

SPATIAL DISTRIBUTION OF BANGKOK CITY GOVERNMENT'S EXPENDITURES ON
INFRASTRUCTURE INVESTMENT



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คณะสถาปัตยกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

ปีการศึกษา 2564

ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

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By Miss Sitanun Anandarangsi

Field of Study Urban Strategies

Thesis Advisor Associate Professor APIWAT RATANAWARAHA, Ph.D.

Accepted by the FACULTY OF ARCHITECTURE, Chulalongkorn University in
Partial Fulfillment of the Requirement for the Master of Science

----- Dean of the FACULTY OF
ARCHITECTURE
(Associate Professor PINRAJ KHANJANUSTHITI, Ph.D.)

THESIS COMMITTEE

----- Chairman
(Assistant Professor PITCH PONGSAWAT, Ph.D.)

----- Thesis Advisor
(Associate Professor APIWAT RATANAWARAHA, Ph.D.)

----- External Examiner
(Assistant Professor Nij Tontisirin, Ph.D.)

ลิตานัน อนันตรังสี : การกระจายเชิงพื้นที่ของรายจ่ายเพื่อการลงทุนในโครงสร้างพื้นฐาน
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การลงทุนในโครงสร้างพื้นฐานและการบริการช่วยกระตุ้นเศรษฐกิจของกรุงเทพมหานครให้เติบโตอย่างรวดเร็ว ซึ่งสิ่งอำนวยความสะดวกสาธารณะและการบริการทั้งหมดนี้ ช่วยเร่งเศรษฐกิจของกรุงเทพฯ ให้มีความสามารถในการแข่งขันอย่างเพียงพอในภูมิภาคเอเชียตะวันออกเฉียงใต้ ซึ่งช่วยเพิ่มโอกาสในการจ้างงาน โดยทั่วไปแล้ว กรุงเทพมหานคร (กทม.) จะได้รับการสนับสนุนทางการเงินจากรัฐบาลเยอะที่สุดในบรรดาระดับท้องถิ่นอื่น ๆ เนื่องจากเมืองกรุงเทพฯ นั้นคือกลไกหลักในการเติบโตทางเศรษฐกิจของประเทศและเป็นศูนย์กลางของกิจกรรมทางเศรษฐกิจของประเทศ ถึงแม้ว่ากรุงเทพฯ กำลังเผชิญหน้ากับภาวการณ์ลดลงของประชากรลงทะเบียน แต่ในปีที่ผ่านมา เป็นที่แน่ชัดแล้วว่ากรุงเทพมหานครยังคงให้ความสนใจในการจัดหาโครงการโครงสร้างพื้นฐานในวงกว้างภายใต้เขตกรุงเทพมหานคร ข้อพิสูจนีคืองบประมาณประจำปีที่กรุงเทพมหานครจัดสรรให้กับสำนักที่เกี่ยวข้องกับการสร้างเมืองและการบริการนั้นมีมูลค่าเป็นจำนวนมากของค่าใช้จ่ายประจำปีทั้งหมด และงบประมาณรายจ่ายประจำปีที่จัดสรรให้กับสำนักงานเขตทั้ง 50 สำนัก มีแนวโน้มที่จะเพิ่มขึ้นในทุกปี งานวิจัยชิ้นนี้พยายามที่จะศึกษาการลงทุนในโครงสร้างพื้นฐานของกรุงเทพมหานครและการจัดสรรงบประมาณโดยพิจารณาจากรูปแบบพื้นที่ของการกระจายงบประมาณ โดยใช้ข้อมูลการวิเคราะห์จากข้อมูลงบประมาณในทุกสองปี ตลอด 13 ปีงบประมาณ ตั้งแต่ปีพ.ศ. 2551 การศึกษานี้เกี่ยวข้องกับการวิเคราะห์เนื้อหาเกี่ยวกับการใช้เครื่องมือทางสถิติและภูมิศาสตร์ และมุ่งเน้นเฉพาะรายจ่ายที่เป็นของกรุงเทพมหานครเท่านั้น ผลการศึกษาระบุว่าแผนพัฒนาระยะยาวของกรุงเทพมหานครนั้น เป็นฐานของปัจจัยในการกำหนดงบประมาณรายจ่ายประจำปี

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ปีการศึกษา 2564

ลายมือชื่อนิสิต

ลายมือชื่อ อ.ที่ปรึกษาหลัก

6378009225 : MAJOR URBAN STRATEGIES

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Sitanun Anandarangri : SPATIAL DISTRIBUTION OF BANGKOK CITY GOVERNMENT'S EXPENDITURES ON INFRASTRUCTURE INVESTMENT. Advisor: Assoc. Prof. APIWAT RATANAWARAHA, Ph.D.

The investments in infrastructure and services help spur Bangkok's economy to faster growth. All the public facilities and services stimulate Bangkok's economy to strong competitiveness among the Southeast Asia regions which helps increase employment opportunities. Generally, the Bangkok Metropolitan Administration (BMA) gets the largest portion of the national government's financial support among other local governments, as the city is the primary engine of national economic growth and the center of the country's economic activities. Although the city is facing a net registered population decline situation, in these past years, it is obvious that Bangkok Metropolitan Administration keeps its interest in providing infrastructure projects far and wide under the Bangkok boundary. The proof is that the annual budgets distributed to the city building and services-related departments value a large portion of the total annual expenditures. Also, the annual budgets distributed to 50 district offices tend to rise over time. This paper attempts to take a study of the Bangkok Metropolitan Administration infrastructure investment and the reasons impacting the budget allocation considering the spatial pattern of the budget distributed. Budgeting statistics are analyzed every two years throughout thirteen fiscal years from 2008 to 2020. This study involves content analysis together with integrating statistical and geographical tools. It solely focuses on the expenditures of Bangkok city which belongs to the Bangkok Metropolitan Administration. The findings indicate that the BMA's long-term development plan serves as the basis of the factor determining annual expenditure.

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Chapter 1: Introduction

Bangkok, the capital city of Thailand, is the primary engine of national economic growth and the center of economic actions. The huge Bangkok urban area dominates the whole country's urbanization. The city is now joining the mega-cities, of which around 10.7 million inhabitants are estimated in 2021 (Statista Search Department, 2021). This urbanization has been associated with the demand for infrastructure development. In developing countries, rapid urbanization is the biggest driver of infrastructure spending (Aldred, 2012). In this case, in Bangkok city, a great number of infrastructure projects throughout the city's territory carries out over time. In fact, without these urban infrastructures, counting city-building, and public services provision, Bangkok's economy rarely goes beyond. The transportation networks, environment, sanitation, sewage system, and communication system are the foundation of urbanization, the city's prosperity, and urban well-being. These public facilities and services help encourage Bangkok's economy to strengthen competitiveness among the Southeast Asia regions. They transform the city into an emerging business, trade, and medical hub, which benefits the creation of employment opportunities. The concentration of these infrastructures, along with the indigenous culture, impacts the tourism industry, which creates a significant amount of revenue for the country as a whole.

As the city plays a significant role in boosting the country's economic status, without a doubt, there are multiple stakeholders involved in the infrastructure development of Bangkok city. The only local government, the Bangkok Metropolitan Administration (BMA) has the chief function of providing public services and infrastructure investment. In these past years, the BMA keeps the interest in providing infrastructure projects far and wide under the city boundary. Obviously, the BMA budget expenditures have risen over time. The proof is that the annual budgets distributed to the city building and services-related departments value a large portion of the total annual expenditures.

Also, the annual budget expenditures distributed to 50-district offices continue to grow. All these statements lead to the searching questions and discussion of whether there are any underlying causes of the BMA budgeting process and patterns. Therefore, this study is attentive to provide information and insights on this mentioned topic.

This introductory chapter sets out the key ideas of the thesis. “Bangkok city at glance” and background of the study are mentioned first. Then the research questions, research objectives, and the scope of the study are presented. In turn, the study’s limitations are stated before discussing the research design. The chapter ends with an outline of the thesis structure.

Bangkok At Glance

Bangkok city occupies 1,568.72 square meters. The city borders five adjacent provinces: Nonthaburi, Pathum Thani, Chachoengsao, Samut Prakan, Samut Sakhon, and Nakhon Pathom. There are fifty administrative districts in the city. Thirty-five of these districts are located east of the Chao Phraya River, while fifteen are located on the city's western bank, known as the Thonburi side.

According to the Statistical Profile of BMA of 2020, population registry statistics of Bangkok record 5,588,222 residents, which are belonging to 3,103,483 households. The city has a population density of an average of 3,562 persons per square kilometer or 1.80 persons per household. Sai Mai has been the most populous district, while Samphanthawong has the fewest registered residents. Also, Chatuchak is the district with the greatest number of households.

As Bangkok is by far the country’s largest economy, Bangkok’s Gross Provincial Product (GPP) reached 5,270,460 Thai Baht in 2020. In addition, the city's GPP per capita was 585,689 Thai Baht, putting it in second place in the country's GPP per capita, behind Rayong.

According to the Bangkok Metropolitan Administration Act, B.E.2528, the local government, BMA, has the jurisdiction to develop and enforce laws and regulations that govern the whole city as well as the citizens' well-being. This local government features two primary bodies, the Bangkok Metropolitan Council and the four-year term elected by popular vote Governor of Bangkok. The Governor is the head and the chief executive of the BMA. By law, the Governor of Bangkok's authorities and responsibilities briefly include developing and implementing BMA policies, proposing city laws and bills to the Bangkok Metropolitan Council for consideration, appointing and dismissing deputy governors, advisers, board members, city officials, and government employees, and coordinating and carrying out the Cabinet of Thailand, the Prime Minister of Thailand, and the Ministry of the Interior's instructions. Together with, the Bangkok Metropolitan Council, or BMC, is the administration's legislative body. It has main legislative authority as well as the authority to investigate and advise the governor. The Chairman of the Bangkok Metropolitan Council is in command of the council. The number of BMC members is determined by the population of Bangkok. One hundred thousand persons are represented by one member.

The City Hall also consists of two Secretariats, the Department of Deputy BMA, Office of the BMA Civil Service Commission, and fifteen Departments, The BMA is organized into sixteen departments, each of which is in charge of a distinct component of the administration's duties. The majority of these functions are related to the city's infrastructure, such as city planning, building regulation, transportation, drainage, waste management, and city beautification, as well as education, medical, and rescue services. The BMA also operates fifty district offices, one for each of Bangkok's fifty districts.

