines and ecology, this was first mentioned In his paper Resilience and Stability of Ecological Systems, (Holling, 1973). The concept gradually found its way into urban planning as a transferable concept for dealing with dynamic models (S. Gößling-Reisemann, 2018). One of the most encountered definitions of resilience in planning is adaptation and recover despite of facing adversity by Sir Michael Pitt in his Learning Lessons from the 2007 Floods: An Independent Review by Sir Michael Pitt in 2007, (Pitt, 2007). Lastly, Simin Davoudi sees resilience more as cycle to emergence, in development and stabilization of the system, while reaching rigidification and decline opens the door for “creative destruction” or rather unpredicted possibilities (Simin Davoudi, 2012).

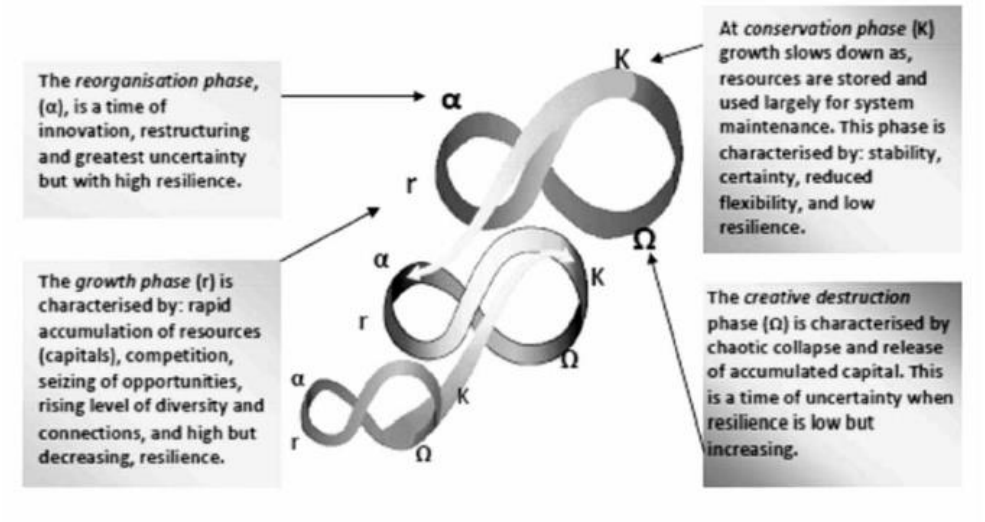


Figure 4 The panarchy model of adaptive cycle. Source: Davoudi, et al adapted from Holling and Gunderson (2002, pp. 34–41) and Pendall et al (2010, p. 76).

Despite of the Crawford Stanley Holling (Holling, 1973), Michael Pitt, (Pitt, 2007) and Simin Davoudi, (Simin Davoudi, 2012) definitions, this concept is yet to be defined by what resilience really means, or how it is expected to be translated into cities. However, for the purpose of this study we are going to focus on some similar characteristics of these urban challenges mitigating models of development.

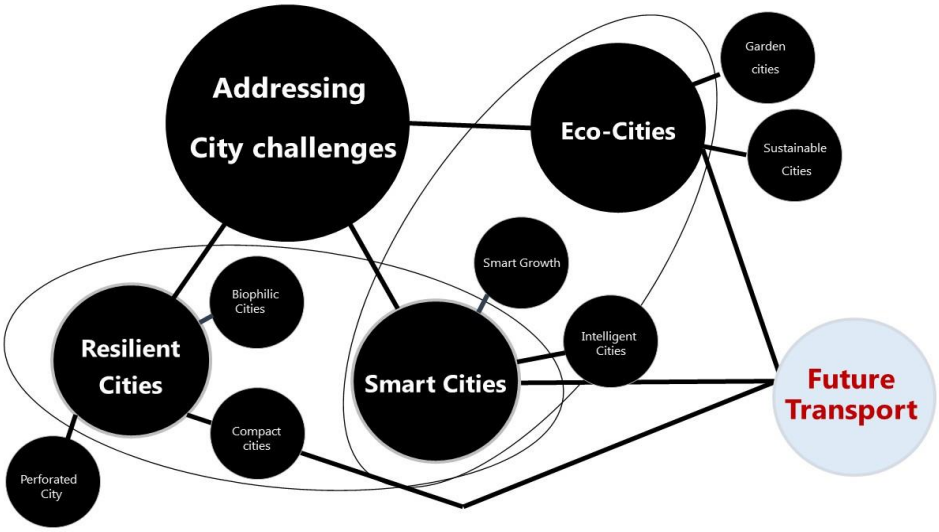


Figure 5 The City challenges/ Urban theories for urban dilemmas diagram source: own elaboration.

Author's reflection: reflected on Figure [5]

Much like Eco-cities focusing on cities that purposely cultivate a close relationship with nature and put a great importance to mobility and modality of navigating these spaces,

Similar to eco-cities, Smart Cities aim to use technological advantage in response to improve the quality of life, considering nature and people, focusing on transport and interconnectivity as an important part of the solution, Resilient Cities bring mobility into the conversation as one of the components that provide cities with the necessary tools to better adapt to challenges by giving a sustainable network of communication within the city , Compact cities and Biophilic Cities share much of the same attributes when it comes to their mobility and transportation focus, these examples come together with concepts as infill and land preservation by attempting to diversify mobility means and design inclusive transport, although quite differentiated as futuristic development models, when it comes to mobility, they collide into enabling accessibility focused interventions, taking away a founding component at each one of these concepts. Although this is a commonsense conclusion, the processes required for the application of these ideas are heavily emphasized in this commonsense conclusion. In order to "effectively" translate eco-cities, smart cities, or resilient cities into their respective contexts, a special emphasis must be placed on transportation planning and mobility inside cities. When we take a hard look at each of these concepts, we can all agree that transportation and transit play a crucial role in both their development and their eventual success in the marketplace.

2.2 Cities and Transport | Let's talk about cities in the past (a futurist vision)

"Cities have the capacity of providing something for everybody, only because, and only when they are created by everybody" is a section from page 60-61 of author J. Jacobs; The death of great American cities published in 1961. (Jacobs, The Death and Life of Great American Cities, 1961)

The city has been both a playground and center of attention forever, for both architects and planners wanting to guide their development. One of the most futuristic visions of the time came in Harvey Corbett's "Scraping City", a mockup vision under the title "The wonder city you may live to see" (Corbett, 1996).

This futuristic image, which was inspired on a popular scientific mockup first published in 1925, surprised many people and provided them with a new perspective on the future. A sky-high density skyscraper with four levels that descend into the

subterranean, with pedestrian traffic, slow motor traffic, fast motor traffic, and electric trains being the primary categories. Even if these notions about the future city, the role of transportation, and densification, or as Corbett referred to it, "crowding," were daring and provocative, they were not a far-fetched dream. Corbett, in contrast to doubters, did not feel that the future would entail the decentralization of cities. To the contrary of the long-standing studies of architecture, city planning, and current words, he equated city life with increased congestion and crowded conditions. Corbett was a visionary who influenced cities, mainly Manhattan. (Schmitt, 2015)

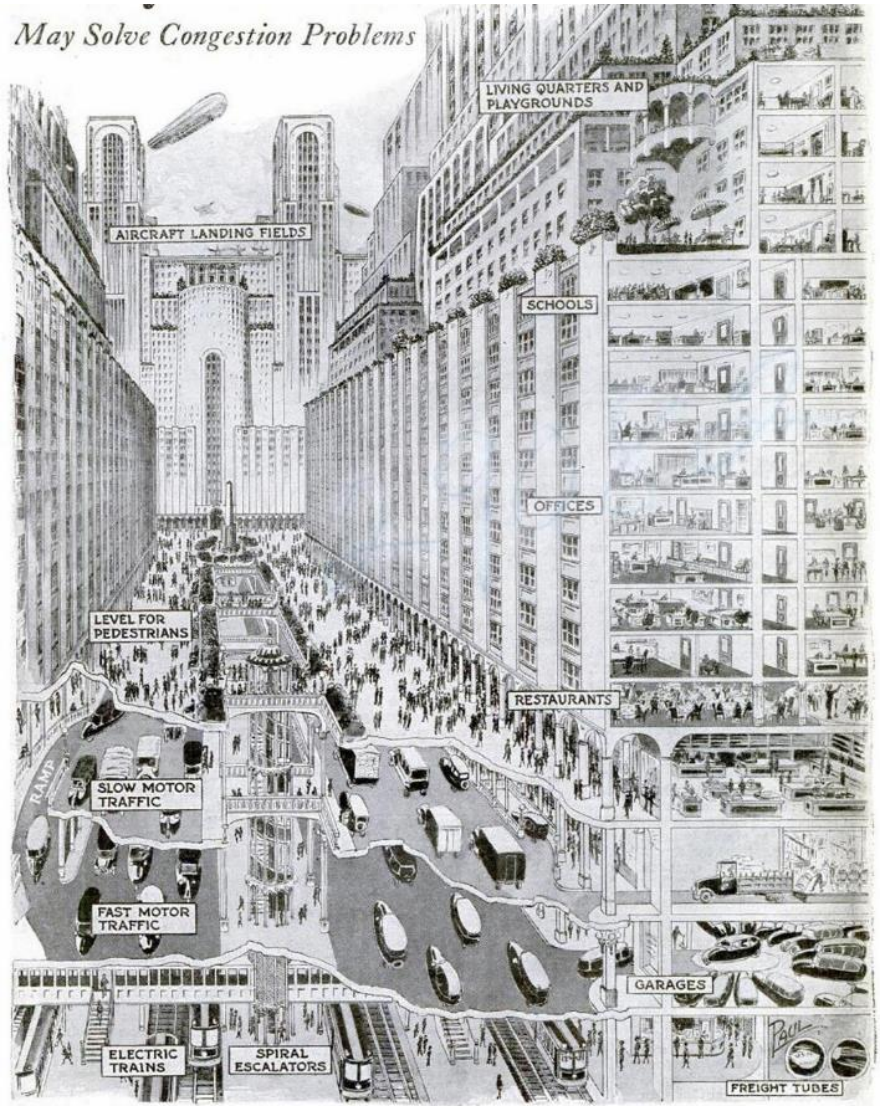
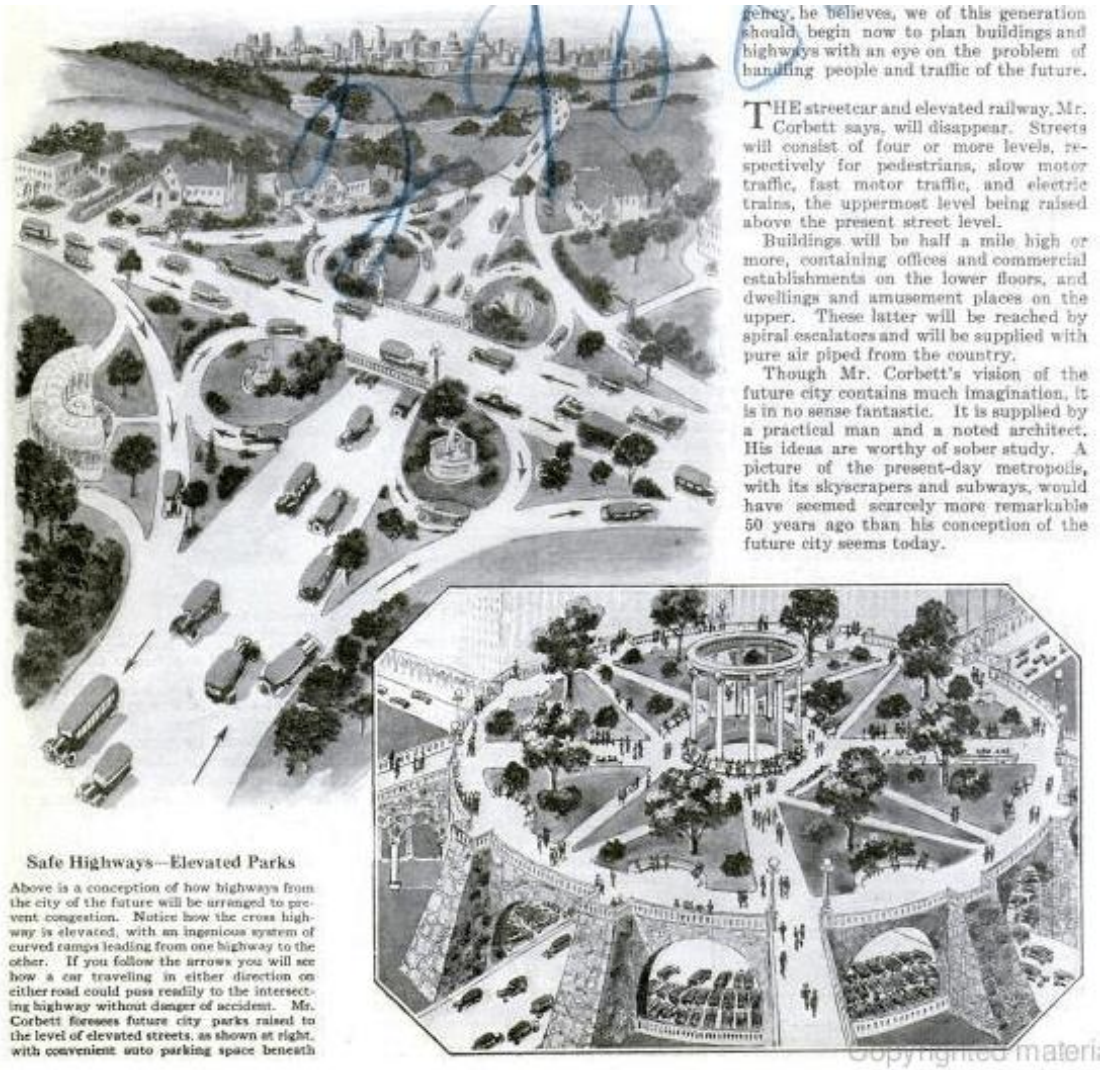


Figure 6 Harvey Corbett futuristic City (1925) source: The street Blog 2015, online source: https://usa.streetsblog.org/2015/08/13/the-future-american-city-as-imagined-in-1925/



ceney, he believes, we of this generation should begin now to plan buildings and highways with an eye on the problem of handling people and traffic of the future.

THE streetcar and elevated railway, Mr. Corbett says, will disappear. Streets will consist of four or more levels, respectively for pedestrians, slow motor traffic, fast motor traffic, and electric trains, the uppermost level being raised above the present street level.

Buildings will be half a mile high or more, containing offices and commercial establishments on the lower floors, and dwellings and amusement places on the upper. These latter will be reached by spiral escalators and will be supplied with pure air piped from the country.

Though Mr. Corbett's vision of the future city contains much imagination, it is in no sense fantastic. It is supplied by a practical man and a noted architect. His ideas are worthy of sober study. A picture of the present-day metropolis, with its skyscrapers and subways, would have seemed scarcely more remarkable 50 years ago than his conception of the future city seems today.

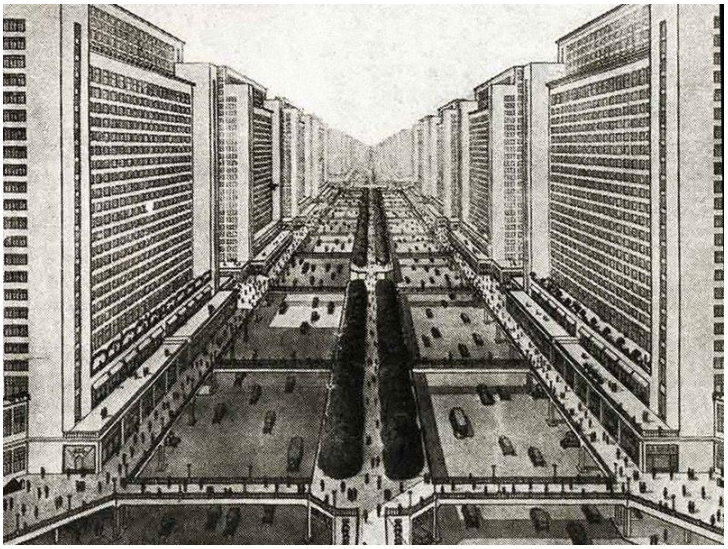
Safe Highways—Elevated Parks

Above is a conception of how highways from the city of the future will be arranged to prevent congestion. Notice how the cross highway is elevated, with an ingenious system of curved ramps leading from one highway to the other. If you follow the arrows you will see how a car traveling in either direction on either road could pass readily to the intersecting highway without danger of accident. Mr. Corbett foresees future city parks raised to the level of elevated streets, as shown at right, with convenient auto parking space beneath

Figure 7 Harvey Corbett futuristic City (1925) source: The Urbanist 2015, online source: https://www.theurbanist.org/2015/08/12/futurism-did-they-get-it-right/

The 1930's has a time for change and new challenges. Le Ville Radieuse (The radiant city) was a futuristic masterplan of a contemporary city that remained unrealized as a tabula rasa approach to the European vernacular cities. However, this remains an important masterplan in echoing a new way of thinking. This masterplan was introduced by Le Corbusier in his book of the same name, published in 1933. Despite its contentious and perhaps severe structure, the goal of this masterplan was to provide people with a higher quality of life. Modern urban planning and density typologies have been impacted by the ideals proposed by Le Corbusier. In this futuristic metropolis, a multitude of prefabricated sky-high density structures will be constructed on a geometrical Cartesian grid, creating a dense urban environment. Within this project, there was a clear separation of zoning that was coupled to an infrastructure grid and public landscapes that were positioned in the core of this future modernist concept.

Separating residential and business zones from automotive usage is accomplished through the use of subterranean transportation. (M. Montavon, 2006), (Merin, 2013).



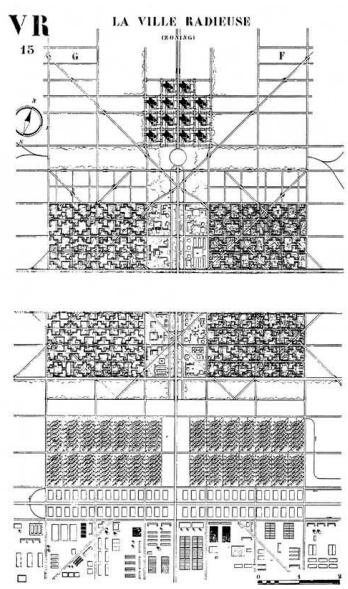
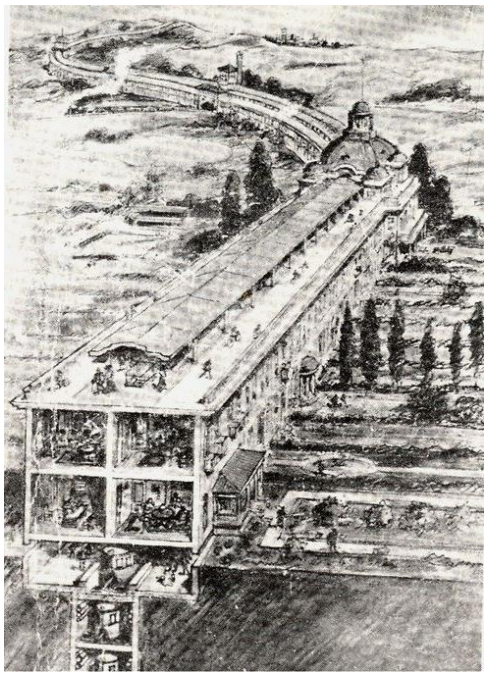


Figure 8&9 Le Corbusier (1933), "AD Classics: Ville Radiuses / Le Corbusier" source: via labourbanisticaventura.voila.net

In the 1910s, Edgar Chambless published "Roadtown," a book that is very contentious because it contains notions that are radically innovative for the time. The novel depicted a forward-thinking new metropolis that was anchored on transportation and the demand for mobility; this specific city was a direct competitor to urban sprawl in terms of planning and design. The city was a ribbon-like development built along a railway line with a high density that focused all development along a horizontal line where transportation, mobility, and activities were horizontally positioned and integrated. This form of development sought to preserve the surrounding land's scenery and agriculture. Chambless lobbied for his laydown tower but was never able to get the project off the ground. Regardless of how utopian this concept was, its effect of a metropolis directed by transportation, based in and grown by it, was subsequently partially translated in a number of current works. (Chambless, 1910). “Road Town transportation includes all the links in the system of transportation automatically coupled into one system. This is what I mean by a new conception of transportation” (Edgar, 1910, p. 21).

What Chambless meant was that transportation should be viewed as a whole system, from the modes of travel to their systems, components, and application in conjunction with urban development and land use. Road Town believed everything to be a mode of transit, arguing that the one and the above are so inextricably linked that they form a cohesive system. Roads, transit patterns, land development, distribution of products,

and farming have all been compartmentalized, conceived by distinct brains for a restricted collective goal (Chambless, 1910).



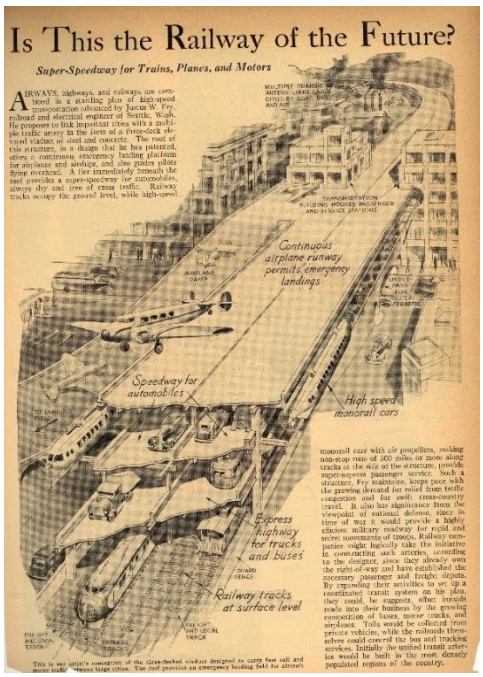


Figure 9 & 10 Edgar Chambless – Road Town, 1920. Railway and self-published by public promenade above Source: NY, Road Town Press [1910], [6],172 pp

Author's reflection on Chapter 2.2:

The first formal urban planning crises emerged in the 1960s, when the technological reason behind blueprint design came under scrutiny from a number of groups. Cities are steered by transportation, both in terms of demonstrating futuristic ideals for cities and in terms of the impact they have on the rest of the globe. While they emphasized future concepts centered on or near transportation, regardless of how contentious or implausible their atopies may sound today, they affected both their personal and professional life by urging people to seek a fresh viewpoint or modify their traditional thinking. Other Frank Lloyd Wright works, such as Broadacre City (1932), La ciudad lineal (1882), and Michael Graves and Peter Eisenman's The Jersey Corridor (1965), all share similar perspectives on the not-too-distant future, with an emphasis on density, transportation-centered development, close proximity of services, and the overall quality of urban living. Purwanto and Darmawan (2014) assert that "when we think of cities, we think of transportation; the two are intimately linked and influence our connection with cities" (Purwanto, 2015, p. 25).

2.3 Urban growth and the comet of sprawl

Urbanization began with Mesopotamian settlements over 5000 years ago, but they were little creatures. The upward trend began during the medieval period and has continued through the Industrial Revolution's boost to the present day. According to Mumford, the village is the ancestor of the city during the Neolithic period, when the economy shifted from foraging to food cultivation or farming. This town is characterized as modest and basic, yet has city-like features such as palisades, food storage, permanent housing, garbage collection, and burial grounds. At this point, he asserts that the interaction between nature and city is harmonious (Mumford, 1956, pp. 382-398). According to Kingsley, prior to the 1980's, we could not recognize large-scale urbanization since the urban-rural divide was dominating. (Davis, 1965, pp. 3-15) From the mid-twentieth century, the urbanization process started increasing, more rapid that the boom of the industrial revolution surpassing it many times over. (S. Davoudi, 2002, p. 269).

During the initial stage of urbanization, the number and size of cities varied according on the availability and productivity of agricultural land. Cities were mostly concentrated in valleys and river basins such as the Nile, Fertile Crescent, Indus, and Hwang Ho. As a result, population growth in any one city was constrained. Construction of large-scale river and sea transportation networks, as well as roads for chariots and carts, initiated the second stage of urbanization (Davis, 1965). As a result of surplus grain and oil production for export, agriculture, trade, and industry grew, complementing the religious and political specialization that dominated the previous stage. In other situations, such as the Greek city of Megalopolis, the population of lesser places was consciously concentrated in a single major core, a planned reproduction of a process that occurred less deliberately in other cities (Davis, 1965).
Employment and development were given emphasis in the late 19th and early 20th centuries (Grübler, 1990), (Anas, 1978), (Ween, 2012) .

Clark states that Urbanization is the process through which a world dominated by cities and urban ideals emerges (Clark, 1982, p. 231).
The growth of great cities and their increasing spatial influence sparked a shift away from mostly rural to predominantly urban areas and lifestyles that has impacted the

majority of countries during the previous two centuries. It is critical to distinguish the two primary phases of urban development—urban expansion and urbanization (Clark, 1982).In reference to Clark's definition Urbanization is a geographical and demographic phenomenon that refers to the rising prominence of towns and cities as population concentrations within a given economy and society. When population distribution shifts from being heavily concentrated in small towns and villages to being heavily concentrated in urban areas, the phenomenon occurs. By contrast, urbanization is a non-spatial and social phenomenon that refers to the changes in behavior and social interactions that occur in social dimensions as a result of people living in towns and cities. Urbanization is also characterized as 'the transfer of people from rural to urban regions as a result of population expansion' (Nations, 2005).

In the late 1950s, urbanized areas in the United States of America expanded rapidly outside due to the suburbanization process of residence, industry, and commerce, which encroached on significant amounts of farmland and forest, had negative effects on the environment, and exacerbated traffic congestion. Urban sprawl is a term used to describe this trend of uncontrolled urban expansion (Zhang, 2004).
The concept of sprawl is the emergence of a situation of unauthorized and unplanned development, normally at the fringes of cities, particularly haphazard and piecemeal construction of homesteads, commercial areas, industrial areas, and other non-conforming land-uses, generally along major lines of communication or roads adjacent to specified city limits, which is often referred to as urban sprawl (Rahman, 2008, pp. 19-23).

The concept of sprawl suffers from an ambiguity in definitions, there are many perspectives defining the process the impact on territories, cities, however the Oxford Dictionary in 2000's defined sprawl as: "A wide area densely populated with structures that stretches in an unsightly manner from the city to the countryside" (Dictionary, 2000). On the other hand, an older definition by Ottensman in 1977 defined it as: "The dispersion of new construction on small plots of land that are insulated from one another by open space" (Ottensmann, 1977, pp. 389–400).
This morphological transition was aided by contemporary transportation technology and the construction of transportation infrastructure networks, resulting in vastly expanded and functionally dispersed urban districts that ate up cheaper and more accessible land in the suburbs. (William D. Anderson, 2001). "The phrase "urban

sprawl" refers to low-density, automobile-oriented population patterns with insufficient comprehensive public planning." (Bruegmann, 2006). Sprawl began in Europe in the eighteenth century with the rise of the middle class, resulting in congested and troublesome cities such as London and Paris[5].

Although the city's economic importance has increased, it was congested, loud, and dirty, making living unpleasant and fueling anti-urban views. As a result, the increasing middle class grew to value tranquil, clean, and natural home suburbia living. (Bruegman, 2005).

Suburbanization truly began with the establishment of the railway system in the mid-nineteenth century. Citizens traveled from rural regions to cities in pursuit of work during the industrial revolution, completing the process of urban expansion and changing cities into both urban and suburban districts. By the 1930s, the bus system, as well as private vehicle ownership, had contributed significantly to the process of sprawl becoming a reality. While the rise of sprawl in North America and Europe are analogous in certain aspects, they vary when it comes to the more complicated characteristics associated with Europe. Increasing investment in the highway infrastructure has supported the rise of suburban regions in North American cities, making suburban development even more enticing. However, European towns are focusing on a slower purchase of private cars and relying more on the public transportation infrastructure. European towns are evolving in the opposite direction of the expanding urbanism of the nineteenth century, thanks to the notion of "Garden Communities"[6].

For a long period of time, urban sprawl has been a negative presence, resembling possibly the most significant shift in land use in Europe and northern America's cities. This might be considered a cornerstone of modern town planning. Taking center stage and posing a continual issue, sprawl has been the subject of several theories addressing both its prevention and aftermath, as well as the influence of sprawl on land use, eventually defining the function of transportation and mobility in cities

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[5] *Cities were very dense, with little space and constant pollution, functions and services of production were often found into the same structure and space.*

[6] *Ebenezer Howard who created a movement centered on satellite cities connected by rail transit access[6]. The concept of this movement was based in Real estate development with rail as the primary conduit between developed areas*

2.4 Compact Neighborhoods

Urban communities that are compact and livable attract more people and economic capital than other types of neighborhoods. The establishment of such settlements is critical to reducing urban sprawl and protecting the environment. Complicating the concept of dense neighborhood is the adoption of redevelopment plans and zoning restrictions that guide housing and job growth into urban centers and neighborhood commercial districts in order to create compact, walkable, bikeable, and transit-friendly hubs. Several aspects of compact neighborhoods draw attention to the following:

Neighborhoods with a mix of uses- It is usual practice to accommodate for many types of usage inside a single structure or group of buildings. In planning terminology, this can refer to any combination of residential, commercial, industrial, office, institutional, or other land uses, as well as a single land use. This can assist reduce dependency on autos, which have their own set of zoning laws.
Affordable housing- As a consequence, more people will be able to live in the city. Additionally, many urban planners believe that a scarcity of cheap housing has a detrimental influence on a city's general health, in addition to the dissatisfaction experienced by families unable to find a place to reside. Consider the following hypothetical situation: A lack of affordable housing may make it more difficult to recruit low-wage employees, hence increasing the demands placed on transportation infrastructure.

2.5 New Urbanism

In the United States, the New Urbanism or 'neotraditional planning' movement has developed as a significant alternative to the dominant patterns of low-density, automobile-dependent land development. Born in the 1970’s - 1980s, new Urbanism began as a little experiment. Its impact has risen tremendously since then (Pyatok, 2000, pp. 803-817). The concept itself was an antagonist to the phenomena of sprawl and land-consumption, believing that land is invaluable resource that should be traded as it won’t always be available.

The New Urbanism has caught the American public consciousness in a way that no other urban planning movement has in decades. New Urbanists are attempting to change the character of the American metropolis amid considerable hoopla by reinstating conventional conceptions of community planning and adapting them to a range of urban and suburban contexts. The New Urbanism movement originated as a reaction to conventional suburban planning practices in the United States dating all the way back to the 1940s. The decentralized, automobile-oriented suburb, according to New Urbanists, is a prescription for disaster. Occasionally referred to as "neotraditional" or simply "traditional neighborhood development," it is not a "new" concept (nor, as I shall argue below, is it "urban"), but rather a methodical integration of a range of planning and architectural methods that have been recognized and employed for many years.

What is novel and distinctive in new urbanism is the way these technologies are packaged in a unified ideological package (Christoforidis, 1996). However, the origins of this concept may be traced back to the official establishment of a Congress for New Urbanism in 1993 and its approval of a formal Charter in 1996 (Marcuse, 2012, pp. 4-6).

The New Urbanists advocate for the incorporation of mixed uses (commercial, civic, residential, public spaces, and others) in each town. The objectives are to provide jobs close to inhabitants' homes and to enable residents to walk or bicycle to their destinations (Day, 2003). Similarly, New Urbanists advocate for areas to embrace alternate modes of transportation in order to reduce reliance on automobiles, especially transit. The concept finds many common grounds with Transit oriented development, something Calthorpe acknowledge in his book the next America metropolis published in 1993.

While New Urbanist philosophy stresses the value of variety in neighborhoods, New Urbanist practice offers few clear measures to promote diversity. New Urbanism promotes variety primarily through promoting a range of dwelling costs and styles within each neighborhood (Day, 2003, pp. 83-95).

Critics commonly think that New Urbanism overlooks contemporary social and economic realities. According to this opinion, the vehicle, affordable energy, computers, telecommunications, new construction technologies, multinational firms, and worldwide trading spheres have rendered traditional city-building processes obsolete (Cliff, 2002, pp. 261–291).

With the emerging concept of ‘New Urbanism’, a return of TOD along transportation routes is regarded as a resurgent ideology. It is being viewed not only as a financial basis, but also as a means of long-term growth.

We describe planning as the process of identifying the most appropriate course of action in the future through a series of choices. We use the term determining in two ways: to ascertain and to discover. Given that suitable means a criterion for making judgements about desired situations, planning entails a concept of objectives.
Action embodies specifics, and so we face the question of relating general ends and particular means. We further note from the definition that action is the eventual outcome of planning efforts, and, thus, a theory of planning must be directed to problems of effectuation (Faludi, 1978). With the emergence of the New Urbanism idea, a return to TOD along transit corridors is viewed as a resurgent philosophy. It is considered as a financial foundation as well as a method of long-term progress.

The fundamental objective is to concentrate urban development around stations in order to stimulate transit use while also connecting current and projected growth areas with transit lines (Curtis, 2009). This system is being promoted by politicians and planners worldwide not only to increase public transportation use and reduce greenhouse gas emissions, but also to provide better mobility alternatives for today's complicated lives and company operations. A transit station generates a natural catchment area for urban activity, which sets it apart from other models for urban growth.

2.6 Defining Transport

Movement of things or people from one place to another is as old as human existence. However, the mode used in this movement has changed through ages. The journey of animal power to steam and fossil fuel power explains this phenomenon. Along this line, the mobility has a social dimension more than machines. Transport helps human beings in removing this unwarranted barrier of physical separation and “enables a given flow of resource to produce greater results” (Bonavia, 1936, p. 189). It also promotes homogeneity among the people of a country, and this sense of oneness strengthens political unity. “Transport the de facto barometer of economic, social and commercial

progress has transformed the entire world into one organized unit. It carries ideas and inventions to the people, and has considerably contributed to the evolution of civilization" (Ogburn, 1946, pp. 373-379) .The demand for transport may not be fundamental in human nature for essential commodities. "It is an indispensable part of culture, as the hallmark of civilization" (Ambaprasad, 1960).
When we see mobility as a deliberate, meaningful – and hence cultural – act, we must consider both the material circumstances and political implications of transportation networks.

The growth of transportation is currently of the utmost socioeconomic and commercial importance. The transport industries, which are concerned only with the movement of people and objects, have contributed to one of the most significant human activities at every level of civilized civilization. It has a critical role in the diffusion and development of culture. As a result, a culture without a sophisticated mode of transportation stays primitive (Jagadish, 1998).

Prior before the invention of any other mode of transportation, mankind went on foot. Lower Mesopotamia created the wheel about 3500 BC, and the first wheel was constructed of wood. Initially, water transportation was accomplished using a canoe-like construction constructed by burning logs and excavating out the charred wood. The Egyptians created the sailing boat about 3100 BC, while the Romans afterwards built highways across Europe.

The transportation system has evolved with human society. It evolved through numerous stages, including the hunting stage, the pastoral stage, the agricultural stage, the industrial stage, and the commercial stage. Man has produced several advancements in the field of transportation while also contributing to the development of civilization. Roads did not exist in the pre-human era, and people relied on walking for their livelihood and social life. In Paleolithic times, long distance walking trails arose as trading routes.

2.7 Placing Transport and Mobility

Transportation is a significant component in shaping how urban areas are organized spatially. Medieval towns were designed for walking, which necessitated the separation of dwelling and working areas (Wegener, 1995, pp. 157-162).
Transport, in general, refers to any device used to move an object from one location to another. The term "transport" refers to the transportation of people or goods between locations. A vehicle, or a system of vehicles, such as buses, railroads, or other forms of transportation, is a mode of transport. Transportation is the movement of freight and persons from one point to another. However, mobility, or the ability of freight or people to change their physical position, is a critical component of any definition of transportation. The ability—and necessity—of transporting large amounts of commodities or large groups of people across enormous distances in comfort and safety has long been a gauge of civilization, particularly technological advancement. Humanity's existence altered tremendously with the invention of the wheel. Individuals could travel quicker and further as a result, seeing more, conquering more, and exploiting more resources.

The study by Mitchell and Rapkin published in 1954 “Urban Traffic- A Function of Land Use” as a study seminar, was the first link between land use and Transport. This publishing puts a in depth analyses to how transport and land use are interlinked and the correlation between the two, activities connected with certain land uses could be quantified, quantitative estimates of the traffic associated with those land uses could be generated. Traffic volumes in urban areas were directly tied to land usage (Banister, 1995, pp. 1-16).

The decentralization of cities, the creation of discrete centers of activity within the sprawling city, and the emphasis on certain tasks (e.g., specialization in banking and financial services) all contribute to this rise in travel (Banister, 1995). However, the connections between transportation and urban growth are not fully understood, even physically. Along with physical links (for example, density), there are significant economic considerations (for example, rent levels and land prices), social issues (for example, equity and distributional factors), and environmental factors to consider (e.g. quality of life).

