

MINISTRY OF EDUCATION AND TRAINING

MINISTRY OF CONSTRUCTION

**HANOI ARCHITECTURAL UNIVERSITY**

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**LE CHINH TRUC**

**SPATIAL PLANNING OF TOD  
(*TRANSIT - ORIENTED DEVELOPMENT*)  
IN HANOI'S CENTRAL URBAN AREA**

**SUMMARY OF DOCTORAL THESIS  
MAJOR: REGIONAL AND URBAN PLANNING**

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## PREAMBLE

### **1. The necessity of this Thesis theme**

The Capital City of Hanoi is the central area of Hanoi Metropolitan (Hanoi region). With its rapid increase of population due to a large volume of migrants, its economic has achieved some numerous outcomes. New urbans are well established with larger road and more modern technical infra networks, leading the City a fast change and a dynamic development in recent years.

However, due to some factors such as unbalanced allocation of work - residential places, inappropriate population distribution and the development of private vehicles..., traffic congestion is getting worse despite regular expansions of road networks.

It is an inevitable trend to develop a TOD model for Hanoi. This will enhance mass rapid transit, utilize the allocation of mix - used buildings in transport hubs and utilize land use planning for transportation. A TOD model is expected to bring the City economic benefits, environmental protections and ceasing traffic congestion. Moreover, it is considered the most suitable solutions for urban development of Hanoi and of other cities in the world in short - term and long - term.

There were many studies on TOD by international scholars, however, a TOD model suitable for specific conditions of Hanoi is still a question.

The Thesis themed “**Allocation of TOD in Hanoi’s central urban area**” is expected to study in details and to propose solutions which are capable with socio - economic conditions of Hanoi; supporting urban planning projects. Besides, a TOD model is considered necessary for the City Government to solve current issues and to develop the City to become greener, more sustainable, more civilization and modern.

It is expected that the proposals of this Thesis can bring helpful solutions with high applicability for Hanoi.

### **2. Research purpose**

Propose solutions for the development of a TOD model for Hanoi with high applicability; for the City’s mass - rapid transit development; utilization of mixed - land use planning for transport hubs that adequate to natural and social conditions of Hanoi; energy savings, environmental protections, traffic

congestion reduction; for the allocation of TOD space in zoning planning, detailed planning and other investment projects.

### **3. Research subject and range**

*Research subject:* TOD network and allocation of TOD space (category, location, range and feature).

*Research range:* Central area of Hanoi Metropolitan (defined by the approved Hanoi's Master Plan to 2030, vision to 2050; includes surface and sub - surface spaces).

### **4. Research method**

The research is carefully conducted under practical methods such as: data collection, existing conditions survey, existing document/data references, comprehensive analysis and assessment, comparison method, map layering, systematic approach, modeling and forecast.

### **5. Research content**

General assessment on urban development under TOD model in Vietnam and in the world; development trend and related researches.

Study features and characteristics of Hanoi's development timeline through historical phases and its issues. Study current urban conditions and forecast urban development under TOD model for Hanoi; propose solutions to cease traffic congestion and allocate TOD areas.

Study on scientific bases, theories, practical issues and lessons learned on spatial organization in TOD areas in the world and in the country. Researching solutions for TOD development in the urban center of Hanoi.

### **6. Research outcome**

Propose TOD model based on initial criteria and its network solutions.

Propose solutions for the allocation of TOD in Hanoi's central urban area (specific area(s)) that suitable for natural, socio - economic conditions and landscape.

Propose solutions for the transition from traditional urban development to a TOD model.

### **7. Contribution of this Thesis**

- Define and systemize theories on TOD model; propose new theories based on actual conditions of Hanoi and of Vietnam; propose specific solutions.

- Propose principles, criteria to determine TOD location, range, features... for Hanoi.

- Propose model, arrangement and criteria for TOD area, specifically for each urban area such as: historical urban, expansion urban, new urban that suitable for natural and socio - economic conditions, urban landscape; legal regulations...; Prepare urban design guidelines.

- Propose managerial principles on surface and sub - surface allocation; space connection between existing areas and new areas with TOD.

- Propose solutions for the transition from traditional urban development to TOD model, traditional housing units to TOD neighborhoods.

## **8. Scientific contribution and applicability of the Thesis**

### **8.1. Theoretical studies:**

Collect theoretical information, study specific conditions and propose theoretical ideas for Hanoi.

Add principles for categorization and organization of TOD for Hanoi.

Add ideas for modeling and allocation of TOD areas in Hanoi's central urban.

### **8.2. Applicability of the Thesis**

The Thesis can be used as a reference source to determine existing conditions of transport network development of Hanoi, of Vietnam and of other cities in the world.

Research outcomes can be used for Hanoi's urban planning projects and for other big cities in Vietnam.

## **9. Structure of this Thesis**

The Thesis includes an opening session (Preamble), a main content (Contents) and a closing session (Conclusions and Recommendations) where, the main content includes 3 Chapters:

Chapter 1: General assessments on the allocation of TOD area in Hanoi's central urban.

Chapter 2: Scientific study on the allocation of TOD area in Hanoi's central urban.

Chapter 3: Modeling and solutions for the allocation of TOD area in Hanoi's central urban.

## **CONTENTS**

### **Chapter 1. GENERAL ASSESSMENTS ON THE ALLOCATION OF TOD AREA IN HANOI'S CENTRAL URBAN**

#### **1.1. General assessment on TOD model in Vietnam and in the world.**

##### **1.1.1. Historical landmarks and opinions on TOD**

In the 1990s, due to serious traffic congestion in big cities, a new concept named TOD (Transit - Oriented Development) was initiated to promote urban planning development projects. It was a method to set - up a public transport network as a base for urban planning where residents were allocated around transport hubs, creating scatter transport networks.