Background of The Study

As mentioned, Bangkok flourishes its national economy. In these past years, plenty of infrastructure projects run throughout the city. The infrastructures and public services do, in fact, provide tight connectivity to this metropolis. Additionally, the infrastructures not only allow the flow of people and commodities, but also the information and pieces of knowledge. They perhaps shape Bangkok to grow into a global city that serves as a significant node in the interconnected networks of information and money, as well as a source of wealth (Sassen, 2005).

It is undeniable that numerous sectors, including the national government, are aware of the need to participate in the Bangkok city development process. The local government, BMA, is counted as one of the most public services providers in Bangkok city. In general, the BMA receives a significant amount of funding from the Thai government in order to plan out infrastructural projects. The BMA's revenue is mostly derived from government grants and large own-source earnings, as the BMA has the ability to collect both tax and non-tax revenues. The BMA has the technical competence to set the infrastructure projects and budget expenditures in response to city-building and urban growth.

Many infrastructure projects have been undertaken in each of the city's 50 administrative districts over the years. In many cases, the BMA manages both big and small-scale projects, such as the operation of the transit system, bridge, and road network (re)construction, flooding prevention, and water quality controls. These BMA's efforts do have an impact on the well-being and living conditions of city residents. These infrastructure projects lay the foundations for creating the annual budget.

Since 2007, the BMA expenditures have been increasing. According to the records, the BMA budget expenditures accrued at a rate of 5.13 percent on average from the fiscal year 2007 through the fiscal year 2021 (see Table1). Despite the BMA's large workforce, budget expenditures are typically allocated primarily to salaries and routine operational expenses, as well as a diverse range of works, investment projects, and services, such as general administration, healthcare, education, environment, drainage and sewerage system, public works, and traffic, and the operation of the district offices.

Table 1: Percentage change in the BMA annual budget (the fiscal year: 2007-2021)

Fiscal Year	Annual Budget Expenditures (million: THB)	Change (%)
2007	39,508	
2008	45,528	15.24
2009	46,549	2.24
2010	41,588	-10.66
2011	46,458	11.71
2012	55,508	19.48
2013	60,527	9.04
2014	65,517	8.24
2015	65,442	-0.11
2016	70,425	7.61
2017	75,636	7.40
2018	79,047	4.51
2019	80,446	1.77
2020	83,398	3.67
2021	76,452	-8.33
Average Increase		5.13 %

The expenditures distributed to the city infrastructure building-related departments value a large portion of the total budget. The Public Works Department, the Environmental Department, the Drainage and Sewerage Department, and the Traffic and Transportation Department conceive considerable infrastructure projects. They capture a significant share of total annual expenditures (see Figure1). These costs are typically for operations as well as city development and maintenance projects.

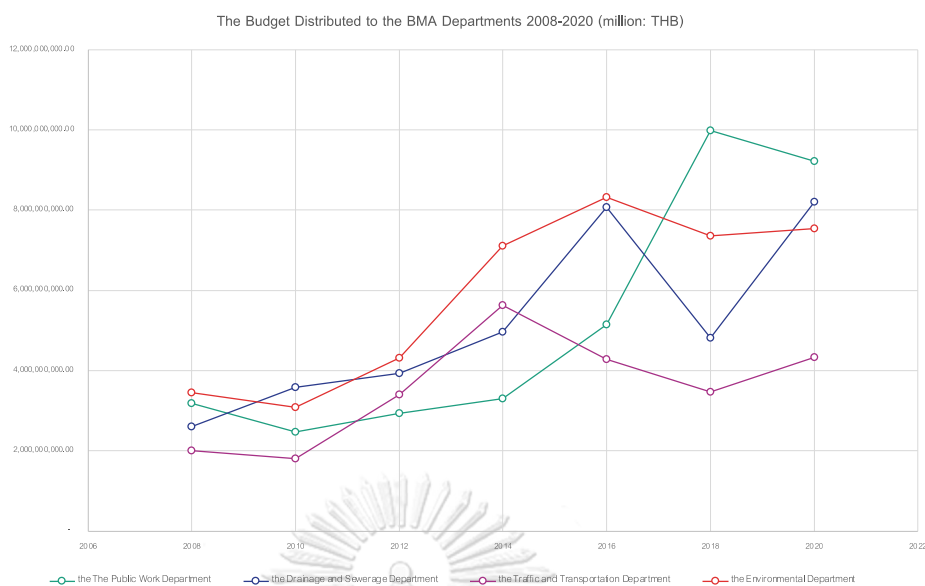


Figure 1: The annual budget expenditures distributed to the BMA Departments (the fiscal year 2008-2020)

Bangkok city is now the country's fastest-growing region. Over time, the city's uncounted housing estates, such as housing developments, as well as commercial establishments, have been filled constantly. Nonetheless, Bangkok is undergoing a demographic decline in the net registered population. The average change in the total registered population between 2008 and 2020 is -0.36 percent (see Table 2). However, when the average population growth in each district is considered, it was discovered that there is increasing average population growth in Bangkok's urban fringes, such as Nong Chok, Khlong Sam Wa, Lat Krabang, and Bang Khunthain. The population increase of Bangkok's suburbs appears to correspond to the population growth of neighboring provinces. Currently, Bangkok's neighboring provinces are seeing a rapid population increase.

Table 2: Changes in Bangkok City's Population

Fiscal Year	Number of Registered Population	Change (%)
2008	5,710,883	
2010	5,701,394	-0.17
2012	5,673,560	-0.49
2014	5,692,284	0.33
2016	5,686,646	-0.10
2018	5,676,648	-0.18
2020	5,588,222	-1.56
Average Decrease		-0.36

The diminishing registered population of Bangkok, however, does not reflect the actual population numbers of Bangkok. The city still has a considerable unregistered population. There are many more international migrants and expatriates, as well as millions of Thais from various parts of the country.

Research Questions

According to the study's foundation and an overview of the research problem, this research aims to mainly answer two broad questions:

- 1) What are the spatial distribution patterns of infrastructure investment projects by the BMA?
- 2) What factors are influencing the spatial distribution of such infrastructure investment projects?

This question in turn leads to research hypotheses, following:

- The population and the housing factors of 50 BMA districts affect the expansion of the number and values of BMA's infrastructure development projects.
- The area size of each district, number of households, number of populations, and the total collected revenues of each district are the

factors impacting the expenditure budget of each BMA's district offices.

Research Objectives

The position of this thesis is to examine the context of the infrastructure investment expenditures financed by the BMA. Therefore, there are two major objectives.

- 1) To analyze the spatial patterns of the infrastructure development projects provided by the BMA.
 - a) To indicate the expenditure budget of infrastructure development projects that emerge in each of the BMA's 50 administrative districts.
- 2) To examine the reasons and factors influencing the spatial allocation patterns.

Scope of the study

The scope of this study only intends to identify and illustrate the distribution of urban development projects and their budgets supplied by the BMA, along with the relevant causes and factors determining the spatial distribution patterns of such projects.

This analysis discloses such causes and factors for both the infrastructure development projects supplied by the BMA's departments and district offices. The Public Works Department, the Drainage and Sewerage Department, the Traffic and Transportation Department, and the Environment Department are the four departments chosen for the study, as they are involved with infrastructure investment.

It seeks to evaluate the infrastructure projects and their budgetary data every two years from 2008 through 2020, spanning 13 fiscal years. The lists of the infrastructure projects together with their annual budget expenditures that were stated in the BMA Annual Budget Expenditure Ordinances: from the fiscal year 2008 to 2020 were the cornerstone

of this research. The spatial area of the study was BMA's geographical location; 50 districts of 1568.74 square kilometers.

Limitations of the research

There are two significant limitations to this study that should be noted when evaluating its findings and whether planning for future studies. First, because there have been few previous studies on this issue, past research on the Bangkok infrastructure investment, the development projects of the BMA, and the Bangkok budgeting domain have primarily concentrated on the procedure and political aspects. It's unquestionably tough to identify what is driving the distribution patterns. It's difficult to state whether or not the findings of this study will stay constant in the future.

Second, the current documentation failed to identify the sites of the investment projects. It was difficult to pinpoint the exact spot. The author's assumptions were used to determine the precise location. As a result, it's possible that this study doesn't reflect the true quantity of expenditures distributed across a geographical area. Also, the document processing approach was predicated on a judgement call, which could have resulted in an inaccuracy in some cases.

Research design

According to a review of relevant literature, there have only been a few studies on the spatial distribution patterns of the Bangkok city government's infrastructure projects. As a result, the study is required to discover the causes and variables underlying the distribution. This research could lead to more policy recommendations for improving the future alternation of the BMA's plan. The problem's uniqueness should have been the topic of investigation that could have provided some methods for future studies. The research methodology is structured in such a way that the emphasis is on acquiring insights into the issues rather than drawing final judgments about the findings. This study's research design is illustrated in Figure 2 below:

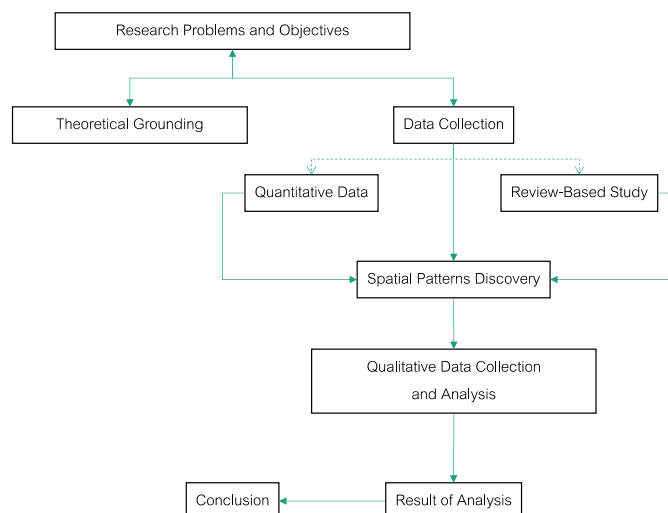


Figure 2: Research design

The study employs the mixed research method. The qualitative analysis with the integration of statistical and geographical tools which are the Geography Information System (GIS) and the Statistical Package for the Social Science (SPSS) are significantly in use. The data collection and processing are critical for achieving the above-mentioned objectives.

Key quantitative data, such as the BMA's expenditures on the infrastructure projects, the size of each district, and the number of populations and housing, is gathered in the first stage to conduct the spatial and statistical analysis. The BMA's Development Plans are the sources for conducting the content analysis to examine the impact of the Plan on infrastructure investment projects.

Thesis structure

The thesis is divided into five sections, each of which opens with the following description:

Chapter 1: The introduction provides a brief description of the research issue. It includes a general summary of Bangkok city, a problem statement, and research questions. It also describes the study's objectives, scope, and limits.