Mobility research contributes significantly to the fields of transportation (Knowles et al. 2008; Shaw and Docherty 2014), transportation geography, and transportation planning, in part because it can assist in "facilitating the quantitative–qualitative gap" (Goetz et al. 2009; and cf. Jensen et al. 2014).

Coming back to our topic, the origins of TOD date all the way back to the dawn of civilization, when humans settled along the most available sources of transit, such as water. Regardless of transit system modifications, the requirement to reside near a handy method of transportation remains. The Brundtland Report (World Commission on Environment and Development, 1987) defines sustainable transport as "meeting present transportation and mobility demands without jeopardizing future generations' ability to meet these needs" (Black, 1996).

3 THIRD CHAPTER | OUR COMPLEXITY

3.1 Exploring Complexity

The term 'complexity' comes from the Latin word 'Complectere,' which means to envelop or encompass, and the Greek word 'Complexus,' which means plated (Mitchell M. , 2011, p. 4). The term's origin just serves as a gateway to the plethora of possibilities that this word implies. Complex systems are ubiquitous; they are characterized as a collection of elements that self-organize and, in some situations, lean and evolve. This multidisciplinary area investigates how seemingly basic components, when combined, become complicated systems capable of self-adaptation (Mitchell M. , 2011, p. 13).

"How do we define complexity?" Upon first examination, complexity appears to be a fabric (complexus: that which is knitted together) of inseparably linked diverse constituents: complexity embodies the paradox of the one and the many. Arguing that complexity is the web of events, acts, interactions, retroactions, decisions, and chance that weaves our amazing world together (Morin, 1990, p. 21).

The purpose of a complex approach to the city is to reconnect disparate types of information that have been severed by disjunctive thinking. Urban complexity may be thought of in terms of consecutive urban scales that reflect hierarchical organizational levels within a metropolis. Certain groups of consecutive levels in these hierarchies have a considerably more defined organization than others, which are much looser (Salat & Bourdic, 2012, p. 27).

Systems dynamics, cellular automata, agent-based modeling, and network analysis have all been used in models for population, land use, and transportation planning. illustrating how complicated approaches have been used to handle difficulties like as housing and anticipating people's movements, generally in combination with deterministic, large-scale urban models (Portugali, Meyer, Stolk, & Tan, 2012, p. 22).

City planning in the modern age is characterized by new environmental and social concerns, as well as a broad range of industrial ecology-related difficulties (Portugali, Meyer, Stolk, & Tan, 2012, p. 21).

The phrases "complex systems" and "complexity theory" are sometimes used interchangeably. Nonlinear behavior, feedbacks, self-organization, irreducibility, and emergent features are all characteristics of computational systems science (CSS). Many homogenous components that do not interact with one another in a cohesive manner are the hallmark of problems of disordered complexity. We come into these issues while trying to represent gas behavior in physics or in markets when there are a large number of buyers and sellers. Statistical approaches may be utilized to provide insight into the dynamics of the system by averaging the behavior of populations (Salat & Bourdic, 2012, p. 29).

As Waldrop in 1992 states 'Where the components of a system never fully lock into place, and yet never exactly dissipate into turbulence either, our dynamic reality, including life itself, arises' Complex reality can be established in which 'the correct combination of solidity and mobility' (Waldrop M. , 1992, p. 12).

We cannot get a better understanding of urban dynamics, identify intervention opportunities, or address dynamic problems by just publishing aggregate data in reports on urban performance and sustainability. To advance, it is vital to detect and model many sorts of interactions (system, network, and agent). In this context, CSS models and approaches may be utilized to get a better knowledge of urban dynamics and, as a result, to guide planning and management choices more effectively (Root, Zurich, & Hillier, 2012, p. 135).

3.2 Considering the role of Complexity in Planning

Various types of urban settings surround us. In this kind of situation, it's necessary to look for the underlying truths that are hidden behind the surface of things. Our comprehensive research is built on fundamental universal laws that govern cities, galaxy clusters, species' evolutionary trees, and economic cycles, as well as their frequency and amplitude(Nottale, 2000).

According to the latest morphological theories, forms are not only independent entities but also, and most importantly, totalities. Because of the hierarchical structure of short- and long-range coupling forces, these complex systems can't be disassembled into their constituent pieces(Salingaros, 2006).

Consider the complexity of a city in terms of the different sizes that correlate to different organizational levels within a metropolis when thinking about urban complexity. In these hierarchies, there are certain groups of sequential levels that have a substantially more defined organization than others, while others have a significantly looser structure (Salat & Bourdic, 2012).

Based on fractal principles, the sizes and distribution of land uses and networks are determined (Frankhauser, 1994). A city's economic activity is concentrated in a tiny region because of the city's fractal layout. As a result, more comprehensive studies of urban density and the hierarchy of major places are now available.

Complex systems theory has unearthed the concept of resilience, which is worth further study. Cities' resilience, defined as their ability to withstand and recover from both internal and external stressors, crises, and shocks, is a topic that deserves further study in light of the present political climate. Many difficulties will confront cities over the next century, including: water shortages, population growth, social unrest, the loss of natural resources and climate change (Salat & Bourdic, 2012).

As a city's stability is measured by its urban tissue's resiliency, its long-term economic worth is affected. A city's ability to withstand natural disasters is directly related to the amount of redundancy in its infrastructure. In densely populated and well-connected

metropolises, the use of functional mix can result in significant financial savings (materials, energy). The complexity and density of feedback loops makes it simpler to handle residual demands in a circular economy.

System dynamics models, as we've seen, are a popular choice for operational settings because they can build global structures that resemble real cities. On the other hand, Gilbert and Troitzsch (2000) identify four issues with this strategy: Micro-level dynamics are generally disregarded, parameters are often over-aggregated, and the consequent global implications are often impossible to forecast. One of the most impressive aspects of employing agents is the ability to show how decisions are made and how they might change (Salat & Bourdic, 2012).

Creating a sustainable city looks to necessitate a higher reliance on one's own resources in order to reduce the flow of rubbish and conserve energy and resources (Grimmet et al., 2008; Jacobs, 1969). First, we need to examine and duplicate the characteristics of existing linkages between various land uses, enterprises, communities, and levels of government in order to promote more connectedness. Complexity theories of cities have enriched our knowledge of cities and spawned an entire field of research, most notably urban simulation models.

Coming together the role of complex systems in planning and cities has come in two ways, connected to Peter Allen, a physicist, adapted Prigogine's dissipative structures to the dynamics of urban dynamics; later, scholars of urban planning applied the notion of complexity to twenty-first-century planning difficulties (Portugali, Meyer, Stolk, & Tan, 2012, p. 18)

3.3 The Integration of complexity into the urban context

“The disorder of the city, it’s a complex order. This order is all composed of movement and change, and although it is life not art, we may fancifully call it the art form of the city (Jacobs, 1961).” Since the Jane Jacobs interventions in the view of cities, they've become increasingly complicated systems.

In Mellanie Mitchell's book, 'complexity, A Guided Tour,' she uses examples such as the immune system, ant colonies, and economic sectors in which the constituents or entities are individuals to show the meaning of complex systems. demonstrating the necessity of group intelligence in order to grasp the complexities of the world (Roo, 2012).

We can't have a system without the presence of other systems that are always interacting and evolving. Due to the term's multidisciplinary application, it is difficult to bring this phrase closer to our topic. A logical-positive viewpoint is used to draw a link between planning and complexity; alternatives reflect an imperfect reality in which future facts are not yet known (Roo, 2012). Unconventionally, it was thought that if we had enough money and time to study everything there was to know about our "imperfect" environment, we could learn everything there was to know. According to Schoen (1938), (Simon, 1957). By introducing system theories and emphasizing the technical and communicative rationales in planning and decision-making, we may pave the way for a deeper knowledge of complex and complexity theory and planning (Portugali, Meyer, Stolk, & Tan, 2012).

Waldrop adds that dynamic reality encompasses life (addressed here are multidimensional and all-purpose, all-interest entities), including human life, which exists on the precipice of order and chaos (Waldrop M. , 1992).
The urban complexity of cities is not determined just by the components they include, but rather by the city's capacity for various actions (Portugali J. , 2016)
Habraken feels that while the city as a material component is a relatively simple system, when combined with human components, the city becomes complicated (Habraken, 1998).
The complexity of urban life necessitates planners to engage in dynamic processes at all times. Cities may work without external control by self-coordinating and hosting multiple actions and activities that allow for adaptation thanks to transportation, which offers some equity to these systems (Andersson, 2017).
No question, by moving from a bottom-up to a top-down complicated system, we are embracing a new level of risk and uncertainty (Mitchell M. , 2011).

Author's reflection on complexity, city and TOD:

After taking into consideration systems theory and complexity in relation to our topic, we must return to the Habraken definition and appreciate the key ingredient that must be included in the mix, which is people, who we may consider to be the center of complexity in our topic.

Complexity may be understood and guided through the use of transportation, land use, urban planning, and public places, among other things. Investigations have demonstrated that both urban complex systems, traffic flows, city networks, and the process of human mobility display a scaling property, which is a trait in which the size of the system rises as the complexity of the system grows

Cities are already complex structures, referencing to the example of the tree and the leaf by Mitchell, M. Complexity a guided tour (Mitchell M. , 2011), explaining how each component of the city is similar to the veins of the leaf. As a result, transit-oriented development reflects the complexities of urban planning and transportation planning and implementation.

4 FORTH CHAPTER | TRANSIT ORIENTED DEVELOPMENT

4.1 Theory unveiling. Calthorpe's TOD

Peter Calthorp was the person behind TOD's definition and implementation. He was born in 1949-in in London but raised in California. His views were influenced by attending Antioch College and then Yale's Graduate School of Architecture. After on he worked as a director of "The Farallon" institute that focused on sustainable gardening, water conservation, and sustainable approaches.

This experience gave him the freedom to start his own sustainably-oriented design firm. He became a member of the Congress of New Urbanism, this chapter his sustainable urban design philosophies. These philosophies were later contextualized with the birth of TOD in his 1993 book "The Next American Metropolis."

His professional practice was influenced by Sim Van der Ryn founder of the "The Farallon" institute. Sim Van der Ryn was a visionary of the sustainable development movement and provided UC Berkeley university with the reputation of a socially and environmentally-focused university.

Van der Ryn and Calthorpe participated in design studios as a ground to test his ideas further. Later on, Calthorpe joined Van der Ryn in his architectural studio. Calthorpe described this period as focusing on the environmental impacts of growth. It wasn't until later in 1983 when with his own firm Calthorpe's Associates started to shift his focus to urban new towns and suburban areas. (Katz, 2014)
In 1986 he co-authored the book "Sustainable Communities: A New Design Synthesis for Cities, Suburbs, and Towns" were hi promoted his ideas of older cities as a

sustainable development model, along with communities, pedestrian-friendly urbanism, and sustainable architecture. At this time his focus was entirely on sustainable communities and transportation was still not a key feature.

Calthorp concentrated on Ebenezer Howard's Garden City Movement as a sustainable approach taking as an example the New Town of Vällingby. Among other observations he discussed the heavy reliance on commuter rail as a key component for this movement. Though still, his theories about TOD were not yet present.

His concepts matured after the publishing of "Sustainable Communities: A New Design Synthesis for Cities, Suburbs, and Towns". He extended his work to compact, traditionally informed designs called Urban Villages. He began to work with a focus on the technical basis for sustainable communities, incorporating "urbanism" to promote social communities, including in his projects affordable housing and mixed uses connected by a walkable setting.

The next step for Calthorp was investigating the theory of urbanism and environmentalism. With the procuring of a grand, he paired with Mark Mack also a professor at UC Berkeley. Together, they developed a new centric neo-traditional new tow concept called pedestrian pockets. In 1989 the faculty published a book, outcome of the student's scenarios and caltrop's testing called "The Pedestrian Pocket Book". This book described the Pedestrian pockets as a cluster of housing, services and shopping within a walking distance of a transit system of a quarter-mile. The principle of walkable distance was an inspiration from Duany and Plater-Zyberk who adopted Leon Krier's original theory. (Florida, 2017)

Calthorpe stated that the pedestrian pockets were a market-oriented solution, rather than a utopian car-free environment. They accommodate the car, transit and walking. Keeping in mind that the goal was to offer an environment that offers choices. These pockets would extend the range of choices, mixed uses would support a variety of transportation means including walking.

In 1988 Calthorp was working on the pedestrian pockets, when he was asked to join a project team for the metropolitan Portland, Oregon. This project evolved from the proposed Western Bypass suburban freeway to redefining Portland's metropolitan

land-use plan. The project was called “Making the Land Use, Transportation, Air Quality Connection” or LUTRAQ. The LUTRAQ study evaluated side-by-side options for either interstate or rail focused corridor development. Calthorpe proposed neo-traditional Pedestrian Pockets be implemented along rail corridors. The project aimed “to promote development patterns that reduce land consumption, vehicle trips, and air pollution nationwide.” (Michael Leccese, 2000, p. 103) Calthorpe assisted the city to create new zoning codes based on Pedestrian Pocket principles to further this development. (Michael Leccese, 2000)

As the project gained more recognition Calthorp was hired by the Sacramento County in 1987 to propose “Pedestrian/Transit-Oriented Development” along with the County rail stations. the first official use of the TOD term but Calthorpe continued to brand his proposals as “Pedestrian Pockets.”

As he had done before in 1989 Calthorpe was asked to assist by consulting on the guiding zoning principles for Sacramento’s TOD. In the fall of 1991, the commission presented the principles to over one hundred government officials, naming the guidelines were called Ahwahnee Principles, these principles paved the way for Smart Growth movement, New Urbanism and TOD.

The West Laguna was the first build example of the Pedestrian pockets. The areas changed from standard suburban development to a neo-traditional neighborhood, connected by tree-lined streets and the town center. Mixed uses, pedestrian paths, and riparian zones, all elements of the later TOD were included in the planning process.

The housing was going to be built in the street frontage, the street was mainly narrow to encourage slow driving and security. This was the first time TOD has mentioned as a model itself. (Dunham-Jones, 2008)
For Calthorp the shift from “Pedestrian pockets” to “Transit-oriented development” was simply rebranding. He consulted with Robert Cervero an expert in the field transportation. He encouraged the shift by explaining a correlation between urban densities and transit. Calthorp investigated the Portland and Sacramento zoning guidelines to promote light rail and connection. The change of the name came as a tribute to the new focus of transit components. R. Cervero suggested “Transit-

Supportive Development" but Calthorp thought that "Transit-Oriented Development," was a better branding. (Peter Calthorpe, 1989)

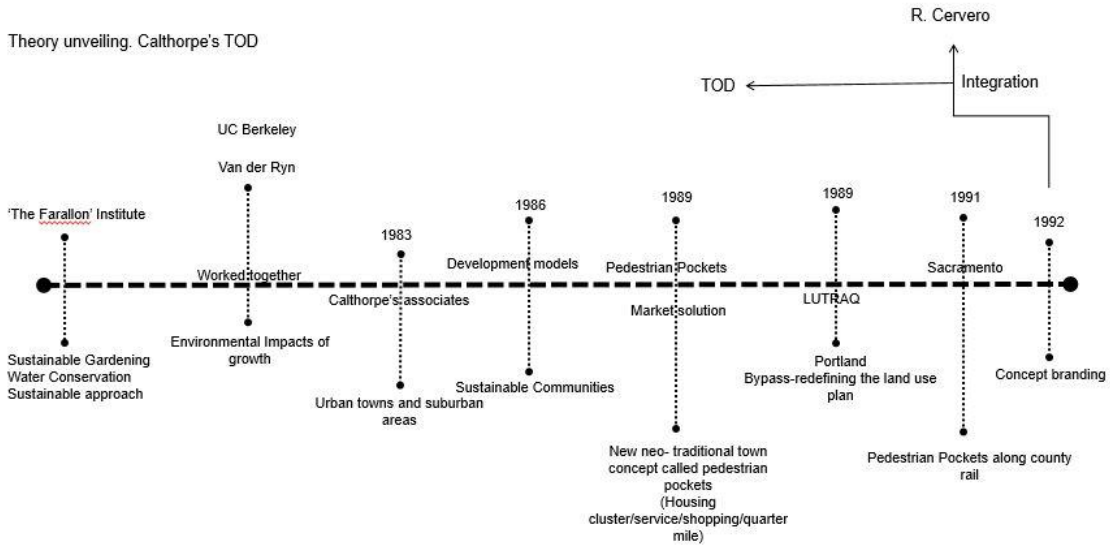
TOD was officially accepted in 1992 when Calthorp introduced it at the congress of New Urbanism. In 1993 when the congress was reconvened, they summarize the charter of the new urbanism which advocated a reconstruction of public policy, diverse use and population in neighborhoods, neighborhood designed for pedestrian, transit, and car, cities and towns should be shaped by public space and public institutions and urban settlements should be planned with architecture and landscape. Calthorp stated that the role of new urbanism was "To learn from (prior urban design) failures, avoiding a sterile suburban character.

Calthorp thought that new urbanism was the same response for environmental groups, neighborhood revitalization groups, and historic preservation groups. He thought that the principles of the new urbanism agenda bonded these groups by offering a common set of principles.

Soon the New urbanism realized that their replicable guidelines were the key for their strategies to be widely adopted. But many of their ideas were forbidden by the current codes in place that were planned for automobile and not people. The next logical step was to intervene and revise the codes. Calthorpe provided a handbook to show the route to effective planning keeping TOD in mind. Shelly Poticha was a great contributor to the handbook Calthorpe was righting, in redefining the guidelines. Her guidelines were published in Calthorpe's "The Next American Metropolis" in 1993.

Viewing the historical precedence to the creation of the concept of TOD, the design element and guidelines are not surprising since they were built on Calthorpe's ideas and synthesis of ecological, aesthetic, anti-sprawl and equitable planning approach.

Figure 10 The evolution of TOD in relation to Peter Colthorp's contribution/ Source: Author's elaboration personal Library



4.2 Transit-Oriented Development Origin

There are several implementations and planning attempts to respond to the continuous evolution of this notion. This evolution accrued when adapting the concept, considered its application context. However, these attempts were no recipe to a successful implementation. We must begin to remember puzzle pieces that brought this idea together, shaped or altered its emphasis as we examine the changes that this notion creates. Going back to the book that impacted planning practitioners and the planning process itself at a greater scale, the Life and Death of Great American Cities by Jane Jacobs, and Garden Cities of Tomorrow by Ebenezer Howard in 1902.[7]

The idea of TOD was completely or partially developed, but what really made a difference was the development of a tailor-made toolbox. "TOD is already viewed as a neo-traditional guide to sustainable community design and mobility," according to Carey Curtis (Curtis, 2009, S. 108). This concept was never fully acknowledged by Peter Calthorp, identified as the 'father' of TOD. Transit Oriented Development was simply a rebranding of an established definition, the transport and mobility were often

[7] *See Working Paper: Histories of Transit-Oriented Development: Perspectives on the Development of the TOD Concept / Ian Carlton (2009)*

co-dependent synergies in relation to the built environment that were bound to construct urban form. And this was nothing new to the world. The concept of TOD had a different connotation at the beginning of the twentieth century, primarily related to the influence of this concept as an enabler on the real estate market. (Hank Dittmar, 2004) The idea of TOD had a different explanation by the beginning of the twentieth century, primarily related to the influence of this concept as an enabler on the real estate market. TOD was "development-oriented transit," meaning that once transit was established, the land was transformed, bringing jobs closer and giving the area a new development that increased the price of land.

Tracing back TOD's precedents would take us to Bristol, England in 1811. Blaise Hamlet constructed a group of cottages with asymmetric and picturesque aesthetics, where John Nash the English architect and pioneer of the picturesque aesthetic, created an inhabitable space where each cottage was unique surrounded by gardens and linked by an oval path that connected the cottages to one and the other around the sundial. For the Bristol workforce, these cottages were compact accommodation, situated in the vicinity of the factories with a walking orientation for transport. In its compactness and orientation towards a strong element of infrastructure, which in this case was a walking road, the above-described example was linked to the TOD theory.

The Bedford Park Master Plan of Jonathan Carr in 1875', following the beginning of transit-oriented development. For the middle-lower class that would no longer afford to live in the main city, Bedford Park was developed. The picturesque aesthetics that wanted to maintain the connection with nature but also provide a community inspired "Car". Bedford Park was an inspiration of the later garden cities, this project lacked the later garden cities planned social framework, but in this model, Carr provided a Club, a church and shops. Bedford Park was linked by rail to London's main station. To serve a large number of middle-class people who move daily neighboring to the station, shops, schools and events were built for people to use in their daily commute (w.Creese, 1992).

The utopian architecture of William Owen, Alexander Harvey and George Cadbury[8] in the late 1880s is close to the planned city of Bedford Park. They focused on improving workers' living conditions, inspired by the movement of arts and crafts.[3] As founders of utopian socialism, in order to improve living conditions, they built working villages, and leisure events were organized by communities and landscaped areas were always the secret to happy societies. The location of this project has been affected by the road and rail networks. But the place at the time was mainly associated with the movement of good and not people (Creese, 1992).

This village became the base of future garden towns and modern TOD, when Owen and Cadbury included Harvey for the construction of Port Sunlight. By specifying that one-tenth of the land should be allocated to parks and recreational areas, Cadbury introduced planning guidelines, he also mandated that not more than one-fifteenth should be occupied by factories. Since the land was privately owned by the soap factory, which requested the construction to house the factory staff, such rules were easily enforced, making this project an integral part of the future garden cities (Knox, 2011).

Another influence was the Boston utopia of Edward Bellamy in 1888. As he, in an antithesis to what it actually was, reflected society. Many social and economic ideas about the future projected many changes in the book "Looking Backward" that affected the planning sphere. Of course, his book was a utopian fiction at the time. (Bellamy, 1888)

A great contribution to Ebenezer Howard's growth of the Garden City was the planned Riverside settlement of Olmstead and Vaux in 1869. The Olmstead ideal of how suburbs should look was known to be the Riverside Neighborhood. Riverside was a suburb of Chicago connected by railway. Olmstead’s idea includes enough space for recreational activities, shaded parkways connecting Riverside with Chicago, streets

[8] *Founder of the comprehensive expression of the Arts and Crafts spirit:*

https://en.wikipedia.org/wiki/Architecture_of_Birmingham

that followed the curve of the land avoiding all right angles and intersection. He aimed to provide a romantic and scenic view of this community. (Ward, 1993)

Going back to the origin of the TOD starting with Ebenezer Howard who created a movement centered on satellite cities connected by rail transit access[9]. The concept of this movement was based in Real estate development with rail as the primary conduit between developed areas. Even though his ideas were based in London's deteriorated social condition the theory was translated in the U.S as well[10]. This movement occurred on the edges of most major U.S. cities of the time.

During the turn of the twentieth century, Sam Bass Warner traced the origin of development-oriented transit in Boston. The metropolitan area of Massachusetts as the phenomenon of the "a two-part city", the city of living separately from the city of working[11]. This phenomenon was the next phase of transit-related development. (Warner, 1978)

After the 1945 depression and lack of investments in public rail that followed WWII, the mass production of the private car dominated the transportation mode.
The reversal of this phenomenon was attempted in 1964 with the "Great Society" movement by the president John F. Kennedy. The idea was to preserve the existing urban values and provide good urban transportation with a balance of public and private transport systems. To enhance this balance, the suburban commuters accessed the public system with the "Park and Ride" idea.

In the 1970's the transport agencies created small real estate agencies to develop or lease the land near transport centers as a means to finance transport projects. This was indicatively called "join Development". (Cervero, Ferrell, & Murphy, 2002). During these years, until the 1980s, this development received great attention as a new

[9] *This movement was developed in "To-morrow: a Peaceful Path to Real Reform" in 1898, and again in 1902, within "Garden Cities of To-morrow.*

[10] *See case studies in Hilton Village (Newport News, VA), Chatham Village (Pittsburge, PA), Sunnyside & Jackson Heights (Queens, NY), the Woodbourne (Boston, MA), Garden City (NY), and Baldwin Hills Village (Los Angeles, CA).*

[11] *See Book Streetcar Suburbs: The Process of Growth in Boston, 1870-1900 by Sam Bass Warner, Jr. in 1962*

financial tool**.** And the local, regional and state authorities began to see that they could play a part in increasing ridership by guiding the type and scale of development on land near stations (w.Creese, 1992).

The modern definition of TOD as defined by Calthorpe relies on design guidelines that municipality is supposed to incorporate into the planning process. The first evidence of this was in the 1880s with William Owen and Alexander Harvey's late utopian designs for worker villages developed considering road and rail infrastructure.

The examples mentioned above as well the influence of Edward Bellamy in 1888 with the Boston Utopia or Olmstead's 1869 with the Riverside community influenced the development of the garden city of Ebenezer Howard. Howard's garden city was a circular diagram and consisted of housing with dwelling density limits and proximity requirements to the central core. A combination of multiple garden cities and connected by inter-municipal railways formed a metropolis of the garden city. Because of the great influence on neighborhood design, the garden city was the most influential precedent of the Calthorpe development of TOD.

In 1903 Howard formed a joint-stock company including Cadbury to develop Letchworth the first Garden city. A city focused on a garden surrounded by public buildings, and of which would radiate a series of avenues leading to residential areas connected by rail. The Master Plan included a central town square with radiating axes, a main commercial corridor, clearly defined along with residential, industrial and recreation areas that were planned into the design. And surrounded by a minimal greenbelt representing the "country." (Council, 2007)
Even though there were later influences the majority of Calthorpe's ideas were represented in the development of Letchworth**.**

Critics like Lewis Mumford supported the ideas of Raymond Unwin in the first decade of the 1900s stating that the best development of the garden cities should be supporting more the pedestrians and less the cars. These concepts were later supported by Calthorpe's developing guidelines.

Adapting to the Future in the 1920's Barry Parker designed a satellite garden city called Wythenshawe. This city provided much-needed housing for the metropolitan area of

Manchester. The difference between this model and the previous ones is the construction of “princess Parkway” a landscaped highway connecting the two areas. This showed the evolution of the concept as garden cities adapted to the future including the automobile.

Soon after the concepts of the garden cities started to shift towards planning with auto-focus. The concept of garden cities has adapted to auto-oriented countries losing their roots.

To illustrate this change from the natural and romantic garden cities to auto-focused planning we can consider Robert Moses planning for New York city. His idea was that cities and automobile were inseparable elements. His biggest opponent of this concept was Jane Jacobs[12]. She believed that the automobile should always be second to the pedestrian connections within the city.

In the 1970’s and 1980’s Leon Krier a German urban theorist revised classic philosophies as a response to modernism (sprawl). He looked into European cities at an urban blocks level, connected by pedestrian-oriented transport defining the 10-minute or quarter-mile walk human-scale neighborhood appropriate for people to walk. This concept was later incorporated into Calthorpe’s TOD as the main principle.

The concept brought to life by Leon Krier was first implemented in Florida’s Seaside resort town. This development offered all-in-one suburban solutions such as offering water features, bike paths, and shops all in the reach of Krier’s human-scale neighborhoods increasing density but preserving open spaces. Infrastructure radiated from the center connecting facilities and services with the automobile and alternative transport like bike routes and pedestrian ways. Concepts all incorporated into the modern TOD.
This rather controversial development concept is a living example into learning by implementation. Many of the components of TOD have seen a myriad of changes as the focus of the concept itself has evolved. Keeping in mind that on how the concept

[12] See Jane Jacobs “The Death and Life of Great American Cites” New York;1961

started and what were the later faced challenges we can simply state that, TOD is an ever-evolving concept.

Table 1. A timeline matrix on the development of TOD theory/ Source: Authors' elaboration

Author	Year	Project	Contribution to theory
John Nash	1811	Bristol, England	Picturesque aesthetics of planning with nature in mind, connected by transport (Walking)
Jonathan Carr	1875	Bedford Park	Developing near Transport and rail, providing services near the station as a service to people
William Owen & Alexander Harvey	1880	Planning Utopia	Nature in connection to the city (Later Garden cities)
William Owen & Alexander Harvey	1888	Port Sunlight	Cities with a focus on activities and public building connected by narrow paths
Edward Bellamy	1888	Utopia standards	People and nature connected by preserving 1/10 of land for recreation and urban parks
Olmstead & Vaux	1869	Riverside Community	The satellite city connected with the city by shaded parkway and narrow streets
Ebenezer Howard	1898	Garden cities	A city focused on a garden surrounded by public buildings, and of which would radiate a series of avenues leading to residential areas connected by rail and surrounded by a minimal greenbelt
Sam Bass Warner	1900	Boston	The two-part city, the working city and the

			sleeping city connected by a transit development
Howard & Cadbury	1903	Letchworth	The first Garden city of residential areas connected by rail
Lewis Mumford & Raymond Unwin	1910	Theory	Garden cities should focus on pedestrian transport
Barry Parker	1920	Manchester	Satellite connection of a landscaped highway connection for people and cars “Princess Parkway”
Robert Moses	1939	New York city	Cities and automobile should be one. (Transit-oriented development)
Jane Jacobs	1961	The death and life of great American cities	Cities, neighborhoods should be pedestrian to preserve the core of their values
Leon Krier	1970-1980	Seaside Community	People should be able to feel human, neighborhoods should provide transportation alternatives within a 10-mile radius of walking

The underlying principle is focusing on urban development around stations to encourage transit usage and constructing transit lines that connect current and projected clusters of development is (Bossard 2010). Global policymakers and planners are promoting this system in an effort to increase public transportation use and reduce greenhouse gas emissions while also providing better mobility alternatives for today's diverse lifestyles and business practices. A transit station has a distinct advantage over other urban development approaches in that it organically attracts people and businesses to the area.

In order for TOD to work, it relies on the three Ds of density, diversity, and design. Shared-ride services, public transportation, and non-motorized forms of transportation are all regarded to be related with these three aspects. In addition, these dimensions are expected to improve public transportation for both work and non-work travel. For

non-work excursions, a more compact location with nearby retail outlets and a pleasant walking environment is expected to encourage greater foot and bicycle travel and short-hop transport journeys. More people will utilize public transportation if the area is densely populated, multipurpose, and hospitable to pedestrians than if it is isolated, single purpose, and auto-oriented (Cervero, 1993). You don't have to limit a railway station's role to only serving as a point of departure and arrival; it may also be used as a gateway for newcomers. Just by emphasizing mixed activities in an otherwise boring setting, TODs generate a healthy and dynamic living environment, flourishing commercial centers, and busy recreational zones.

The three Ds determine the effectiveness of TOD (Cervero Robert 1997). It is considered that these three qualities are favorably connected with the use of shared-ride, transit or other means of non-motorized transportation or non-personal vehicles. For both work and non-work journeys, these dimensions are expected to improve public transportation. For non-work excursions, a more compact location with nearby retail outlets and a pleasant walking environment is expected to encourage greater foot and bicycle travel as well as short-hop transport trips. In a dense, pedestrian-friendly metropolitan area, people are more likely to use public transportation than in an auto-oriented suburban one (Cervero 1993).

4.3 Theory unveiling, Defining TOD

The five 'Ds' are commonly used as a framework for study in transit-oriented development research. Cervero and Kockelman (1997) introduced three, while Ewing & Cervero (2010) added two more linked to diversity and design. These 'Ds' may be used to assess the built environment in a number of ways.

Diversity. Diversity refers to the degree to which land uses coexist. There are several unique land uses. To create comparisons, various degrees of land use are compared across different locations in relation to other criteria, such as the proportion of transit users. Elasticity may then be calculated between the specified categories and values. Design. We're talking to the street layout in this instance. A street network connects straight streets in a metropolis to curved streets and cul-de-sacs in a suburban zone. Additionally, the block size, the number of four-way crossings, and the number of

intersections per square meter of land are included. Setbacks from buildings and highway width are only two examples of non-sidewalk urban planning components.

This approach determines the shortest route from a person's home or place of employment to a local railway station or bus stop. On a regional scale, one can determine the number of stations per unit area or the distance between stations. Obtaining access to the place. This pertains to the locations' accessibility. To put it another way, it relates to the location's closeness to prominent attractions. Destinations on a local or regional level are permissible. Regional accessibility can be quantified in terms of the distance to the city center or the number of employments within a defined time period. If you're close to the city center, going to your locations will be easy. Local accessibility refers to the number of companies and services located within a certain radius of a person's house.

“TOD promotes mixed use in buildings, high density and pedestrian- friendly development around transit to promote transit riding, increase walk and bicycle travel, and other alternatives to car use. Aims to promote development without adding to sprawl, freeing open space and adding public transportation” (Dittmar, 2003, p. 98)

Transit-oriented development (TOD) represents an integrated approach to transportation and land use planning. An often unspoken but key component to TOD theory is pedestrian access between the transit stop and the immediately surrounding area. (M. Venner, 2007) The ultimate goal of city and transportation planning is to enhance the lives of its residents. In order to achieve the quality-of-life aspirations of current and future generations, planners must thus aim towards sustainability.

To encourage people to utilize public transportation more regularly, it was planned that TOD be a compact, mixed-use town centered around a transit station. By concentrating on transit hubs and nodes, TOD strives to improve inhabitants' and tourists' quality of life by making it simpler to travel around on foot, bicycle, or public transportation. TOD may be utilized in a variety of ways to support smart growth and economic development. The value of an apartment located near a railway station was determined to be much more than the value of a comparable apartment located elsewhere. Along with mobility alternatives, accessible housing, and the prospect of increased income, TOD encourages a healthy lifestyle.

Additionally, TOD decreases the reliance on non-renewable energy sources and preserves open space. This may be accomplished by harnessing life-cycle energy to mitigate CO2 emissions, greenhouse gas production, pollution, and respiratory problems associated with smart growth. Among the five critical aims of an efficient TOD are location efficiency, choice diversity, value recovery, place development, and node-place conflict resolution. Transit-Oriented Development, or TOD, is a comprehensive phrase that incorporates anything from densifying metropolitan areas to maximizing the use of public transportation and supporting prudent growth.

4.4 Understanding TOD

TOD projects are commonly cited as effective strategies for increasing transit use and lowering vehicle use while simultaneously spurring local development and improving the quality of life in otherwise depressed places. TOD is a style of urban development that encloses a public transportation station in a mixed-use, pedestrian-friendly, densely constructed area. (2017) (Litman) Given that TOD is a complicated policy concept requiring the involvement of various stakeholders and levels of government over an extended period of time, we challenge the transferability of TOD theory and practice. These current research on TOD may be categorized into three groups based on their methodology: simulation studies, descriptive studies, and multivariate statistical analysis. (2001, Boarnetand Crane)

To quantify the influence of changes in urban design on travel behavior, simulation studies employ fictional communities and a travel demand forecasting model. One may argue that TOD was adopted long ago in the Netherlands: cities are tiny, with dense cycling and public transportation networks, and the nation is supplied by an enormous rail network. Nonetheless, metropolitan districts developed according to TOD principles, which have gained popularity in Asia, Western Europe, and North America over the last several decades, continue to face significant challenges. While TOD has gained popularity in the Netherlands as a transportation policy idea, its implementation has been riddled with obstacles. Several of the definitions in the table below can assist us in developing a fundamental knowledge of TOD and the relationship between TOD, land use, and transportation.

Authors	Definition	Year
Peter Calthorpe	TOD was suggested as a compact, mixed-use community that was based around a transit station to encourage residents, employees, and shoppers to drive their cars less and to use mass transit more	1993
Salvensen	Development around a transit station providing opportunities for a diversity of land uses in a specified geographical area, development within a specified geographical area around a transit station with a variety of land uses and a multiplicity of landowners	1996
Boarnet and Crane	The practice of developing or intensifying residential land use near rail stations	1998
Still	Mixed land use development encouraging people to live around the transit services, at the same time decreasing dependence on a private vehicle	2002
Cervero, R / Ferrell, C / Murphy, S	A transit-oriented development (TOD) system is mainly designed to enhance the use of public transport/transit and to create an urban setting providing pedestrian-friendly environment.	2002
Tom Still, Zane Bishop, Hank Dittmar & Gloria Ohland, Carey Curtis, Peter Calthorpe	TOD promotes mixed use in buildings, high density and pedestrian- friendly development around transit to promote transit riding, increase walk and bicycle travel, and other alternatives to car use. Aims to promote development without adding to sprawl, freeing open space and adding public transportation".	2003
Transit Oriented Development Institute	Transit Oriented Development (TOD) is a new concept focusing on efficient modes of transportation other than the automobile.	2015
Transit Link network	TOD was defined as a combination of land use and transport planning that makes walking, cycling, and public transit use more convenient and attractive, while also optimizing the capacity of existing transit services by concentrating on transit hubs, and nodes	2012

Table 2 Collection of definitions found in literature. Source: own elaboration

Coming into our own realization, for the purpose of this thesis we will use our own elaboration of the definition as stated bellow:

"TOD is a model of development which relays on "A mixed-use community and transport planning", Aims to promote dense development, freeing open space and adding public transportation"

It is hard to build a universal TOD idea as each area is distinct in character, usage, historical traits, and future advancements. Three Australian cities, Newcastle, Hobart, and Geelong, are being researched for the impact of TOD under the light of these factors. Because of their waterfront position and trade-related history, these areas have a particular urban identity. Mining was a huge industry in Australia in the early nineteenth century, and the British created colonies there to take advantage of the country's natural resources. Coal-mining ports Newcastle and Hobart were built, while Geelong was developed during the gold rush. The rise of these cities relied significantly on transportation, whether it was rivers, railways, or roads. As a method of reinvigorating their identities and building a sustainable, walkable, and healthy urban environment, these cities' governments are paying attention to this piece of their past.