##### **1.1.2. General assessments on TOD in the world**

In many countries in Asia, Europe, America..., public transport networks were early developed where urban railways took a vital role, promoting TOD model since then. There was a large railway network in Japan and TOD in big cities. It takes about 5 to 10 minutes walking to nearby stations. TOD in Asia has high density, while in America, it has high efficiency. In Europe, TOD is constructed based on urban railway network, urban renaissance, renovation and sub - surface development projects.

##### **1.1.3. TOD model in Vietnam**

In Vietnam, it was crudely mentioned in some urban planning projects in big cities such as Hanoi and Ho Chi Minh City. However, there were still no further studies and actual projects.

#### **1.2. Current conditions of public transport development in Hanoi**

- TOD model was mentioned in Hanoi's master plan and some zoning planning yet no specific contents. Due to the under - development of urban railway network, TOD is not yet implemented. Currently, only one metro line is under operation with modest capacity; The other line is under construction.

In order to develop TOD, there is a need for further researches, in urban planning projects and investment projects.

### **1.3. Research status and related issues**

- Peter Calthorpe was the first person who initiated the research on TOD. His studies were helpful with theoretical analysis and experience sharing.

- Some researchers have proposed main principles to develop TOD. Some principles are suitable for this country but not for the others. There are not so many researches carried out by Vietnamese experts, except for some articles with general information.

### **1.4. Main contents**

- Determine general issues (*in the world*) and specific urban issues (*in Hanoi*) on TOD. Add and recommend new theoretical contents for Hanoi.

- Add theoretical studies on TOD for Hanoi (by levels and functions).

- Propose TOD principles, categorization criteria and development area. Propose TOD model

- Propose the allocation of TOD that suitable for environmental and socio-economic conditions of Hanoi.

- Add calculation parameters for TOD.

- Solve problems for surface and sub - surface development.

- The transition from traditional housing units to TOD neighborhood; traditional urban model to TOD model.

- Propose urban design for TOD area.

- Determine other issues for TOD in Hanoi. Propose related policies to develop TOD model.

- Select pilot areas for assessments.

## **Chapter 2. SCIENTIFIC STUDY FOR THE ALLOCATION OF TOD IN HANOI'S CENTRAL URBAN**

### **2.1. Theoretical study on TOD**

#### **2.1.1. The transformation of urban development model in the world**

There were 3 phases of urban development in the world. This transformation leads to a more convenient lifestyle, coping with technical and socio - economic development for each phase. Urban development was

connected with transport network. It then becomes one of the essential factors for urban development model.

### 2.1.2. Current urban development trends

New Urbanism, Compact city, urban model with an urban core... are current development trends. The development of public transport network is a base for urban planning projects. The application of IT, smart city helps to improve living standards and protect natural environment.

### 2.1.3. Public transport development trend in the 21<sup>st</sup> century

Urban development based on public transport network is still the world's trend, leading to a stronger community connection with multi - modal transportation, combined with internet connection and artificial intelligence (AI).

Hanoi is hoping to enhance this trend for its solutions to cease traffic congestion. It is expected to be implemented with the best suitability with natural conditions, socio - economic conditions and land used planning.

### 2.1.4. Theoretical base of TOD

*\* Theories on space development, architectural landscape, urban design and sustainable development on TOD model*

**\* Theoretical study on the linkage between land used planning, space allocation and transport hub:**

- General requirements on TOD:

*Right place, right time; saving time, easy movement, saving cost, and safety.*

A mix - used building helps to serve 3 activities at only one transport hub with an appropriate distance (go bicycling or go walking): for living, working and entertainment purposes. Thus, it reduces

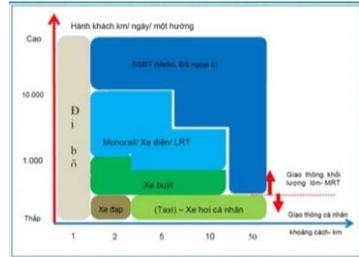


Figure 2.2. Relationship between carrying capacity and service distance of public transport network [4]



Figure 2.1 Relationship among people's demands [10]

travel distance and number of travels, reducing the dependent on private cars while increasing carrying volume.

**\* Theoretical studies on travel needs**

Travel needs may include: Daily and / or weekly. In order to reduce travel time and distance, public utilities under regular usage should be allocated nearby each other (living, trade, office - mix used); other utilities such as green trees, parking spaces, social infra networks... will be together created a comprehensive TOD model.

**\*Relationship between land - use planning and transport planning:**

For the efficiency to implement urban railway networks.

**\* Multi - modal transportation:** Transport modes are appropriately organized.

**Travel distance and time:**

- Appropriate walking time: 10 minutes
- Appropriate walking distance (radius): 400 - 500 m
- With the larger radius ~ 800 m, it is better to use bicycles

**2.1.5. General principles for TOD in Hanoi's central area**

(1) Develop a high quality, multi - modal public transport network; (2) Promote mix - used urban planning; (3) High density buildings; (4) Compact City; (5) Transport hubs; (6) Give priority to bicycle and pedestrian pathways development projects; (7) Arrange space for pedestrians (8) Square stations; (9) Station accessibility (10) Vehicles collecting passengers.

**2.2. Legal documents**

- Law on urban planning, Capital Law, Digital Planning Law, Construction Law of Vietnam, Law on Railway Transport... and other decrees, circulars... related to Hanoi's urban planning projects.

- Although Vietnam has a good structure of legal documents, TOD model is still a new knowledge with no related guidances and technical standards for its implementation.

**2.3. Case studies and experience sharing on TOD**

**\* TOD model features in the world:**

- **North and South America:** TOD model is developed with high density, mix - used to utilize economic development efficiency. TOD model connects

public transport modes, transferring and walking; connecting surface and sub-surface spaces. In South America, TOD is based on BRT due to its flexibility and investment cost saving.