Chapter 2: Literature Overview Following this introductory chapter, the research continues with a study of academic literature that will serve as the foundation for the rest of the thesis. The selected literature covers the overview of urban infrastructure investment in Bangkok, city-building process in brief and the budget allocation structure and budgeting processes.

Chapter 3: Research Methodology addresses all the major features of the research method. It also includes a summary of the data collection process. This chapter begins with the development of the conceptual framework.

Chapter 4: Data Analysis and Findings emphasize the research's findings. This chapter, which focuses on the identification of the factors influencing budget expenditures allocation patterns, presents the findings from the geographical analysis and statistical analysis

Chapter 5: Discussion and Conclusion. In the last chapter, the main points made in this thesis are summarized, attempt to achieve the research objectives, and suggest some room for future study.

Chapter 2: Literature Overview

This chapter dives into the fundamental concept of the budget expenditure allocation system. It includes material from previous literature as well as the theoretical background. This section discusses three major kinds of literature: an overview of urban infrastructure investment in Bangkok, the city building process, and the BMA budgeting processes. This review seeks a comprehensive understanding of the BMA budgeting process to assess the elements influencing Bangkok's allocation patterns. The chosen literature solely includes case studies from Bangkok.

Overview of urban infrastructure investment in Bangkok city

Investment in urban infrastructure is considered a significant issue of study. There are two areas of focus in this study. One is what elements contribute to urban infrastructure development, particularly in Bangkok. The second item to consider is who is responsible for providing and financing infrastructure projects and programs. Understanding these concepts leads to the key factor influencing the patterns of infrastructure investment expenditures, and they can indeed assist shape the conceptual framework.

- *A factor influencing Bangkok's urban infrastructure development*

Infrastructure services, such as electricity, transportation, telecommunications, water and sanitation supplies, and waste disposal, are critical to economic activity and urban growth. Infrastructure is widely acknowledged to play an essential role in encouraging urban land development and private wealth creation. Infrastructure adequacy, which can contribute to diversifying output, growing industry, dealing with population expansion, alleviating poverty, or creating better conditions, helps define a country's success by supporting economic and urban growth. In many metropolitan regions, infrastructure has been employed to stimulate the rise of human settlements. Infrastructure systems have been utilized by policymakers and planners to entice private investments in housing and economic development (Song, 2012).

Indeed, urbanization has emerged as a global megatrend. The story of Bangkok's urban expansion is remarkable. Bangkok has by far the most population and the largest economy in the country. As previously stated, the registered population of Bangkok alone is 5.5 million in 2020. This amount does not include many more foreign migrants and expatriates, as well as many million domestic migrants from various parts of Thailand. The majority of domestic migrants came from Thailand's northern and north-eastern regions, not only to Bangkok but also to the surrounding areas (Yamashita, 2017). These migrants are more or less permanent residents of the area, but they are not formally recognized as residents.

Bangkok's large population, combined with the city's urbanization development, is influencing the country's economic growth. It also contributes significantly to the immense expansion of urban infrastructure. The built-up area has been expanding since 2008. Google Earth (2016) reveals that the city's built-up area now reaches significantly into Bangkok's metropolitan edge. Furthermore, the expansion consumes substantial parts of the neighboring *provinces* of Nonthaburi, Pathum Thani, Samut Prakan, Samut Sakhon, and Nakhon Pathom (see Figure 3).



Figure 3: Google Earth's View – Bangkok City

Several things in Bangkok have changed substantially after the introduction of the rail network system in the early 2000s. This rail network would cause a shift in Bangkok's travel patterns. The BTS Skytrain and the MRT underground transit system are making everyday commutes for hundreds of thousands of commuters much less stressful than they were previously. Traffic congestion and the inability to arrive at destinations on

time would be eliminated (Fitts, 2009). Likewise, the public railway network has a significant impact on intensive land use, particularly in commercial spaces, office buildings, restaurants, hotels, educational, and recreational applications (Denpaiboon et al., 2018). However, there is an opposing argument that certain constructed infrastructure does not benefit low-income people. Clearly, the benefits of this rail networks do not spread to everyone, but rather favor those with money. The biggest beneficiaries are those who can afford subsidized ticket fares, such as middle-class and businessmen, schoolchildren, tourists, and overseas visitors (Jenks, 2005).

When compared to some of its Southeast Asian neighbors, Thailand has done reasonably well in terms of infrastructure development. Furthermore, adequate infrastructure, such as access to electricity and water, has assisted Thailand's rapid economic growth. Good infrastructure has increased Thailand's attractiveness to foreign investment, facilitated international trade, and improved the efficiency of day-to-day business operations. All of this resulted in additional jobs, which raised the poor's income. However, access to infrastructure is no longer a primary concern here; rather, it is the quality of infrastructure and services. Thai governments have been able to construct basic infrastructure to suit the country's economic and social needs. However, as a middle-income country, Thailand's infrastructure requirements have grown to include more than just roads, bridges, and water supply for commercial and public usage. Thailand must increase the quality of its infrastructure and lower service costs in order to compete with other countries. One obvious problem is that Thailand's logistics costs are extremely expensive due to the country's reliance on land transport and imported electricity (Fitts, 2009).

- *Bangkok city's multiple infrastructure providers – who are in charge of the city's infrastructure service investment*

Bangkok is mainly characterized by its network infrastructure, which includes motorways and mass transit systems. The local government appears to have a large role in supplying urban infrastructures inside the city's 1568.74 square kilometers border.

However, the BMA bears little responsibility for providing mega-urban infrastructure. A wide range of organizations provides and provide Bangkok's infrastructure and services.

As Webster (2000) describes, in Bangkok, various state enterprises provide public utility services. Water is supplied by the Metropolitan Water Authority (MWA), energy by the Metropolitan Electricity Authority (MEA), and public transportation by the Bangkok Mass Transit Authority (BMTA). The Expressway and Rapid Transit Authority of Thailand (ETA) is another governmental enterprise in charge of the city's key urban-shaping toll motorway system, operating certain expressways directly and others under contract. The State Railway of Thailand, another state enterprise, offers a de facto commuter rail service throughout the greater Bangkok area. The Metropolitan Rapid Transit Authority, a public corporation accountable to the Ministry of Transport and Communications, is building a subway system. The national government is primarily involved in various aspects of city development, particularly the construction of major roadways and bridges. Other critical systems, like primary and secondary education and basic health care, are shared by the BMA and the national government.

The BMA is expressly compelled by law to perform other responsibilities, such as wastewater and solid waste management and processing. However, if the system in issue requires significant capital investment, as in the case of traditional wastewater treatment plants, the BMA effectively loses control over commencing expenditures because it is funded entirely or partially by the national government. In term of financing, it is worth noting that Bangkok does not borrow for capital expenditure. This indicates that almost every expenditure is covered by current revenues. The majority of revenue is spent on salaries and routine operational costs (Webster, 2000).

City-building process - how the city is built

Webster (2000) elaborates that, in the case of Bangkok city, the city-building like investing in urban infrastructure projects, is primarily associated with three processes; building on the greenfield, the redevelopment of existing urban areas, and the in-filling.

- i. Building on greenfield or low-density rural areas in the suburbs of the city. A greenfield project is one that is unrestricted by previous development on the land. A greenfield project often comprises development on an entirely bare site (HMC Architects, 2019). This form of development, if handled appropriately, can result in the lowest capital investment costs. It is possible to reduce the costs associated with the land acquisition as well as the need to repair or upgrade existing roads and other infrastructure. In the case of Bangkok, pre-development plot sizes are also easier to work with than those in regions that have already been built up (Webster, 2000).
- ii. The urban redevelopment. Urban redevelopment is conceptually comparable to land readjustment, according to the World Bank Group (n.d.), with the exception that it occurs in already-existing urban areas and frequently requires rezoning by the government of a specific region from a low-density to higher-density development. The BMA has been promoting urban redevelopment projects, back in 2000, Webster (2000) provides an example of how a few influential companies made significant investments to transform Rama III into a new downtown.
- iii. In-filling. Large undeveloped lots frequently exist in the voids between corridors or inside "superblocks" in Bangkok due to the city's relative lack of major roads. The structure of the city can be drastically altered if entry is granted (Webster, 2000).

The BMA budgeting processes in brief

The BMA's revenues are derived mostly from three sources. To begin, all taxes and non-tax income received by district offices are classified as local own-source taxes and revenues. The BMA's primary sources of revenue were the building and land tax, local maintenance tax, and signboard tax. Fees and charges are examples of non-tax income. The second source is government taxes, such as VAT and motor vehicle tax. VAT is the source of the majority of BMA revenue. Grants, which are divided into general grants and ad hoc grants, are received from the government as well.

The budget allocation structure of BMA features two tiers of allocation. The first tier is the budget distributed to the BMA departments which covers all areas of Bangkok and is related to citizenship and well-being, for example, the investment in road and rail networks, environment protection, and education. Another tier is the budget distributed to 50-district offices which is location-specific. The district offices utilize these allocated budgets for general administration, basic public services also district development. The previous study found that BMA allocates the budget for district offices equally with the result that district-level expenditure per capita is less unequal

The fiscal year in Thailand begins on October 1st and ends on September 31st of the following year. As a result, the budgeting process must be planned ahead of time in general. The BMA Bureau of Budget defines the budgeting process as a step-by-step procedure that begins with an assessment of the past performance of the other BMA departments and progresses to the preparation of the yearly budget plan. The process continues with the establishment of budget restrictions, the examination of proposed budgets from other BMA sectors, and the presentation of the annual budget report to the Bangkok Metropolitan Council. The budget is then reviewed and approved by the BMC. And it results in the passage of the BMA Annual Budget Expenditure Ordinance. The budgeting process includes these four following major steps (Samakkit, 2016):

- A. **Budget preparation** is the initial step in the budgeting process. The executive is in charge of proposing the annual budget to the BMC for approval. Budget preparation is comprised of three critical phases.
- a. **Budget Revision** is primarily intended to provide a framework for modifying the organization's roles, missions, and action plans to be in alignment with policy priorities, the agency's capabilities, and the changing environment.
 - b. **Budget Planning** is the process of linking the economy as a whole by analyzing the Bangkok Development Plan, Bangkok Administrative Plan, and other associated government sector administration plans to establish a policy, budget, and annual budget.
 - c. **Budget Formulation**, the BMA Bureau of Budget develops and proposes a budget calendar as well as management guidelines for the annual budget. These guidelines are used to prepare and manage annual budget expenditures. The BMA departments shall continue to operate and follow in the areas of planning, management, monitoring, and evaluation.
- B. **Budget Adoption** refers to the approval of the BMA Annual Budget Expenditure Ordinance as well as the accompanying documentation provided by the executive to the BMC. The BMC will be provided with a draft of the BMA Ordinance. The BMC considers the BMA three stages (Buracom, 2011; Samakkit, 2016):
- a. The first stage comprises a general discussion of the Ordinance, including the appointment of a committee to review the annual budget.
 - b. The second stage entails reviewing the amendments
 - c. The last stage is the final consideration. When the ordinance is passed, the Governor of Bangkok officially announces the usage of the BMA Annual Budget Expenditure Ordinance, which is still in effect.