Much of the complexity associated with transit-oriented development stems from the conflict between practical considerations and idealistic objectives. Various TOD definitions incorporate performance metrics such as walkability, density, and location efficiency alongside normative ideas such as livability, diversity, and livability (Cervero, 1998; Dittmar & Ohland, 2004; Reconnecting America, 2007; and Renne, 2008). Mixed-use residential and commercial developments with an appropriate density, an optimal grade, and a focus on (and walking distance from) public transit hubs are at the heart of these TOD requirements.

Urbanization is accelerating at a rate that cannot maintain our current way of life permanently in a planet with finite resources (such as land and fossil fuels) (Newman & Kenworthy, 1999; Tan et al., 2010). As a possible answer to this issue, discussions

on more compact and efficient modes of urbanization and transportation have been launched (Newman & Kenworthy, 1989).
A related trend is a greater emphasis on integrated land use and transportation planning, with a particular emphasis on sustainable mobility and urban growth (Banister, 2008; Bertolini et al., 2005; Collia & March 2012, Goldman & Gorham 2006; Jabareen, 2006).

In contrast to traditional transportation planning's 'predict-and-provide' storylines, sustainable mobility is concerned with people's life and travel choices, as well as their objectives and goals for specific areas (Banister, 2008). As a result, these strategies emphasize the integration of land use and transportation, emphasizing the critical interplay between transportation networks and land use (Hall, 1994). TOD is the logical conclusion of this link. A diverse range of perspectives and expertise from several social sciences interested in TOD invariably results in divergent and sometimes contradictory discussions and evaluations that call into question the sustainability, cost-effectiveness, and justification of TOD (Bartholomew & Ewing, 2011; Debrezion et al. 2008, Gordon & Richardson 1997; Jarvis, 2003; Newman and Kenworthy, 1996; 1999; Lund, 2006; Smith & Gihring, 2006; Smith & Gihring, 2006). While this research acknowledges earlier disputes over whether or not TOD should be adopted, it focuses on how TOD may be implemented, if desired, and what factors and situations contribute to its success.

A TOD is more than a stop for public transportation; it is also a destination for shopping, dining, and socializing. It is a gathering point for people and a site where urban development takes on a more dispersed but yet centralized shape (Bertolini 1999). Researchers are rapidly recognizing that TODs exist in a variety of shapes and sizes and that each TOD performs a distinct but complementary function in a system.
(2014) (Kamruzzaman et al.). Thus, a typology based on the region's urban form, transportation patterns, and public interactions may be built. A few TOD typologies have been developed in the literature, and they will serve as a conceptual foundation for developing regional city design aspects (Bertolini 1999).
They acknowledged that TODs are not a one-size-fits-all solution and proposed the following variations for construction in the region: city center, activity center, specialized activity center, and urban, suburban, and neighborhood TODs (Plan 2009).

4.5 The context of TOD

Peter Calthorpe codified the concept of Transit-Oriented Development (TOD) in the late 1980's and, while others had promoted similar concepts and contributed to the design. TOD became a fixture of modern planning when Calthorpe published "The New American Metropolis" in 1993. TOD has been defined generally as "a mixed-use community that encourages people to live near transit services and to decrease their dependence on driving." Calthorpe saw it as a neo-traditional guide to sustainable community design. Beyond its definition of built form, it was also a community design theory that promised to address a myriad of social issues. (Bertolini, 2007, p. 62)

Calthorpe, a student of the environmental sustainability movement, developed TOD to address the ecology of communities. He also saw TOD as an easily comprehensible solution for regional growth.

Transit oriented development around the world has been a priority of many cities. The concept itself seems quite simple, with an integration of transport and urban development under the umbrella of TOD. (Dittmar, 2003) However, the simplicity of the concept stands beyond the concentration of development around stations and nodes. However different, the context in which this concept is materialized, the argument of increased accessibility takes priority to the automobile-based alternative. (Bertolini, 2007)The concept aims to increase the possibility of choice in transportation today, almost touching the urban quality of life paragon that in a TOD reality has an almost forced interaction, in comparison to the isolated private "my car" urban environment.

Competing with principles of "fast or speedy" transportation and slow but accessible nodes is the one of the central ideas of the transit-oriented development. The successful TOD would obey these principles in the presence of high-density development and short distance between nodes. (Curtis, 2009).

By focusing on local livability and minimizing transportation footprints, TOD is an integral aspect of both smart growth and new urbanism. Promoting both a move away

from automotive reliance and, as a point of contention, a justice of social cost and sustainable responses to the segregated boundary (considering the impact that this theory has on the real estate market and value) (M. Padeiro, 2019).
In recent years, the focus of many studies on TOD shifted to examine the issue of causality between the built environment and travel behavior.

TOD tactics are frequently justified on the grounds that they would result in both social and economic advantages. For example, they will reduce CO2 emissions, limit urban sprawl, and result in greater property (real estate) values (Cervero & Kockelman,1997; Rene & Wells,2002). Even in vehicle-oriented cultures such as North America, research indicates that car ownership and use are lower among households located near train stations.

Numerous urban regions in the United States have adopted the idea of transit-oriented development (TOD) during the last two decades in an effort to mitigate and manage the negative environmental and social consequences of scattered growth patterns (Porter 1997). TOD, it is argued, will enhance pedestrian and transit journeys while decreasing the number and duration of automobile trips, so contributing to the livability that some perceive to be lacking in contemporary suburban development (Calthorpe 1993).

ToD can only produce the requisite development potential in the vicinity of nodes if they are connected by rapid transit systems and provide the necessary transportation diversity of modes (Curtis, 2009).

4.6 The shift of TOD

4.7 Mitigating the problems associated with Sprawl

Although TOD is referred to differently around the world under terms such as smart growth, urban form, new urbanism, walkable communities, neo–traditional neighborhood or development, activity centers, new community design, transit village, and transit supportive development, the benefits sought are the same. Multiple parties are involved in the planning and execution of a TOD, including state and local governments, landowners, financing agencies, developers, design experts, investors,

management agents, residents and occupiers, public interests, and community interests (Dittmar and Ohland, 2004). The success of TOD becomes a complicated phenomenon as a result of the engagement of so many stakeholders.

“Transit–Oriented Development (TOD) is moderate to higher–density development, located within an easy walk of a major transit stop, generally with a mix of residential, employment and shopping opportunities designed for pedestrians without excluding the car. TOD can be new construction or redevelopment of one or more buildings whose design and orientation facilitate transit use.” (Parker et al., 2002)

Urban lifestyles and population expansion have significantly altered the travel demands of urban residents, increasing average journey lengths and reliance on individualized means of transport, most notably the vehicle. The implications of these changes are visible in the form of increasing pollution and congestion on roadways, which results in longer travel times (BTRE, 2007).

The conclusion reached by multiple academics that a robust local economy is critical for effective TOD provides insight into why newly constructed TOD is largely absent from many older, slow-growth towns such as Buffalo, New York, and St. Louis, Missouri. It also sheds light on why the TOD tendency is most pronounced in high-growth metropolitan regions such as San Diego, California, and why it appears to bypass suffering districts within them, such as South Central Los Angeles, California (Daniel Baldwin Hess, 2004).

Porter (1997) concludes in a study of TOD across the United States that rail tends to drive concentrated development in regions such as major business districts where transportation is readily available and vehicle traffic is congested and expensive to park. Another research discovered that rail alone is insufficient to spur growth; strong market forces and supporting government policies are also required (PBQD 1996).

4.8 The Typology of TOD

Transit-oriented development (TOD) is frequently characterized as mixed-use development located near or next to public transportation. TOD is characterized by

urban compactness, pedestrian and bicycle friendly corridors, public areas next to stations, and stations meant to function as community hubs (Transit Cooperative Research Program (TCRP), 2002). TODs are classified as follows: (1) new towns developed around new public transportation services; (2) high-density TODs in which new public transportation services are provided within existing, compact, mixed-use areas; and (3) low-density TODs in which the density and diversity of existing, suburban-style neighborhoods adjacent to public transportation services is increased (DeVos, Van Acker, & Witlox,2014). In sections of Asia, North America, and Europe, the TOD strategy extends beyond stations to reorganize entire metropolitan areas around rail transportation (Knowles,2012; TransLink,2012).

Prior to the 1990's, TODs were viewed as a kind of successful real estate development, utilized to generate income for transit agencies and the government, and were judged only on a financial basis rather than on the basis of sustainable transportation principles.
Newly planned development is now widely acknowledged by planners as requiring both a reduction in total vehicle use and a concentration of urban movement patterns around single Central Business Districts (CBD).
In layman's words, transit-oriented development is defined as mixed-use planned development centered on a major public transportation hub.

Transit-oriented development (TOD) is frequently characterized as mixed-use development located near or next to public transportation. TOD is characterized by urban compactness, pedestrian and bicycle friendly corridors, public areas next to stations, and stations meant to function as community hubs (Transit Cooperative Research Program (TCRP), 2002). TODs are classified as follows: (1) new towns developed around new public transportation services; (2) high-density TODs in which new public transportation services are provided within existing, compact, mixed-use areas; and (3) low-density TODs in which the density and diversity of existing, suburban-style neighborhoods adjacent to public transportation services is increased (DeVos, Van Acker, & Witlox,2014). In sections of Asia, North America, and Europe, the TOD strategy extends beyond stations to reorganize entire metropolitan areas around rail transportation (Knowles,2012; TransLink,2012).
To begin with, TODs were designed to be successful real estate developments that generated income for transit agencies and the government. They were assessed only

on the basis of their financial viability, rather than on the basis of sustainable transportation principles.

According to planners, new construction must minimize total car usage as well as the concentration of urban travel patterns towards single Central Business Districts, and this is now widely acknowledged by the public (CBD).

A transit-oriented development is defined as a mixed-use planned development that is located near a major public transportation hub.

TOD Type	Land–use mix	Minimum housing density	Housing types	Scale	Regional connectivity	Transit modes	Transit frequencies	Examples
Urban downtown	**Primary office center, urban entertainment, multifamily housing, retail**	**>60 units/ acre (> 148 units/ ha)**	**Multifamily loft**	**High**	**High Hub of radial system**	**All modes**	**< 10 minutes**	Printer's row (Chicago), LoDo (Denver), South Beach (San Francisco)
Urban neighborhood	**Residential, retail, Class B commercial**	**> 20 units/ acre (> 50 units/ ha)**	**Multifamily Loft Townhome Single family**	**Medium**	**Medium access to downtown subregional circulation**	**Light–rail Streetcar Rapid bus Local bus**	**10 minutes peak 20 minutes off peak**	Mockingbird (Dallas), Fullerton (Chicago), Barrio Logan (San Diego)
Sub urban center	**Primary office center, urban entertainment, multifamily housing, retail**	**> 50 units/ acre (> 124 units/ ha)**	**Multifamily Loft Townhome**	**High**	**High access to downtown subregional hub**	**Rail Streetcar Rapid Bus Local bus Paratransit**	**10 minutes peak 10-15 minutes off-peak**	
Suburban neighbourhood	**Residential neighbourhood, retail, local office**	**> 12 units/ acre (> 30 units/ ha)**	**Multifamily Townhome Single family**	**Moderate**	**Medium access to suburban center Access to downtown**	**Light-rail Rapid bus Local bus Paratransit**	**20 minutes peak 30 minutes offpeak**	Crossings (Mountain View, CA), Ohlone–Chynoweth (San Jose, CA)

Neighbourhood transit zone	**Residential neighbourhood, retail**	**> 7 units/acre (> 17 units/ha)**	**Townhome Single family**	**Low access to a centre**	**Low**	**Local bus Paratransit**	**25-30 minutes demand responsive**	
Commuter town center	Retail center, Residential	> 12 units/acre (> 30 units/ha)	Multifamily Townhome Single family	Low	Low access to downtown	Commuter rail Rapid bus	Peak service Demand responsive	Prairie Crossing (Illinois), Suisun City (CA)

Table 3 New Transit Town, Dittmar and Ohland 2004, Author's collection and conclusion

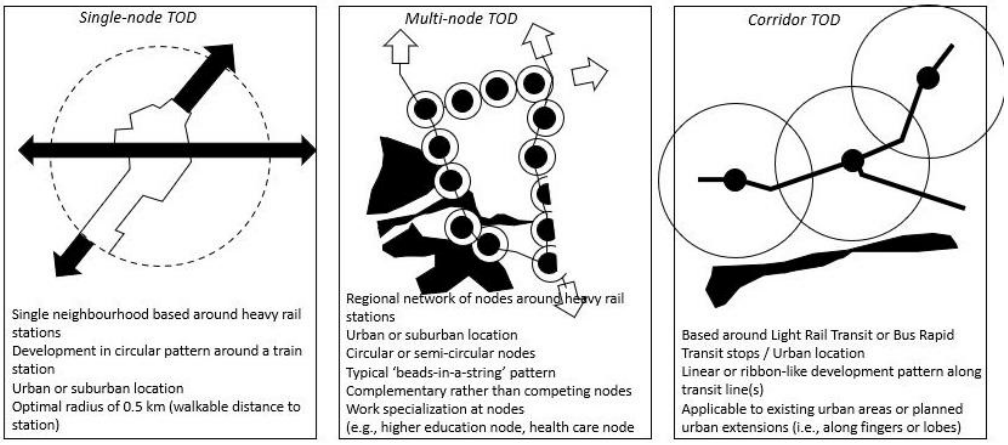


Figure 13 The Typologies of TOD, a comparative typology selection between the case studies and the classic typology/ authors personal library

However, while the fundamental principle of planning and creating TODs stays the same, the results are diverse, with each TOD having its own set of characteristics. It is depending on the quantity of land that is available and devoted for this purpose that the TOD will be large or little. Urban TODs support a significantly bigger commercial and office or employment area, as well as a higher density of residential uses, compared to rural TODs.

Urban TODs are typically constructed with a minimum residential density of 30 dwelling units per net hectare and an average residential density of 45 dwelling units per net hectare, whereas rural TODs are typically designed with a minimum residential density of 17 dwelling units per net hectare and an average residential density of 25 dwelling units per net hectare (Calthorpe, 1993; Gatzlaff et al., 1999). To categorize distinct TODs at various levels based on the variations between places and destinations within regions, as well as to find the most relevant performance measurements and

descriptive metrics benchmarks, a TOD typology is defined as listed in Table 2.1. The TODs are classified with respect to location, size, and transit type.

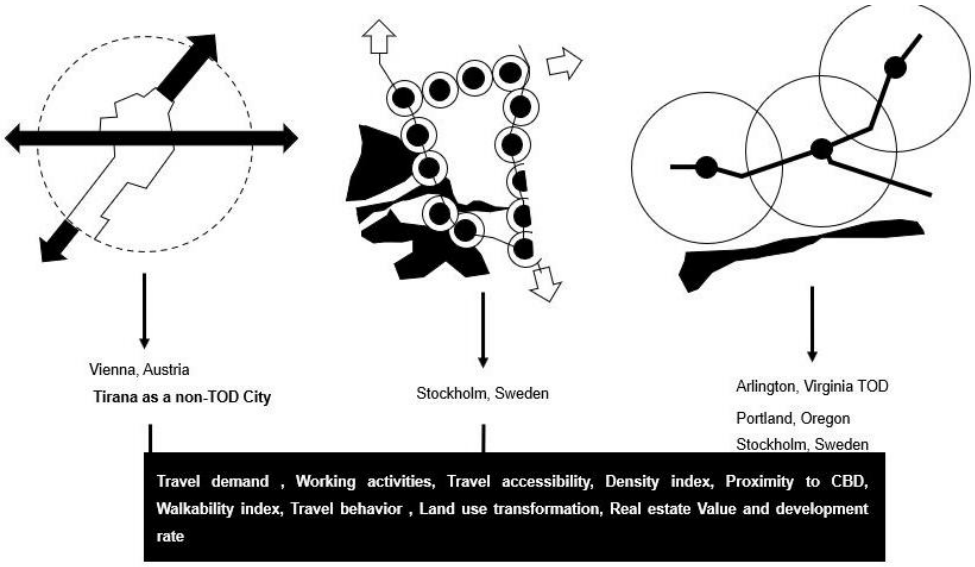


Figure 14 The Typologies of TOD, a comparative typology selection and sub components between the case studies and the classic typology/ authors personal library

4.9 The components of TOD

Developing under the TOD “wing” to support urban challenges is now a common practice. As a tool to address key challenges such as increased transit ridership, sprawl, accesses to service, a number of authors have attempted to translate the main components of TOD development.

4.9.1 Density

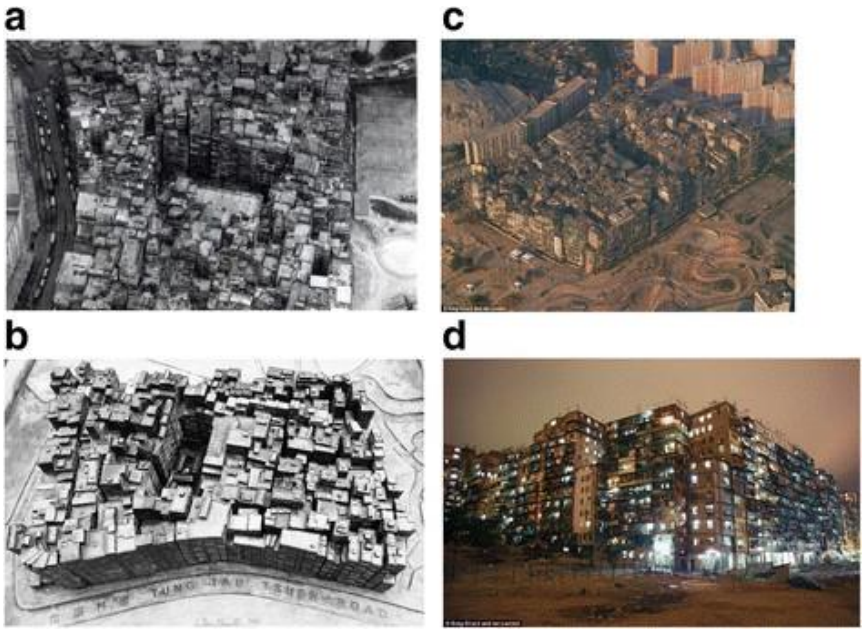
Density appears to be a good notion for planners because it is objective, quantifiable, and impartial at first appearance. (Churchman, 1999) The ratio of a city's total population to its whole area is sometimes referred to as urban density. This is the most appropriate single statistic for tracking urbanization progress, and it is currently a key goal of the global climate change agenda. The ratio of the total number of individuals living within a well-defined footprint of a city to the total area of this footprint is known as urban density or, more precisely, urban population density. Densification, or increasing urban density, has been rightly identified as a worthy environmental goal.

First, because urban density translates population into land consumption: a city with a given population will occupy a smaller geographical footprint, requiring less conversion of the surrounding countryside to urban use. Second, residents in a more compact city with a higher population density will be closer to one another. In 1592, Queen Elizabeth I issued a proclamation to limit London's growth, but it failed. The construction of new and satellite towns, as well as the adoption of green belts and urban growth boundaries, have all been used to help decongest core city regions and absorb population expansion.

Density, perceived density, and crowding are three terms used to address the topic of density and how it impacts people's lives (Alexander, 1993). The term "density" refers to the relationship between a physical region and the number of people who live in or use it. It's calculated as a ratio of population size (the numerator) to area units (the denominator). It's neutral in the sense that it's impossible to tell if a certain density level is positive or negative right away (Churchman, 1999).

A particular number of individuals within various sized spaces creates spatial density. The concept of perceived density and crowding is founded on the idea that the same density can be perceived and judged in a variety of ways by various people, in a variety of situations, and across cultures and countries. Perceived density is a person's perception and estimate of the number of people in a given place, the available space, and the structure of that space. Crowding is defined as an individual's subjective assessment that a certain density and perceived density is unfavorable. Density, as an objective and quantitative phrase, may appear to be unproblematic, however this is not the case simply because, there is no universally acknowledged metric of density that can be used to compare countries or even metropolitan areas. (Alexander, 1993) The phrase "urban density" refers to the dimensions of interactions between attributes of urban substance and existence, such as the number of homes or people per hectare. The assessment of various aspects of urban density provides essential data for city planning, development, and management. Considering this urban density is largely dependent on the context, the “good” and “bad” of urban density is related to a large component of indicators, both vertical and horizontal. (The Swedish National Board of Housing, 2017) The Kowloon Walled City in Hong Kong, for example, was demolished in 1992-93 due to its extreme density and poor living conditions. The bronze replica of Kowloon Walled City in the center of a public park where it once stood is all that survives

of the Hong Kong legend today. [13]The Kowloon Walled City was a densely packed superblock with a population of over 50,000 people. Until 1994, Hong Kong's Kowloon Walled City was one of the city's and world's densest self-built constructions for the Chinese community.



Kowloon Walled City in Hong Kong; it earned its Cantonese nickname 'City of Darkness' (photo around 1989)

In many ways, the Kowloon Walled City is a microcosm of Hong Kong's metropolitan environment. The Kowloon Walled City shows that a high-rise, high-density urban environment as extreme and abnormal as itself does not have to be brutal and uncomfortable but can be a vibrant and highly livable city. The city of Hong Kong's prosperity is largely due to its residents' refusal to accept the disadvantages of living in a cramped and congested environment (Greg Girard, 1993).

[13] *The Kowloon Walled City was in the heart of Hong Kong, which was once a British colony but is now a Chinese special administrative area. With 359 tenement buildings sticking together on this plot of land at a height of 10 to 16 stories, it was a conglomeration of buildings that formed a living and breathing organic creature. Its area coverage is 2.9 hectares (roughly four football fields),. The Kowloon Walled City seeks to put this to the test, as Hong Kong is one of the world's densest cities. It pushed the living environment of mankind to a surrealistic extreme, with an average of 13,000 people per hectare compared to 91 people per hectare in New York City.*

4.9.2 Walkability

Walkability is about the ability of crossing a distance of space on foot. A pedestrian is defined as "a person who travels on foot rather than by car." As a result, pedestrian activity is characterized as a method of transportation comparable to motor means of transportation such as driving, cycling, and using the train. This lack of focus on pedestrian planning shows that it is either not considered a critical component of the transportation system, or that it is considered too little to warrant significant investment in research, planning, and design.

Walkability has only recently been recognized as a key component of efficient, accessible, equitable, sustainable, and livable cities in the post-modernist planning age. Walkability metrics that consider the physical environment at a finer level are discussed in urban design debate. Although little effort has been invested to understand how to maximize areas for pedestrians, how we define walkability has huge consequences for our knowledge and design of urban transit networks and public spaces (Lo, 2009).

Some considerations of walkability concentrate on the means or conditions that permit walking, such as locations that are traversable, compact, physically appealing, or safe. Others argue that walkability refers to the effects or performance of such walkable surroundings, such as making locations livelier and more convivial, improving transportation options, or encouraging physical activity. Since at least the eighteenth century, the term "walkable" has been used (Oxford English Dictionary,2014). Walkability, on the other hand, is a more contemporary concept that is rarely defined in dictionaries but is widely used. Finally, walkability is frequently utilized as a proxy for improved design of pedestrian-friendly urban environments. [14]The need for understanding regarding the walkability of the built environment is expanding. Walking in the city has been studied in urban planning, design, and transportation research (Gehl, 1987).

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[14] *Books by Christopher Alexander, Jane Jacobs, Kevin Lynch, William Whyte, Gordon Cullen, and the Responsive Environments group can all be found in the same ideological school. It's also known as "people-centered urban design."*

There is also a rising branch of research known as "walkability" research, which is a multidisciplinary style of research that originated in the preventive medicine profession and focuses on the health benefits of walking. Through statistical analysis of the amount of time spent walking and aspects of the built environment, walkability studies have produced evidence that individuals' walking behavior is related to the state of the urban form. Some significant aspects in the walkability of urban form, such as density, connection, and land use, have been characterized by previous findings from transportation and urban planning research and contemporary walkability studies.

Physical activity and the existence of varied land uses have been demonstrated to have favorable connections in previous studies. While 'walkability' studies frequently measure and analyze walking by the amount of time spent walking by individuals, there is also urban design research dealing with pedestrian movement with an empirical-quantitative approach that frequently deals primarily with collective patterns of behavior and their relationship to the physical environment. Walking behavior has been treated as a very simplistic concept in most urban planning and design research that examines walking in the urban environment, frequently grouped under the label "walking" or "pedestrian mobility."

Walking activities differ in terms of effort, goal, efficiency, frequency, continuity, intensity, and duration, among other factors. Some recent walkability research has highlighted the necessity of recognizing these distinctions in order to have a better understanding of how the built environment might support walking (Rodríguez, 2006), (Land Use Mixing and Suburban Mobility, p. 125)

4.9.3 Public transport

In terms of the material road, urban circulation and transportation ideas are related to actions that are comparable to each other. Examined is the role of historical accessibility and road networks in the development of transportation and circulation systems. The supply-demand analysis for urban transportation, as well as the types of urban transportation and the agents that provide them, as well as rural and urban transportation networks, are all kept. Urban land use, function allocation in urban land,

and matching activity patterns are all related with circulation-access patterns in order to depict transportation economics, as well as future roles and developments in the transportation industry. Approximately what percentage of the population lives within 500 meters of a public transportation station is the official global core indicator for SDG[15] (which equates to a walking distance of around 5 minutes). While this indicator is significant as a globally consistent metric, it will fall short of demonstrating how urban public transportation is 'growing' as the SDGs intend. Indicators may be quite useful in assisting cities in determining their needs and performance, which is essential for identifying new financing options. Measuring walking and public transportation combined provides a far more accurate picture of how people really move and what they require for transportation.

Typically, these are neighborhood-level evaluations of the quality of pedestrian and public transportation infrastructure, rather than national or international standards. In an effort to keep the system as practical and economical as possible, the quality measurements have adopted a "traffic light" (Red-Yellow-Green) value grading system whenever possible.

It is advised that existing metrics and definitions be used to provide more uniformity whenever possible (UITP, 2019). Indicators of sustainable urban mobility are an important tool for cities and urban regions to utilize in identifying the strengths and weaknesses of their transportation systems and focusing on areas that need to be improved.

As cities and urban regions continue to construct Sustainable Urban Mobility Plans (SUMPs) and work toward achieving EU policy objectives, it is critical that their progress be documented in order for their accomplishments to be recognized. In different regions, urban areas have varied shapes and characterizations, and urban growth patterns are diverse as a consequence of disparities in socio-economic, cultural, historical, and environmental characteristics.

[15] *Sustainable development Goals, more info can be found at: https://ec.europa.eu/futurium/en/system/files/ged/convenient-access-to-public-transport.pdf*

For example, in the United States, individuals choose to live in low-density, single-family homes and drive to work. On the other hand, high-rise residential structures dominate the Japanese landscape, while employees travel via public transit (Yamagata, 2014). Priority should be placed on assessing the relationships between network infrastructure, socio-economic indicators, and the performance of the transportation system based on existing city experiences; understanding how cities are shaped by setting the appropriate transport priorities can aid in the achievement of sustainable mobility objectives; and understanding how cities are shaped by setting the appropriate transport priorities can aid in the achievement of sustainable mobility objectives.

Due to the fact that transportation networks are critical components of urban environments, their long-term viability is critical in attaining complex urban sustainability. Despite the fact that there are no complete and commonly agreed definitions of both urban sustainability and sustainable transportation, the assessment of urban sustainability is now a hot topic in a variety of scientific disciplines. The first step in identifying the key difficulties, barriers, and intervention areas in the transportation sector in cities is to define what is meant by sustainable urban transportation in the first place (A. Buzási, 2015).

4.9.4 Mix-use

The traditional economic theory of urban spatial structure predicts that urban land cover will expand as a function of population and affluence, as well as a result of a reduction in the cost of transportation (S . Angel, 2011). Buildings with three or more purposes, such as residences, hotels, retail stores, parking lots, transit hubs and cultural and entertainment venues are categorized as mixed-use buildings. Whatever the mix, it brings together a variety of applications in a single structure or a limited space. Vertical. Because it is a single, multi-story structure, a common combination includes residences on the higher floors and retail or office space on the ground floor. Parking and/or access to subterranean public transportation are both available on the basement level.

Horizontal. These separate structures, which are spread throughout a number of buildings, such as a city block or around an open space or courtyard, serve one or two

unique functions while establishing a microcosm inside a community by serving one or two distinct functions. As urban populations continue to grow, there is increasing demand on structures to "do more with less." A successful design for a mixed-use complex, on the other hand, entails more than just packing as much as possible into a single structure.

TOD must take into consideration the requirements of its future residents, as well as the influence on its surroundings and the potential benefits to the surrounding community.
A structure with many functions that responds to the demands of its surroundings helps to create different neighborhoods by allowing people to live in more than one place. Despite the fact that mixed-use buildings are environmentally friendly, there are other advantages to these structures besides saving resources. They assist us in rethinking how we may construct metropolitan places in such a way that expanding urbanization becomes a gift rather than a hindrance to our lives. When seen in its broadest meaning, mixed use zones are composed of a variety of purposes such as residences, shops, restaurants, cultural centers, institutions, and manufacturing facilities that are physically integrated at various sizes, intensities, and combinations.

A wide range of functions enables people to coexist in one location while also working, relaxing or shopping; this place then becomes a vital activity destination for people from other areas, which can increase economic viability and security of space by increasing the number of people on the street and in public places. It is the notion of effective use of urban areas and infrastructure that serves as the foundation for the concept of multi-function areas and spaces. This is achieved by bringing everything people require as close as possible to their places of living. Different functions being located within the limits of quarters and districts will aid in the promotion and preservation of economic growth.

This method saves a significant amount of area while also meeting the growing demand for homes in the city center and accommodations close to sources of employment (A.V. Vorontsova, 2016).

4.9.5 Proximity

The ability to effectively access public and human services when they are needed is essential for population health and well-being and for functioning communities. Standards of proximity are indicated by law, specific to countries. Things such as schools, healthcare centers etc. (Urban Journal for future cities). Find yourself close to what you are looking for, to something you need.In order to guarantee that individuals can easily get the goods they need on a daily basis, planners must design mixed land use zones (shops, schools, health care, employment etc.).

This reduces the need to travel and encourages the development of thriving, diversified communities in the immediate area (Dena Kasraian, 2019). The ultimate facilitators of proximity are transportation and land use planning. It is up to our urban structure, including density, authorized uses, and transit patterns, to support or impede economic development. Despite the best efforts of many corporate and civic leaders, the current transportation paradigm in the United States places too much emphasis on traffic and not enough on distance.
Physical closeness was the aim in each case. Clustered buildings and streets helped connect as many areas as feasible over small distances in the era of walking, biking, and shared trips on carriages or streetcars. Prioritizing closeness on a human scale and the resulting reduction in travel time. As a result, short-distance travel benefits from an urban shape that encourages this mode of transportation.

- By encouraging agglomeration and the expansion of local enterprises and economies, proximity has a contagious effect. Urban economies gain from locating people and businesses close together (or clustering), as this reduces travel time and encourages the sharing of information. Agglomeration may be encouraged by creating cities and suburbs that encourage closeness, such as dense, diversified, and pedestrian-friendly areas.
- Community fiscal responsibilities are reduced when people are closer together. Cities and suburbs require less infrastructure—not only roads, but also water pipelines, broadband networks, and electricity lines—to function

when they use less area. This lessens the cost on the taxpayers to create and maintain the initial infrastructure.

- It is easier to go about when you are close to where you want to go. The closer individuals and destinations are to one other, the more likely they are to consider walking, biking, or taking particular means of transportation. By encouraging more individuals to walk, cycle, or utilize public transportation instead of driving, households will be able to save money. People of all ages, especially those who can't drive, benefit from increased proximity between people and locations.
- For achieving carbon reduction goals and building more resilient communities, proximity is key. The transportation industry is presently the most polluting, and personal automobiles are the primary cause. More non-driving journeys will lead to greener transportation since proximity encourages non-driving demand. While sprawl has its own environmental costs, such as increased per capita stormwater runoff and energy usage, it also has its own drawbacks (Bank, 2019).

4.9.6 Scale of implementation

Cities will have to adapt and evolve to better manage their resources, infrastructure and human capital if they are to remain successful. This is, in essence, the concept of ‘futureproofing’. Future proofing cities is about utilizing and developing the capabilities of cities to respond to the risks and challenges of the next century and beyond. (Green, 2018)

There is no one-size-fits-all approach to creating thriving societies. The Portland region's station areas (the 12-mile area surrounding fixed-guideway stations) have a diverse mix of intensities and land uses. Many of the station's zones are mainly
Others are more jobs-oriented and high-intensity, while others are more residential and low-intensity. As a result, the types of TOD investments that are needed in the
Mixed-use development is characterized as pedestrian-friendly development that blends two or more residential, commercial, cultural, institutional, and/or industrial uses. Mixed use is one of the ten principles of Smart Growth (Wagner, 2014).

Every Building will be a city within a city, with all the services that they will need, without having to step outside the building. In this study, urban planning and land usage were interwoven by their nature. Planning control indices and landscape metrics were developed to evaluate the physical outcomes of planning implementation, and underlying issues contributing to the discrepancy between planned and actual outcomes were discussed (Eizenberg, 2019).

4.9.7 Security

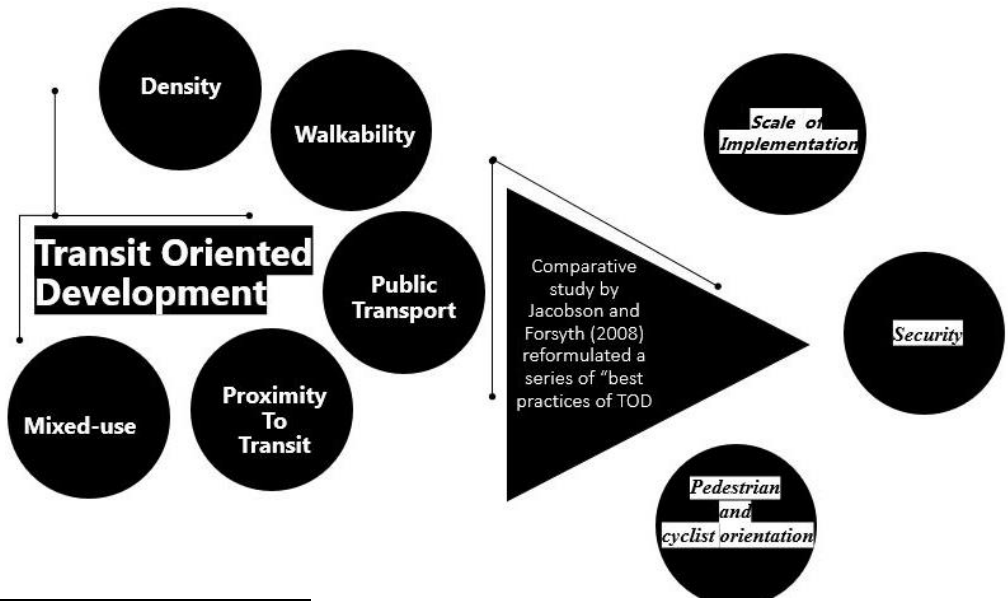
Understanding urban security entails first tracing the semantic bounds of the world we want to convey before the physical ones. The first topic to ponder from a social science viewpoint is what it means to be secure. Coercive authority, which was held by the state, was also assigned to police and armed forces, which were responsible for preserving domestic and foreign order.
This growing political prominence of the city raises the second preliminary question of what it means to talk about urban security in the modern day. History shows that cities have always been favored as battlegrounds, from the ancient sieges and medieval world to the World War I terrorist attacks (Graham, 2004). (Coward, 2009) An individual's sense of community has been best conveyed by referring to themselves as a "country" since the eighteenth century.

Using this concept, we were able to delineate the boundaries between the legitimate space within a sovereign authority and the legitimate space outside of a sovereign authority. (Stephen Graham, 2001). the gated community phenomenon was fueled by the same thinking that led to the creation of defensible areas in urban planning and its speculative-real estate consequences. For the most part, urban policing methods rely on utilizing the enormous new potential that have been provided by the growth of Information and Communication Technology (ICT) (Armao, 2016). Several variables, some of which are connected with urban planning, impact the degree of real or perceived security in a given area at the local level. Cities' spatial design is shaped by urban planning, which has a direct impact on social segregation and inhabitants' perceptions of urban security. People's sentiments of insecurity are influenced by how public areas are planned, designed, and managed, according to several studies.