- **Europe:** TOD model is developed with medium density due to a lower volume of population, mixed - land use connecting public transport modes, go walking and go cycling. Its main purpose is to improve living standards.

- **Asia:** TOD model is developed with high density due to a higher volume of population, mixed - land use. It is a cooperation between railway network investors and real estate investors to increase land price around TOD areas, creating land fund and capital resources; connecting with public transport network, go walking and go cycling. Its main purpose is to increase land value and to generate capital resources for urban development.

**\* Lessons learned and applicability for Hanoi**

From the analysis above, it is estimated that the most suitable TOD model for Hanoi can be derived by Asia's experience due to its higher volume of population, higher compact capacity, connecting railway projects with real estate development for economic benefits. Some experiences from Europe also can be derived to create a more favorable architectural landscapes, community utilities, better living quality and some can be learnt from America for its economic efficiency.

**2.4. Factors that effect the allocation of TOD for Hanoi's central area**

- **Urban space development stated by Hanoi's master plan, includes:** *Historical central urban, expansion central urban; urban areas in the east of Ring road 4; urban areas in the north of Hong river and 8 railway lines (metro).*

**- Capability to develop TOD for Hanoi**

+ *Lifestyle and travel habits:* Hanoi is the center of cultural values of Hanoi metropolitan region with many precious cultural relics/ values. The work of reservation is highly appreciated. Community spaces such as green space, open space, retails, shops, pavements... should be paid more attention to increase TOD attractiveness.

+ *Current land use:* Vacant land in central urban area is rare, thus, sub-surface development can be carried out; urban renaissance for old condos, industrial zones... with appropriate building height; renovate and reserve historical relics. Areas with larger land parcels (in the east of ring road 4 & in the north of Hong river) can be implemented large scale TOD models to

become a comprehensive transport network.

+ *Architectural landscape*: There are many historical relics in the central area. It is necessary to apply appropriate space arrangement, building height restriction to remain local cultural and historical values.

+ *Transport network*: Inefficient bus network. Urban railway is considered the main factor for TOD. At TOD hubs, parking spaces must be arranged properly for people using motorbikes or bicycles to enhance their accessibility and convenience.

+ *Socio - economic conditions*: High population density is considered a factor for a TOD model formation; utilizing urban land use, connecting transport development projects with land use for urban railway networks; increase land value; A well organized TOD with walking spaces.

+ *Climate and natural landscape conditions*: The temperature in Hanoi is quite high in summer with high volume of rain water and cold in winter; therefore, it is necessary to organize good walking spaces with green trees, street utilities, covering roofs and pathways.

+ *Terrain*: In the center of Hanoi, terrain is plain with many water surfaces (lakes, ponds), suitable for the establishment of open spaces, green spaces for TOD.

+ *Geology*: Geology conditions are favorable for underground metro lines construction.

## **2.5. Categorization of TOD**

### **2.5.1. Categorization of TOD by level and service range**

#### **- Urban TOD:**

Urban TOD is Central Business District (CBD), a center of commerce, trade, office, culture and services. There are transport hubs in CBD for mass rapid transit and MRT; high compaction, high building density and high land - use rate. Urban TOD focuses on high - density building constructions (office & commercial centers), providing employment, not housings.

#### **- Local TOD:**

Local TOD is a center for public commercial areas, services, offices for local level; balancing the provision of housings and employment. It has a high compaction but lower than Urban TOD.

Local TOD is located at public transport lines with mass rapid transit such as MRT.

### **- Neighborhood TOD:**

Neighborhood TOD is a center for housing units or street units; main functions: housings, offices, retail shops, social infra networks serving its community. There are more housing units, open spaces and public utilities at Neighborhood TOD.

Neighborhood TOD is located at public transport lines with medium transit capacity such as MRT, LRT.

#### **2.5.2. Categorization of TOD by functions**

TOD can be classified by its specific functions: culture, sport, tourism; commerce, finance; industry; health and education

#### **2.5.3. Categorization of TOD by areas**

- + Areas for new urban development.
- + Areas of developed urbans where vacant lands can be exploited.
- + Areas for urban renaissance or conversion of land use.

## **Chapter 3. MODELING AND SOLUTIONS FOR THE ALLOCATION OF TOD AREA IN HANOI'S CENTRAL URBAN**

### **3.1. Aims, point of views and principles for the allocation of TOD model at Hanoi's central urban**

#### **3.1.1. Aims**

- To gain social - economic benefits; environmental protection; suitable for natural and urban development conditions of Hanoi (limited development areas, open areas, new urbans). Depending on areas, TOD can be regulated by different principles and development criteria.

- To cease traffic congestion: increase the efficiency of metro lines, well connected with other public transport modes.

- To improve landscape, living standard for a sustainable development: Reserve architectural landscapes for Hanoi, reduce private vehicles and increase public and green spaces.

- Utilize land fund, energy and investment cost savings.

#### **3.1.2. Point of views**

- It is capable with Hanoi's master plan to 2030, vision to 2050 (land use, space arrangement, technical infra and transport network); reserve architectural buildings and enhance specific features.

- It can solves current conditions of Hanoi, land use, linkage between

existing urbans and new urbans; urban form conversion; resources generation and policy preparation for urban development.

### 3.1.3. Principles

TOD is allocated at the location where the railway networks with mass transit determined; railway stations are transport hubs. Service radius is determined around the stations with walkable distance.

## 3.2. TOD model for Hanoi's central urban

### 3.2.1. The allocation of TOD at Hanoi's central urban area

**A TOD model is divided into 3 levels:**

**Regional TOD:** is determined through urban areas where several TODs can become urban centers (Figure 3.1)

**TOD Corridor:** TODs along metro lines. They take the role as the region's centers.

**Point TOD:** is determined by metro stations or public transport hubs of MRT, LRT

#### a/ Regional TOD

##### - General development :

TOD stations take the role as transport hubs with a diversity of passengers and travel needs. They generate development sources for surrounding areas and regional urbans.