The BMC budget consideration must be completed within 45 days of the onset consideration date.

- C. **Budget Execution:** Following the announcement of the BMA Annual Budget Expenditure Ordinance, the BMA sectors must operate in compliance with the operational plan and budget utilization plan indicated in the supporting papers of the Annual Budget Expenditure Ordinance.
- D. **Budget Monitoring and Evaluation** entails methods for controlling and monitoring processes and the usage of the budgets to ensure that they are in conformity with the stated objectives in the Ordinance and related documents.

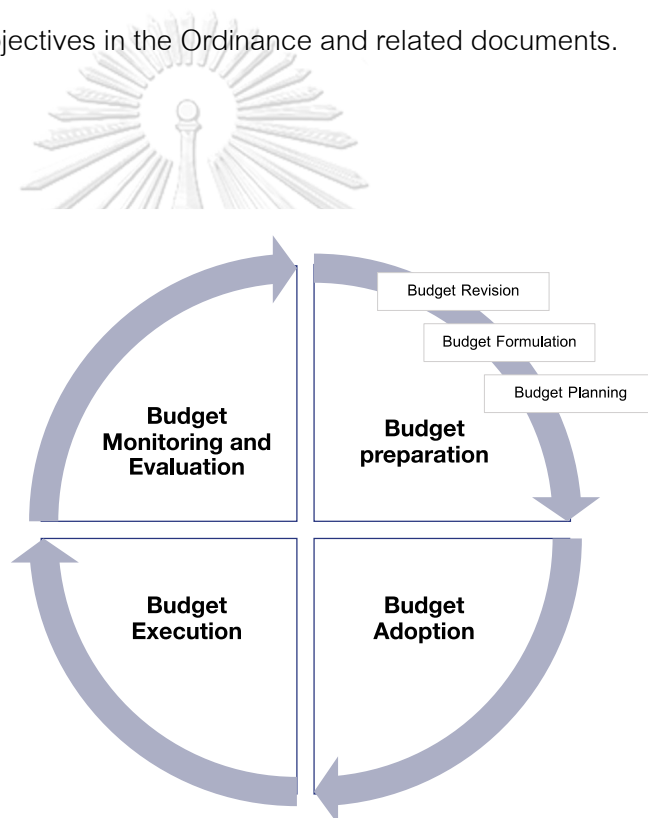


Figure 4: The BMA budgeting process

The BMA's common budget allocation structure has two tiers of allocation. The first tier is the budget allotted to BMA departments, such as the Public Works Department and the Environmental Department, which encompass all areas of Bangkok and are related to citizenship and well-being, including investments in road and rail networks, environmental protection, and education. Another tier is the location-specific budget

given to 50 district offices. These budgets are used by district offices for general administration, basic public services, and district development. The previous study discovered that the BMA allocates the funds for district offices equally, resulting in less unequal district-level expenditure per capita.



Chapter 3: Research Methodology

This chapter opens with an explanation of the study's conceptual framework and how it was created. This conceptual framework is developed using insights from earlier literature and urban studies aspects that influence the distribution patterns of infrastructure investment expenditures. This chapter's primary objective is also to outline the research methodology used to examine the causes of such allocation patterns. The conceptual framework, research approach, research instrument, data collection method, and interviewees of the study are all discussed.

Constructing the conceptual framework

The conceptual framework was established based on the synthesis of previous literature and other components of geographical and demographical information to further study the spatial distribution patterns of the BMA urban infrastructure investment and the factors driving such patterns. Previous research indicates that the concept of urbanization has an impact on the development of infrastructure in emerging nations such as Bangkok. Thus, it is a smart option to further investigate the population, households, and area size of each BMA administrative district. Additionally, understanding the BMA's revenue element is vital for the analysis, thus another factor to consider is the amount of revenue collected by each district.

Aside from the variables stated above, it is a fine decision to analyze the BMA Development Plans, as the plans are the strategic guideline for which the BMA's Departments implement. During the selected timeframe of analysis, 2008 to 2020, the BMA presented two issues of the development plan. The conceptual structure of this study is depicted in Figure 5.

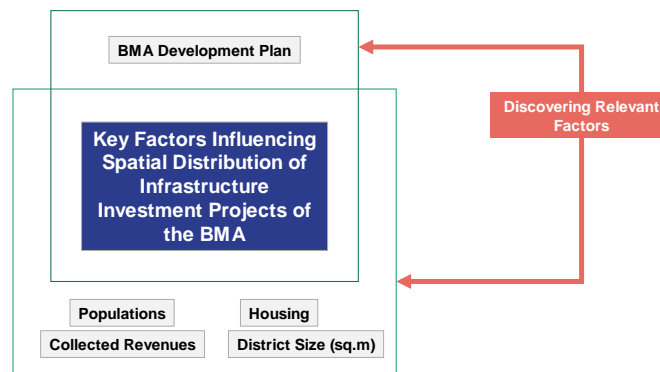


Figure 5: Conceptual Framework

Research Methodology – Setting out the research strategy

A research strategy is an overarching plan for conducting a research investigation. It is an overarching plan for conducting research investigation (Johannesson & Perjons, 2014). The research strategy for this thesis began with background information about the BMA's infrastructure investment expenditure matters, and then the research questions and the conceptual framework were determined. In turn, the BMA budget and other statistical data were gathered and scientifically analyzed in order to uncover the spatial patterns. Once the patterns were identified, interviews were conducted to obtain information and corroborate the patterns discovered. All of the obtained primary and secondary data will be examined and reviewed to determine the most essential findings. Furthermore, some conclusions will be reached based on the findings related to the research questions. Figure 6 represents the overall research strategy.

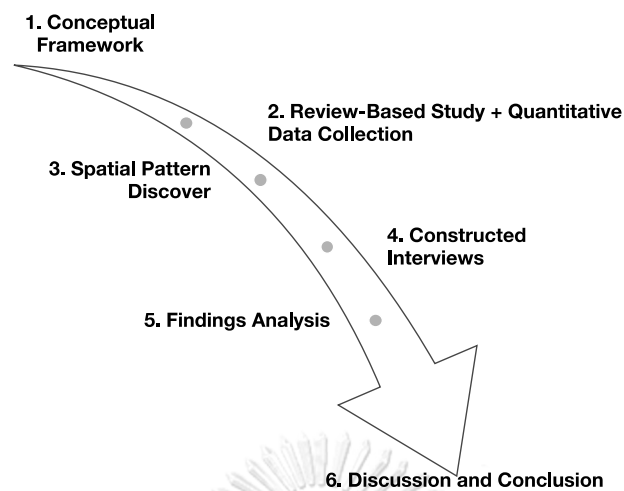


Figure 6: Research Strategy

Research Approach – The Mixed Method

This research seeks to evaluate the changing factors of the BMA annual budget expenditure by analyzing budgeting data every two years from 2008 to 2020 (B.E. 2551 to 2563). Urban infrastructure investment projects are categorized into main four groups from four departments of the BMA, the Public Work Department, the Environment Department, the Drainage and Sewerage Department, and the Traffic and Transportation Department. The investment project locations are spread across Bangkok's 50 administrative districts.

This research topic necessitates an understanding of the spatial distribution patterns of the BMA's infrastructure investment expenditures. The projection of projects' location and their distributed expenditures through geographical visuals is required for this thesis. This study also requires a more in-depth and qualitative identification. For this reason, the mixed approach was chosen as the primary methodology for this thesis.

Mixed methods research combines and integrates qualitative and quantitative methodologies in the same study (Molina-Azorin, 2016). The main objective of mixed

methods research, which combines qualitative and quantitative research aspects, is to broaden and reinforce the conclusions of a study and so contribute to the published literature. The use of mixed approaches should contribute to answering research questions in all investigations (Schoonenboom & Johnson, 2017).

Following the collection of data, the spatial distribution patterns of the BMA's infrastructure investment projects and the expenditures must be determined, according to the research strategy. At this step, a quantitative approach to data analysis is required to gain an understanding of what variables are connected with the distribution patterns. The use of quantitative methods in investigating complex human or social systems has been one of the most significant advances in modern social science research (Wang, 2006). The geographical graphics in this study must be created using accessible statistical data. Because it depends on concrete numbers and fewer variables, this quantitative method helps to cement the study. This can assist to remove biases from the research and improve the accuracy of the findings (Indeed Editorial Team, 2022). This research also considers the use of regression analysis in addition. Regression analysis is used to create models that describe the relationship between variables (Mara Calvello, 2020).

This study also relies greatly on qualitative methods. Since the primary objective of this study is to explore significant spatial patterns by examining phenomena and finding essential variables associated with the BMA geographical site and the development projects with the budget expenditure allocation criterion. For exploratory studies such as this thesis, qualitative methodology appears to be a viable choice. The qualitative research method is an ideal method for this study as it aids in the acquisition of insights.

Data Collection and Data Analysis Method

This section describes the data collection methods used in the study's quantitative and qualitative methodologies. Primary and secondary data sources were used to analyze

the data. The BMA Statistical Profile from 2008 to 2020 is the main source of data for conducting quantitative research. The semi-structured interview is the primary instrument for gaining qualitative insights to support the findings.

Quantitative data collection and analysis

As previously stated, a quantitative study is required to develop this thesis. The BMA Statistical Profiles from 2008 to 2020 and the BMA budget expenditures stated in the BMA Annual Budget Expenditure Ordinance are the key sources of accessible data. The statistical data utilized in the investigation include the annual budget of the BMA, the number of registered populations and the number of registered housings the area size in square meters, and the total annual revenue collected by the BMA's 50 districts. The increase and decline of the population and housing are further calculated. The BMA's collected revenue is obtained by calculating the major sources of tax and non-tax revenue gathered by the district offices each year. The total revenue examined is the sum of the building and land tax, local maintenance tax, signboard tax, and fees and charges. This data set is the foundation of the quantitative analyses of this thesis. This data collection serves as the foundation for this thesis' quantitative analysis.