Securing public spaces by design[16] is another term for this approach, in which security elements are considered from the outset of the design process, taking into account their openness and interaction with the surrounding urban environment (Tulumello, 207). Due to the tripartite nature of urban security (or community security), it is a political issue rather than a "social problem" that can be dealt with in a neutral manner.

4.9.8 The Translation of Components

This part will focus mainly on how the main components of TOD are translated into our case studies, considering each component and the context in which they are applied. According to these researchers, instead of focusing on the diffusion of ideas and practices between businesses, translation is the key to understanding how change occurs. When an idea is both transported and transformed at the same time, translation occurs. As a result, a concept's spread does not follow a linear model of diffusion but is instead transformed into various meanings and articulated in a non-linear fashion across documents and local activities. It views sustainability as a series of interconnected components that also work and integrate in a variety of different sizes. The purpose of this research is to examine the enormous and widespread effect of western urban planning paradigms on non-western contexts.



[16] *As defined by the Urban Agenda for the EU Partnership on Security in Public Spaces, "security by design is an all-encompassing concept and a new culture that needs to be developed across European cities.*

Figure 12. The components of TOD, a comparative study of the classic components found in TOD definitions and project / Authors elaboration

4.10 The components and principles of TOD-Density, diversity and design

Most of the existing studies on TOD focused on the suburban areas and greenfield sites, in which the transit system and urban development took place hand in hand. Not much attention has been paid on TOD in large metropolitan cities that already have well-developed transit systems. In these cities, transit stations are often located in high density areas, such as the Central Business Districts (CBDs), and are having high rail ridership. Nonetheless, the traditional urban for single urban core has gradually been replaced by a more polycentric form even in this large metropolitan cites. xxx

4.11 TOD as a Narrative concept

How does Theory become a Narrative model?

TOD as a paradigm concept

4.12 How do we integrate Paradigms into Theory?

"The practice of developing or intensifying residential land use near rail stations" (Boarnet and Crane 1998).
"Development within a specified geographical area around a transit station with a variety of land uses and a multiplicity of landowners" (Salvensen 1996).
"A mixed-use community that encourages people to live near transit services and to decrease their dependence on driving" (Still 2002).

A planning doctrine is defined by Faludi and Van der Valk (1994) as a set of interrelated and durable notions about the spatial arrangements within an area, the appropriate development strategy and guidelines about the ways both are to be handled (1994, p.18). Planning doctrine has two interrelated dimensions, that is, a principle of spatial organization and planning principles.

This normative theory must have a stable foothold of adherents in the planning community to become effective in coordinating decision-making within this community by ensuring consistency in planning decisions (Korthals Altes, 1995). The paradigm shifts from a top-down kind of planning towards a more dialogic, participatory and discursive form of planning (Fischer, 2009) also includes a move towards the acknowledgement and increasing use of diverse urban narratives.
In the wake of the argumentative turn, new analytical approaches towards planning narratives appeared, drawing on rhetoric's (Throgmorton, 1993; 1996), and the analysis of story lines and discourse coalitions (Hajer, 1993).

If planning practices have moved towards becoming more discursive and more dialogic, this entails a vision of the planner as a moderator of potentially competing narratives (Mandelbaum, 1991).
The paradigm shift from a top-down kind of planning towards a more dialogic, participatory and discursive form of planning (Fischer, 2009) also includes a move towards the acknowledgement and increasing use of diverse urban narratives.
In the wake of the argumentative turn, new analytical approaches towards planning narratives appeared, drawing on rhetoric's (Throgmorton, 1993, 1996), and the analysis of story lines and discourse coalitions (Hajer, 1993).
If planning practices have moved towards becoming more discursive and more dialogic, this entails a vision of the planner as a moderator of potentially competing narratives (Mandelbaum, 1991).
Urban planning is increasingly conceived as a form of "persuasive storytelling" (Throgmorton, 1996), with planners actively engaging in "city story-writing" (Healey, 2000, pp. 527–528).
Three distinct types of narrative exist in the context of urban planning: narratives for, in and of planning.
But what counts as narrative? what kinds of narratives can be identified? and how can narratives support planning processes?

4.13 Theory Gaps

After almost three decades of supporting a nearly idealized TOD approach for enhancing local communities while promoting a modal shift contributing to the reduction of gas consumption, transit-induced gentrification has recently emerged as a matter of concern.

Fragmented ownership of land and properties may also act as a barrier to the (re)development of station areas; station areas may have contaminated soils as a result of industrial uses throughout the 20th century (e.g., Nijmegen and Zwoll station areas). The design quality of TOD areas is also a fac-tor: several TOD nodes outside historic centers are generally considered unattractive, indicated by high office vacancy rates (e.g., Amsterdam Sloterdijk or Bijlmer Arena stationareas).

FIFTH CHAPTER – Methodology / Proposed research method

Roadmap to the Methodological approach

The overall collision between qualitative and quantitative research followed in the first part of this research has specified the beginning of this research path based on an analytical research of the data collected from the selection of our four case studies, shifting from a theoretical study, with the collection of data in the Tirana case, through primary research, and the analysis of the historical pathways that the theory takes, helping us set the theoretical framework for this research. The second part of this journey comes with the deductive research, considering the data collection from the case studies and the spatial analyses with the criteria extracted from the case studies. The research's structure is based on earlier research that explains the idea of TOD and its practical applications. Using these notions, a design dimension is built so that the selected case studies may be compared against one another. Global best practices in TOD as well as urban concepts developed in previous research have informed these dimensions. The efficiency of TOD in diverse urban situations will be established through the analysis. There are three case studies based in Australia's three regional cities.

A greater understanding of the evolution of Australian cities may be gained by studying the cities' history. While cities like Hobart and Newcastle have already begun incorporating TOD into their urban planning plans, Geelong is yet to follow suit. These case studies, Geelong in particular, lead to a debate on the workability of TOD principles in regional cities based on the dimensions identified. TOD's efficacy in various urban situations and its applicability as a tool for future urban development will be assessed. Short-term and long-term goals are taken into account in the evolution of urban design framework. It is much easier to put plans into action and track their results when there's a deadline included in the plan. When it comes to creating an appropriate design framework for regional cities, a thorough evaluation of their current conditions is necessary, as well as an assessment of their future prospects, as detailed in urban

design frameworks like Newcastle 2030, Hobart 2025 and Geelong Vision 2, among others.

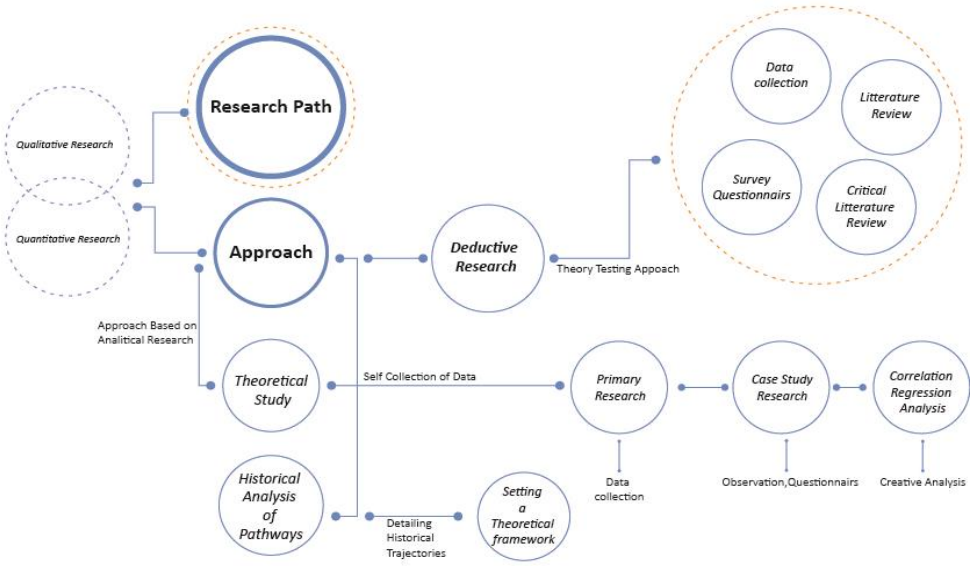


Table 4 The Roadmap of the overall methodological design for the research of TOD conducted by the researcher. Source: Authors own elaboration

4.14 GIS Instrumental Method

The research process is a systematic activity directed towards the development of knowledge and discovery. Because of the improving quality of sensor technology and the growing number of operational satellites deployed by various space organizations and enterprises throughout the world, the area of earth observation (EO) has seen extraordinary growth in recent years. For more than three decades, aerial imagery has been one of the most used data sources for geographic information systems (GIS).

A geographic information system (GIS) is a type of information system that is designed to operate with data that is referred by spatial/geographical coordinates. In other words, GIS is both a database system with specialized capabilities for geographically referenced data and a collection of data manipulation activities. Additionally, it may be viewed as a higher-order map or an intelligent map capable of being subjected to computer analysis. GIS has numerous definitions (Bhatta 2008); however, from the perspective of urban growth, a good definition of GIS is as follows: an information system that is used to input, store, retrieve, manipulate, analyze, and output geographically referenced data or geospatial data in order to support decision making

for land-use, natural resources, environment, transportation, urban facilities, and other administrative records.

The majority of GIS geographical features (such as manufactured objects) may be automatically retrieved from photos. For applications like traffic control, transportation flow analysis, vehicle navigation, travel advice, and fire or medical emergency services, GIS road data is critical. Aerial imagery has been one of the most widely utilized data sources for geographic information systems for more than three decades (GIS). The vast majority of GIS geographical elements (such as manmade things) may be extracted automatically from photographs. GIS road data is essential for applications such as traffic control, transportation flow analysis, vehicle navigation, travel counseling, and fire or medical emergency services. GIS technology is at the heart of geospatial decision support. GIS's most basic decision aid is data management, which is used to boost human computing performance. Using GIS as instrument, this research will aid in bringing spatial components together. GIS methods will aid in the mapping and structuring of policies for the world's most vulnerable sites. GIS techniques are also very useful for identifying and managing problems in any area.

The GIS will be used for this research with satellite imagery in a timeline to before the application of TOD components, to collect partial data of the case studies and through the process of digitalization and after the application of the components, and paired with the database for this case studies spatial data we will be able to put together a complete special feature include modeling, optimization, and simulation functions required to produce, assess, and evaluate the TOD components. Taking into consideration the TOD model of development, which is translated through its components utilizing GIS (model builder) to consider each of them individually.

SMCA Methodology

In order to resolve our hypothesis, we will use the spatial multi criteria analyses, divided into steps and tools. The Spatial Multi Criteria Analyses[17] comes as a way to evaluate different forms of inputs and output by using instruments such as Geographical information systems (GIS).

It is intended that this technique bring together a collection of methodical processes for examining complicated decisions and data. Breaking down this methodology into smaller parts will include data collection and the creation of a database rooted in land use through the use of Geographical information systems (GIS), followed by the identification of criteria and the derivation of indicators for each criterion that will be used in the research based on the characteristics of transit-oriented development as an urban form.

One of the most important applications of GIS is the display and analysis of data to support the process of environmental decision-making. A decision can be defined as a choice between alternatives, where the alternatives may be different actions, locations, objects, and the like. For example, one might need to choose which is the best location for a hazardous waste facility, or perhaps identify which areas will be best suited for a new development.

This article's approaches will be based on an analytical approach inside the GIS context of the indicators produced from the specified criteria, which will be discussed in detail later. These indicators will be compared to the particular requirements for the urban form of the transit-oriented development model, and the results will be discussed through the use of maps, quantitative and descriptive indicators, and other means.

TOD enables clustering of activities with a wide range of choices offered by a combination of mixed land use, pedestrian friendly environment, good quality public transport service, increased density and affordable housing. Looking from the transport

17 See Spatial Multicriteria Analyses Toolbox: http://eprints.lse.ac.uk/12761/1/Multi-criteria_Analysis.pdf

point of view, the presence of all these things at a place makes the travel behavior different, so needs to be studied or analyzed specifically. Multicriteria analysis is “a decision-aid and a statistical method that allows the comparison of various alternatives or scenarios based on a number of criteria.”

Step I- The selection of the criteria of analyses

The selection of a development and confirmation of its TOD components is the first step in pre–TOD assessment. The measures involved in pre–TOD evaluation, such as a mixed-use development or any projects near a transit station, may be assumed to have certain TOD-like transportation characteristics without evidence. Despite certain similarities, these technologies do not work in the same way.

Step II-Map Preparation, data attributes translation

The land use mix in a TOD is critical for integrating different activity nodes by increasing accessibility. Different types of trips are created and attracted by these various land uses. The presence of trip attracting land uses is significantly higher than the presence of trip generating land uses at a TOD. As a result, for all modes of transportation, TODs usually have a higher trip attraction rate than trip output rate. Rolling, cycling, and public transportation should all be available to ensure that these journeys are made using sustainable modes of transportation.

Step III-TOD index aggregation

In contrast to other motorized modes of transportation, such as the automobile, the use of public transportation, walking, and cycling is commonly accepted in the transportation professional community as being more sustainable. Data for three characteristics, land use mix, car parking provision, and infrastructure for sustainable modes of transportation, were used to assess a study development for TOD specification If the chosen development does not exhibit acceptable TOD characteristics, a different development type should be chosen, and its suitability evaluated.

The combined spatial impact of changes in land use patterns and transit service was segregated using this approach. The findings were presented in the form of a dimensionless neighborhood accessibility index (NAI) and compared across four separate TOD projects in both Northern and European cities. Proportional coverage,

frequency factor, travel time, and jobs within walking distance. A variable was used to represent the share of accessibility change attributable to transit. The accessibility was found to vary due to different causes.

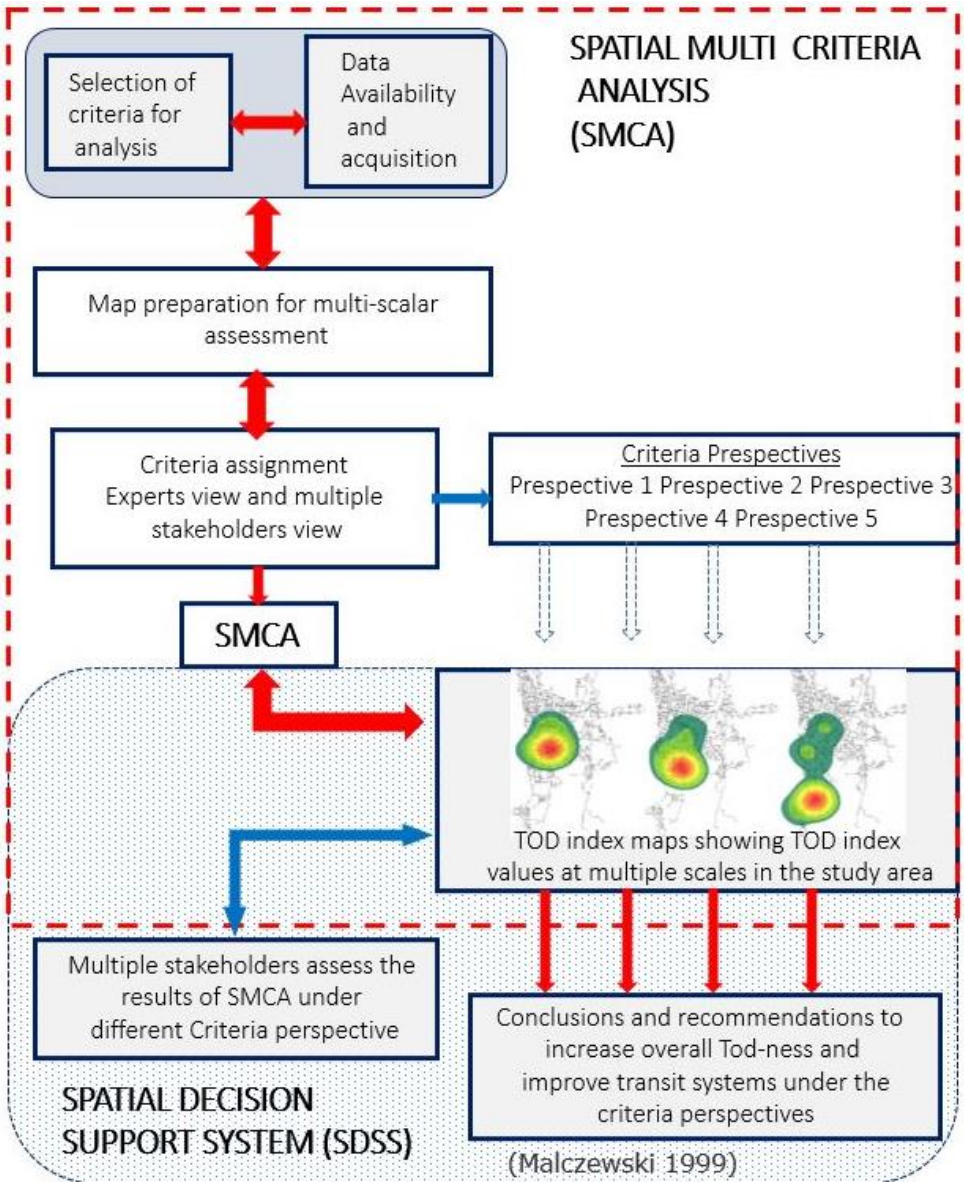


Table 5 The SMCA Design for the evaluation of TOD in our case studies/ Based in Malczewski 1999 model. Source: Author's elaboration on the method using our criteria and steps

Indicators of TOD

Because the complexity of urban systems is formed of synergic integration of fundamental pieces, it is possible to get insight into the urban condition by integrating these elements in a meaningful way. This technique will take into account indications that correspond to TOD components, resulting in a shift in how we assess urban indices such as density, FAR, and so on. The 'Subsystems,' which are characterized by physical traits and arrangements, are used in this technique to investigate the relationships between urban morphology, energy consumption, and environmental performance, among other things. With this design style, the ultimate objective is to create an urban environment that is more sustainable and efficient in nature. Buildings, like any other system, are defined by the existence of elements and subsystems that are interconnected in a sophisticated manner. It is vital to have information on the spatial and temporal extent of cities, as well as the expansion tendencies of such cities, in order to properly monitor and map urban growth and to develop efficient urban planning methods. To provide just a few instances, urban expansion may occur in a variety of ways, including the redevelopment of existing built-up regions at higher densities, the infilling of remaining open spaces in previously built-up areas, and the development of greenbelt land around cities, to mention just a few. (2011); (S. Angel, 2011).

5 CHAPTER FIVE – CASE STUDIES

5.1 TOD in US Cities / Europe, Case studies

Case studies include a systematic and in-depth examination of a particular case, which is often dictated by its location. The number of TODs in North America is currently abundant and analyzing all of them will take much more time than the time allocated for this research project. As a result, an investigation was performed on a small number of TODs that were considered "successful" in the literature. However, the crossing over of this concept into Europe it is not new or unexpected.

The current literature evaluates TOD performance by the amount of design elements found in the neighborhood, such as high density and a mix of uses. However, as previously mentioned, a TOD may have most or all of these elements but fail to take advantage of its proximity to public transportation.

5.2 An enquiry of the motivation after TOD

In this section we will explore why TOD was a viable option in the development of these projects and the expectation in Appling these principles.

5.3 Arlington, Virginia TOD

5.4 The overall expectations from the development of TOD

Arlington's prominence as a county has increased since the 1970s, owing in part to its proximity to Washington, DC.

Realizing a specific aim, such as increasing the demand for higher-density structures in areas near public transit and urban centers, is essential. Develop a pool of developers with previous experience building higher-density mixed-use projects in suburban settings. By incorporating high-quality architecture into urban-style structures, you may increase public acceptance of them. Participate in the creation of new places and the building of a sense of belonging in your community.

Arlington's primary goal was economic development and growth control in order to protect low-density communities, but the initiative also had positive environmental effects from decreased private vehicle use.

For all journeys, public transit usage is doubled, cycling is tripled, and walking is six times higher than in the rest of the area. In comparison to adjacent suburban areas, total vehicle miles driven per capita in the transit corridor is slightly lower. (D. A, 2000)

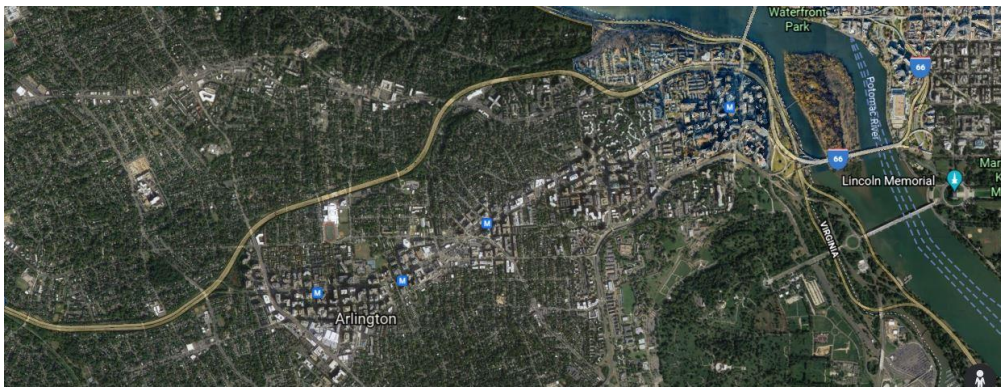


Figure 14 Arial view of the Arlington Rosslyn-Ballston corridor Source: Google Maps, January 2021

Arlington's successful transition to transit-oriented development was not without its challenges, especially in terms of improving the station areas' pedestrian design. Even though the TOD principles upon application improved the overall area, the increase of public transport within the area was more related to design of walkable spaces and the number of people living within the range of the walkable distance near the stations.

Improved pedestrian design, such as uninterrupted and direct sidewalk access and a healthy atmosphere to drive through, may help to reduce private vehicle usage even further. Private sector investment in transit-oriented growth in Arlington was promoted

by the county's long-term planning, which was matched with public infrastructure and urban design investment incentives.
High-density development was encouraged within a 0.4-kilometer walking radius of Metro stations, and mixed-use development, which combined industrial, retail, and residential uses in the same building or location, was encouraged.

5.5 Translating TOD

High-density construction was encouraged within a 0.4-kilometer walking radius of Metro stations, and mixed-use development that combined industrial, retail, and residential uses in the same building or area was encouraged. (Cervero R. , Land Use Mixing and Suburban Mobility, 1988)
Infrastructure, public amenities, and urban design upgrades were funded by the county and the private sector, demonstrating the value of public-private partnerships.
Arlington exemplifies how transit-oriented development can be built and coexist with traditional automobile-oriented development.

The system will be a hybrid underground/commuter railway, dubbed Metro today. Arlington will have ten stations, five of which would be located along a three-mile, failing commercial corridor that stretches from Rosslyn to Ballston (RB) in the county's northern part.
The decision did not guarantee TOD, however, as some residents banded together to push for the preservation of low-density communities along the corridor by planning park-and-rides at each stop.
The county listened to their concerns and developed a General Land Use Plan (GLUP) that would limit the highest densities to a walking distance from each station.

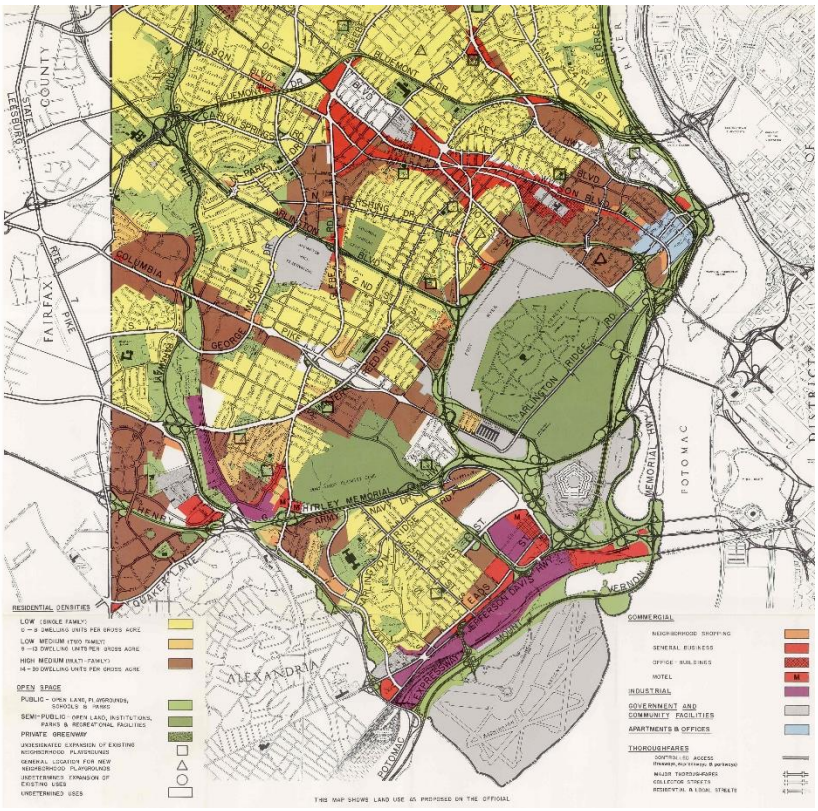


Figure 15 The Arlington's General Land Use Plan map Source: Arlington county General Land Use Plan document, June 30, 2018 /https://arlingtonva.s3.dualstack.us-east-1.amazonaws.com/wp-content/uploads/sites/31/2017/02/GLUP Booklet Dece

5.6 Why a successful TOD

The Rosslyn-Ballston corridor, which is home to some of the country's most popular TODs, is one of the busiest transit lines in the area.

The area has developed into a booming business district and a lively downtown where people want to live and work.

These TODs are thriving urban centers surrounded by a dense network of transit-friendly neighborhoods, and they serve as excellent examples of what TOD policy can accomplish. One of the main reasons why the Rosslyn-Ballston corridor is a model for TOD success is because of its high transit ridership. (Brinklow, 2010)

Ridership was also strong along the Rosslyn-Ballston route, which includes many station areas, and has almost double of percentage of ridership that the region according to US census bureau publication of 2008. Since 1980, office construction along the Rosslyn-Ballston corridor has exploded, transforming the area into a Class-A office market.

The retail business in Rosslyn-Ballston has also performed exceptionally well. Currently, the transit corridor contains half of all retail space in the county.

Market Common, a mixed-use center adjacent to Clarendon Station, was built in response to this trend to draw shoppers to the city. As a result, retail in the Rosslyn-Ballston corridor is doing exceptionally well, thanks to the large number of customers who live, work, or commute through the city.

In the transit corridor, housing has also performed exceptionally well. What was once a low-density industrial thoroughfare has become a mixed-use, high-density corridor.

Figure 17 Arlington County's Smart Growth Journey, Rosslyn – Ballston Corridor a compare sent between 1979 and Today, Source: 2017 American Planning Association National Planning Achievement Award for Implementation. http://www.pgplanning.org/DocumentCenter/View/9199/Article-on-Arlington-County-SGJRB-Corridor-9-18

Rosslyn, Ballston, and Clarendon are all communities with a deep sense of belonging. Clarendon Alliance, for example, is a neighborhood group that brings together residents and business owners to address issues in the community and promote the area to other areas.

The three TODs along the Rosslyn-Ballston corridor that were sampled are all high-density, mixed-use centers. All station construction must include dense, mixed-use developments in compliance with the General Land Use Plan to ensure that each station has its own sense of community.

5.7 Portland, Oregon

5.7.1 The overall expectations from the development of TOD

Many of Portland's planning strategies are seen as models in other cities. Re-zoning land adjacent to light rail stations to build new mixed-use development has been a key policy for the Portland area.

A New Urbanist initiative was followed in many Portland cases, resulting in well-connected, pedestrian-friendly streets and a diverse mix of housing, retail, and civic uses.

Portland's downtown station areas have a high level of intensity, the region's non-downtown station areas have a low level of intensity. Notably, there appears to be a strong distinction between the intensity of Portland's core station areas (in blue, which includes the Portland Streetcar) and the intensity of the region's non-core station areas (in green, clustered in the chart's lower left corner).

Portland Metro's Transit-Oriented Development Program was the first in the country to be granted permission to use federal transportation funds to purchase land for renovation next to a light rail station in 1998. This program was used to develop Metro's 2040 Growth Concept, which emphasized transit villages and main streets. (County, 2008)

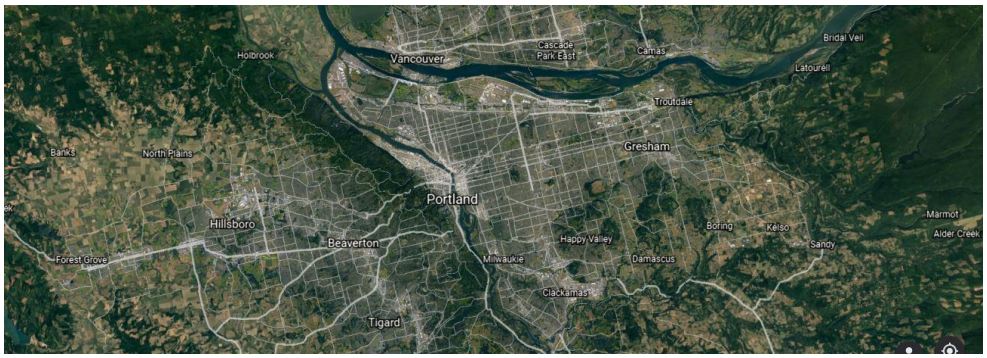


Figure 18 Arial view of the Portland, Oregon TOD topologies Source: Google Maps, January 2021

Orenco Station is a New Urbanist neighborhood in Hillsboro, Oregon, located just 15 miles west of downtown Portland. Orenco's growth started in the 1980s, when the city made a deliberate planning decision to attract high-tech industrial development, such as Intel, NEC, Fujitsu, and Toshiba, to the area.

Pac Trust, an industrial and commercial developer, bought the Orenco Station lands and developed the entire area around the MAX light rail station. Orenco Station is one of the most widely cited TOD examples today, but there is much controversy about its popularity.

As a result, while transit ridership is comparable to that of other popular TODs, the surrounding area continues to be car-centric.

Hillsboro agreed to construct more than the minimum necessary parking spaces after Pac Trust, which owns land near the station, negotiated with them. Pac Trust also built

parcels nearest to the highway system first, while owning land on both sides of the station.

Neighborhoods are built in a way that resembles small urban communities, with residents interacting and participating in community activities. Orenco Station's architecture follows this concept, with homes with narrow side yards rather than the traditional suburban big backyards.

It is hoped that by reducing the amount of private space and increasing the amount of public space, more leisure time would be spent in shared spaces, resulting in more interaction. Furthermore, pedestrian-friendly streets and sidewalks connect to the main town center, where residents can get to know their neighbors and socialize in a central location. Many of the design concepts developed by TOD pioneers were adopted by Orenco Station. (Carlton, 2014)

Figure 19 Portland TOD Corridor development Source: A CNU Journal by Robert Steuteville in May. 2, 2018. https://www.cnu.org/publicsquare/2018/05/02/connected-and-walkable-suburb

Higher densities were chosen in particular to establish a typical urban neighborhood that would benefit from its proximity to public transportation. Orenco seems to do better in some areas than others. Many of the TOD design features are present: high densities, vertically mixed uses, and higher ridership than the rest of the country. Orenco Station, on the other hand, is still a car-dependent neighborhood, with massive surface parking lots and suburban-style shopping malls.

Given the fun walking experience, residents still prefer to drive their vehicles, despite the site's proximity to public transportation.

Typologies have recently become a popular method for structuring short- and long-term investments in transportation communities in many cities and regions across the country. A TOD typology is a way of classifying and distinguishing the region's many

transit-rich neighborhoods by grouping them together based on key common characteristics.

5.8 TOD in European experience

5.9 Copenhagen, Denmark

5.9.1 The overall expectations from the development of TOD

Two factors characterize the capacity for growth and transformation: the attractiveness of the urban environment as a dynamic state, and the various drivers of urban change as processes.

The growth of distinct communities and identifiable cityscapes that are represented as urban characteristics.

Orestad is a linear new town in Copenhagen that will be developed over the course of 30 years around stations on an elevated, driverless mini-metro line. The construction of the Copenhagen Metro was to be funded by the selling of publicly-owned property along the route to developers. Since the internationally renowned 1947 Finger Plan, Copenhagen has had a 60-year track record of transit-oriented growth.

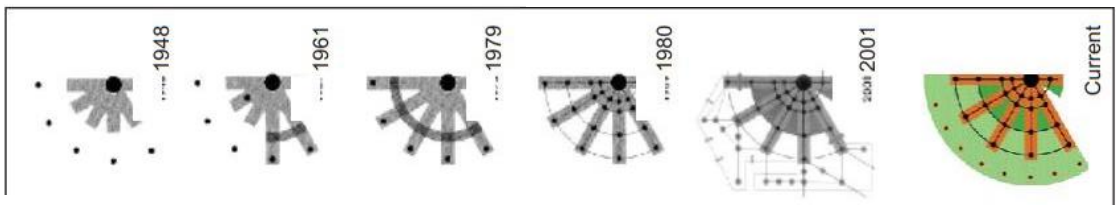


Figure 22 Copenhagen finger plan development, Greater Copenhagen plan 2005

The main principle of this plan: Access to green space, Urban development to follow transport, Proximity to natural spaces, Development linearly,

Densification and mix use, Transit nodes for transport, Overlap Multimodal transports., multi-center development, Center not for cars, Long-term development

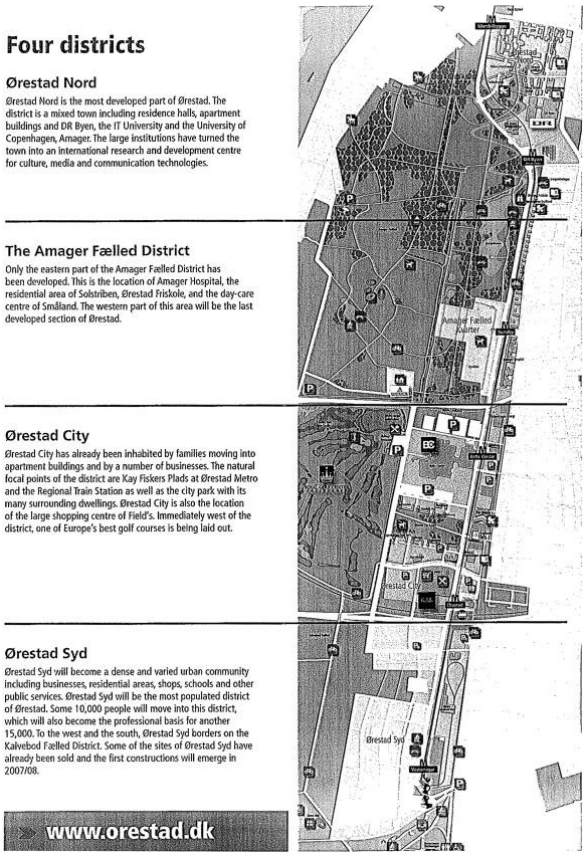


Figure: 28 Four main districts of TOD corridor development in the extension of Copenhagen Finger plan, Source: Copenhagen plan

5.10 Vienna, Austria

5.11 Findings from the case studies we reviewed

TOD (transit-oriented development) is a strategy that promotes the use of public transportation by designing and developing dense, pleasant, and walkable urban environments. TOD is concerned with synchronizing urban life - its growth and development, daily activities, and mobility patterns - with public transportation networks in a wider sense.

Figure 29: Venna Step plan 2030, The development corridor of the south, Vienna step plan 2012

5.12 Spatial analyses

The Spatial analyses will start with the scale of implementation, in a spatial comparison set between our four case studies, considering seven main criteria for each case in relation to the case implementation, giving us access to almost 30 parameters.

These parameters translated into spatial analyses maps, have been translated into a spatial dimension of 500-meter radius (in accordance of TOD components and Leon Krier distance of walkability), considered with the main notes implemented into the TOD projects, from design to implementation. TOD was conceived to be a flexible concept, each city, region or state can develop it according to need and context. There are no set rules and development does not have a standard process.

Figure 14 The 10 miles radius of the area considered for the index measurement within the node, map from Arlington Virginia scale 1:8000, Source Authors creation

The considered criteria started by classifying the scale into three main groups, starting from the first group the radius defined the measurement starting from the center of the node. The second group followed the same practice increasing the radius to 500 meters.

Taking into consideration services within the area into the two different type radius groups, considering travel accessibility the density index, proximity into the central districts area, FAR parameters, and LUC parameters. These indicators will eventually provide a well-rounded comparison with all case studies providing some similarities and unveiling essential components of applying the TOD indicators and how. Grengs (2004) demonstrated a method to measure changes in transit accessibility on one neighborhood from Buffalo and another from Rochester, New York by developing a gravity model using Geographic Information Systems (GIS).