##### - Spreading development:

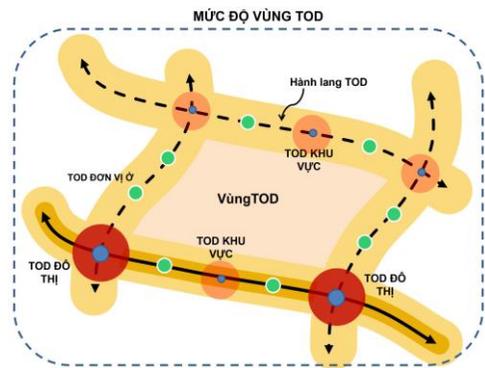


Figure 3.1: Regional TOD model

At open urban development areas, mixed land use can be prioritized; promote commercial activities and urban services to attract surrounding passengers [16].

#### - Hanoi's TOD network:

Hanoi's central urban area is developed by a network of ring roads and centripetal roads, including metro lines and roadways. Therefore, it is suitable for the development of regional TOD model (Figure 3.2)

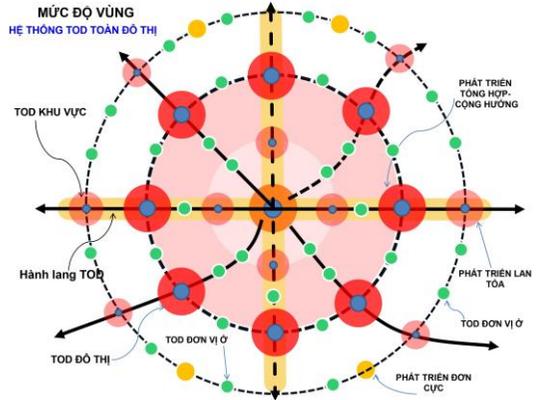


Figure 3.2: TOD model for Hanoi's central urban area

#### - TOD for open - centralized urban areas:

There are 9 metro lines in Hanoi with high density at open - centralized urban areas; a regional TOD model can be established (Figure 3.3)

#### b/ TOD Chain

TOD along metro lines create an urban chain development (Figure 3.4)

Urban areas which are developed along metro lines, usually new urbans, forming new housing units. There are 3 types of TOD connection corridors: *Arrival corridor, departure - arrival corridor and local travels* [14].

#### c/ Single point TOD (Figure

3.6)

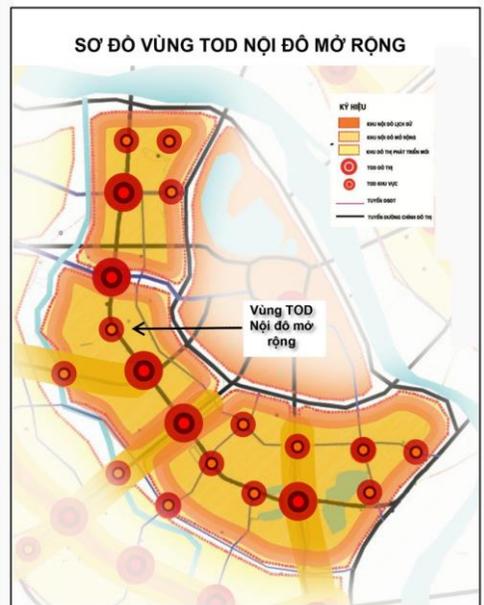


Figure 3.3: TOD at open central urban

A TOD point can be classified by 3 categories:

Type A: urban TOD; Type B: regional TOD; Type C: Neighborhood TOD

### 3.3. Determination of TOD location for Hanoi's central urban area

#### 3.3.1. Criteria to determine location, range and feature of a TOD point

##### \* *Criteria base and method:*

- Base: principles of TOD model (at Chapter 2).

- Method used: statistical and comparison methods of case studies from other cities in the world [100], [182]; reference sources concerning to actual conditions of Hanoi; propose criteria for assessments; consult experts for the criteria evaluation.

##### \* *Criteria for the selection and categorization of TOD:*

There are 7 criteria, total:

#### 100 point:

(1) **Criteria 1.** Roles, features, functions and ranges of TOD (20 points); (2) **Criteria 2.** Carrying capacity and range of transport hubs (25 points); (3) **Criteria 3.** Location, landscape factors for cultural relic reservation (10 points); (4) **Criteria 4.** Favorable land conditions for urban development & limitation (20 points); (5) **Criteria 5:** Density, importance, land use rate,

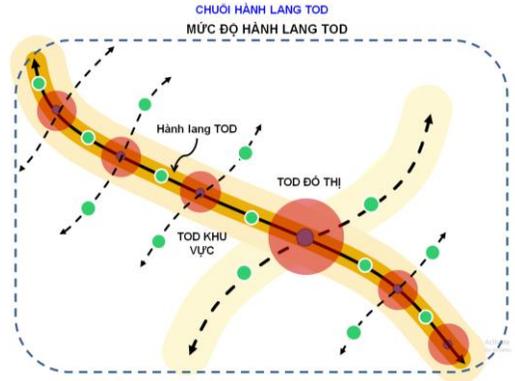


Figure 3.4: TOD chain - corridor

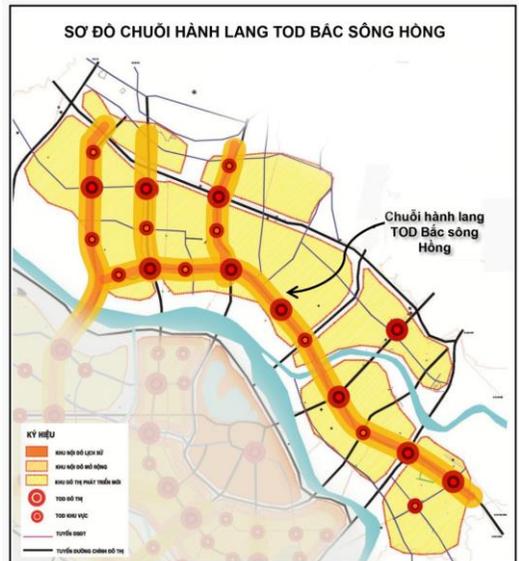


Figure 3.5: TOD chain - corridor in the north of Hong river

population, labor force and employment (11 points); (6) **Criteria 6:** Land value (7 points); (7) **Criteria 7:** Sub - surface development capacity (7 points).