1) *Geography Information System (GIS) – mining the spatial patterns*

GIS is a computer system that collects, stores, manipulates, searches, analyzes, and displays data that is spatially related. Among the many functions that a GIS can perform, mapping is the most crucial. GIS can be utilized to improve research on social topics and public policy. Applications span from common themes in urban and regional studies to crime and health concerns – for example, regional growth trends, and trade area analysis (Wang, 2006)

In this thesis, GIS is performed to illustrate the specific location of the urban development projects contributed by the four departments and 50 administrative districts beginning the fiscal year 2008. Together, it explores

the spatial patterns of the BMA's infrastructure expenditures distribution. The seven years of data sets, which were used for analysis, were collected every two years between 2008 and 2020 for this GIS analysis. This geographical tool also analyzes the average demographic change of each district. The data classification method of these analyses is equal interval classification. The equal interval classification method divides attribute values into size ranges of equal size (GISGeography, 2014). QGIS is the GIS application utilized in the study. The original shape files for Bangkok city were obtained from www.bangkokgis.com.

2) *Regression Analysis - investigating the relationship between variables*

Regression is the technique through which one variable influences another, or how changes in one variable induce changes in another, — in other words cause and effect. It suggests that the outcome is determined by one or more variables. Regression analysis assists in determining the logical relationship between two variables (x and y) so that future projections on events and objectives may be made. Linear regression analysis is thought to be the best fitting line through the data points (Mara Calvello, 2020).

After obtaining the GIS-based data, the regression analysis was carried out. To model the correlation between multiple variables, multiple linear regression analysis is used to describe the reasons affecting the distribution patterns. The Statistical Package for the Social Sciences (SPSS) is a software package utilized for statistical data analysis in this study.

To answer research question number 2, What factors are influencing the spatial distribution of such infrastructure investment projects? – the research hypotheses are constructed, as follows:

A. *Do the population shift and the housing increase of 50 BMA districts affect the expansion of the number of BMA's infrastructure development projects?*

Hypothesis A is that:

H0: The population shift and the housing increase in 50 BMA districts do not affect the expansion of the number of BMA's infrastructure development projects.

H1: The population shift and the housing increase in 50 BMA districts positively affect the expansion of the number of BMA's infrastructure development projects.

Dependent variable (Y1) = the expansion of the number of BMA's infrastructure development projects

Independent variables = the population shift (X1), and the housing increase (X2)

B. *Do the population shift and the housing increase in 50 BMA districts affect the changes in the values of BMA's infrastructure development projects?*

Hypothesis B is that:

H0: The population shift and the housing increase in 50 BMA districts do not affect the changes in the values of BMA's infrastructure development projects.

H2: The population shift and the housing increase in 50 BMA districts positively affect the changes in the values of BMA's infrastructure development projects.

Dependent variable (Y2) = changes in the values of BMA's infrastructure development projects

Independent variables = the population shift (X1), and the housing increase (X2)

C. What factors are influencing the expenditure budget allocation of the BMA district offices?

Hypothesis C is that:

H0: There is no association between the annual budget distributed to each district office and area size of each district, number of households, number of populations, and the total revenues of each district

H3: There is an association between the annual budget distributed to each district office and area size of each district, number of households, number of populations, and the total collected revenues of each district

Dependent variable (Y3) = the annual budget distributed to each district office

Independent variables = the area size of each district (X1), number of households (X2), number of populations (X3), and the total revenues of each district (X4)

Qualitative data collection and analysis

Following the quantitative method, the process of gathering further qualitative data was undertaken. The analysis of the BMA's Development Plans enables one to determine whether or not it is a contributing factor to the urban development project. The major sources for the analysis are two BMA development plan documents, namely the BMA's

12-year Development Plan (2007-2020) and the 20-year Development Plan for Bangkok Metropolis.

In-depth semi-structured interviews were designed to conduct dialogues with BMA officials who have solid expertise in the budgeting and policy formulation processes at the municipal level. These interviews would yield a wealth of information to support the scientific findings. The semi-structured interview has the advantage of allowing the researcher to obtain data by asking a predefined set of questions. It does, however, allow the researcher to ask extra questions if an intriguing or novel path of inquiry emerges during the interview. This flexibility in questioning allows the researcher to go into more detail on a certain issue (Mannan, 2020). This is why this research instrument was selected for data collection for this thesis.

The interviews were conducted over the phone for logistical, practical, or safety considerations, like COVID-19. However, there may be a detrimental impact on the richness and quality of the information acquired; however, the literature shows that telephone interviews are a technique with both benefits and drawbacks. They provide more anonymity, which appears to improve self-disclosure and emotional expressiveness (Azad et al., 2021).

The interviewees are the following:

- Interviewee A: a BMA Bureau of Budget official
- Interviewee B: former administrative chief of BMA's district office
- Interviewee C: a BMA strategist
- Interviewee D: a member of the Bangkok Metropolitan Council
- Interviewee E: a BMA the urban planner

These individuals provided valuable insights into the BMA budgeting and policy development processes. They presented specific causes and variables influencing the BMA's investment expenditure.



Summary of Research Methodology

This chapter discusses the conceptual framework and research methodology, covering the research approach, data collection, and data analysis methodologies. The literature overview chapter revealed several contributing elements to the spatial dispersion of the BMA's investment expenditures.

The mixed approach was chosen as the principal methodology for this thesis, which included data collection from statistical profiles of the BMA, the BMA plans, and budgeting regulations. The study employs both statistical and geographical techniques, including the GIS and the SPSS. The content analysis along with semi-structured interviews is also seen as the main tool for gathering findings. This study aims to assess the changing elements of the BMA annual budget by examining budgeting data every two years from 2008 to 2020. The in-depth semi-structured interviews took place over the phone. Table 3 below summarizes how the above methodology can be applied to achieve the research objectives.

Table 3: Summary of research methodology

RESEARCH OBJECTIVES	RESEARCH METHODOLOGY	DATA SOURCES
1. To analyze the spatial patterns of the infrastructure development projects provided by the BMA. a. To indicate the expenditure budget of infrastructure development projects that emerge in each of the BMA's 50 administrative districts.	<ul style="list-style-type: none"> • Review-based study • Quantitative approach: <ul style="list-style-type: none"> ✓ Mapping process 	<ul style="list-style-type: none"> • Bangkok Metropolitan Administration (BMA) Ordinance: Annual Budget Expenditures B.E. 2551 to 2563 via the official website of the Royal Thai Government Gazette and BMA reports • Statistical Profile of BMA
2. To examine the reasons and factors influencing the spatial allocation patterns.	<ul style="list-style-type: none"> • Quantitative approach: <ul style="list-style-type: none"> ✓ Statistical analyzes – Regression analysis • Qualitative approach <ul style="list-style-type: none"> ✓ Content analysis ✓ In-dept interviews 	<ul style="list-style-type: none"> • Statistical Profile of BMA • BMA's Development Plans

Chapter 4: Data Analysis and Findings

The results of the content analysis, geographical analysis, and statistical test are included in this chapter. The material in this chapter was put together by first examining the urban projects of four BMA departments: Public Works, Drainage and Sewerage, Traffic and Transportation, and Environment Department. These projects were listed in the annual budget documents, along with their valuations. The analysis makes an effort to understand the relationship between the causes contributing to urbanization, population and housing changes, and the expansion of the number of development projects and the amount of money allocated to them. Features of the budget expenditures distributed to 50 district offices are then analyzed in order to determine what factors contributed to the distribution criteria. The geographic visualizations below show how urban development projects and budget allocation have changed every two years from 2008 through 2020.

The Urban Development – examining the infrastructure projects provided by four BMA core departments

Bangkok is experiencing a demographic decline in the net registered population. The average change in the total registered population between 2008 and 2020 is -0.36 percent, as was mentioned in Chapter 1. Figures 7 and 8 below depict the shift in population and the increase in housing.

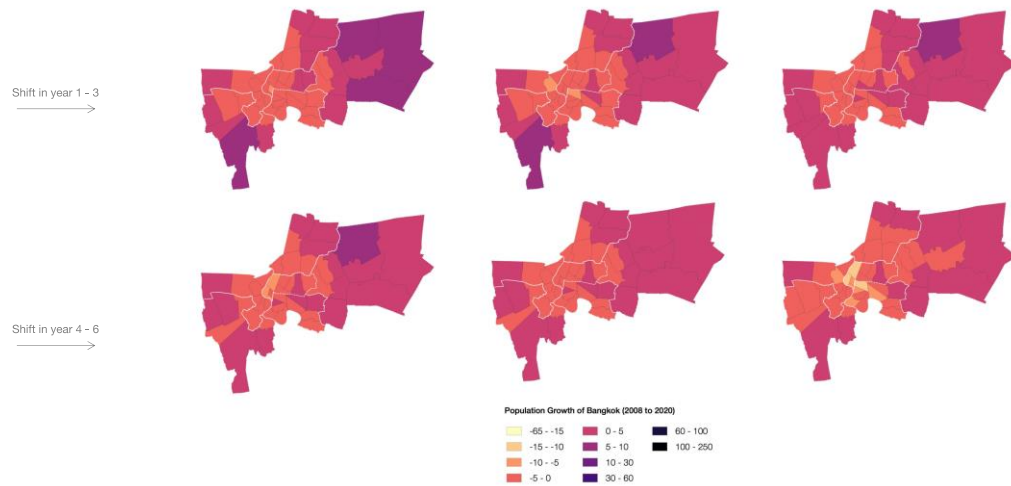


Figure 7: The population growth of Bangkok (2008 to 2020)

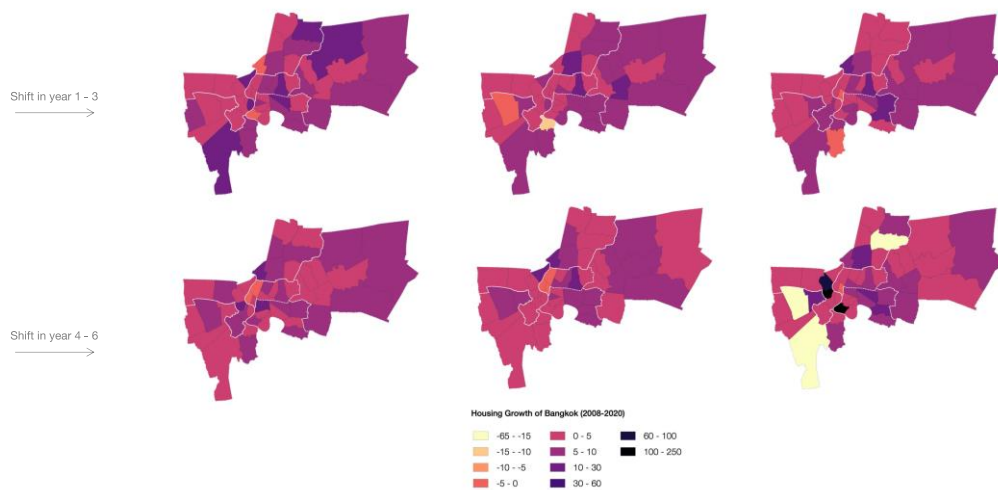


Figure 8: The housing growth of Bangkok (2008 to 2020)

The city's declining net registered population is not impeding city development, nevertheless. Also, there are a large number of unregistered residents, which makes it impossible to count the precise number. Bangkok has seen a noticeable improvement throughout the past ten years. Mass transportation systems, extended road networks,

and other public service operations have been moderately constructed. Urban development projects are constantly underway. The BMA continues to invest significantly in the provision of urban infrastructure since the departments responsible for developing city infrastructure acquire a larger portion of the expenditure budget.