This method separated the combined spatial effect of shifts in land use patterns and transit service. The results were obtained in the form of a dimensionless neighborhood accessibility index (NAI) and were compared at two points in time, 1990 and 1997. NAI was based on proportional coverage, frequency factor, travel time and employment

within walking distance of transit stop (Equation 2.13). A variable was used to represent the share of accessibility change attributable to transit.

The accessibility was found to vary due to different causes, in Buffalo case it improved because of changes in transit service while in Rochester study, accessibility improved because of changes in land use. The analysis was mainly for transit dependent poor people who live in inner–city neighborhoods. It may not be obvious why spatial data requires special treatment and why substantial research in transport planning still applies non-GIS based data analysis, despite acknowledging that it is addressing inherently spatial processes. Given the relatively recent diffusion of GIS technologies and analytical tools, research has relied on concepts of distance, adjacency, neighborhood, and network (Figure 8), without questioning the relationships between attributes and the spatial location.

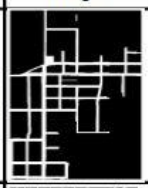
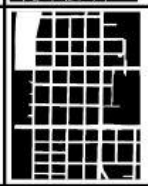
As described by Harvey (2008 p. 629), it is the “mechanistic approach that ignored the spatial, temporal, and individual interdependencies among transportation, land use and population”, which “has left a legacy of urban areas with seriously inappropriate land use and transportation systems.”
Brown’s (2008) investigation of land-change dynamics, integrating survival analysis with GIS, presents urbanization as a unidirectional land-use transformation process, driven by a complex array of factors (Zhang, 2001). Once the land has been developed, the infrastructure is expected to last for decades (at least) and land-use changes may result in rigid, highly inflexible frameworks that are constraining opportunities for future modifications. The minute human actions have sculptured a new urbanized face of the earth, the resultant transformations, such as the core settlement and economic fabric and intertwined transport network, continue to dominate human life in perpetuity and represent nearly irreversible influences.

This is referred to by Munroe (2009) as a “*spatiotemporal path dependence*” of development patterns (p.154). Unless extreme events, such as natural disasters (the 1755 Lisbon earthquake, more recently the 2010 and 2011 Canterbury earthquakes in New Zealand or earthquake related events, such as the Tsunami impacting the east coast of Japan in 2011; the emerging response to sea level rise triggered by climate change for many low lying cities around the world) or human destruction (warfare, fire, other catastrophic events) occur and alter the urbanized area, future modifications are

often limited and urban regeneration potentials are “constrained” by their historic core (e.g., Rome, Paris, London) (Tacitus, in Church *et al*., 1876; Lauran, 2012; Ween, 2012). Extreme economic conditions (deindustrialization, outmigration) may also have severe impacts on the urban form.

The effects of Detroit’s fall in the 1950’s made it an example of a disarticulated planning process, with disruptive effects on the functioning of the city until the present day. Create new market comparable for higher density buildings near transit and urban centers. Cultivate developers with expertise in higher density mixed-use buildings in suburban settings. Increase acceptance of urban style buildings through high quality design. Carry out placemaking and contribute to local identity as a result of the TOD Program, six projects, ranging from small to large, have been completed.

Portland, Oregon

	Portland, Oregon	Working activities 400m	Travel accessibility	Travel behavior 600m	Density index	Proximity to CBD	Walkability index	FAR	LUC
section 5/3		3.1	1.1	3	536	2.4	1	1.35	30-40
section 5/4		4.2	2.2	2.6	655	2.5	2	1.6	35-45
section 5/8		3.3	2	2.9	356	3	2.5	1.2	40-50
section 5/6		1.5	1.5	2.5	256	3.1	3.2	1.1	55-65

The first set of parameters started the same for all the considered case studies from the Portland Case study to Vienna, considering our choice of methodology the corridor of development was divided into 1 mile matrix which divided the area into 1 mile * 1-mile squares.

The areas were the starting point for the multicriteria analyses, using GIS and particularly ArcMap we created a model that involved nine parameters that were

initially, picked apart from our database of each case study based into the national database of each country.
These initial data have both measured into the geographical dimension on the database, compering these data with the data extracted from the national plan and the institute of statistics of each country, updated no less than 5 years from the extraction of the data.
After each parameter was compared and identified it was represented into our geographic space with a basic component of GIS, a shapefile.

The Database was then created as a merger of each data from each category and each case study into the matrix comparison, within the model measuring the derivate data of each parameter (such as FAR= Total surface of build environment* number of flours /Sub-traction area of subdivision within the general plan).

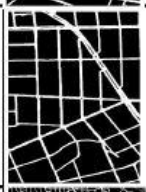
Each Section was compared within the area and between the two scales of implementation and translated into a scale of implementation. Starting from the lowest value (for example the concentration working activities within the 400 meter of proximity and the number of activities within the 1*1 mile of initial square, and later from the section of the 1 mile's radius to the 400-max limit of the walkability possible valued at 0,1,2,3 etc.) to the heights value not going over our comparisson setting scale of 10 point indicating the max of value from the model, subtracting the total of the max value from the matrix and adding our valued scale.

The purpose of this matrix is to understand the value of each component and how each component finds its place within the overall project applicability by quantifying the data representing the physical development of each component in the geographic scale of a unit of 1 mile with 1 mile considering the walkability index and development of the corridor depth.
The tables set below represent the translation of the data into our case studies and our finding, from each component and the role they play in the overall development of the TOD corridor.

We must consider that even though the selected case studies are quite different in origin, implementation and development. This selection was quite intentional since the theory has such a wide application and the context of application is very diverse but

also represents two different cultures of applications. The American based case studies have a different approach to the data and translation of the components, even though the basic components find their application into all our case studies.

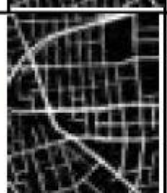
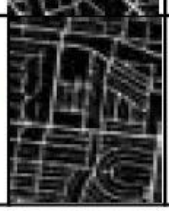
Arlington, Virginia

	Arlington, Virginia	Working activities 400m	Travel accessibility	Travel behavior 600m	Density index	Proximity to CBD	Walkability index	FAR	LUC
section 12/4		4.2	1.2	2.1	458	1.8	3	1.35	40-50
section 12/2		2.1	2.2	2.2	322	1.4	1.7	1.52	30-40
section 12/6		3.6	3	2.6	238	1.2	2	1.2	25-35
section 14		6.4	2.6	2.2	562	3.1	3	2.1	40-50

Copenhagen, Denmark

	Copenhagen, Denmark	Working activities 400m	Travel accessibility	Travel behavior 600m	Density index	Proximity to CBD	Walkability index	FAR	LUC
section 14/5		1.6	0.7	2	785	2	1.1	1.4	40-50
section 14/7		3	1.4	2.1	652	2.3	1.4	1	35-45
section 14/6		3.2	1.9	1.5	801	2.5	3	1.4	30-40
section 14/10		3.5	1.4	2.2	463	1.7	1.5	0.7	30-40

Vienna, Austria

	Vienna, Austria	Working activities 400m	Travel accessibility	Travel behavior 600m	Density index	Proximity to CBD	Walkability index	FAR	LUC
section 7/5		3	2.2	1	644	1.5	2.1	1.4	40-50
section 7/2		2.5	2.4	1.4	743	1.4	1.4	1.4	35-45
section 7/1		3.1	3	1.3	568	1.2	1.6	1.2	25-35
section 7/4		3	3.1	2	685	2	2.1	1.3	30-40

While the TOD framework provides a general guide to the types of investments that are suitable in each station area and corridor segment, those types of investments must be tailored to the unique circumstances of each station area and corridor segment. Some aspects of TOD implementation, such as affordable housing construction, land acquisition, mixed-use and sustainable living facilities, and job uses, may need to be weighed against local market conditions and genuinely supportive local stakeholders, as evidenced by direct donations, abatements, SDC credits or discounts, and tax increment financing.

The matrices below depict the universe of activities in which the TOD Program currently invests, and in which it could invest more significantly in the future if additional funding is available. Each of the matrices is used to distinguish between activities that are core to the program, activities that are more incidental to the program, and activities where the program personnel only provide assistance to other agencies.

6 SIX CHAPTER- COMPERATIVE ANALYSES TIRANA

6.1 Setting the stage | Tirana

Due to historical, political, cultural, and social factors, Albania's planning process has undergone many changes and challenges. All of these problems reshaped the planning methods and tools that are currently in use.
Despite the fact that these improvements improved the planning platform, many of the instruments remain static and inflexible, rendering the planning process even more complex and, in some cases, ineffective.
During the socialist period, the planning process was highly centralized. There was no definition of private property. All belonged to the state, so everything had to be carefully planned to achieve a particular goal. The design process was part of a larger effort to standardize architecture, lifestyle, and planning tools. The regulatory plan, which was very strict, was the main instrument in the planning phase. Its main function was to regulate and define centralized political initiatives. Having said that, we can see a strong distinction between two separate planning methods during this time span.

The first was the massive construction of new cities from the ground up with a predetermined number of inhabitants with no differences between them and regardless of their surroundings.

Albania was an example of a stable economy and growth at the start of the 1990s. Economic shifts, as well as cultural and urban transformations, resulted from the radical changes in the political regime. The two most important development requirements at the time were: The sprawl of main cities and the large concentration of settlements. xxx

Transportation challenges, solutions, and innovation stand as the main focus in the development agenda of cities today. As cities change, grow and become more complex, so do their needs and transport planning approach. The Transport Sector in Albania before the 90s was developed in line with the needs of the economy, focusing more on industrialized areas and areas with intensive agriculture and less on urban centers as a result of their expansion. Transportation was a state monopoly. After changing the system of government public transport as well as many other sectors and changed. The quality of its offer decreases, creating chaos in the lives of citizens. The transport sector after the 90s was developed dynamically. Despite the changes nowadays, our country is far from the standard of European Union countries. Main cities like Tirana are almost in chaos and people must spend hours to travel short distances, despite efforts to introduce alternative means of circulation.

Shift began in 1993, when the parliament passed the 7693 nr. Law “For Urbanism,” which aimed to establish, many reforms in the planning process, though many amendments were made to the same law from 1994 to 1997 (R.Toto, 2010).

The slow awakening of the state's lack of control and the lack of a proper planning system created a void in the country's management and planning, which was clearly reflected in the lack of measures and regulations to address the phenomenon of informal growth. The planning process was in disarray, and the planning tradition remained stagnant, with few planning instruments. The turning point in the creation of a new structure occurred in 2006, when, in response to external pressures and community-based organizations, the initiation of a document for territorial policies began, with help from The United States Agency for International Development, USAID (The decentralization process).

6.2 Tirana | Transport Condition and Study

Tirana is the current capital of Albania and the largest city in the country. Mobility preparation is a critical component of this study's structure. As a result, we will divide Tirana's mobility planning progress into three phases, each reflecting critical changes in the country's overall development as well as historical changes that influenced social, economic, and territorial changes. The mobility planning process did not include any

new infrastructure, instead focusing solely on the reconstruction of existing roads. From 2000 to 2005, it was time to reconstruct by investing in new and improved infrastructure. This new approach resulted in the advancement of national infrastructure (improving Albania's connectivity with its neighbors) as well as an increase in city mobility planning. The reorganization of public transit networks in 2006, which was accomplished by public-private partnerships, increased the efficiency of city mobility planning.
The majority of Tirana's infrastructure is of the radial kind. The infrastructure is in good shape and consists primarily of primary roads, but since the city's rapid growth, a significant number of informal settlements have expanded the infrastructure into tertian roads

6.3 Urban Development and Land use

The countries transition from a centralized economy to a market-based one has influenced many spheres including transportation, were it experienced a shift from the single centralized institutions that planed based on economic and uniform territorial connections “Central place theory” (Christaller, 1966) to long-term objectives and territorial cohesion planning. The new Tirana urban legislation will serve as a good starting point for a new set of town planning rules, which the country urgently requires. Regardless of the variations that may occur, the drafting of this new regulatory plan as a mechanism and in collaboration with many specialist agencies and other concerned groups and communities is likely to be successful and not liable to raise concerns. The future of Tirana is a challenge that depends on the contribution of its people, the position of communities, private sector, and the leadership of the public administration, based on lessons learned from previous urban planning, current urban phenomena, and new proposed urban plans for Tirana Region (as outlined in this Guide). Another powerful motivator is Tirana's and Albania's drastic changes in the 1990s, especially in terms of urban growth.

6.4 How and why TOD in Tirana

“Walkable, compact, mixed-use, higher-density development within walking distance of a transit facility” is what transit-oriented development (TOD) is known as. TOD is a mixed-use development that aims to make public transportation more efficient, improve the convenience and safety of walking and bicycling, and create a vibrant, livable

community. By the year 2025, 14.6 million households will demand homes within walking distance to public transit and rail systems. TOD can help meet some of that demand.

TOD has the potential to enhance public health. Vehicle dependency and congestion can be reduced in a city with a good and reliable transit system and streetscaping elements. It is thought that a TOD culture would boost community health and even reduce obesity. According to a study titled The Effect of Light Rail Transit on Body Mass Index and Physical Activity, commuters who used a recently built train were more active. TOD has the potential to make a society more resilient. Transportation accounts for about 28% of all greenhouse gas (GHG) emissions, according to the Center for Transit-Oriented Development's Planning for TOD at the Regional Scale. TOD, on the other hand, has the ability to minimize annual GHG emissions.

TOD has the potential to boost local economies. Improving local public transportation will reduce car transportation costs and travel time. People will be able to spend their time and money at local restaurants, stores, and museums as travel times and costs decrease.

A neighborhood with TOD components is less expensive than sprawling suburbia. Since sprawl construction necessitates the expansion of public infrastructure and services, it is expensive.

Community opposition and an unsupportive regulatory system are the two biggest obstacles to TOD. Although nearby property owners may be concerned that TOD would detract from a neighborhood's character or cause traffic congestion, TOD has been shown to be pedestrian and bicycle friendly, help local businesses, increase property values, and reduce sprawl.

6.5 Urban Policies and legislation

Local governments should review their regulatory structure to help TOD. The need for TOD and the roadmap for policy implementation should be included in comprehensive and master plans. Furthermore, zoning and land use ordinances must promote and endorse transit-friendly development patterns and regeneration strategies.

Automobile-oriented, single-purpose, suburban-scale construction should not be the primary focus of zoning ordinances and land development codes. To accommodate the construction density needed for TOD, zoning codes will need to be changed physically. The planning process for TOD can differ from community to community. When a community has adopted a transit-friendly regulatory structure, a TOD study will begin (including comprehensive plan and codes). A TOD analysis is used to identify the need for improvements to a community's transit-served area(s) and to evaluate the potential for TOD around a proposed transit station/hub.

A public participation strategy should be developed to ensure feedback from all stakeholders. To oversee the planning process and engage community members, a town's planning board, a special TOD study committee, or an advisory may be created. A group may wish to hire consultancy services to help with the planning process.

The transition from urban sprawl to inclusive TOD is a critical issue that must be addressed immediately. It is, however, easier to conceptualize than to implement. Several interconnected and diverse elements must be aligned and brought together. Infrastructure, street, and building planning and design are among them, as are codes, regulatory reform, and finance.

Rail owners can cover capital costs of construction and secure long-term profits to offset operational costs once in operation by introducing smart transit hubs, or transit-oriented projects. They will meet critical development targets and smart city projects at the same time. In this way, transit hubs have the ability to serve as a powerful mechanism for implementing new growth strategies.

6.6 Transportation Background on Tirana

Tirana was named the capital in January 1920 by the Lushnja Congress. Along with the political factors of the time, it appears that the geographical location of Tirana possessed all the characteristics of an ideal settlement and capital, including the proper distance from the sea and the mountain, a very favorable climate, an abundance of natural elements such as water and greenery, fertile areas for agricultural development and population growth, and most importantly, was located in the intersection of important commercial routes. Time has demonstrated that this election justified the consecutive problems that Tirana would confront as a rapidly rising metropolis.

Beginning of 1917 and 1918, Austrian academics made the first attempts to map Tirana and its road network. On this basis, an Austrian engineer and architect drew up the first plan for the city in 1923, with the intention of correcting and regulating the city's road structure to a more rectangular shape that would fit as closely as possible with the existing grid and also maintained the city's radial directions. In locations where building was not taking place at the time, the objective was to develop a quadratic network of clean drinking water. The enlargement of Durres Street, Kavaja Street, and Barricades was a result of this concept.

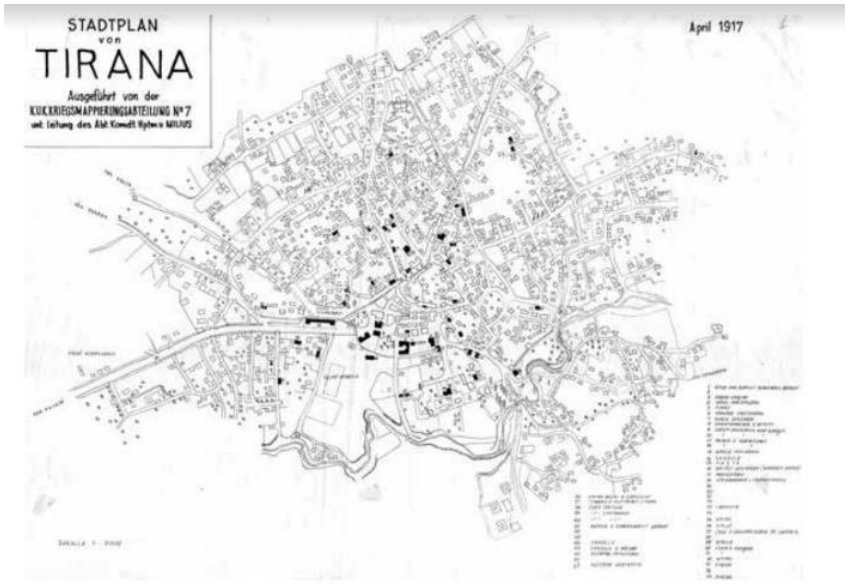


Figure 11
Tirana Plan map 1917 / source: National cartographic archive

It was in this context that architect Armando Brasini (a well known Italian architect …)was called to Albania in 1925, where he worked with the original proposal for the city's core. His concept was to create a central axis and a series of colossal structures that would not only introduce a new European trace into Tirana's oriental construction but would also serve as indicators of a new way of life. Based on the design proposed by Brasini, the city's northern section and the historic bazaar were feared to be demolished by the proposed axis.

However, while the Roman models of Cardo and Decumanus appear to have inspired the design of this axis, its adaptation to Tirana's specific situation is not solely based in this abstraction, but rather on the clear orientation about local elements such as Dajti Mountain, river flows (originally Lana and the river of Tirana), hills raised at the beginning and end, etc.

For the first time at the city level, the Brasini proposal for the north-south axis that runs through Tirana was manifested in a more complete design produced in 1926. This plan was more of an adaption of the earlier in the year 1923 plan.
Changes and alterations were made in 1929 to the original 1928 plan. As part of this plan, the boulevard was extended further to the north, taking its full length of 2 kilometers from the royal palace to "Skanderbej" square and to the new stadium (where the train station was located up until a few years ago) located north of the boulevard (where it had previously been located).

Following this design, the city's borders (4.5 km2) and the most central sections along the boulevard, as well as the important historical entrance routes (Durrs Roads, Kavaja, and Elbasan) were delineated, as well as the places to be renovated and constructed along them. Layout presented a plan that included two main perpendicular axes: the vast north-south road as a "Cardo," which included the promenade Viktor Emanuele " (now Zog I Par Street) and the promenade of the "Empire" ("Dshmort e Kombit" boulevard), which featured a square on one side. Bus travel or philo buses were planned for in the plan's urban transportation section, which used the word "circumvallation" to describe the radial lines linking and circling within and beyond the circle of rings. Additionally, the plan called for the development of public transportation systems that would connect and operate across a variety of modes of transportation and public areas.

6.7 Breaking down the method

Integrated Modification Technique (IMM) is a novel design methodology based on a specific procedure with the main purpose of increasing the energy performance of CAS (Complex Adaptive Systems) by modifying its ingredients and optimizing the architecture of its ligands. The Integrated Modification Methodology (IMM), created by the Polytechnic of Millan department of the ABC (Tadi, 2015), is a multi-stage, multi-layer, multi-scale, holistic, and iterative procedure for urban components.

It focuses on the ‘subsystems' characterized by physical characteristics and layout to examine the links between urban morphology. It also emphasizes the importance of acting not only on the physical properties of units (architecture), but also on the operation of the urban system, taking into account functions, services, transportation,

resource management, and anything else that has the potential to influence citizens' behavior from an ecological standpoint. It takes a holistic, multi-layer, multi-scale approach to problem solving. According to this concept, the city is a dynamic Complex Adaptive System (CAS) composed of the synergic integration of a number of primary pieces, which give a specific physical and temporary arrangement of the CAS through their arrangement and the architecture of their ligands (Tadi M., 2013).
According to this concept, the city is a dynamic Complex Adaptive System composed of the synergic integration of a number of primary pieces, which give a specific physical and temporary arrangement of the CAS through their arrangement and the architecture of their ligands.

Key categories are the emergent processes of interaction between primary pieces to generate a synergy in IMM. The synergy between elementary pieces produces key categories, a new organization that emerges not (merely) as an added result of the properties of the primary elements.

In our case the key elements tying this methodology to our topic are the 7 components of TOD identified in the theoretical chapters. These components (density, proximity to transit, mixed use, walkability, public transport, scale of implementation, security, pedestrian and cycle orientation) will become the accor for the IMM methodology to translate the application of these components in our case study of Tirana. The methodology will translate the components of TOD into the context, allowing us to compare the indicators, extracted from the four case studies (as successful TOD applications) and measure the difference of context with these indicators. The final result will allow the researcher to understand through data, what level of TOD we should and can implement in a variety of contexts. As a final step attached to this methodology we will connect to GIS our instrumental method, the formula of indicators measure, for each of the 7 components in a single model. Enabling the use of this model in every context, to measure and identify gaps and measures in the application of TOD, in an existing build context.
The IMM focuses on the 'subsystems,' which are defined by physical characteristics and arrangements, to explore the links between urban morphology, development consumption, and environmental performance.

6.8 The selection of the Area

For the purpose of this study three interconnected areas are selected. In continuity of the criteria identified of TOD in the previous chapter the selection of the study areas is guided by two main criteria. Firstly, the selected area must represent one or more than one typology of TOD and, secondly, in order to include the three Ds of TOD basis diversity in the selection of the areas is a key component.

Figure 15 The selected Corridor of study area / Map generated and extracted by the researcher from ArcMap 10.7 . source ……

The selected areas start with an important corridor at the beginning of the Tirana-Durres corridor, continuing to the western part of the outer ring road, extending to the outer city Elbasan corridor. The selection of this continued area fits the two main criteria. The selected area, as an added value, differs in the typology of development, where the first part is the Tirana-Durres corridor is mainly an economic area, that slowly invited housing development, the western ring road is a newly high density build area that was just divided by the construction of the ring road, the final part of this section is the outside Tirana-Elbasan corridor a still developing area with low density private housing. The overall study corridor area is 20 km long, which makes it hard to apply

the methodology throughout the entire corridor. In helping to frame the study subsections, to match our four initial case studies we will select 12 sub areas from the structural units of the local general development plan of Tirana 2030, which will reflect the typology, diversity and overall design of the section.

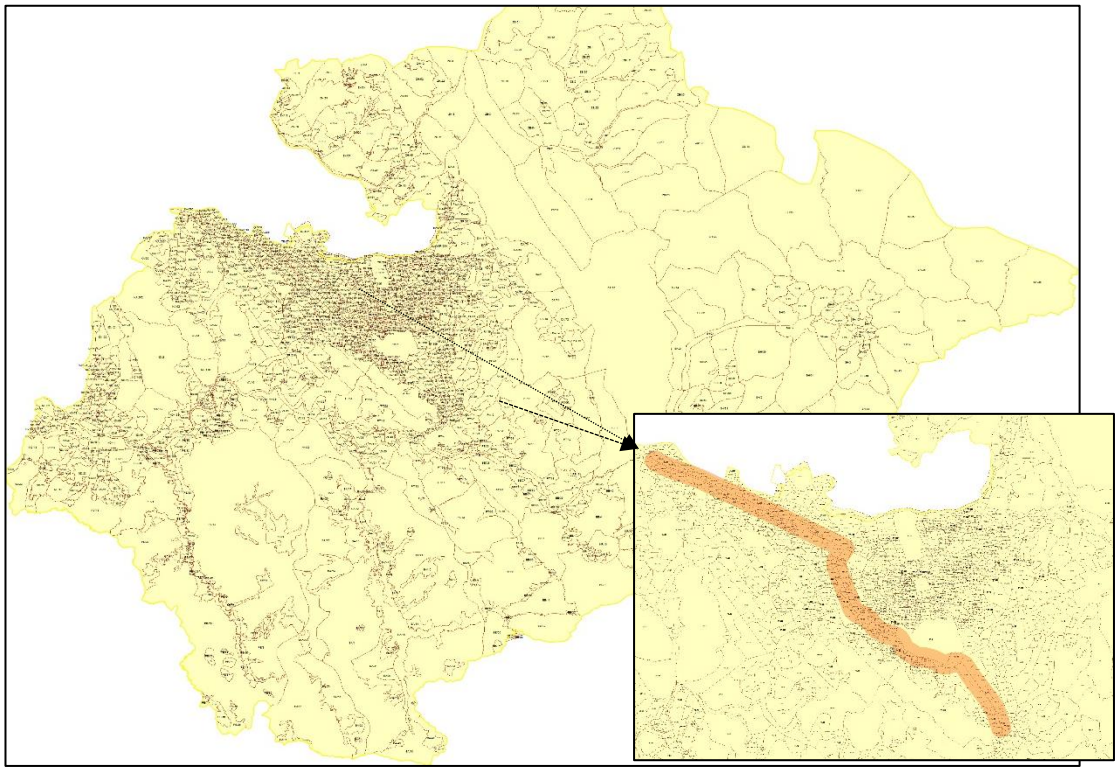


Figure 12 Map of the Structural units defined by the Local general plan, with a focus in the study corridor / Map extracted by the researcher from the ASIG national database

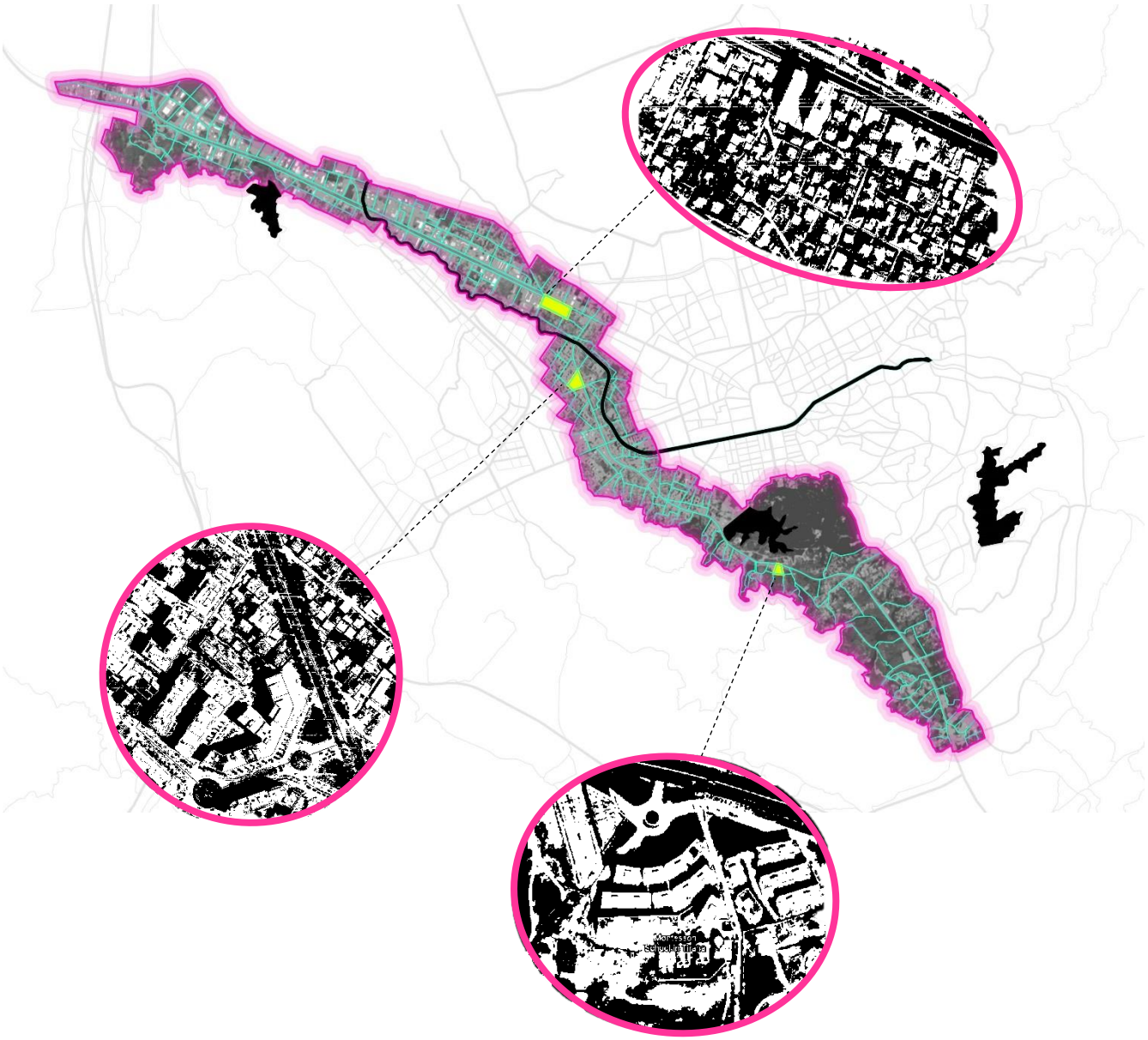


Figure 13 The area of study of the 240 units of division, Map created by the researcher 2021

The third and final area is a newly developing section near the Tirana artificial lake, this particular area is under development that has been supported by the ring road infrastructure.

TR/ 441 Area 1

118 buildings

2.45 km Infrastructure

16 services and business

Figure 14 Arial photo of the area nr 1, photo of 2021 extracted by the researcher from ArcMap

Our first area is located at the edge of the Tirana- Durres Corridor, based on the division of the Tirana 2030 Plan division nr TR/441 with a total surface of 78700- square meters with 17805 meters of existing build area, the existing 0.3 far and primary development of housing build, maximum of 7 stories build and 1322 of green area space and a population capacity of 5289 people (when?). The area was developed as an informal sprawl to the city of Tirana in the late 1998-2002. The first development of business started in 2005 with mainly commercial services. In the arial photos below we can track the development of the area (figure 15).

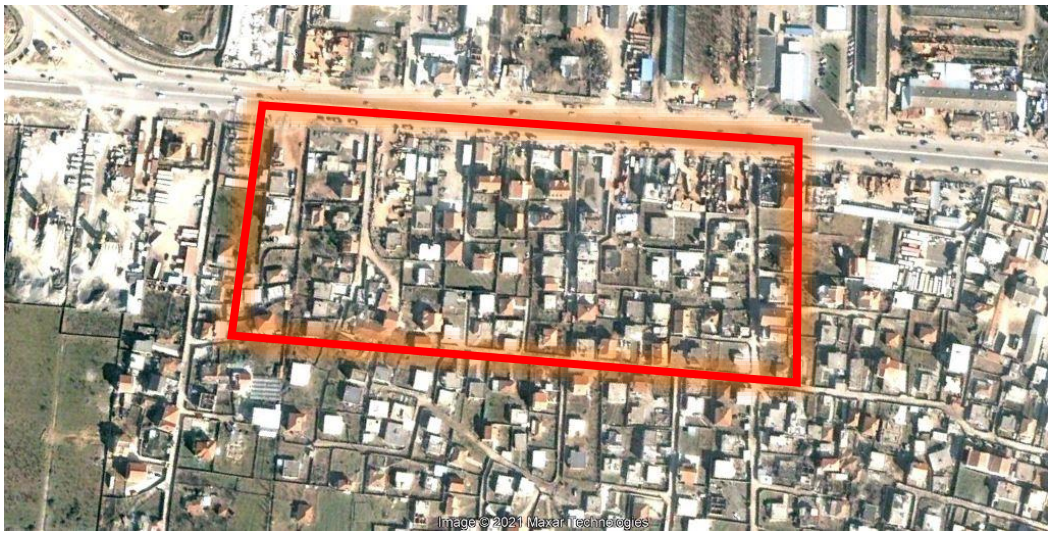
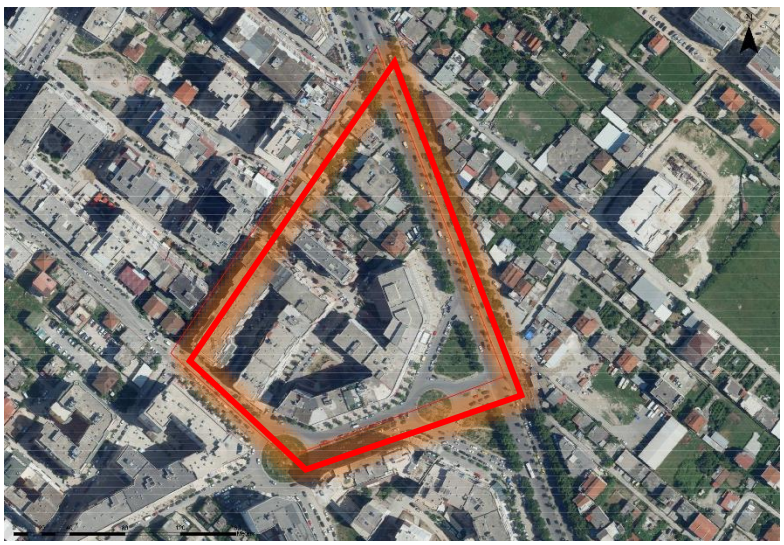


Figure 15 Arial Photo of the Area 1 extracted by Google Earth historic data 2003 by the researcher in 10.10.2021

Figure 16 Arial Photo of the Area 1 extracted by Google Earth historic data 2009 by the researcher in 10.10.2021

It is obvious by the observation of the two historical photos that the area started the development of large residential areas after 2010 with the infill of private houses and residential buildings.

KA / 53 Area 2



27 buildings

1.40 km Infrastructure

28 services and business

Figure 17 Arial photo of the area nr 2, photo of 2021 extracted by the researcher from ArcMap

The second area is located at the edge of the Western Ring-road, based on the division of the Tirana 2030 Plan division nr KA/53 with a total surface area 36100- square meter, with 11332 meter of existing build area, the existing 2.41 FAR and primary development

of housing build, maximum of 8 stories build and 7650 of green area space and a population capacity of 3060 people (when?). The area was developed as an informal sprawl to the city of Tirana in the late 1998-2002. The first development of large residential areas started in 2010. With the first development of infrastructure this was the start of business development and commercial services as illustrated in Figure 18 below.

Figure 18 Arial Photo of the Area 2 extracted by Google Earth historic data 2003 by the researcher in 10.10.2021

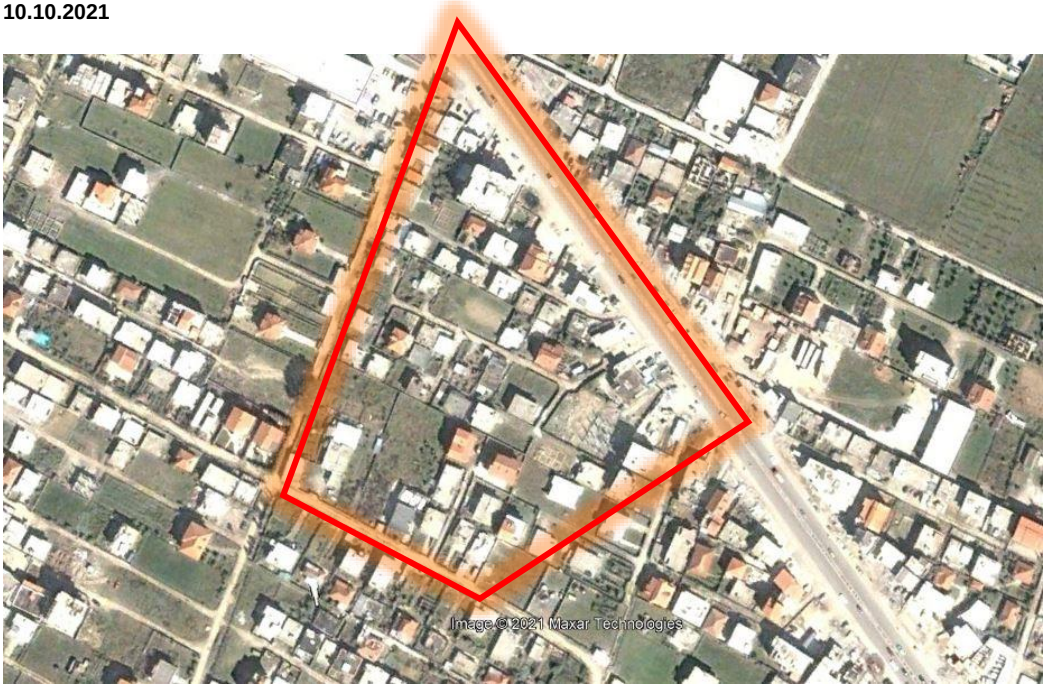


Figure 19 Arial Photo of the Area 2 extracted by Google Earth historic data 2009 by the researcher in 10.10.2021

Figure 20 Arial Photo of the Area 2 extracted by Google Earth historic data 2013 by the researcher in 10.10.2021

FA / 145 Area 3

15 buildings

1.24 km Infrastructure

6 services and business

Figure 21 Arial photo of the area nr 3, photo of 2021 extracted by the researcher from ArcMap

The third area is located at the edge of the Western Ring-road, based on the division of the Tirana 2030 Plan division nr FA/ 145 with a total surface area 14600 - square

meter with 10434 meter of existing build area, the existing 0.72FAR and primary development of housing build, maximum of 3 stories build and 745 of green area space and a population capacity of 298 people (when?). The area was developed after the approval of the local development plan and has been developed in agreement with the indicators of development established by the plan. The development of the area started in 2020 as a new development area with low residence buildings, before 2020 the area was only a natural space as shown in the Figure 22 below.