### 3.3.2. Calculations by criteria:

**Total: 100 point** (Conditions: Criteria 1: > 5 point; Criteria 2: > 5 point; Criteria 4: > 5 point)

**Urban TOD: 75 - 100 point**, Criteria 1 must be  $\geq 15$  point; Criteria 2  $\geq 20$  point; criteria 4: 15 point. Criteria 5: 5 point.

**Regional TOD: 55 - 75 point**

**Neighborhood TOD: 40 - 55 point**

### 3.3.3. The allocation of

**TOD model for Hanoi's central urban area**

#### a. Directions to develop

**TOD for Hanoi**

**\* TOD in limited development area and historical city center:**

Restrain high - rise building construction to protect featured landscapes; give priority to underground space development; restrict housing construction and large scale TODs (Figure 3.7); Develop offices, commercial centers; Allocate small - scaled TODs to improve landscape, space, environment and accessibility for pedestrians.

Potential development areas: Hanoi Railway Station and old condos.

**\* TOD in open - centralized urban area:**

- High density, mixed development area, regional TOD.

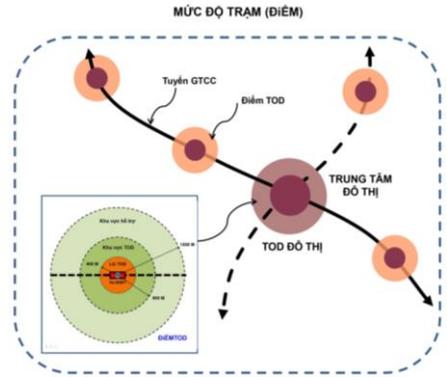


Figure 3.6: TOD Point model

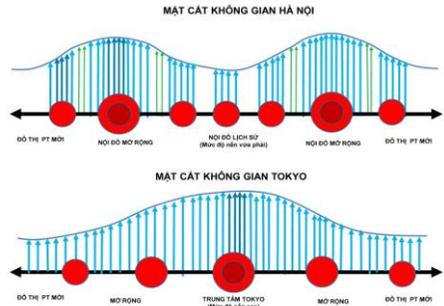


Figure 3.7: Cross - section of Hanoi's central urban area

- MRT lines: 1, 2, 3, 4, 5, 6, 8 promote the development of regional TOD network. For centripetal roads and ring roads, TOD chain can be established.

- Features: develop large - scaled urban TOD with high building density and building height; utilize carrying capacity of public transport; based on the area's land use planning; restrain population density and distribution for the adequation to social infra network.

- Allocate a modern TOD model for sustainable development

**\* TOD in new urban areas: in the east of Ring road 4 and in the north of Hong river**

- Lower population density and building density; new urban centers promote TOD model through regional spreading development.

- Generate potential land fund for a modern and synchronize development.

- Appropriate for regional, urban and neighborhood TOD; forming a large scale TOD model for urban's strategic development. A neighborhood TOD is connected with new urban area development.

### **b. Directions for the allocation of TOD:**

By the criteria given, TOD location is evaluated for every area in Hanoi's

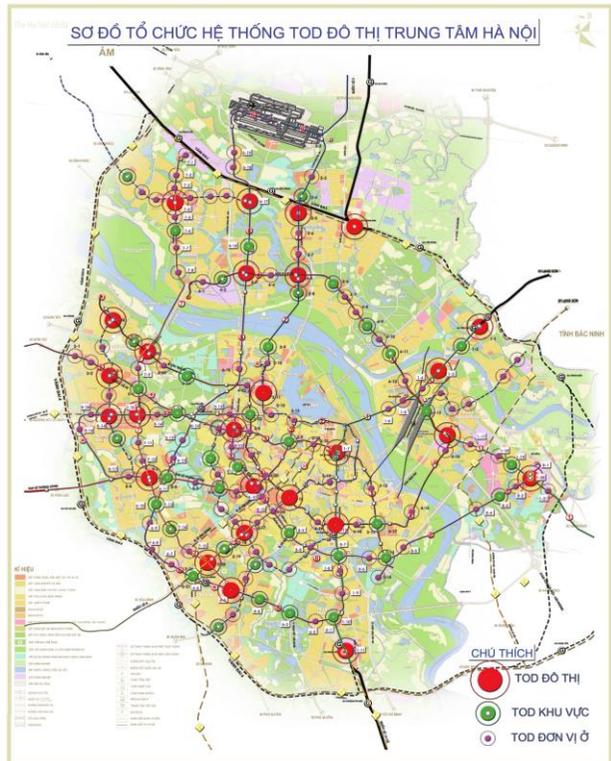


Figure: 3.8. Organize the urban TOD system in the center of Hanoi

central urban, including: urban TOD, regional TOD and neighborhood TOD (Figure 3.8).

### 3.4. Solutions for the allocation of TOD in Hanoi's central urban area

#### 3.4.1. Principles for the allocation of TOD

A TOD point is developed based on a “transfer hub” such as: metro station or public transport hubs of MRT, LRT and BRT.

- In order to ensure a walkable distance (~10 minutes), walking radius should be ~ 800m, surrounding areas ~ 1500 m. (Figure 3.9). There are several areas:

\* **Commercial core center:** Mixed use, neighboring transport hubs. There are shops, offices, restaurants, commercial services and entertainment functions.