The Public Works Department, Drainage and Sewerage Department, Traffic and Transportation Department, and Environment Department have completed a countless number of projects from 2008 to 2020 fiscal year. Two main purposes can be derived from the objectives of these projects. The first is for urban development. Another is for the operation and maintenance tasks. Most of the projects are for urban development projects, which are meant to serve as the study's unit of analysis.

The study's data from the fiscal year 2008 to 2020 shows that there were 589 urban infrastructure development projects in progress specifically across the city (see Figure 9, Table 4). Following the analysis, the Drainage and Sewerage Department held most of the development projects each fiscal year. There had been 317 projects of drainage and flood control. Both minor and large-scale development projects were undertaken.

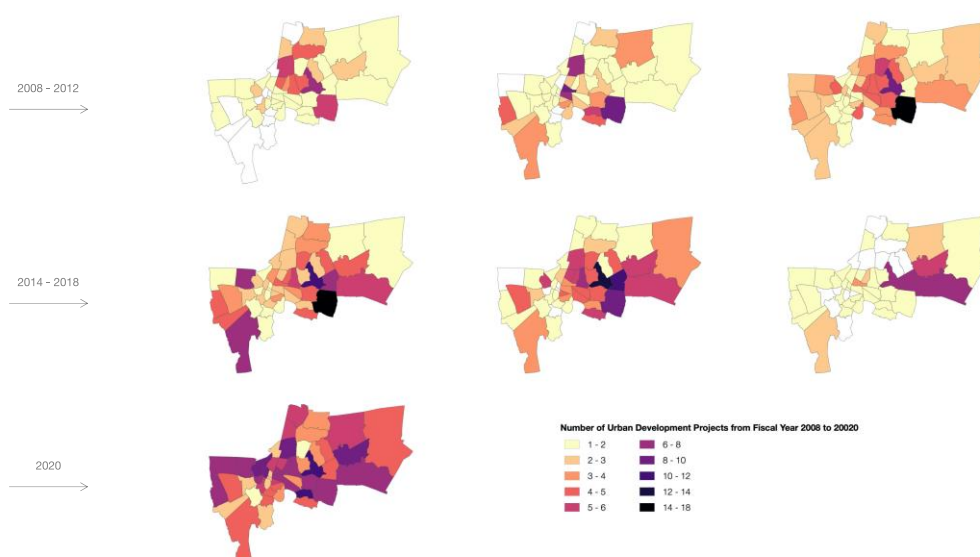


Figure 9: Number of urban development projects from the fiscal year 2008 to 2020

Table 4: Number of location-specific projects provided by four departments of the BMA (operation and maintenance - urban development projects)

Fiscal year	The Public Works Department		The Drainage and Sewerage Department		The Traffic and Transportation Department		The Environment Department	
	Operation and maintenance	Urban development and enhancement	Operation and maintenance	Urban development and enhancement	Operation and maintenance	Urban development and enhancement	Operation and maintenance	Urban development and enhancement
2008	3	7	5	31	2	2	8	8
2010	6	23	3	39	3	5	8	10
2012	11	11	6	72	3	5	11	7
2014	11	33	8	59	3	12	17	8
2016	9	27	7	68	3	5	16	6
2018	6	33	6	15	2	1	15	2
2020	1	32	7	33	2	28	22	7
The total number of projects for operation and maintenance		204 (projects)		The total number of projects for urban development and enhancement		589 (projects)		

*The budgets used in the calculations are based on location-specific projects in 50 Bangkok districts.

** The four departments of the BMA are as follows: Public Works, Drainage and Sewerage, Traffic and Transportation, and Environment.

Many projects were completed in a single fiscal year. At the same time, there were some continuation projects that required out-year funding. In each of the 50 administrative districts, there are a significant number of development projects scattered across them. Investments in these projects often spanned Bangkok's whole geographic area during certain fiscal years. However, development projects in certain places were halted for some years. Although there has been no consistent increase in the number of development projects provided, there was an average increase in project values of 41.55 percent (see Table 5).

Table 5: Total expenditures on infrastructure projects provided by four departments of the BMA (operation and maintenance - urban development projects)

Total expenditures on infrastructure projects provided by four departments of the BMA				
Fiscal Year	Total of the four departments' operation and maintenance expenditures	change (%)	Total of the four departments' urban development expenditures	change (%)
2008	2,581,253,099.99		1,239,993,466.57	
2010	2,129,025,999.98	-17.52	1,794,137,599.99	44.69
2012	2,639,179,600.00	23.96	1,959,884,864.99	9.24
2014	3,057,912,651.98	15.87	3,641,210,070.97	85.79
2016	5,779,447,759.24	89.00	6,401,026,616.70	75.79
2018	5,847,225,100.04	1.17	5,507,032,398.96	-13.97
2020	5,304,950,468.00	-9.27	8,137,309,126.62	47.76
	Average Increase	17.20	Average Increase	41.55

*The budgets used in the calculations are based on location-specific projects in 50 Bangkok districts.

** The four departments of the BMA are as follows: Public Works, Drainage and Sewerage, Traffic and Transportation, and Environment.

In any case, it can be noted that the BMA intends to spend its funds on operations and maintenance no less than urban development. The construction of public buildings, such as BMA City Hall 2 and a district office in Din Daeng, the operation of the solid waste disposal system, and the operation of the Bangkok Mass Transit System (BTS) were all included in the operation and maintenance projects, which is why in some fiscal years the expenditures for operation and maintenance appeared to be higher than those for urban development. The BTS project accounts for the majority of the Traffic and Transportation Department's operation expenses. Since this mass transit project is marketable and requires extensive capital, a special purpose corporation, Bangkok Mass Transit System Corporation Limited (BTSC), was established from the start. Tanayong Public Company Limited and the BMA inked a concession agreement to develop, operate, and transfer an elevated mass transit train system on two routes in Central Bangkok (Tangkitsiri & Ogunlana, 2004). Therefore, the BMA must unavoidably share in this operational burden.

As mentioned in the beginning, the BMA pursued various projects in one fiscal year, both small and large-scale. Whether it is the development of a flood protection system, the upgrading of various roads, the investment projects enabling access to mass transit, or the waste management systems. The study's findings are broken down by each department's issues on investment in urban development projects to make them simpler to understand, beginning with the Public Works Department and progressing to the Drainage and Sewerage, Traffic and Transportation, and Environment Department.

The Public Works Department

The BMA's Public Works Department handles some construction projects, including road networks, bridges, and public buildings, along with restoration and maintenance. Another duty is to inspect, analyze, and supervise the quality of construction materials. It also monitors and advises on building permits in Bangkok for construction, alteration, demolition, relocation, usage, or change of use. The department established its vision to be the leading organization in the development of adequate and effective infrastructure in addition to managing the city to be well-ordered, beautiful, convenient, and safe for people to live in.

Since 2008, the Public Works Department has offered more than 166 projects. Road construction and improvement projects accounted for the majority of the projects. Most of the development projects were concentrated in the city's low-density areas. The eastern side of Bangkok received a large number of development projects, as well as expenditures. Figure 10 illustrates the Public Works Department's development project expenses from the fiscal year 2008 to 2020.

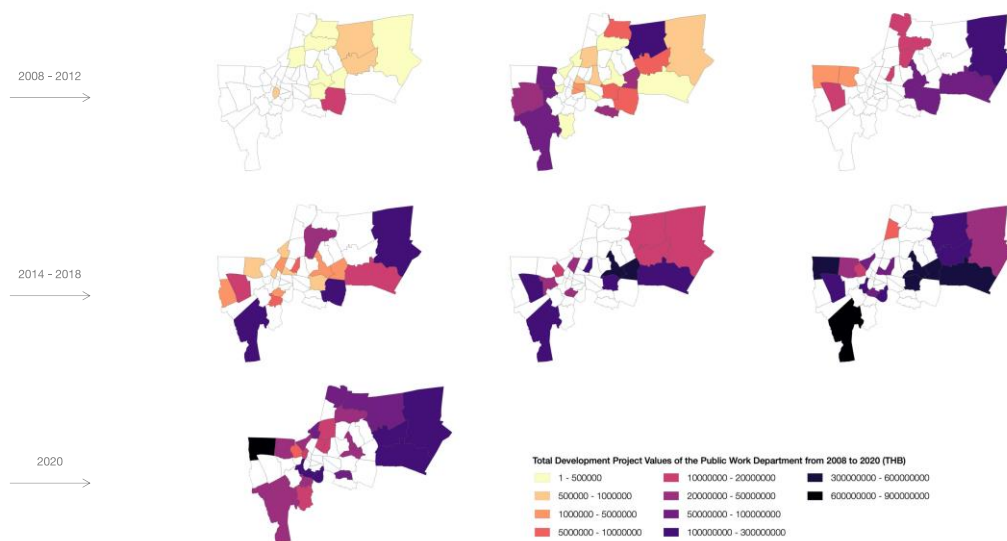


Figure 10: Total development project values of the Public Works Department from the fiscal year 2008 to 2020 (THB)

One of the key projects was the construction of a new road connecting Srinakarin to Rom Khiao Road. This was a long-term commitment project that appeared in budget documents from the fiscal years 2014 to 2018. This road network connects at least three districts: Bang Kapi, Saphan Sung, and Lat Krabang. The project's purpose was to reduce traffic congestion and provide access to minor routes. Aside from road work, there were construction projects for several BMA hospitals and community health clinics from the fiscal year 2014. Certain urban health facility constructions were also seen in the city's suburbs.