Figure 22 Arial Photo of the Area 2 extracted by Google Earth historic data 2019 by the researcher in 10.10.2021

All three selected areas are connected by the same infrastructure corridor; however, this newly build corridor was built in sequence. The first area was developed unrelatedly to the corridor since at that time the corridor had only an inter-urban corridor, but with the new corridor and the expansion of the road into the overpass the area is developing into residential area with higher density. The second area is also located in the same corridor. This area has developed very intensively in the last decade after the infrastructure redevelopment of the corridor started. The entire section of the corridor has changed radically, focusing on high rise residential buildings, however this is something that happened before the general local plan of Tirana. The third area selected in this corridor is also in the lastly developed part of this corridor. This section was finished between 2018 and 2020, which also coincides with the local general development plan of Tirana.

7 CHAPTER SEVEN - INDICATOR AGGREGATION

7.1 TOD criteria and the bases for these analyses

In order to further investigate the application of TOD components in an urban context, we must firstly understand the relation of these components to the urban situation and how to apply them into an urban context. The aggregation of the components, naturally sum up the TOD theory, as the aggregation is based into the primary components of this theory.

With the thorough investigation of components relying into the IMM methodology for the translation of these components, we have matched the need for evaluating the component with the “how” is translated into a context. Starting this approach by understanding what the component is measuring, how will the measuring process occur and what data will better illustrate this component.

Starting from our first indicator “Density” as simple indicator considers only the number of people situated into a meter square area, in our case we will measure Density with the porosity of the area, including the change build volume and void in the area, the link to transportation and the functions within this area the aggregation of these data will guide this research to portray Density as the complex component it is.

The word "urban density" encompasses a wide variety of urban features and is multidimensional. Most research on urban density focus on demographics and other aspects of human settlement, which is a limitation. However, there are many other aspects of urban density that have a substantial influence on the sustainability of cities,

which will be discussed later. It is difficult to say if compact cities are more sustainable than scattered ones because of the lack of data on the link between urban density and long-term growth. City planning, development, and administration may benefit greatly from the analysis of many aspects of urban density. According to a variety of circumstances, urban density can give significant information for city planning and growth.

A city is more than the sum of its parts. Buildings, on the other hand, aren't only places to live. Densification, however, is frequently framed in terms of building as many houses as feasible and doing it as rapidly as possible. However, given that there is now a huge need for housing and the hurry to construct, it is imperative that we sit down and ask ourselves: What kinds of surroundings are we creating? Who are we constructing this for? How can we guarantee that our cities are safe, sustainable, and comfortable for all of our residents? Is the built environment and the quality of life enhanced by the new structures we are building?

Cities may be broken down into their basic pieces in several ways to display their anatomy. Back in the 1940s, Le Corbusier, one of the great masters of modern architecture, created the concept of a completely self-sufficient community within a single high-rise building. This eventually materialized into a building called the Unite d'Habitation, an eighteen-storey building consisting of about 400 residential units, and providing integrated commercial and communal facilities, such as a shopping arcade, a hotel, a kindergarten, and a rooftop exercise area complete with a swimming pool and a running track. xxx

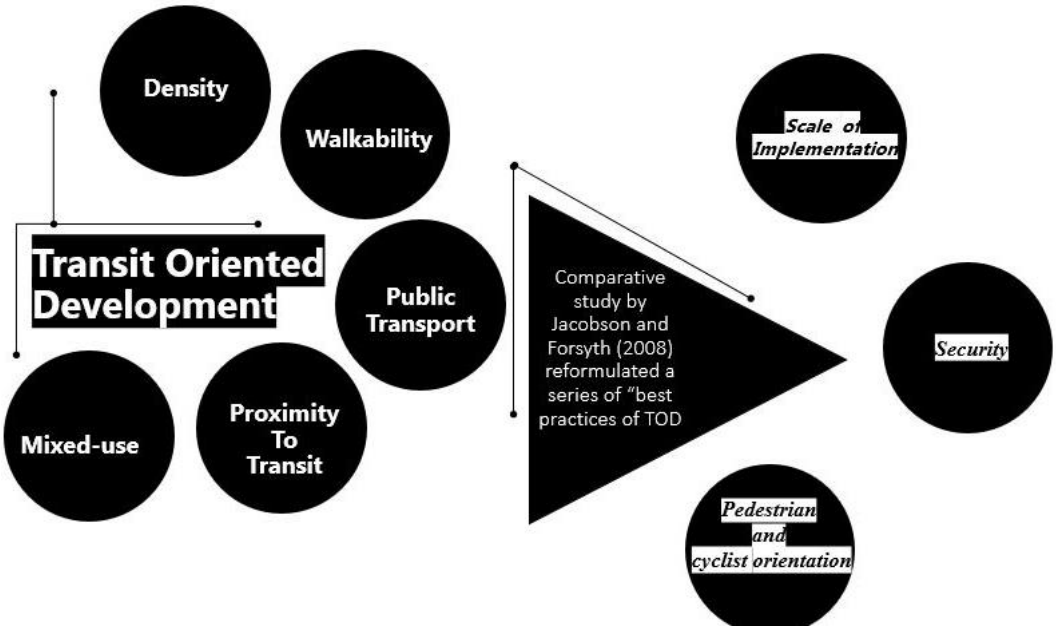
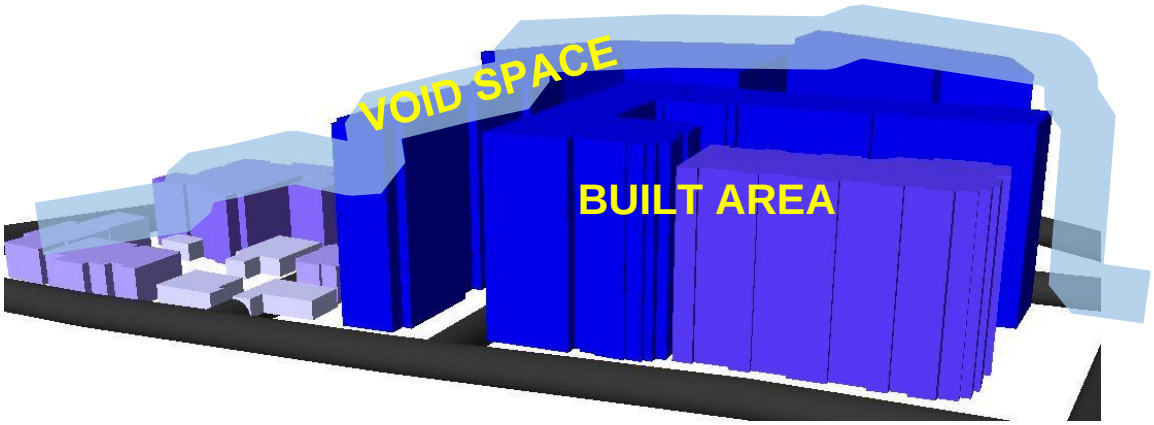


Figure 23 The main components of TOD identified in this study Source: Authors personal library

7.2 Measuring and investigating Density

Density is a vertical indicator related to the possibility of building within a space, but measuring density for this study takes into consideration the complex and vast indicators collected within an urban space. This study will measure density in relation to layer in superimposition outlining volumes in an urban context. The layer superimposition means that each layer has a different role in the key categories in our first component is VOID / Volume / link / Transport / functions. Considering this the analyses effectuated in ArcMap model builder integrates the data of volumes, surfaces, footprint (buildings), distribution of services and the buildings number. To provide a simplified method in calculating we will use the average height of the building, covering the area to finally define the boundary of urban volume. In the classical representation of the Density the overall formula is only a collection between the **floorspace occupancy** × floor area ratio × residential share = urban density, however this representation of the formula leaves many of the urban components outside its findings. Density is necessary to understand the morphology of the city. The components as part of the TOD are much more complex and require much of the vertical and horizontal representation, taking into account not only the density as its classical representation, but also the void in between representing urban space, services within this space the distribution and linkage to the space. Breaking down the following formula:



mean
Xh

Extinction of the Analyses Area

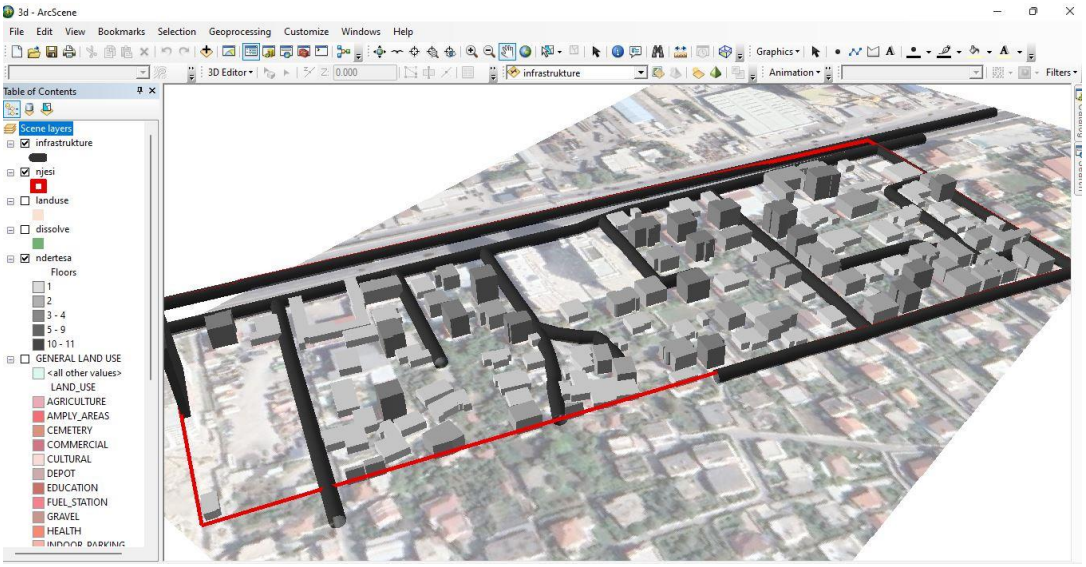
$$Xh = \sum_{\breve{V}o} (A\,\dot{x}\,h) / \sum A$$

A = Area of Building footprint
h = height of building
Vo = Volume of Built area

Building footprint means the area of land measured at finished ground level that is enclosed by the external walls of a building. As a first step, we must acknowledge the current situation and understand the total volume of the area we are testing our indicators.

As a first step in generating a unified model is to create three separate files, each area must be an independent input to the model.

Area 1 calculations of the Volume of Built area:


3d - ArcScene
File Edit View Bookmarks Selection Geoprocessing Customize Windows Help
Table of Contents
Scene layers
infrastrukture
njesi
landuse
dissolve
ndertesa
Floors
1
2
3 - 4
5 - 9
10 - 11
GENERAL LAND USE
<all other values>
LAND_USE
AGRICULTURE
AMPLY_AREAS
CEMETERY
COMMERCIAL
CULTURAL
DEPOT
EDUCATION
FUEL_STATION
GRAVEL
HEALTH

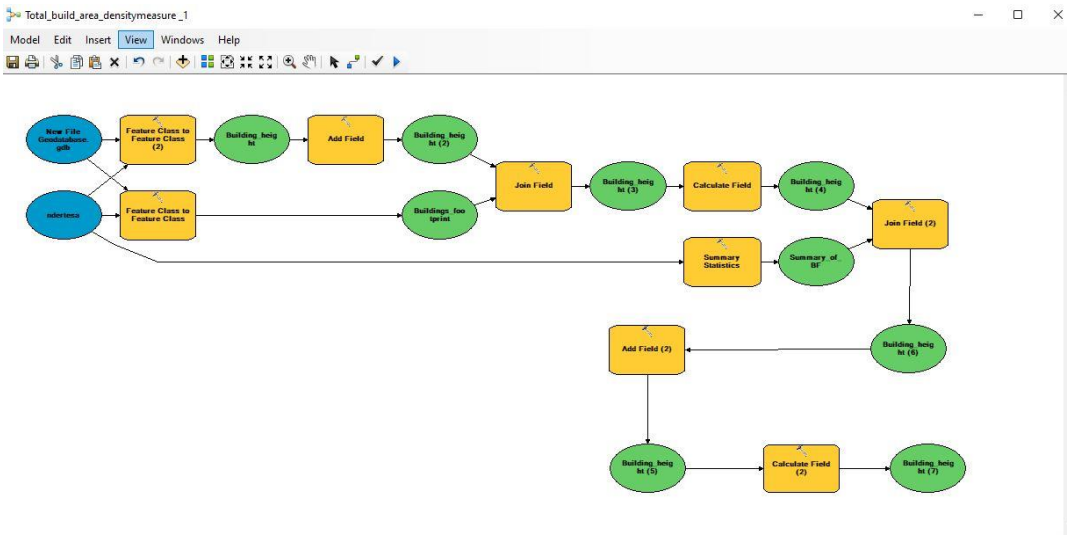
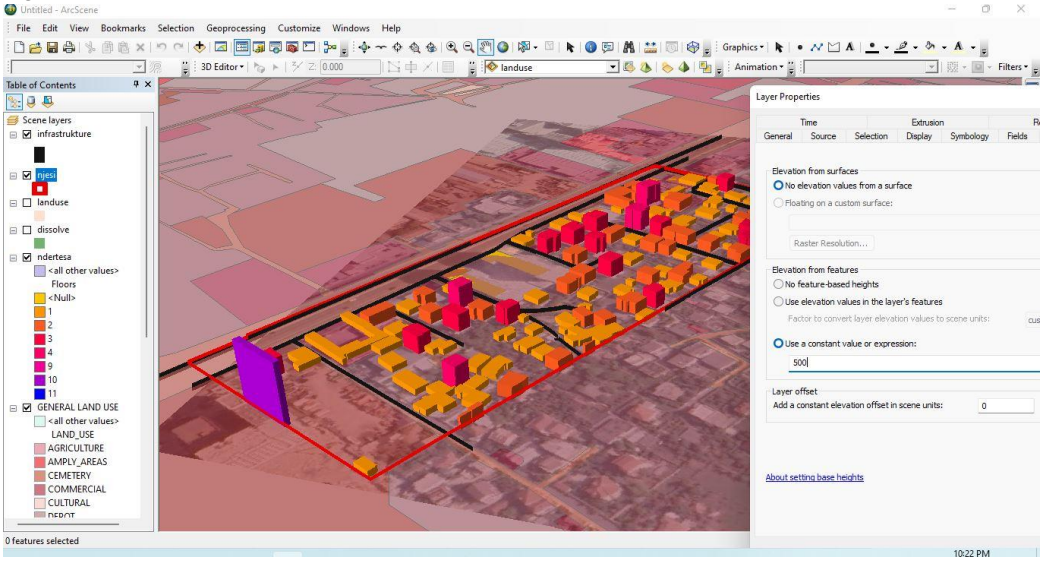

Total_build_area_densitymeasure _1
Model Edit Insert View Windows Help
New File Geodatabase.gdb
Feature Class to Feature Class (2)
Building_height
Add Field
Building_height (2)
ndertesa
Feature Class to Feature Class
Buildings_footprint
Join Field
Building_height (3)
Calculate Field
Building_height (4)
Join Field (2)
Summary Statistics
Summary_of_BF
Building_height (6)
Add Field (2)
Building_height (5)
Calculate Field (2)
Building_height (7)

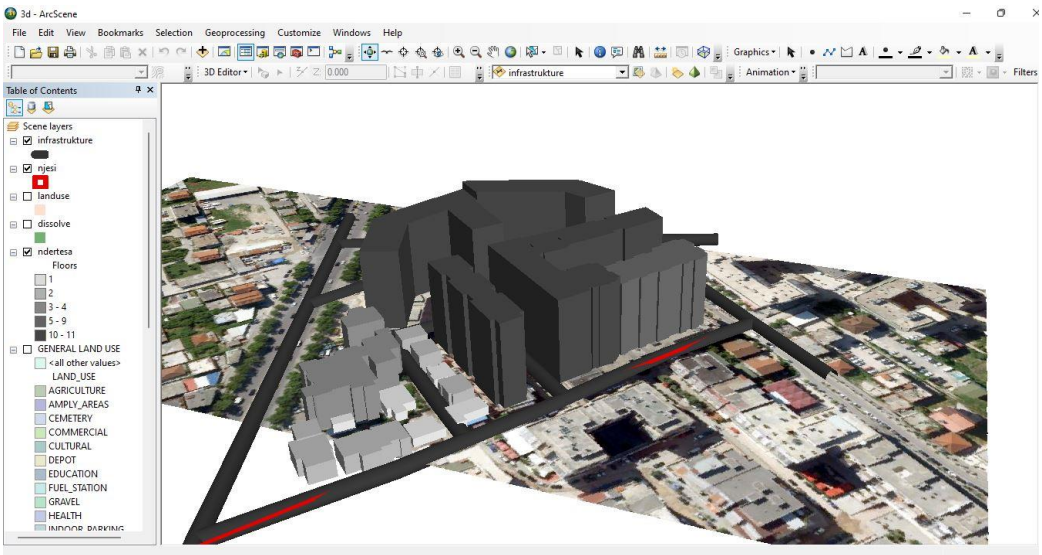
Figure 24 The formula for the total volume of the neighborhood

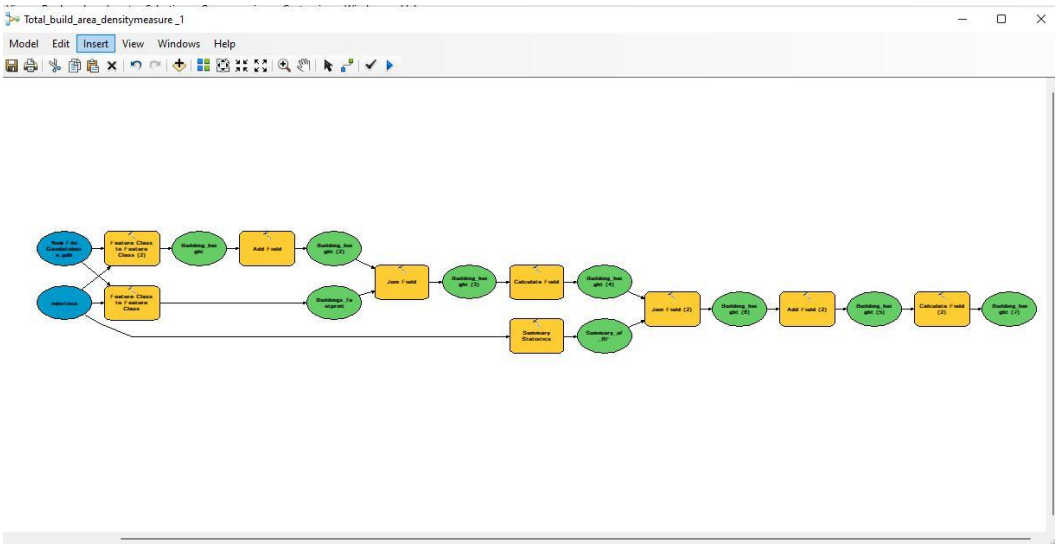


xxx

Calculating the total volume of built area is **1.9** for our first area

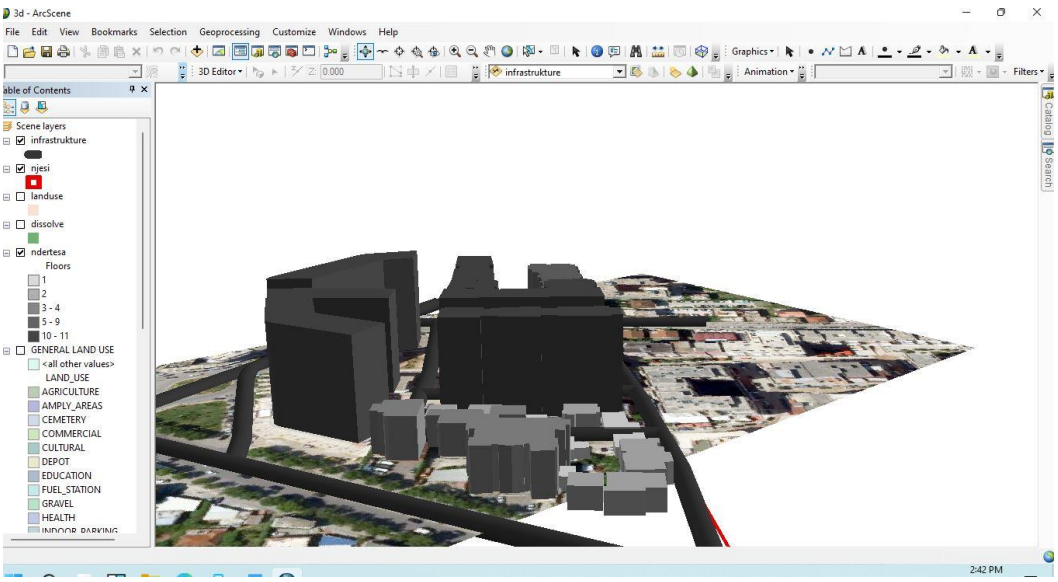
Area 2 calculations of the Volume of Building area:

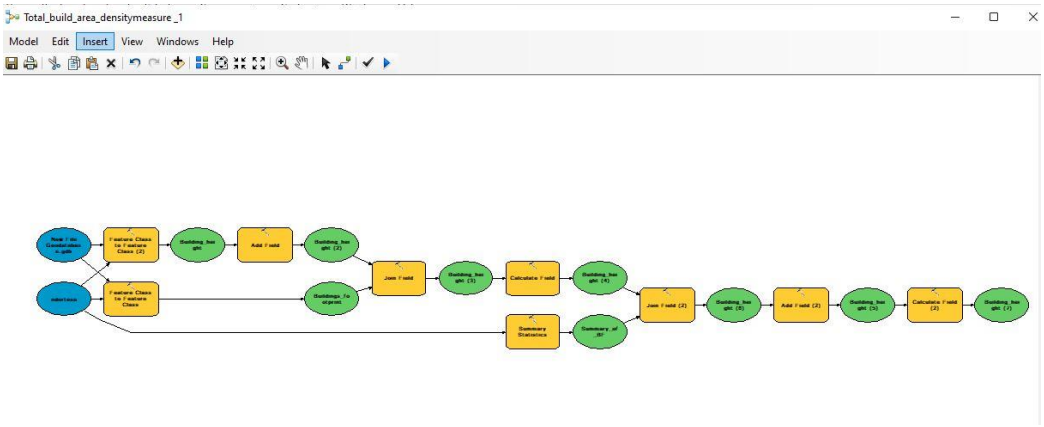




Calculating the total volume of built area is **10.9** for our second area.

Area 3 calculations of the Volume of Building area:





Calculating the total volume of built area is **4** for our third area

The volume of the area is only the first step, illustrating the measure of built area in proportion to the total area space, in a measure of build and void.

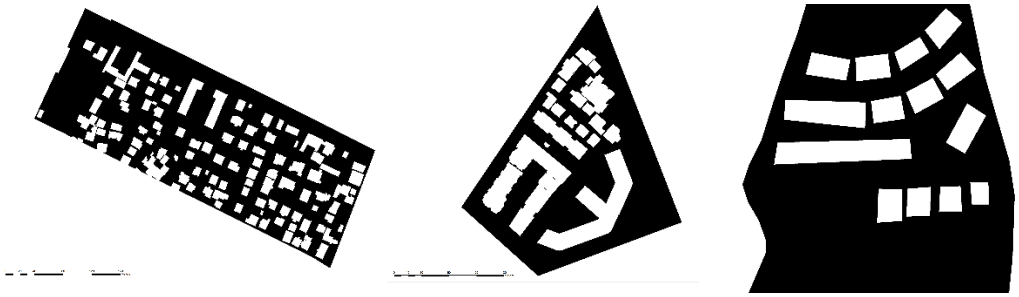


Figure 25 The illustration of Void and Build area for our test sites illustrated by ArcMap / Arc scene Created by the Author

After obtaining the first part of this formula, we will find the total volume of our neighborhood. After calculating the volume of built area in this second part of this formula, we can easily calculate the volume and void of the space in a percentage ratio.

Calculate the volume of built space (**Vv**):

$$Vt = At \times Xh$$

$$Vb = \sum (Axh)$$

$$Vv = Vt - Vb$$

Vt= Volume of the site

Vb= volume of the buili area

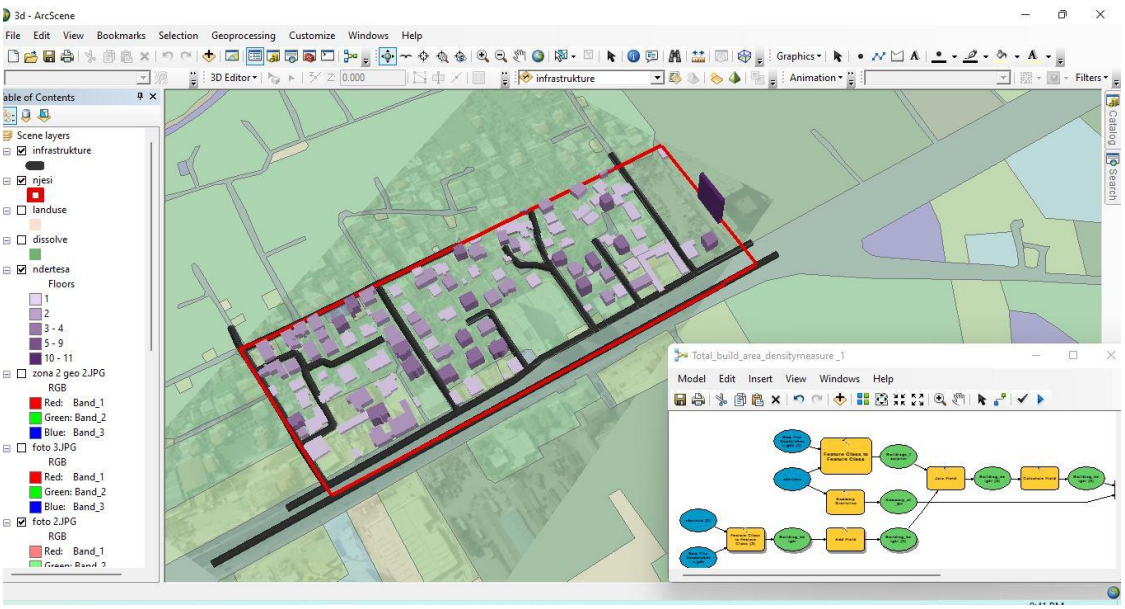
Vv= void space volume

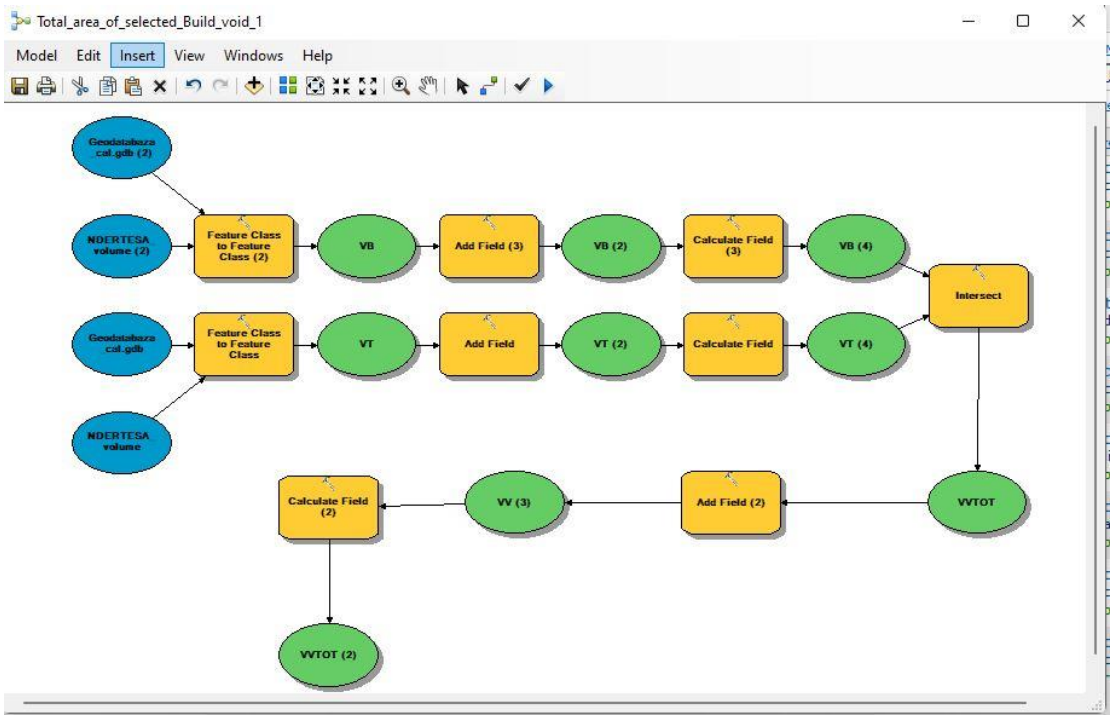
A = Area of Building footprint

At = Total area of selected site

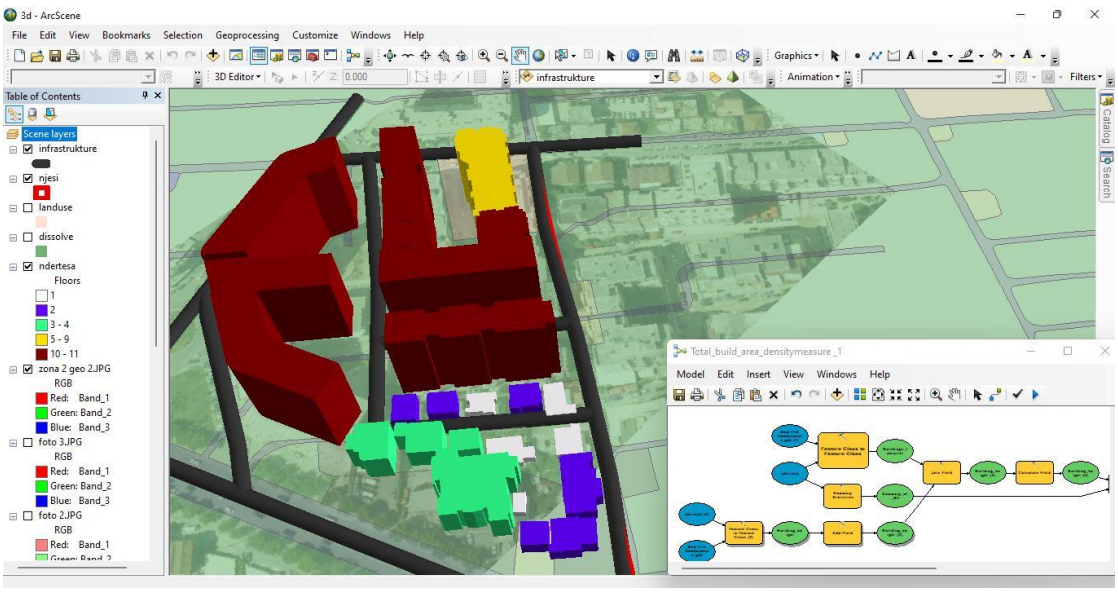
h = height of building

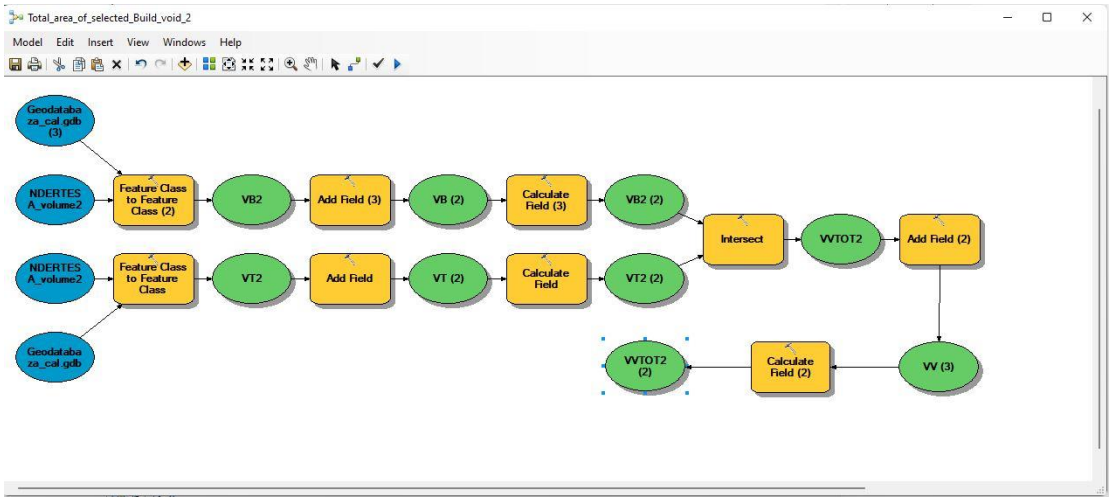
Ps= porosity (%)



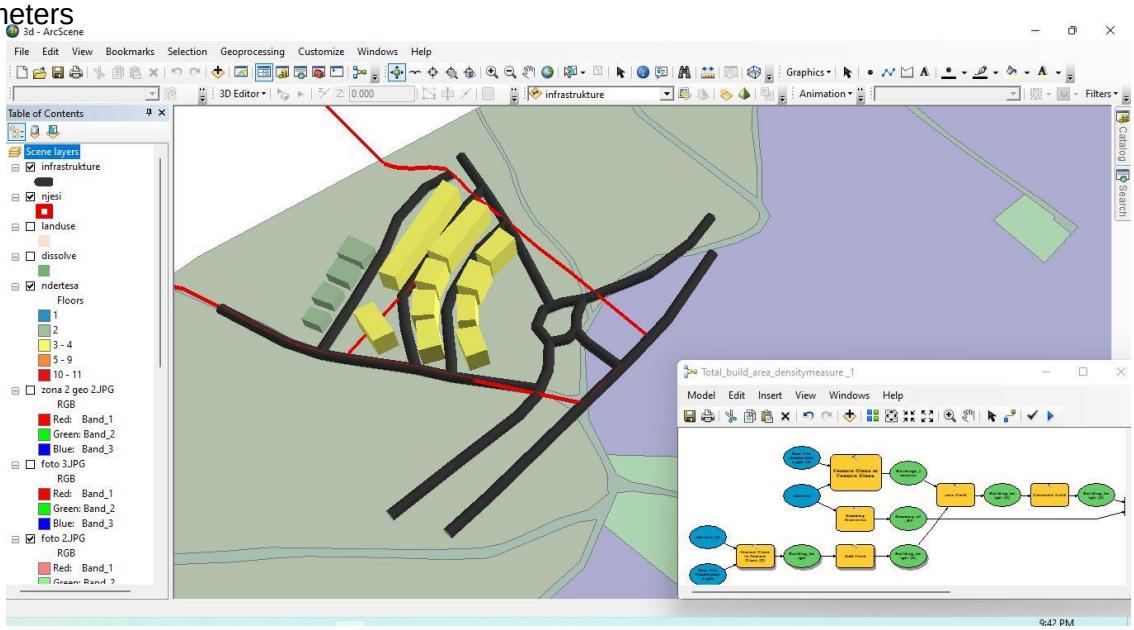


Calculating the volume of built space for area 1: **156868.99- square meters**





Calculating the volume of built space for area 2: **382896.98- square meters**



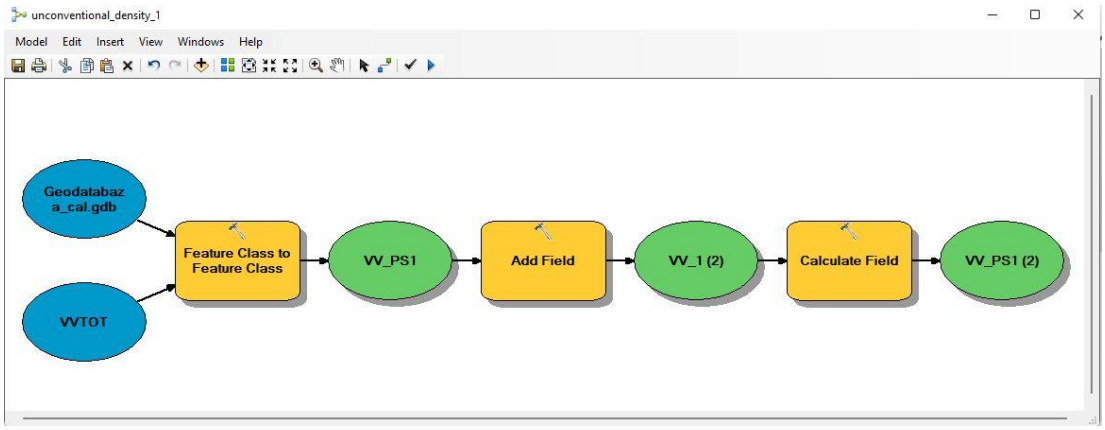
Calculating the volume of built space for area 3: **56970.21-meter square**

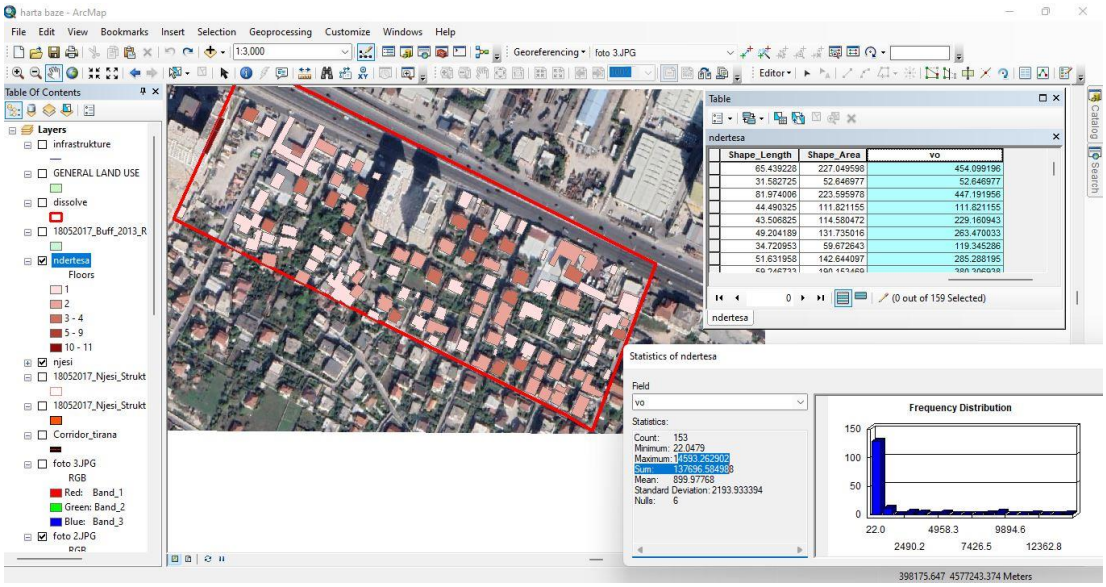
And finally measuring our unconventional density, therefore, density of buildings and the density of build void space through:

$$Ps(\%) = Vv \,/\, Vt$$

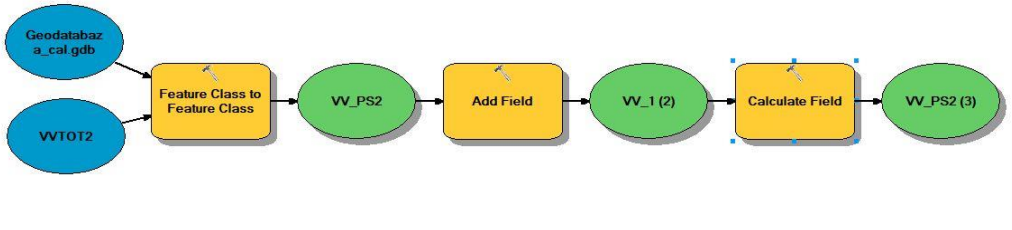
The measurement of the unconventional density considers the volume building and the volume and void of the area, in order to establish the Density of the area.