\* **Adjacent areas:** radius ~ 400 - 800m with walkable distance, mixed functions: commercials, offices, housings and other social infra networks; green trees.

\* **Buffering areas:** radius ~ 1500m, lower density housings, green trees and other public utilities.

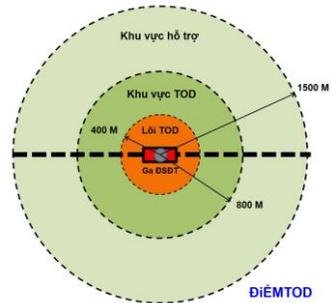


Figure 3.9: TOD point model

#### 3.4.2. Solutions for the connection of TOD functions

(1) Stations and mix - used buildings, connection points. (2) Station squares; (3) Bus and taxi parking spaces; (4). Car parking spaces; (5) Motorbike and bicycle parking lots; (6) Bicycle pathways; (7) Pedestrian pathways; (8) Services.

#### 3.4.3. Allocation on TOD's surface

##### 3.4.3.1. Allocation of urban, regional and neighborhood TOD

+ TOD allocation by grid - based road networks

+ TOD allocation by grid - based road networks and diagonal green network & centripetal pedestrian pathways

+ Space organization by mixed transport networks...

##### 3.4.3.2. Specific solutions for the space allocation at TOD points

**a: Space arrangement for regional TOD and urban TOD in open - centralized urban and new urban areas (Figure 3.10)**

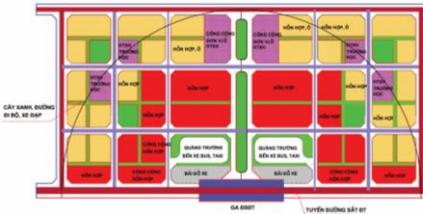


Figure: 3.10: TOD allocation by grid - based road networks



Figure: 3.11: Space arrangement for urban TOD with underground metro stations

**\* TOD organization with ground and underground metro stations (Figures 3.11, 3.13).**

In open - centralized urban area, when there is a vacant land, construction work can be implemented as theoretical study; having grid - based road networks. Metro stations will be allocated at center point, adjacent to station squares, bus & taxi parking lots, transport hubs, green trees and parking lots; creating landscape highlights. Commercial centers, offices, mid used buildings, housings, social infra networks... shall be allocated at a gradually declined density from the core center. Sub - surface space for metro stations can also be used for parking and commercial purposes while surface space can be used for squares and commercial activities; Establish pathways connecting with sub - surface spaces.

**\* Regional and urban TOD allocation: centripetal space arrangement, pedestrian pathways**

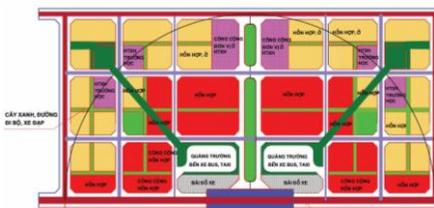


Figure: 3.12: TOD allocation by grid - based road networks and diagonal green network & centripetal pedestrian pathways



Figure: 3.13: Urban TOD allocation with elevated metro stations

**and bicycle riding routes:**

Bicycle riding and pedestrian pathways shall be allocated by diagonal & centripetal model to reduce ~ 35% travel time and distance (Figure 3.12)

**\* Regional and urban TOD stations and station squares in new urban areas (Figure 3.15)**



Figure. 3.14: Proposals for land use at TOD stations

**\* Proposals for land use planning at TOD stations (Figure 3.14)**

For large areas, allocate green trees and squares. For small - scaled land areas, allocate commercial centers, offices... adjacent to TOD stations to enhance business profit and convenience. Green trees shall be allocated at a little bit farther distance.

**\*Allocation of TOD in urban areas (Figure 3.16)**

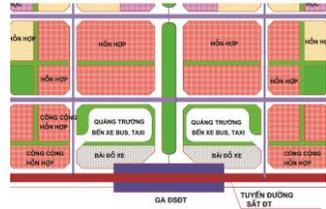


Figure. 3.15: Space allocation at station squares

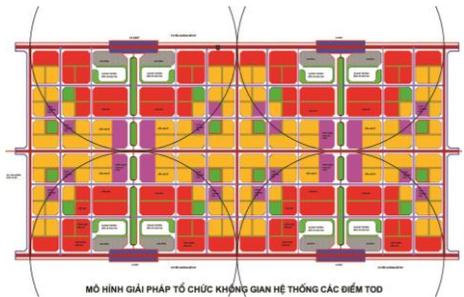


Figure. 3.16: Allocation of TOD in urban areas

The connection and integration of TOD model create urban TOD; different from traditional urban development.

**b: Allocation of TOD in new neighborhoods**

A neighborhood TOD has fewer commercial functions than that of urban TOD, having smaller squares and transport hubs, however, it has more social infra utilities. (Figure 3.17)

**c: Allocation of TOD at renovation, restricted development area** (Figure 3.18)

**\* TOD linkage, existing area and new development areas.**

Existing areas are renovated and enlarged to improve carrying capacity of public transport.

**\* Space surrounding TOD stations at renovation and restricted development areas:** (Figure 3.19)

Spaces in front of TOD stations are expanded to become a multi - modal transport hub and pedestrian space.

**\* Allocation of TOD in historical urban center; restricted development area with underground metro lines:**

Focus on sub - surface space exploitation due to the lack of surface space.