The Drainage and Sewerage Department

The majority of disasters that take place in Bangkok are sudden events, like floods brought on by a city's incapacity to drain water during the rainy season. Additionally, some threats gradually increase, such as coastal erosion and land subsidence, however, their effects are widespread. In particular, the 2011 flood chaos forced the BMA to emphasize lowering the dangers from floods and coastal erosion. As a result, preventing flooding in the Bangkok region fall under the purview of the Drainage and

Sewerage Department. The department is also in charge of managing operations to ensure that water quality is within the standard and providing for the maintenance of various drainage systems.

This department provided the greatest amount of urban development projects. There were more than 317 development projects in the previous years, the majority of which involved the construction of reinforced concrete floodgates and dams, as well as large-scale projects including drainage system facilities, pumping stations, and drainage tunnels. The locations of the projects are often found along Bangkok's canal banks, which are mostly placed to the east of the Chao Phraya River. Most of the time, a district with several canals occasionally acquired more than one project each year, resulting in a significant portion of the cost being concentrated in one place. Figure 11 below shows the development project expenses of the Drainage and Sewerage Department from the fiscal year 2008 to 2020.

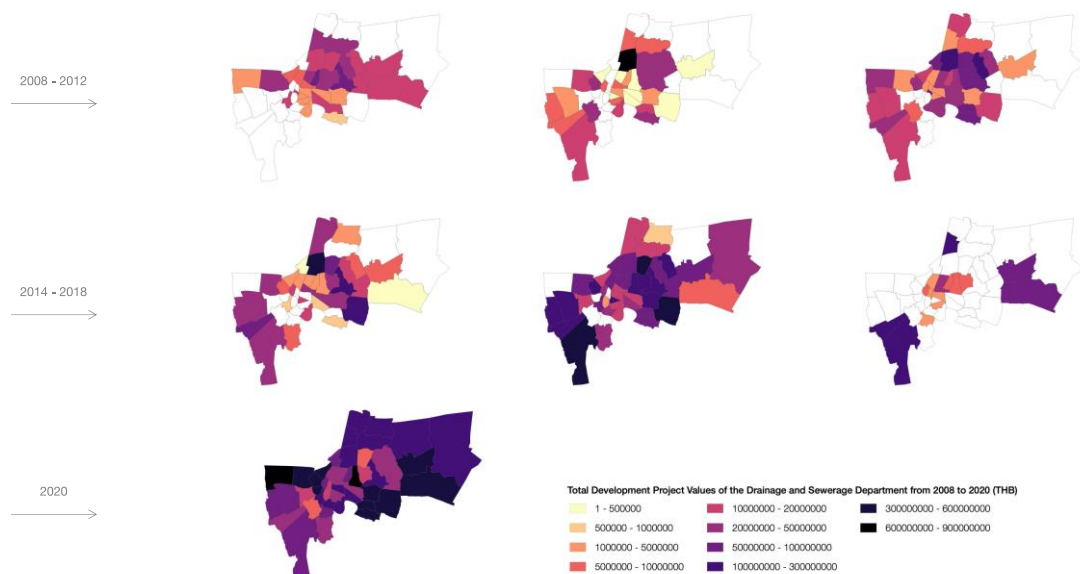


Figure 11: Total development project values of the Drainage and Sewerage Department from the fiscal year 2008 to 2020 (THB)

The Drainage and Sewerage Department's urban development projects took a significant share of the investment expenditure budget each year. This is due to the fact that, in comparison to the other three departments, this department delivered the most projects each year. Each year, the growth in development costs has increased significantly, on average by 113.71 percent. Additionally, in contrast to the Public Works Department, the distribution of the development project provided by the Drainage and Sewerage Department did not cluster only in the low-density area.

The Traffic and Transportation Department

The Traffic and Transportation Department is in charge of conducting research, surveys, and gathering data on traffic and transportation in order to assess, plan, and create Bangkok's transportation and traffic systems. To improve people's quality of life, the department set the goal of creating a range of transportation networks and developing technologies for security systems.

There have been around 58 development projects since 2008, according to budget documents. The majority of the projects involved creating facilities to make it easier for people to access the BTS, undergrounding utility lines, and—most importantly—installing closed-circuit television (CCTV) systems throughout the city. In certain ways, the development project's budget was not as large as that of other departments. Yet, the Traffic and Transportation Department's development projects aimed to cover the area of 50 BMA districts. Figure 12 represents the Traffic and Transportation Department's development expenses since 2008.

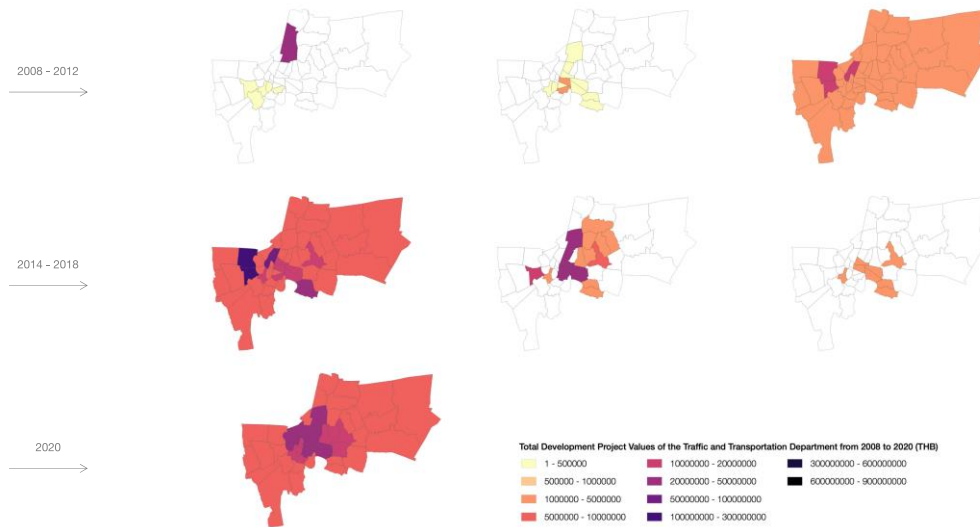


Figure 12: Total development project values of the Traffic and Transportation Department from the fiscal year 2008 to 2020 (THB)

In the budget documents for the fiscal years 2012, 2014, and 2020, there were listings of CCTV upgrading and installation projects. The investment for this development was split across the 50 BMA districts. By installing CCTV, the community's high-risk areas were to be made safer. The building of the Sky Walk and Park & Ride, which were flyovers and parking lots designed to enable access to the BTS, was done to support access to public transit network services. This project was originally mentioned in 2010 and then again in documents from 2014 through 2020. Sky Walk intended to provide better alternatives to Bangkok's notoriously dangerous sidewalks for pedestrian travel. Park & Ride facilities, on the other hand, are parking lots with connections to public transportation, enabling commuters and those who want to travel into cities to park their cars and then transfer to a bus or rail system for the remainder of their trip.

A BMA strategist, Interviewee C, stated that "it is reasonable that the spatial distribution patterns of the Traffic and Transportation appear like this." There have been several investments in the city's transit system, however, those projects have not been funded

by BMA. The Ministry of Transport, in collaboration with several coalitions, is responsible for the majority of transit system projects.

The Environment Department

The Environmental Department's core responsibilities, in addition to ordinary operations, include waste and sewage management, garbage disposal, air and noise pollution control, and park operations. The challenge in addressing the Environmental Department's spatial distribution pattern is that, in the case of waste management and trash disposal, there is not just one district area that benefits from this action. Indeed, all Bangkok district regions benefit from the investment in waste management. As a reason, only this figure displays the significant place of the garbage-eradication factories (see Figure 13).

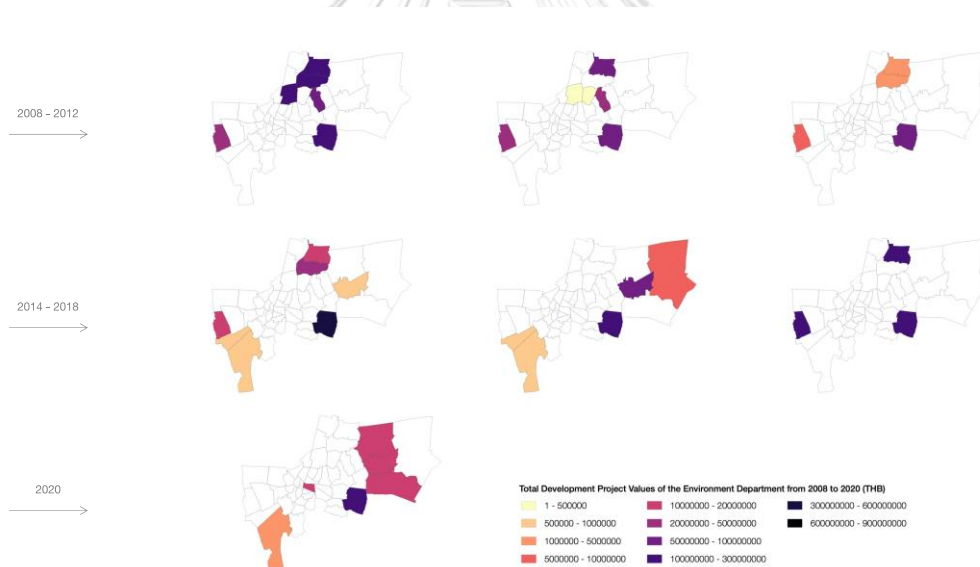


Figure 13: Total development project values of the Environment Department from the fiscal year 2008 to 2020 (THB)

The three main garbage-eradication factories are in Pra Wet, Sai Mai, and Nong Khaem. As there have been certain attempts to advance waste disposal technology, their development expenses have increased over time. But the department has not made a considerable input commitment to the development of the park. Since 2008, very few

parks have been constructed and upgraded in some low-density areas of the city. There was a significant disparity in investment between park development and waste management. Approximately 432 million Baht went into the building of the park, while roughly 2.19 billion Baht went toward the improvement of the waste management system.

Interviewee C also remarked that "if the BMA provides more parks, the pattern will be drastically changed." The Environment Department's budget has been so high in recent years because the BMA has full responsibility for waste management, while "there is no Ministry of Waste Management that can support the BMA with garbage and wastewater disposal." As a result, the BMA has absolute authority for the city's sanitation.

Statistical insights

– the association of urbanization factors and the development projects

Multiple linear regression is in use to conduct the statistical analysis to answer research question number 2: What factors are influencing the spatial distribution of such infrastructure investment projects?

A. *Y1: Do the population shift and the housing increase of 50 BMA districts affect the expansion of the number of BMA's infrastructure development projects?*

Hypothesis A is that:

H0: The population shift and the housing increase in 50 BMA districts do not affect the expansion of the number of BMA's infrastructure development projects.