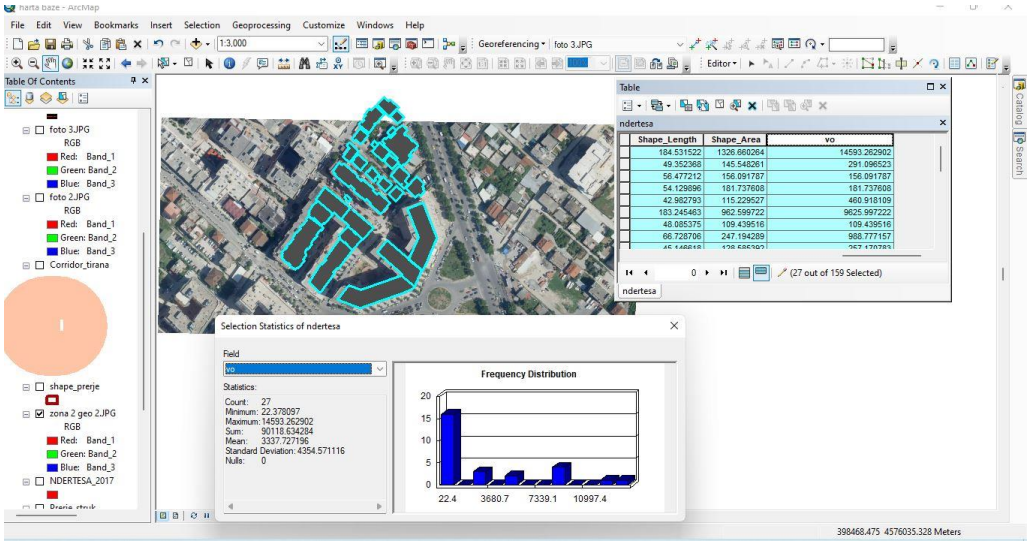
Density of area 1 = **82 %**



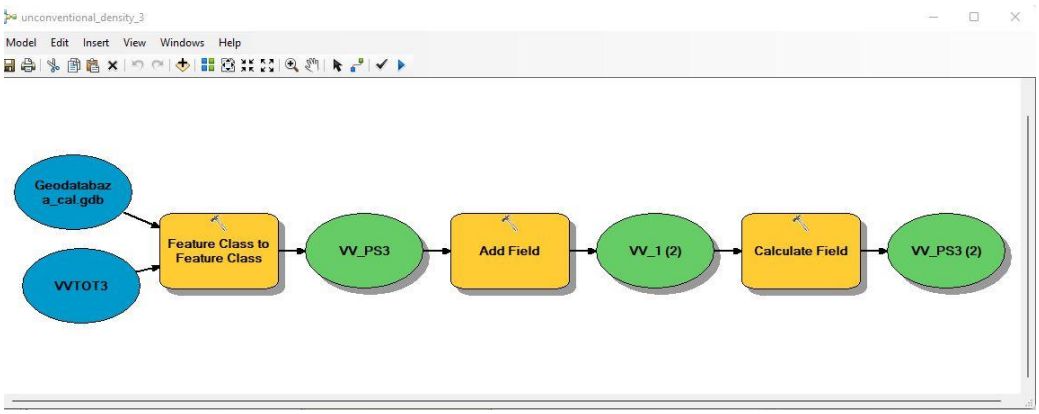


Density of area 2 = **68 %**





Density of area 3 = **66 %**



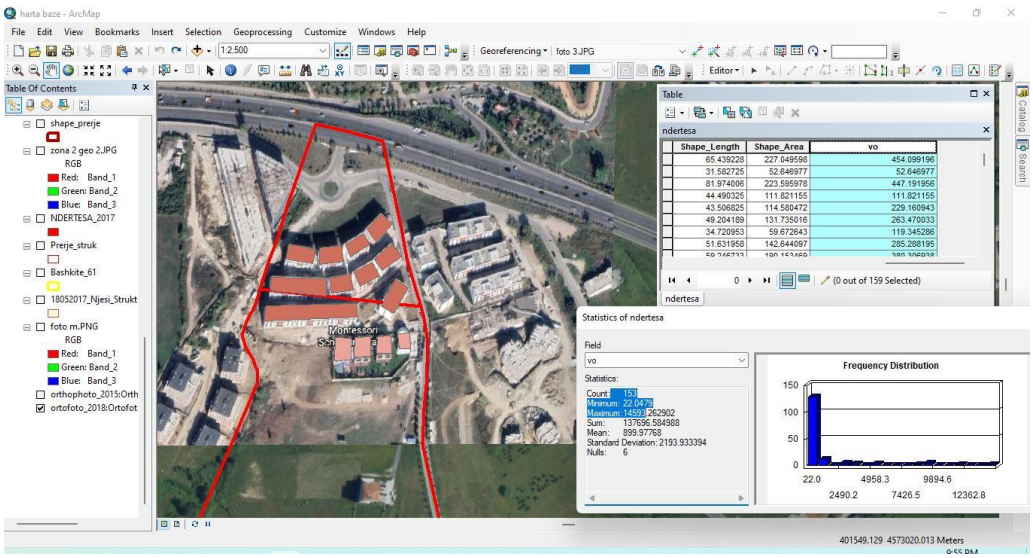


Figure 26 The representation of the volume, two cases of the same volume represented into the example

In this study we have found that Density should be considered in relation to the volume, however in the above representation, we understand that this is not the case, because a volume influences Density qualitatively. For this reason, we consider the horizontal elements that influence indirectly density in the calculations bellow.

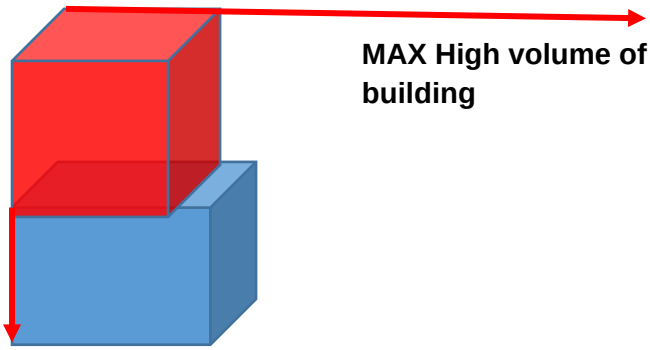
Defining the calculation of density in the city considering surfaces, our calculating method broadly considers the total area surface of the buildings and the sum of the total free area and make a ratio between the two for the total analyses area.

The calculation expands into surfaces:

$$Sr = \sum (P \; x \; h)$$

$$At = Ab + Av$$

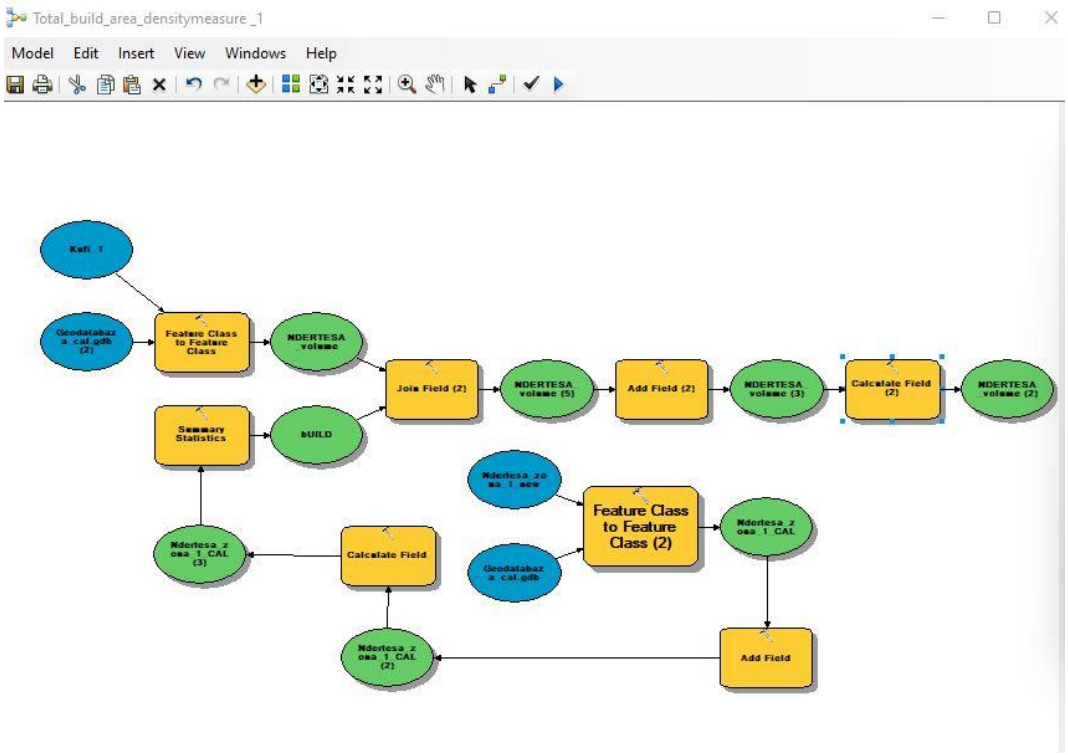
Ab = total area of Building footprint
Av = total void area
h = height of building
p = Building perimeter
Sr = Free vertical space of the building
At = total area of analysis

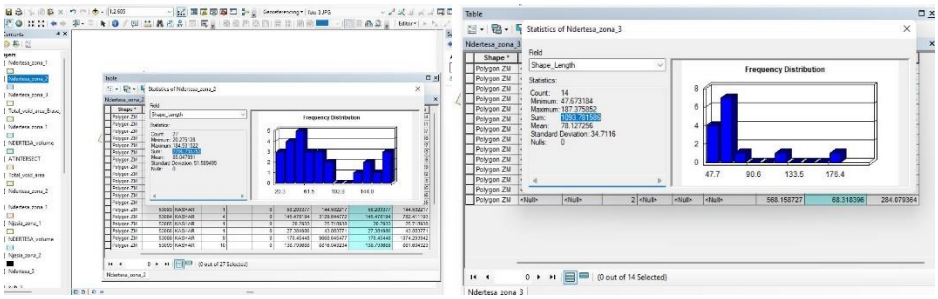


Current building height

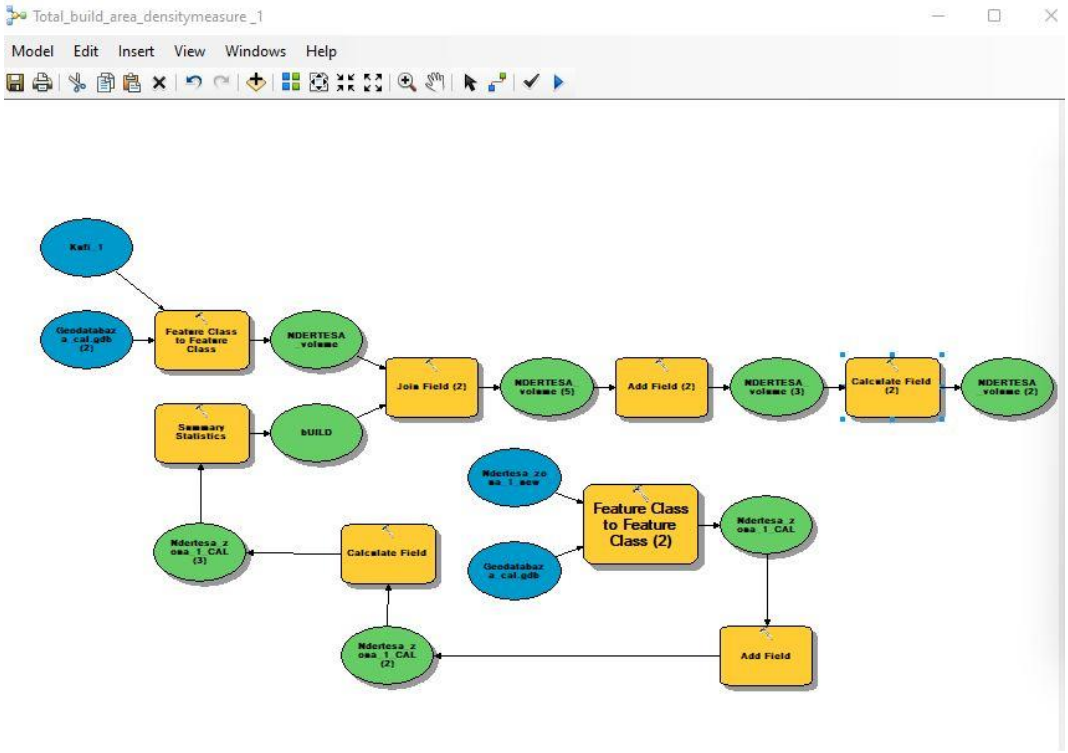
The calculations for the first area:

In our first area the total height of the building as a data extracted by the calculation, however the free vertical space, in our case will be the data extracted by the Local development plan which establish the FAR and the max height of the buildings. In the first area the max floor heigh its 10 floors.

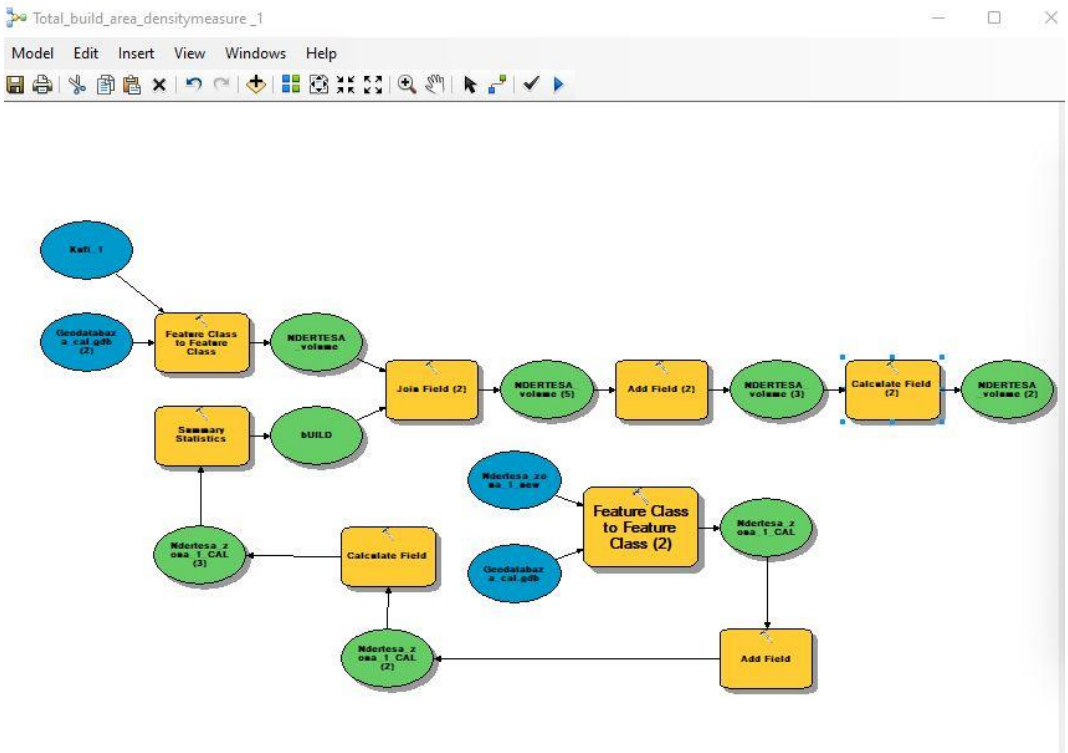




The free total area and total area of the analyses is equivalent to: 37708.4 for area 1



24928.64 for **area 2**

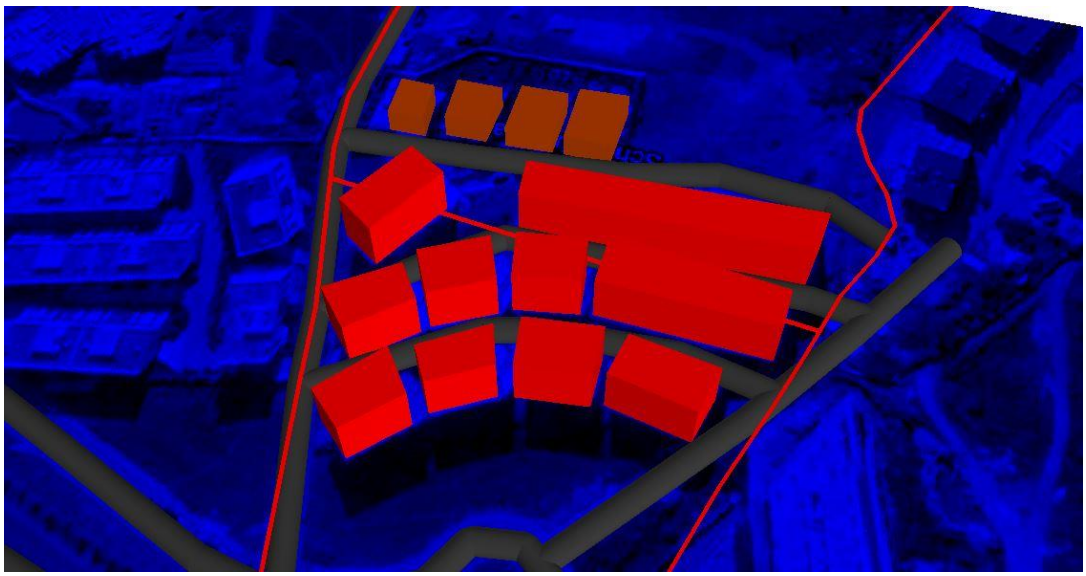


and 6179.81 for **area 3**

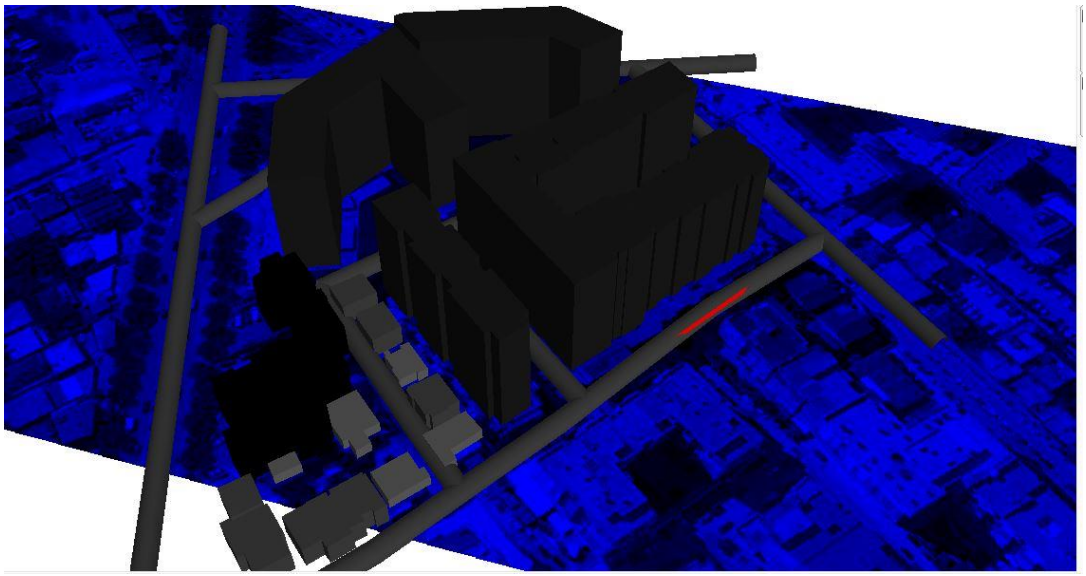
This will finally allow us to apply the formula of the surface.

As a final step is that the formula can apply the formula surface ratio giving the percentage as follows:

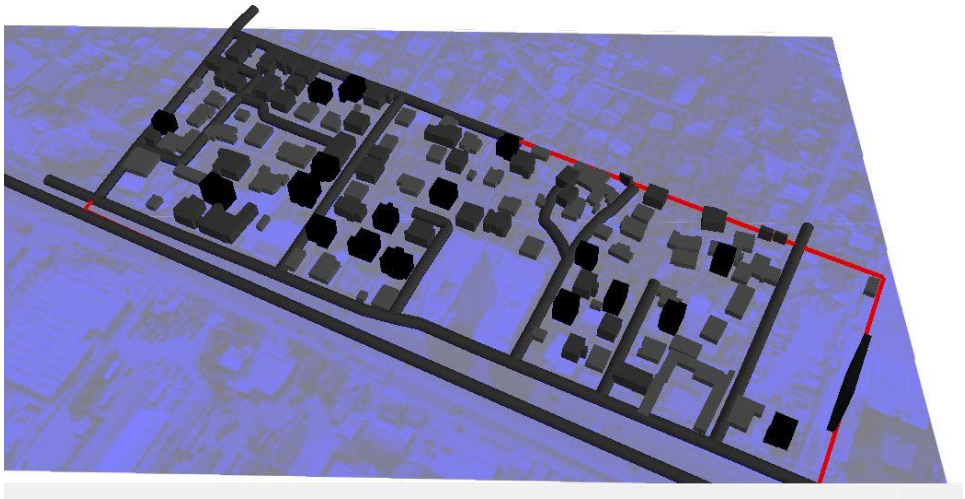
$SURF(\%) = (Sr \ / \ (At + S))$



Total surface area for the is 45%



Total surface area is 60 %



Total surface area is 40%

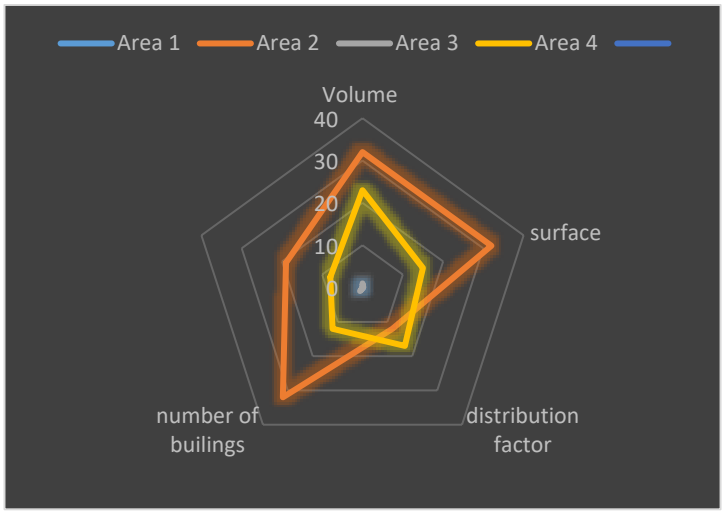
Measuring coverage and gross floor area ratio:

$$COV(\%) = Sground \ / \ At$$

$$FAR(\%) = \frac{(Sground \ x \ Nfoor)}{At}$$

Applying our measures to the selected area of our study, the final findings will be compared with the case studies from the American and European prospective.

As these studies have been selected as successful cases. The finding will help us establish the missing components of TOD parameters.



In the Density (porosity) spectrum diagram above the case studies outcomes measured by breaking down the calculation of the density, within each element has been attributed the findings of the automatization in Arcmap. The variation of the findings shows that area 2 and area 4 have a disproportion in the number of buildings and the total surface of the area. These findings clearly show that the area has a low distribution of services in attribution to the surface and volume of the area. This clearly shows the gap within this first parameter.

7.3 Measuring and investigating proximity to transit

In order to measure the proximity to transit in a classic scenario we would only divide the area into a grid of 15x15 (we could easily use the grip provided by the institute of statistics which can be found in:

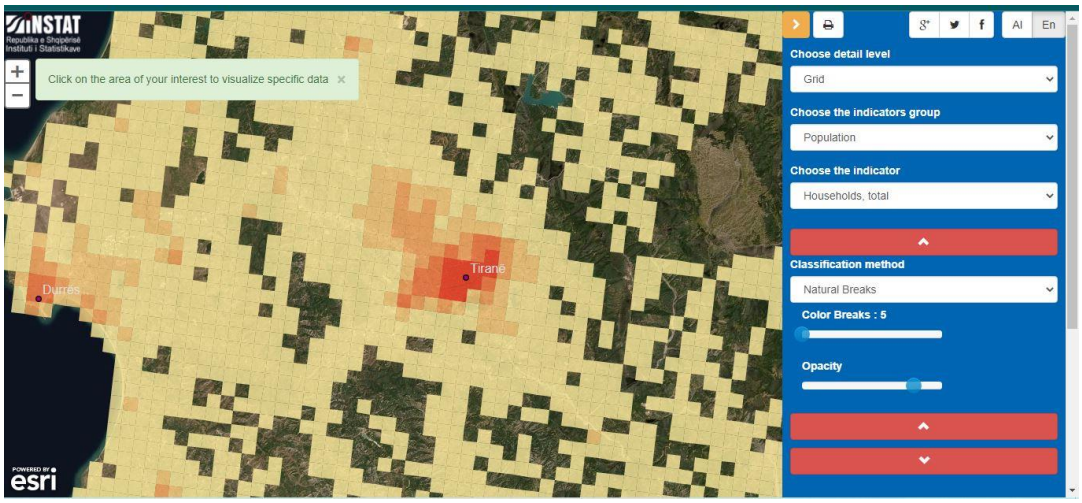


Figure 27 Table of grip division of the territory established by the institute of statistics of Albania in 2017 Source; Institute of Statistics open source Webgis platform

https://instatgis.gov.al/#!/l/prefectures/population/prefpop1) as measure of distance and usee it as a base to identify the stations. From there, the second step would be to establish the area of walkability according to the 500-meter established by this study in the theoretical part. However, we will consider this parameter as a more complex filter, using not only the horizontal analyses but the vertical as well. Firstly, we establish the intermediate scale which we defined as our area of study, then we locate all the built volumes in the area adding the bus stops, taxi stops and bike stations. We continue by ending the comfortable walking area which we have established in the research (500 meter). By overlaying these two pieces of information we can easily understand the high-density walkable areas and the areas with low walkability. The outcome of this analytical process will be established in a measurement grip (to help us understand the translation of the coverage of built, void and transport better). More on this can be viewed into the picture:

xxx

Figure 28 The overlying of the build, void and transit areas in our case

With this map outcome we can observe what is the number of buildings that have a high density with low accessibility and what buildings have low accessibility, also high accessible areas with no built volume, which as a result become areas were future development can occur. Calculating the overall proximity to transit and how effective this proximity is within the area we use:

$$Ef = Np \ / \ Nt$$

Np= Number of Trips in Public transportation
Nt= Total number of Trips

The data measured in the table below belong to the data field by the researcher during the two different times of observation. The first observation happened in the interval of two hours from the 11:00 am to 13:00 pm on June 20th 2020, in the two intersections of the area. The second observation took place between 9:00 am and 11:00 am at the same intersections on 21st November 2021.

Type of Transport	Origin A	Destination B
Private Transport	397	1354
Public Transport	645	794
Total	1042	2148

Table 6 The observation for the proximity to transit and fluxes represented by the authors findings

Translating these parameters in urban planning models aided by Arcmap is not an easy task. For the translation of this model, we had to overlay existing information from the database offered by the local development plan. This data is accessed by the ASIG[18] which is the institution in charge of data aggregation and management at country level. These data are free to use, but with restricted access to changes and alterations. The translation of the formula into a model that can be used and operated independently by only altering the input, considering the logical road to the conclusion of the data which in this case is the formula:

[18] *"ASIG is focused on presenting the geospatial data and services provided by the responsible public authorities, as defined by law no. 72/2012, "On the Organization and Functioning of the National Infrastructure of Geospatial Information in the Republic of Albania". Https://geoportal.asig.gov.al/en*

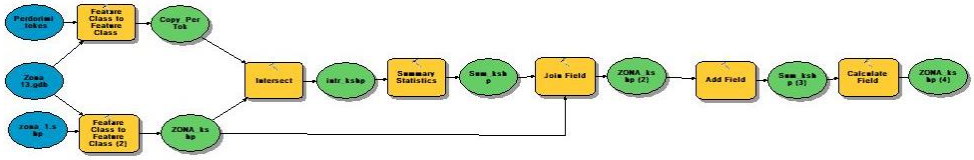
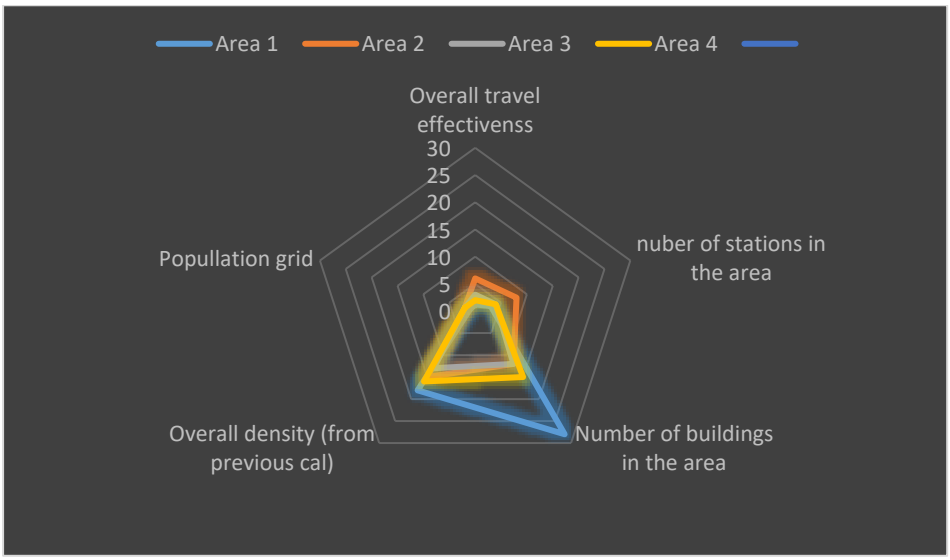


Figure 29 Model builder for the measurement of effectiveness part of the proximity to transit analyses Source: Autor's findings from the application of the formula in ArcMap



From our findings there are some preliminary conclusions related to the high number of buildings in our three areas, unproportionally to the number of stops and transit lines. This gives some clear indication of the planning of the area and the need for a better coverage of the accessibility to transit stops in comparison to the density and buildings in the area.

7.4 Measuring and investigating Mixed use

The classical approach to mixed use would consider this indicator either at the isolated building level, by understanding the percentage of services allocated into a single building or it would simply identify the overall percentage of the services in the area and make a simple deduction on the areas surface. In our case we incorporate the volume, built environment and the function layer considering the key functions of the area accessible by walkable distance in accordance to the 500-meter distance we have established. The step followed by this indicator measurement is to establis the built area which in our case will be extracted from the built volumes that we identified in the

measurement of proximity to transit, when the key functions through the land use cover provided to us by the database of the local development plan of Tirana city, overlaying the buffer circles of 500-meter of walkable space to reach transit stops defined into the proximity to transit parameter and finally analyzing the outcome of the map identifying the areas of mixed uses in comparing to service, build density and transit. xxx

In order for our data to be centralized in this study the key functions will only consider these categories: education (Schools, kindergardens, daycare, universities and educational spaces), administrative services (documentation office, municipality etc.), entertainment, commercial and business. The scale of applying these principles will remain the same by considering the administrative division of the smaller division unit accepted into the plan in our case (administrative unit borders defined by the Plan).