Organize sub - surface spaces around metro stations; connecting with high rise buildings' basements through underground pedestrian pathways. Allocate underground parking lots (Figure

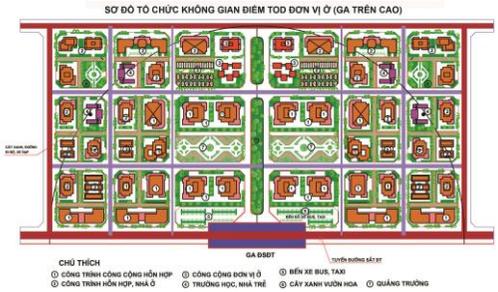


Figure: 3.17: Allocation of neighborhood TOD with elevated metro stations



Figure. 3.18: Space allocation connecting old and new areas under TOD model

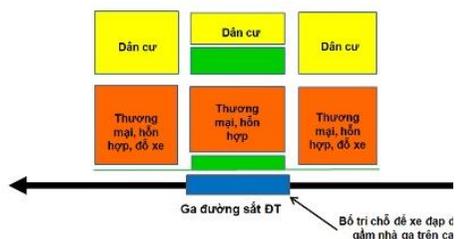


Figure. 3.19: Allocation of station space in restricted development area

3.20)

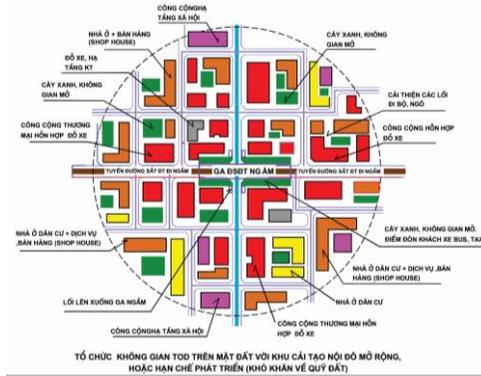


Figure. 3.20: Allocation of TOD in renovated and restrained area, underground metro lines (limited landfund)

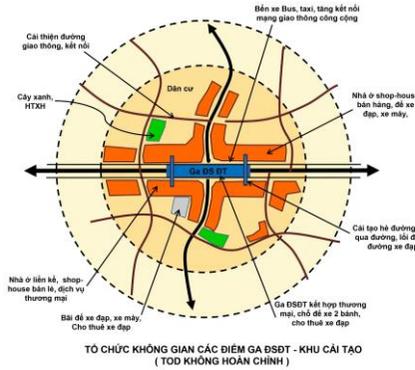


Figure. 3.21: Metro stations' renovation proposals (incompleted TOD)

**3.4.3.3. Determine TOD development criteria for urban areas:**

*Historical urban center, opened urban center and new urban.*

**Land use rate (times)**

TOD category	Radius 0-200 m	Radius 200- 400 m	Radius 400- 800 m
Urban TOD	9- 17 (*)	8-15	6-12
Regional TOD	8-14	6-12	4-10
Neighborhood TOD	8-14	6-10	4-8

(\*) For highlight buildings, this rate can > 13

**\* Functional classification for TOD types**

Functions	Urban TOD	Regional TOD	Neighborhood TOD
Public, commerce (%)	20-30	40-50	15-25
Office (%)	40-55	20-30	10-20
Housing (%)	15-25%	15-30	50-70

### 3.4.4. Solutions for the allocation of underground space for TOD

#### 3.4.4.1. Requirements on urban space allocation and its connection with sub - surface space.

The usage of sub - surface space helps to utilize land use, connecting urban activities and creating convenience for urban activities in 3 space dimensions (sub - surface, surface and elevated)

#### 3.4.4.2. Principles and criteria for the arrangement of appropriate locations for sub - surface space.

- Sub - surface space planning includes:

- + Development through width dimension:
- + Development through depth dimension (Figure 3.22)

#### 3.4.4.3.

#### Allocation of sub - surface space at TOD and TOD stations

Metro network and sub - surface planning; railway lines connection; underground stations & underground parking lots; underground civilized - construction projects; underground pedestrian pathways; Connection points between sub - surface and surface spaces.

### 3.5. Solutions for the conversion from traditional urban model to

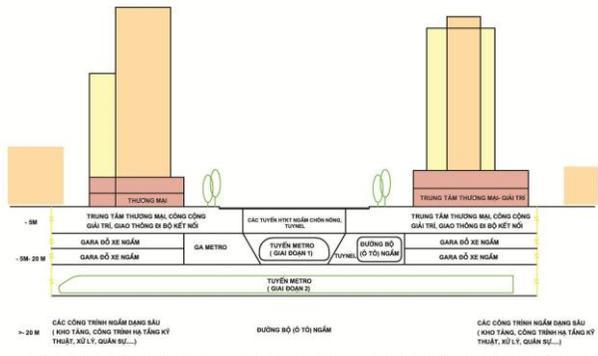


Figure 3.22: Direction on sub - surface development: by width and by depth dimensions

**TOD model for existing urban areas.**

There is a typical difference between traditional urban development model from TOD model: the conversion from roadway networks (lines, patterns) to TOD points where main transport modes are public modes, combining go walking and traveling through transport hubs.

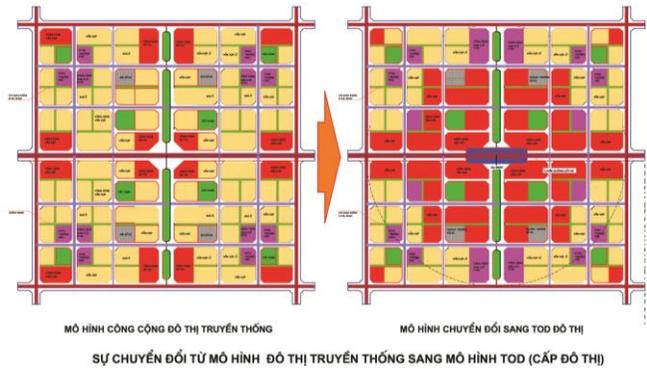


Figure: 3.23. Solutions for the conversion from traditional urban model to TOD model

**a. Urban and Urban TOD:**

Urban public activity centers will be transferred to TOD model. There are higher density of travels at TOD points. Therefore, new criteria, compression level and functions will be converted respectively (Figure 3.23)

**b. The conversion from traditional neighborhoods to neighborhood TOD**

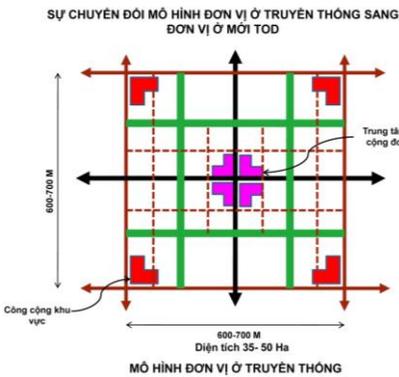


Figure: 3.24: Traditional neighborhoods model.

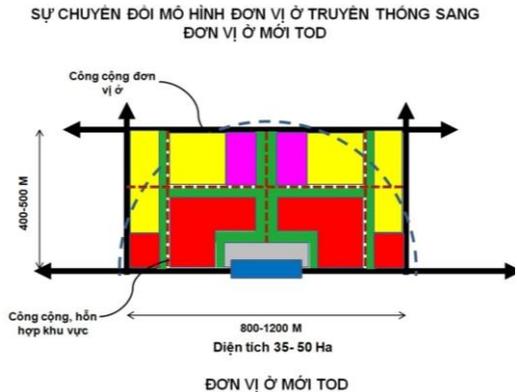


Figure: 3.25: TOD Neighborhood model.

**\* Traditional neighborhood.**

In the conversion to new neighborhood TOD, its range and population are remained unchanged, however, there will be a change in the organization of TOD connecting with urban railway stations, walkable distance from 400 - 500m. Thus, the dimensions of a neighborhood TOD will be: 400 - 500m and 800 - 1000m. A railway station will be allocated in the middle and on the regional road network or inter-regional road network, no pedestrian pathways crossing a neighborhood TOD (Figure 3.25)

### **3.6. Guidances on urban design.**

- Allocation of public space
- Urban design framework
- Building height, point line
- Guidelines on urban's functions allocation

### **3.7. Policies needed to promote TOD model for Hanoi.**

There is a need for policies to develop metro line networks connecting with TOD, utilizing land use among TOD stations.

TOD need to be combined into the City's urban planning projects; supplement of standards for TOD.

### **3.8. A pilot project allocating TOD at Giap Bat railway station.**

- The Thesis' research outcomes can be applied for the project "Allocation of TOD at Giap Bat railway station" with high feasibility and efficiency. These can be capable with master plan, zoning planning and detailed plans.

- Depending on categories of urban planning projects and on current conditions of planning area, space allocation principles and solutions can be applied specifically for each area.

## **CONCLUSIONS AND RECOMMENDATIONS**

### **1. Conclusions**

This Thesis brings a comprehensive study on natural and socio-economic conditions, urban development features of Hanoi and its issues; analyzing previous and on - going development projects in Vietnam and in the world; TOD model in Vietnam and in the world; natural condition assessments for Hanoi and its capability to be implemented in Hanoi's urban center area.

The Thesis brings new theoretical ideas and solutions for specific conditions of Hanoi; There are 5 point of views, 4 aims, 2 principles for the model establishment and space allocation resolution; allocating TOD areas:

- Establish TOD model (by level and functions): 3 TOD levels (*regional TOD, TOD chain, TOD point*) suitable for actual conditions of Hanoi. Propose directions for the allocation of TOD areas.

- Define the linkage between land use and transport planning, between surface and sub - surface spaces; Propose TOD model: range, functions, standards, space organization (surface and sub - surface) for each area of Hanoi's central urban, including: *restricted development area, open development area and new urban area*, suitable for Hanoi's actual conditions.

- Add standards and regulations for TOD model; requirements and principles for urban planning and urban design.

- Propose a method for the conversion from traditional urban, traditional neighborhoods to new TOD units for sustainable development.

- Propose a pilot project at Giap Bat railway station by TOD model.

## **2. Recommendations**

Regulations and policies shall be reviewed and completed to promote TOD model for urban areas and for Hanoi City; They should be revised in order to reduce their conflicts

Develop urban railway networks in a complete connection with TOD projects to utilize land use and create development resources for their investment and operation.

Related Departments should enact standards and regulations for TOD, requirements and principles for urban planning and urban design.

Bring TOD into the City's master plan to develop a green - cultural - civilization and modern.

**LIST OF SCIENTIFIC RESEARCHES PUBLISHED  
BY LE CHINH TRUC**

❖ **Scientific Researches.**

1. **Le Chinh Truc (2012) "Issues on urban traffic and congestion cease"**, Vietnamese Journal of Urbanism, No. 10/ 2012.ISSN- 1859-3658.
2. **Le Chinh Truc (2017) "Underground space in Hanoi's urban planning projects"**, Vietnamese Journal of Urbanism, No. 29/ 2017.ISSN- 1859-3658.
3. **Le Chinh Truc (2022) "Transit - Oriented Development (TOD) in Hanoi - solutions for urban development issues"**, Vietnamese Journal of Urbanism, No. 45/ 2022. ISSN- 1859-3658.

❖ **Workshops & Scientific Articles.**

1. **Le Chinh Truc (2016) "Pedestrian and bicycle pathways of Hanoi"** - Seoul International workshop: "Asian Cities Bicycle Forum 2016", Korea.
2. **Le Chinh Truc (2018) "Proposal of underground space planning and management solutions for Hanoi"** - City level scientific research (code: 01C-04-TC/03-15-3).
3. **Le Chinh Truc (2018) "Sustainable development solutions for Hanoi with public transport networks"** - International workshop "Strategies for smart city and transport network - Urban management and sustainable development: adequate future demands and climate change " – Hanoi Architectural University, KRDA, The Korea Transport Institute, October 2018. ISBN: 978-604-82-2696-1.