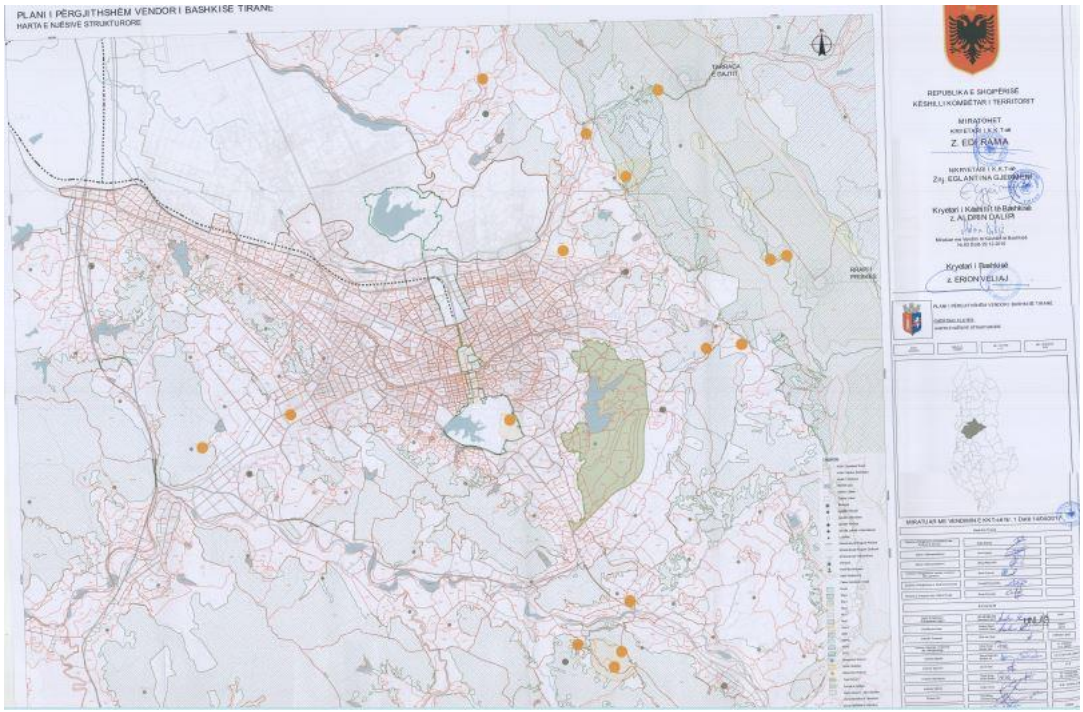


Figure 30 Map of Tirana for the Administrative planning units in 2019 national plan Source: National Planning Agency document 2019

Measuring the mixed use within the indications explained for our case studies is done by the formula:

$$P_x = \frac{\sum_{i=0}^{N} nf}{N} \qquad P_x = \frac{\sum_{i=0}^{N} nj}{N}$$

Nf= Number of functions
Nj= Number of jobs in the walkable distance
N= Number of circles by (walkability)

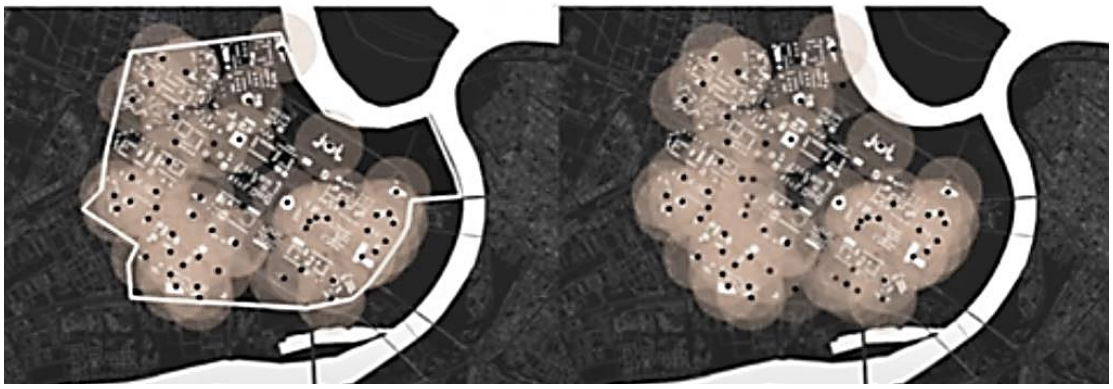


Figure 31 Data overlay on the mixed uses on the area using the superposition of the main services

As the data shows, the overlay on the main services divided by our main categories in the area, the stops and the proximity to transit mainly paint a picture of the dense services in the area mainly into the outskirts of the area leaving some of the inner area with no service. However, inputting a second layer in this equation would mainly explain the lack of services in the open space area and public space with no use, this serves as a first observation for the creation of shared space and incorporating services in the areas were the map shows deviation. Finally, translating this indicator into a reusable tool suing model builder, as a reminder that the model can be adjusted through input, so the new area or a city, considering this model, can implement the same method and model, changing the number of inputs in the model:

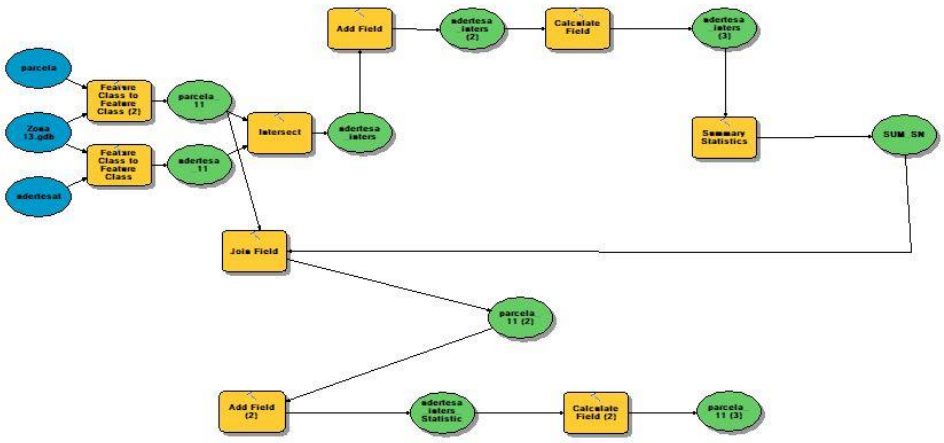
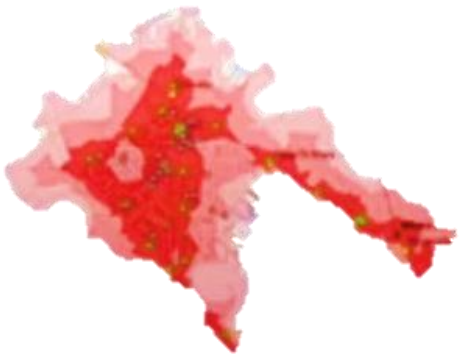


Figure 32 Model builder creating the Mixed-use parameter data aggregation

7.5 Measuring and investigating Walkability

Walkability is actually a very basic concept to understand. It basically defines in a simplified idea if I can go from (A) to (B). As investigated in this research the walkable distance simply defined as the 500-meter of possible walkable area. However, walkability is a much more complex structure that can be viewed as possibility of spatial access. This refers to access in adjacent properties. The synergic integration of the main components measuring walkability names walkability in a relationship between sustainability and environment. In our case the indicator is measured as follows. The walkability is measured considering walkable distance (the time you spend from the closest to the furthest limit of the area), attractor value (the number of services, infrastructure and intramodality), network measure and betweenness (the space left in-between).



The first generated value for the walkability in reference to the adjacent space. The map has a superposition of the main billings, their functions as defined in the second index and considers the two main infrastructure nodes of the area.

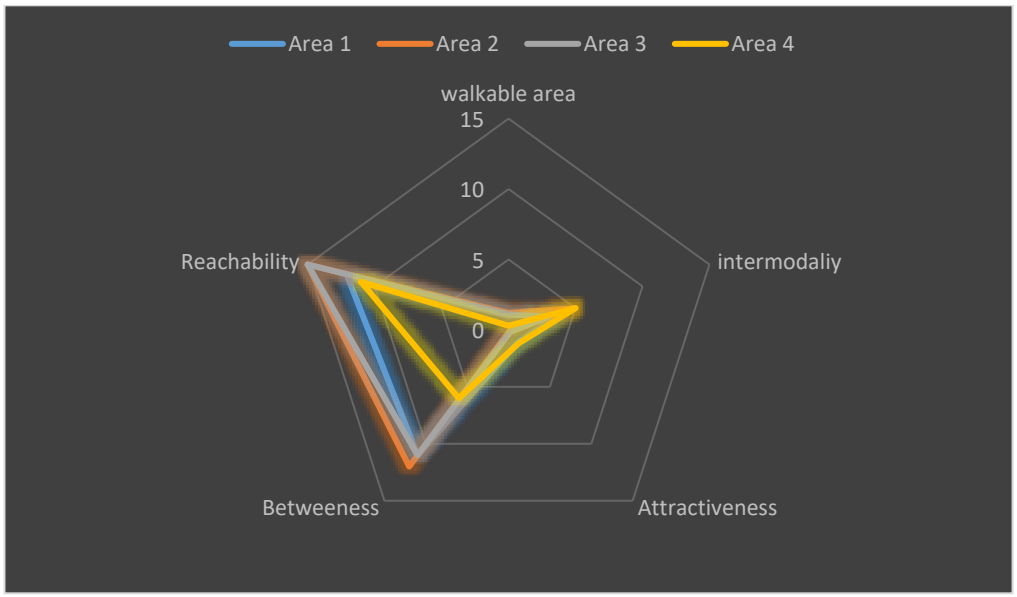


Figure 33 The data of the measure of Walkability considering the 5 components of measure

XXX

Integrating this data into a model would be the overlay of the five components of measuring walkability using the ArcMap and borrowing information from the first two parameters which were measured in the first part, the findings of this walkability show clearly that the “no use”, betweenness is very high in all of our case studies indicating that walkability is not fragmented but is limited by the permeability of the in-between areas. This indicator can help to improve urban condition since pointing out the areas of distress within the areas is notable. For the translation of this method, we have translated the parameters into a model for continuity through a model builder:

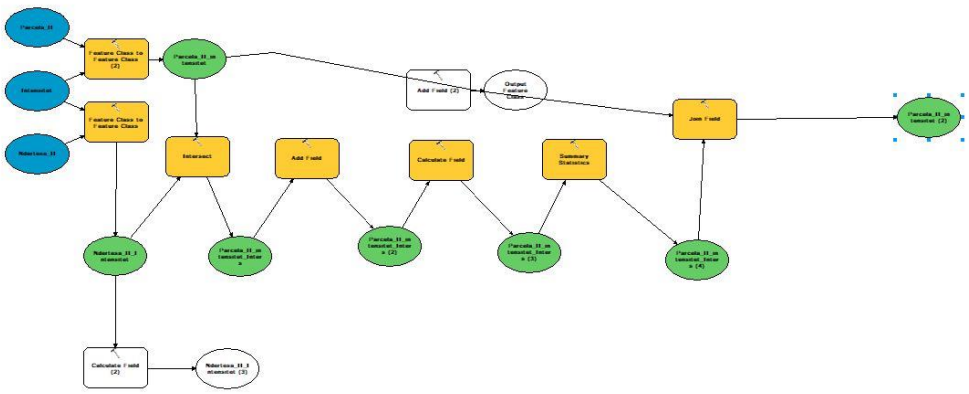
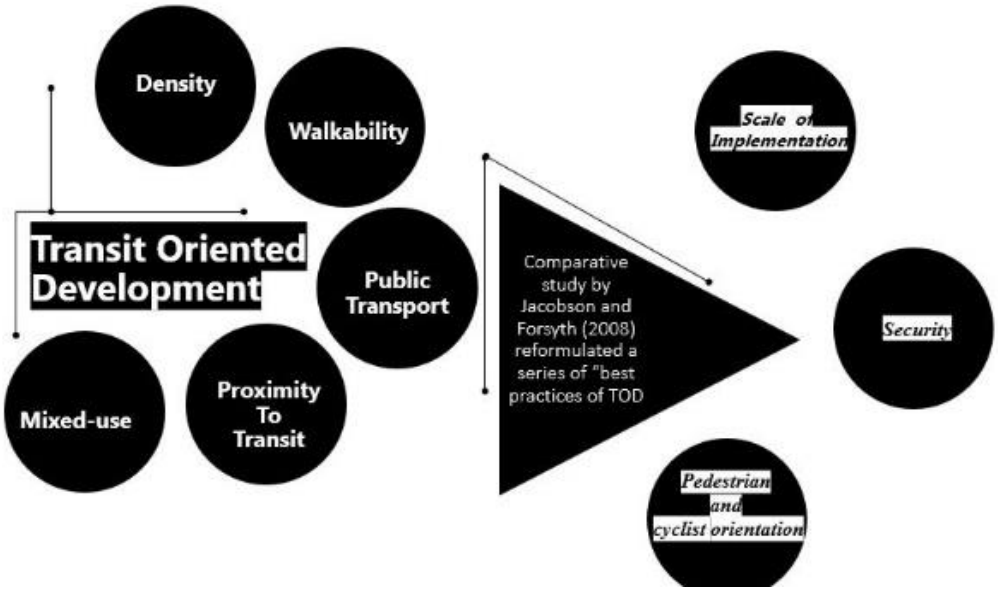


Figure 34 The model builder for the automatic calculation of the parameter of Walkability

7.6 Final data Aggregation

The importance of the data is only useful to professionals and planners, as a tool to measure a complete application of the TOD concept and its components. From our previous analyses we have identified the four main indicators with which we can measure the application of TOD. Our components have been treated as parts of a puzzle, as an attempt to create a relationship between these indicators and the urban condition.



As mentioned in the previous section of chapter 6, cities and the urban condition are quite complex and interconnected, influencing development. Therefore, the indicators have been broken down and each is analyzed through a specific, context appropriate measure. Starting with Density our first indicator has been broken down into five individual components as shown below:

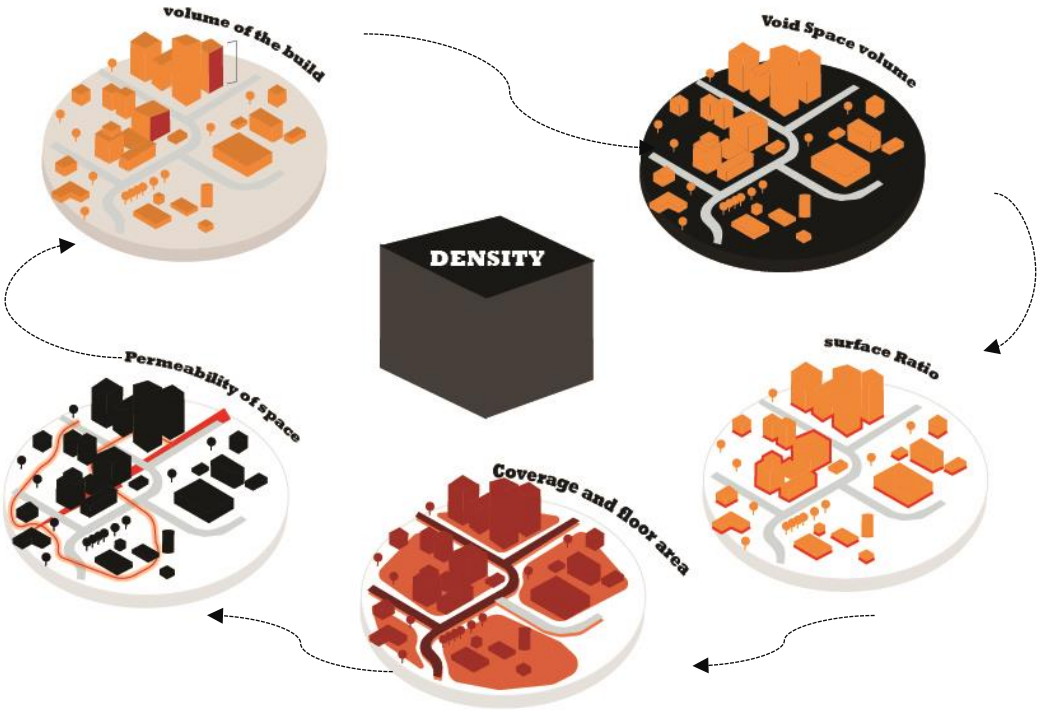


Figure 35 The Measurable indicators for the TOD component of Density Isometry created by the author

These five components were measured individually to create a separate environment for each of the indicators as a final product we were able to measure automatically by using the model we generated, the vertical and horizontal unconventional density of our three study areas.

Our second component is the measurement of Proximity to transit. By measuring this component, we provide a full and complete understanding on how the area is serviced by public transport, bicycle infrastructure and walkable distances, coming together with the total infrastructure network and the distance from each building to the nearest station as illustrated by the two components of this indicator:

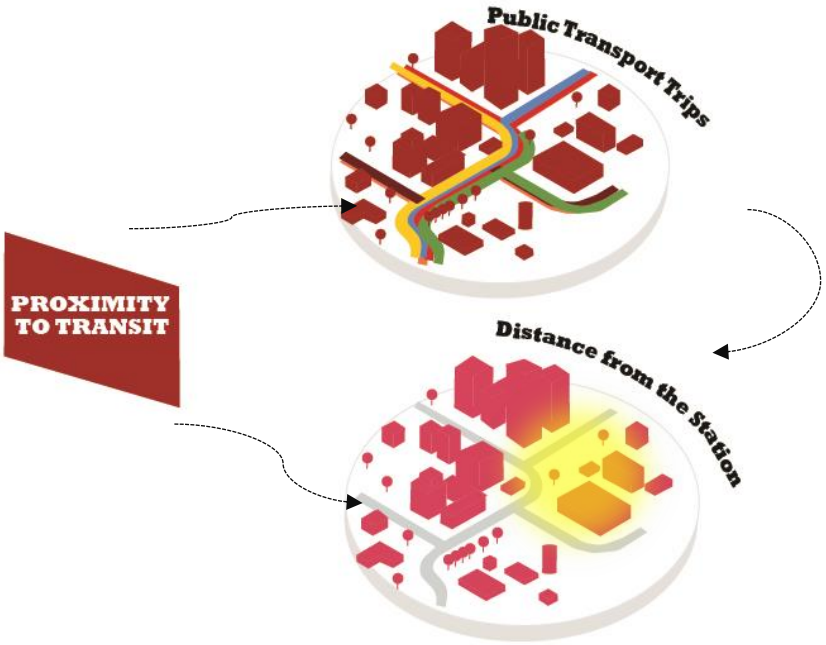


Figure 36 The Measurable indicators for the TOD component of Proximity to Transit / Isometry created by the author

The measurement of the components of this indicator must proceed the Density measurement, since the input for this data is the output of the total footprint of the buildings that we derive from the measure of the density in the first part of the indicator calculation.

Measuring mixed-use is a rather complex indicator which must consider a number of area characteristics. It is the third component which uses as input data from our second component the proximity to transit, taking these analyses a step further, considering three datasets as illustrated below:

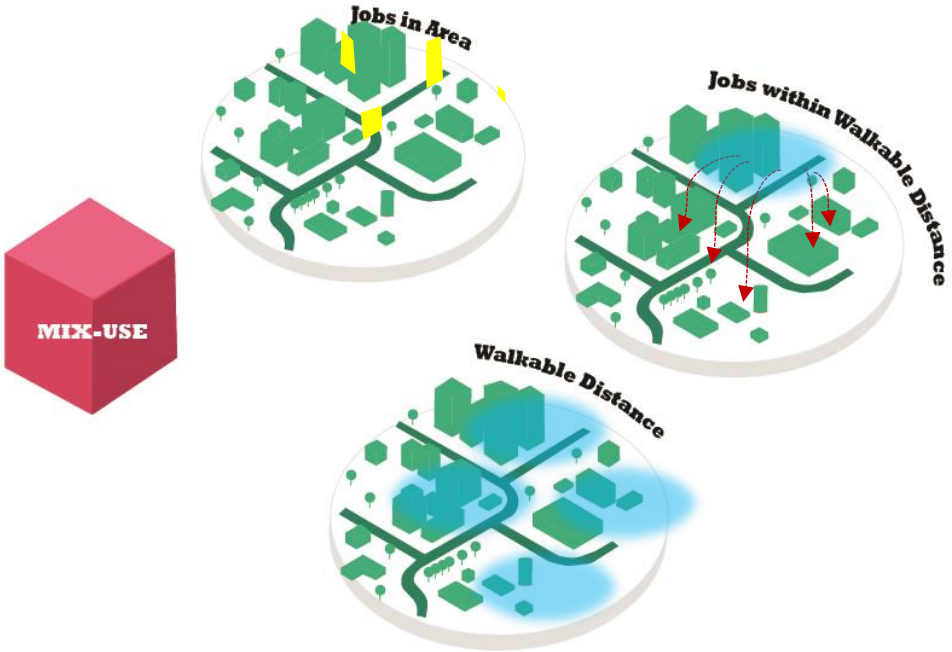
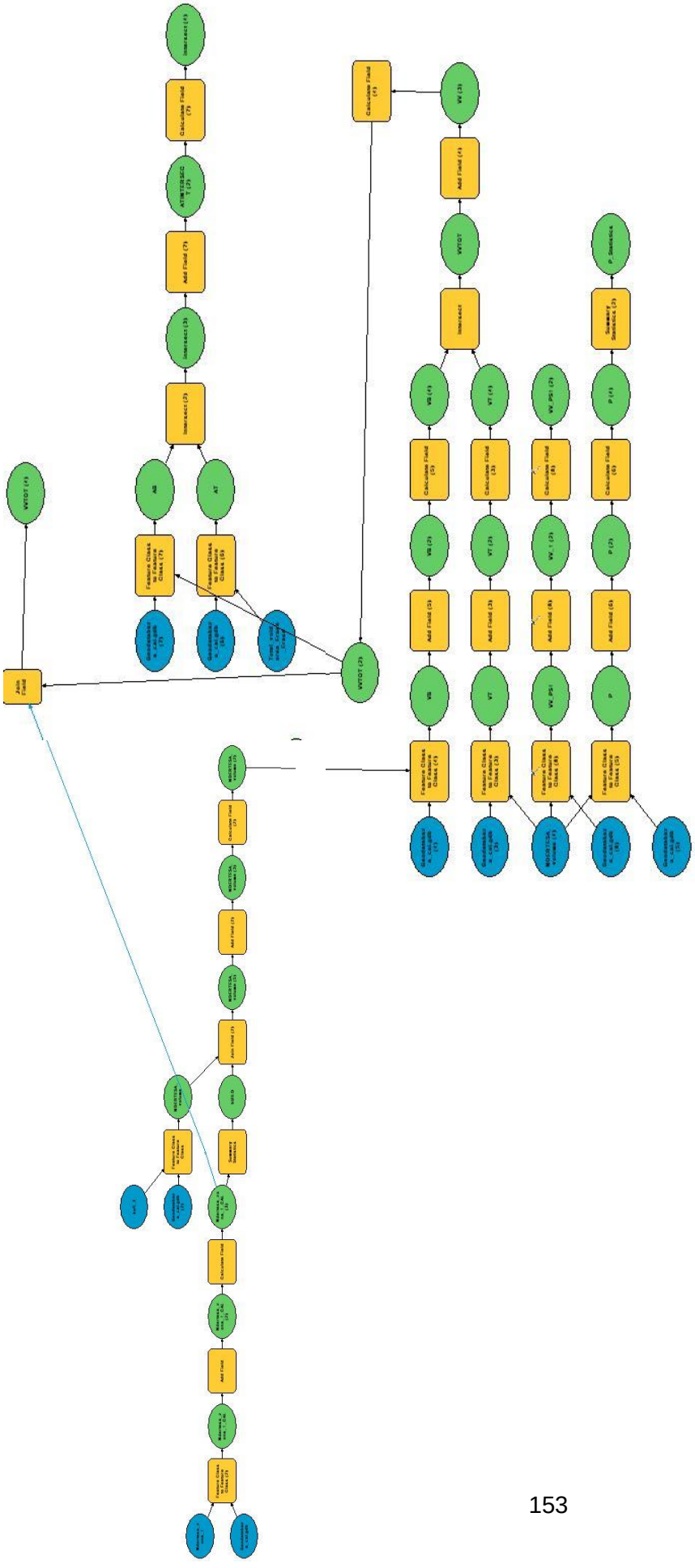


Figure 37 The Measurable indicators for the TOD component of Mixed use / Walkability / Isometry created by the author

The representation of the data we extracted from our indicators in the three study areas is constructed by each indicator output being the input for the next indicator calculations, creating a chain of interconnected data, representing the translation of the TOD principles in the area. The correlation between the data is established in the creation of the final model, translated into a universal tool for measuring “TOD” through its parameters, giving us the possibility to apply this tool in the future by only changing the input of the data, area, scale or even the characteristics. This final model is a tailor-made correlation between the data we extracted from our site, the indicators of each parameter and the limitations, represented by our choice of case studies from the three successful TOD applications we used in the case studies. The final model is nothing but an urban measure tool, that allows planners to make necessary evaluations, into the adaptation of TOD concepts at its fullest and parameter evaluated level. The model allows future prediction and scenario development, in relation to the input data. The case of Tirana outcomes established the necessary decision-making in order to establish the TOD in our three areas.



The final model as described above will be our main tool for comparing the “deficits” of TOD components application into an urban context, and case studies Findings on the components have some room for interpretation since the contexts of TOD are very different to the case studies, leaving some room for professionals and planners to define what components should be rearranged to increase the TOD-ness of the area.

8 CHAPTER EIGHT | DISCUSSION OF FINDINGS

8.1 Conclusion

8.2 Theoretical conclusions

The first formal crises in urban planning occurred in the 1960s, during which the technical reasoning of blueprint design came under scrutiny from a number of sources, including the American Planning Association. City transportation is a guiding force, both in terms of presenting examples of futuristic plans for cities and in terms of the impact that cities have on the rest of the globe. Their personal and professional lives were influenced by the futuristic ideas that were all centered on or in close proximity to transportation, regardless of how controversial or unfeasible their atopies may appear today. They were encouraged to consider a new perspective or shift their conventional thinking. Frank Lloyd Wright works, such as Broadacre City (1932), La ciudad lineal (1882), and Michael Graves and Peter Eisenman's The Jersey Corridor (1965), show parallels with the examples above, as do other works by contemporary architects. Broadacre City, La ciudad lineal, and La ciudad lineal are some of the other works of Frank Lloyd Wright that are worth mentioning. Our above-mentioned utopias have similar viewpoints on the not-too-distant future, with a special emphasis on density, transportation-centered development, services in close proximity, and the general quality of urban life, among other things. When it comes to cities, "we think about transportation; the two are intricately interwoven and have an influence on our relationship with cities," according to Purwanto and Darmawan (2014).

It has been a long time since the phenomenon of urban sprawl has been associated with negative connotations, and it represents possibly the most significant change in land use in European and North American cities. We may claim that this was a watershed moment in the history of contemporary town planning. Many theories have been developed to deal with both the prevention and after-effects of sprawl, as well as the effects of land use on the environment, with sprawl taking center stage and constituting a continuous issue. Ultimately, the function of transportation and mobility in urban environments is defined.

Consider the implications of systems theory and complexities inside our issue. We must return to the Habraken definition and comprehend the crucial element in the mix, which we may consider the significance of complexity in our discussion. Transportation, land use, urban design, and public spaces are all critical components of understanding and guiding complexity. Investigations have revealed that both urban complex systems, traffic flows, city networks, and the process of human mobility exhibit a scaling property, which is a property that increases in size as complexity increases. As a result, transit-oriented development takes into account the complexity of urban growth and transportation planning.

The philosophy of Transit-Oriented Development has undergone continuous development and refinement. The idea has grown as a result of its prior failures. There is no clear strategy on how to transfer the theory into practice in the future.

The findings bellow help understand from the analyses of the case studies what is the importance of each component of TOD and how it fits in the overall concept. Considering our case studies, the findings are defined into primary important components, secondary important components, third components and instruments or policies aiding the overall process.

In the case of Arlington deriving from our case studies changes in the area density and mixed uses into this density is very important the same characteristics are found in the case of Copenhagen and Vienna, the secondary important components are a mixture of proximity to transit stations and useable open space giving an importance to complementary indicators, the third level components are mainly decision-making that effects the adaptation of the first and second component. Supporting the implementation of these components, each of our case studies has a strong tool for the implementation and overall inclusion of these urban components. The case of Arlington and Oregon is the drafting of a strategic plan, Copenhagen and Vienna relay on

regional development plan as supporting strategy for the implementation of these components.

Definition	***Important components***	***Secondary components***	***Third components***	***Supporting/Policies/ Instruments***
Arlington /Virginia	High and mid density	Preserve and reinvest in neighborhood	Expending Travel options	Strategic Planning Instruments
	Around Transit	Enhance open space		Future Traffic trends
	Mixed uses	Pedestrian and Bicycle environment	catalyze private development	
Portland/Oregon	mixed-use buildings	corridors according to market readiness	Guide future investments	Strategic Plan
	existing conditions			Strategically Target Program
Copenhagen, Denmark	mixes residential and commercial	maximizing access to public transport	optimizing the use of land	Regional Planning
	hubs		secure long-term	new development corporation to manage and act as planning authority for future regeneration
Vienna/Austria	mixed-use development	building a completely new district	value capture	
			growth in public transport	Strategic Plan
	Car-restrictive measures	maximizing access to public transport	Increasing quality of life	

8.3 Definition Conclusions

Transportation-oriented development (TOD) projects are widely cited as effective methods for increasing transit use and lowering vehicle use while simultaneously spurring local development and improving the quality of life in otherwise deteriorating regions. Generally speaking, TOD is characterized as a style of urban development

that brings together a variety of uses in a pedestrian-friendly, densely constructed area around a public transportation station (Litman, 2017). We ask whether TOD theory and practice are transferrable since TOD is a complicated policy idea the implementation of which includes various stakeholders and levels of government over an extended period of time. These extant works on TOD may be divided into three groups based on the approach employed: simulation studies, descriptive studies, and multivariate statistical analysis.

Authors	Definition	Year
Peter Calthorpe	TOD was suggested as a compact, mixed-use community that was based around a transit station to encourage residents, employees, and shoppers to drive their cars less and to use mass transit more	1993
Salvensen	Development around a transit station providing opportunities for a diversity of land uses in a specified geographical area, development within a specified geographical area around a transit station with a variety of land uses and a multiplicity of landowners	1996
Boarnet and Crane	The practice of developing or intensifying residential land use near rail stations	1998
Still	Mixed land use development encouraging people to live around the transit services, at the same time decreasing dependence on a private vehicle	2002
Cervero, R / Ferrell, C / Murphy, S	A transit-oriented development (TOD) system is mainly designed to enhance the use of public transport/transit and to create an urban setting providing pedestrian-friendly environment.	2002
Tom Still, Zane Bishop, Hank Dittmar & Gloria Ohland, Carey Curtis, Peter Calthorpe	TOD promotes mixed use in buildings, high density and pedestrian- friendly development around transit to promote transit riding, increase walk and bicycle travel, and other alternatives to car use. Aims to promote development without adding to sprawl, freeing open space and adding public transportation".	2003
Transit Oriented Development Institute	Transit Oriented Development (TOD) is a new concept focusing on efficient modes of transportation other than the automobile.	2015
Transit Link network	TOD was defined as a combination of land use and transport planning that makes walking, cycling, and public transit use more convenient and	2012

	attractive, while also optimizing the capacity of existing transit services by concentrating on transit hubs, and nodes	

8.4 Analyzes Conclusions

The data is only valuable to experts and planners since it serves as a tool to measure and evaluate the overall implementation of the TOD concept and its constituent parts and components. Based on our prior research, we have identified the four primary indicators That may be used to assess the effectiveness of TOD implementation. Our components have been considered as if they were each a piece of a puzzle, in an effort to establish a link between these indications and the urban environment.

As previously discussed in the preceding section of Chapter 6, cities and the urban situation are extremely complex and linked, and their growth is influenced by these factors. Therefore, the indicators have been split down and each of them has been assessed through the lens of an appropriate measure for the given situation. For example, the density indicator has been decomposed into five distinct components, as indicated in the table below:

In order to build a different environment for each of the indicators as a final result, we were able to measure automatically by applying the model we built the vertical and horizontal unusual density of our three study regions using these five components independently.

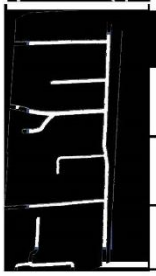
By measuring the proximity to transit component, we can gain a full and complete understanding of how the area is serviced by public transportation, bicycle infrastructure, and walkable distances, all of which are combined with the total infrastructure network and the distance from each building to the nearest station, as illustrated by the two components of this indicator: distance from each building to the nearest station and distance from each building to the nearest station.

The representation of the data we extracted from our indicators in the three study areas is constructed by using the output of each indicator calculation as the input of the next indicator calculation, resulting in a chain of interconnected data that represents the translation of the TOD principles into practice in the region. The correlation between the data is formed during the development of the final model, which is then converted

into a universal tool for measuring "TOD" through its parameters, allowing us to use this tool in the future by simply modifying the data input, area, size, or even qualities.
A custom connection between the data we acquired from our site, the indications of each parameter and the restrictions, which were represented by our selection of case studies from the three successful TOD applications we represented in the case studies, has resulted in this final model. Ultimately, the model is nothing more than an urban measurement instrument that enables planners to perform the essential assessments into the adaption of TOD principles at their most comprehensive and parameter analyzed level. With respect to the input data, the model is capable of making future predictions and developing scenarios. Our three regions were formed as TODs as a result of the outcomes of the Tirana case, which established the required decision-making for our TODs.

The comparison between the data is reflected into the matrix, which allows professionals to understand and evaluate these areas, and any new application in the future. As we have considered the urban challenges that cities face, in our first chapter, were concepts such as smart cities, 15 min cities and many more that were considered and broken down to their bare components. We highlighted the similarity of these components and the importance each of them has in implementing these models. One important outcome of this study is related directly with the adaptability that the generated model holds. In the case of 15 min cities many of the components are quite the same, so in translation this model would easy be adapted, changed, and reused to measure how smart cities are developed in relation to their components, how 15 min cities should be translated to what level and how. This is what using Geographic Informational Models is aiming, and how easily planners and practitioners can “test” different contexts, add more components or simplify the models to measure each component individually.

In addition to case studies, the final model as described above will serve as our primary tool for comparing the "deficits" of TOD components application in an urban context. However, because the context of TOD is vastly different from the case studies, findings on components have some room for interpretation, allowing professionals and planners to determine which components should be rearranged to increase the TOD-ness of the area.

TOD COMPONENTS	PUBLIC TRANSPORT				Walkability		
	PROXIMITY TO TRANSIT			PROXIMITY TO TRANSIT			
			DENSITY			Security	
	MIXED USE						
Selected area	Working activities 400m	Travel accessibility	Density index	Proximity to CBD	walkability	FAR	Data derivation
Portland, Oregon							
	3.1	1.1	5	2.4	1	1.35	high density Low services
	4.2	2.2	6	2.5	2	1.6	high density higher service
	3.3	2	4	3	2.5	1.2	low density high service
	1.5	1.5	3	3.1	3	1.1	low density / high service
Arlington, Virginia							
	4.2	1.2	4	1.8	3	1.35	low density higher service
	2.1	2.2	3	1.4	1.7	1.52	high density
	3.6	3	2.5	1.2	2	1.2	low density higher service
	4.3	2.6	5	3.1	3	2.1	high density
Copenhagen, Danmark							
	1.6	0.7	7	2	1.1	1.4	high density Low services
	3	1.4	6	2.3	1.4	1	low density higher service
	3.2	1.9	8	2.5	3	1.4	high density higher service
	3.5	1.4	4	1.7	1.5	0.7	low density
Tirane, Albania							
	1.5	0.7	2.8	0.7	0.7	0.7	low density Low services
	3.2	1.1	3	2.3	1.1	1.4	high density Low services
	1.8	1	3.1	2.5	0.7	1.6	high density Low services

The final correlation of data represented in our findings table takes into consideration the data extracted from the case studies, us successful applications of TOD and translates these data into our components.

As we have demonstrated in the analyses chapter, the measure of our density is viewed as a complex element considering minimally all of the data measured by our case studies, such as working activities within a radius of 400 m., the travel accessibility from point A to point B, the index of conventional density, the proximity to the Central Business District, the index of walkability in the area, and the FAR parameters. The measuring of the density for our case study considers an unconventional density which

goes beyond these indicators, and this is something applicable in all our components. However, for the purpose of plain we have classified only the components that we have extracted from our case studies. In the measure of mixed uses in the area we have considered five elements, such as working activities within a radius of 400 m., the travel accessibility from point A to point B, the index of conventional density, the proximity to the Central Business District, the index of walkability within the area. In the measuring of proximity to transit, we have measured working activities within a radius of 400 m., the travel accessibility from point A to point B, the proximity to the Central Business District, and the index of walkability within the area. In measuring public transportation, we have considered the travel accessibility from point A to point B, the index of conventional density, the proximity to the Central Business District, the index of walkability within the area, and the FAR parameters. The purpose of these component was to bring a visualization to the model of TOD we have created. Comparing the parameter of each area with the successful TOD case studies to easily identify how to increase the TOD in the area.

In the Tirana area from our comparison to the successful application of the TOD components, we can see that the density is low in comparison to European case studies, but not in comparison to the US case studies. The accessibility index is very low in all of our areas almost 1:3 of the case studies, walkability of the areas is very low, and it almost represents a deep problem, influencing the other criteria. From these findings and measuring each component separately as we have demonstrated in our analyses section and then by understanding and comparing with the case studies, we can establish how to intervene in the area to increase the TOD-ness of the overall area By using this model, the process is easily replicable to different context and areas.

8.5 Limitations

Transit-induced gentrification has lately surfaced as a topic of concern after almost three decades of supporting a nearly idealized TOD method for strengthening local communities while advocating a modal shift contributing to the decrease of gas consumption.

It is also possible that polluted soils from industrial usage in the 20th century may be a barrier to the (re)development of station sites (e.g., Nijmegen and Zwoll station areas). It's also important to examine the TOD area's design quality, as evidenced by high

office vacancy rates in some places outside of historic cities (e.g., Amsterdam Sloterdijk or Bijlmer Arena stationareas)

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