H1: The population shift and the housing increase in 50 BMA districts positively affect the expansion of the number of BMA's infrastructure development projects.



The general form of equation A to predict the expansion of the number of BMA's infrastructure development projects (Y1) from the population shift (X1), and the housing increase (X2) is:

$$\text{Predicted } Y1 = 199.690 + (1.809 \times X1) + (0.002 \times X2)$$

∴ A multiple regression was run to predict Y1 from X1 and X2. These variables did not statistically significantly predict the expansion of the number of BMA's infrastructure development projects (Y1), $F(2, 47) = 0.422$, $p\text{-value} > 0.05$, $R\text{ Square} = 0.18$. Both variables were not statistically significant to the prediction, with $p\text{-values} > 0.05$.

In this case, it fails to reject the null hypothesis (H0) at the 5 percent significance level. There contains insufficient evidence to conclude that the population shift and housing growth cause an increase in the number of infrastructure development projects undertaken by the BMA.

B. Y2: Do the population shift and the housing increase of 50 BMA districts affect the changes in the values of BMA's infrastructure development projects?

Hypothesis B is that:

H0: The population shift and the housing increase in 50 BMA districts do not affect the changes in the values of BMA's infrastructure development projects.

H2: The population shift and the housing increase in 50 BMA districts positively affect the changes in the values of BMA's infrastructure development projects.



The general form of equation B to predict the changes in the values of BMA's infrastructure development projects (Y2) from the population shift (X1), and the housing increase (X2) is:

$$\text{Predicted } Y2 = 3562.034 + (83.898 \times X1) - (0.011 \times X2)$$

∴ A multiple regression was run to predict Y2 from X1 and X2. These variables did not statistically significantly predict the expansion of the number of BMA's infrastructure development projects (Y2), $F(2, 47) = 0.613$, $p\text{-value} > 0.05$, $R\text{ Square} = 0.025$. Both variables were not statistically significant to the prediction, with $p\text{-values} > 0.05$.

Again, the test result fails to reject the null hypothesis (H0) at the 5 percent significance level. There is not enough evidence to support the claim that the population shift and housing growth raise the value of the BMA's infrastructure development projects. It can be concluded that although the BMA intends to increase the investment in urban development projects, neither population shift nor housing growth is the factor that causes the rise in the number of urban development projects and their values.

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BMA long-term development plans the guideline to follow

– did the proposed urban development projects link to the BMA Development Plan?

As Bangkok city's population changes and housing increase are no longer contributing factors to urban development projects, the BMA development plan is brought into the analysis to assess if it is a contributing factor to the urban development project or not. This section describes the connection between the BMA Development Plan and the urban development projects proposed by the four departments: the Public Work Department, the Drainage and Sewage Department, the Traffic and Transportation

Department, and the Environment Department. It explains how the Development Plan affects the urban development project each year.

Within the selected timeframe of the study, 2008-2020, the BMA had formulated two grand long-term development plans. The first long-term development plan of the BMA was conducted around 2007, namely the BMA 12-year Development Plan (2007-220). Later in 2013, another development plan was introduced, and the term was extended to 20 years (2013-2032). The 20-year Development Plan for Bangkok Metropolis went through complicated processes of plan formulation. The academics, BMA planning officers, BMA technical officials, and district office representatives convened the workshops to assess Bangkok City's 2032 vision. As the BMA claimed, this 20-year Development Plan would serve as a key factor in propelling Bangkok to become Asia's leading capital. The basic idea of both versions of the development plan is to strengthen Bangkok's competitiveness among Asian nations; yet there are some variations in details.

[Putting the BMA's 12-year Development plan in action – How did the urban development projects respond to the first issue of the long-term plan?](#)

The national government's "metropolis" development strategy was in place back in 2007. At that time, the development of Bangkok city was just one aspect of national policies. Various developments in the province's neighboring provinces were expanded such as a government's mega project of constructing the Chaeng Watthana Government Complex. There was a rise in real estate developments. Numerous housing projects were launched in the provinces close to Bangkok and its suburbs. Due to their impact, both locals and those who moved to Bangkok for employment have increased the demand for housing and are looking for affordable accommodation. Since the housing prices of the inner and middle of Bangkok are high, it was causing more houses to be moved to the suburbs or nearby provinces. The shared connection between Bangkok and the surrounding area was thus established by this movement.

The BMA then made an effort to increase its economic ties to the neighborhood and position itself as the center of the metropolis. The BMA hoped that Bangkok could have the potential to be an economic, commerce, and service hub for Southeast Asia on both a national and regional scale. While also being concerned with sustainability, the BMA worked to establish a safe atmosphere for its habitats. This vision was presented through three primary concepts: "Gateway-Green- and Good Life." Being the 'Gateway' meant being the center of connectivity between many locations with varying settings. Connectivity included not just physical aspects such as road networks and telecommunication systems, but also the exchange of know-how, technology, information, and people resources. Being 'Green' meant improving the city's natural environment while also coupled with production and trade, services with high competitiveness. Lastly, because human resources were a key component of urban development, having a 'Good Life' meant promoting people's good quality of life. The BMA realized how important it was for the city and its citizens to be clean, convenient, beautiful, and safe.

Based on the three key concepts mentioned, this development plan suggested the guidelines for the BMA's infrastructure provision. First, Bangkok would be developed as a regional transportation and communication hub. The BMA intended to establish a transportation system and public utilities that supported convenience, economizing, and economical and strong connectivity. Second, the plan stipulated that Bangkok be designated as a "Green City." The BMA sought to conserve and restore the city's natural environment in two ways: to tackle existing problems by improving and restoring the deteriorating natural environment to good condition and to prevent future problems. Finally, the plan recommended that in order to improve the city's citizens' quality of life, the city should be developed into a "beautiful, lively, and convenient city" by creating the necessary infrastructure to support a vibrant neighborhood. This would enable diverse economic activities to run properly and efficiently. Bangkok should therefore be a lively

urban community that sought to be appropriate to the nature of each activity 24 hours a day.

Scoping into the investment projects in urban development in the specific location from 2010 to 2012, certain development projects were begun to spread around the city. Road network construction and renovation projects were carried out in eastern Bangkok, as well as in parts of southern and western Bangkok. During this time, road construction projects attempted to connect several areas through shared networks. The construction projects also sought to enhance connectivity with Bangkok's bordering provinces. Along with several projects to protect the flood protection system, two drainage tunnels were built. Northern, central, and southern Bangkok received the majority of the drainage system and flood protection utilities, with certain locations in the south-western area. In 2012, 50 administration districts had CCTV installation projects underway. At the time, the BMA made significant investments in city sanitation projects. Projects were planned to enhance the performance of the three main garbage-eradication facilities owned by the BMA. However, only a small number of parks were being built during the day. The Environment Department only offered around five projects for building parks.

Of certain road network construction provided by the Public Works Department, which facilitated neighborhood connectivity, the development projects also tended to adhere to the 'Gateway' idea. Additionally, as there were significant development projects in the strengthening of the drainage system and flood protection, urban development projects tended to offer 'Green' conditions. The Drainage and Sewerage Department set the expenditure budgets for development projects in the amount of 2 billion Thai Baht in the fiscal years 2010 and 2012. In this view, being 'Green' was intended to mean merely preventing flooding rather than being environmentally conscious by creating more eco-friendly community spaces for aesthetic and recreational purposes. The idea of having a "Good Life" was quite subjective to measure. All the proposed urban development projects possibly improved the living conditions of city residents, as the provision of

infrastructure has resulted in an increase in living standards. For instance, investment in city sanitation projects, in particular, helped keep the city clean while also bringing some visual quality to the city.

[BMA's 20-year Development Plan – Was the long-term plan still being fulfilled by the BMA urban development projects?](#)

In January 2013 the BMA announced the application of a 20-year Development Plan for Bangkok Metropolis. More detail on the suggested strategies for the BMA to achieve its vision of Bangkok in 2032 was added to this development plan. The BMA set the vision that "Bangkok is hoped to become the Capital of Asia as Bangkok: Vibrant of Asia in the next 20 years". The development plan was divided into four five-year phases based on the priority of the actions to implement the strategy. Bangkok would have been a safe city throughout the initial five-year phase. Also, Bangkok would develop into a convenient, cost-effective, and environmental-friendly city ten years after it first began. The BMA defined seven sub-dimensions of the vision, which were relevant to the strategic concerns and the objectives that had to be met. The seven sub-dimensions comprised:

- 1) Bangkok as a safe city; by 2032, the BMA hopes to be free of pollution by providing decent sanitation, clean air, and appropriate rubbish management. Second, there will be no crime or drugs in the city. The third requirement is to be accident-free. The fourth goal is to be free of disaster. Fifth, all BMA public buildings will have met safety criteria by 2032. Eventually, Bangkok inhabitants' food will be safe, and the city will be free of urban illnesses.
- 2) Bangkok as a green and convenient city; the BMA aims to have a pleasant streetscape that provides more convenience and a higher standard of living by relocating overhanging electricity and telephone cables to underground conduits. In addition, the BMA intends to provide more green spaces. Green spaces must be spread all around the city. By 2032, it is expected that all

public transit systems will be fully functional, reasonably priced, and offer a variety of commute options.

- 3) Bangkok as a city for all; primarily, social welfare, utilities, and basic facilities shall be made available to the elderly, the disabled, and the disadvantaged so that they can live decently. In addition to having greater work opportunities, individuals who are struggling economically and informal workers will also be guaranteed the minimum wage and given access to low-interest loans to help them support their life. Thirdly, the BMA intends to guarantee that all schools under its control in all districts would be able to offer a comprehensive basic education with curricula tailored to the needs of Bangkok. Lastly, Bangkok is seen as Asia's premier metropolis where all households learn to value the distinctiveness of their family's way of life and transmit it to future generations while respecting cultural variety.
- 4) Bangkok as a compact city; it is planned for orderly urban growth and effective use of resources. Moreover, the BMA expects that residents will be able to commute from their homes to workplaces within a five-kilometer radius in 30 minutes. At least 20 sub-centers or minor towns, each with all the necessary economic, social, and educational support elements and capacity for 15 million people, will be located within Bangkok and its surrounding areas.
- 5) Bangkok as a democratic city; the BMA attempts to form a special administrative unit to take responsibility for the city's utility operations. The BMA also plans to set up district councils, a council of Bangkok citizens, and a participatory budgeting system. Additionally, the BMA wants to become more decentralized. Moreover, the BMA expects that the citizens would be willing to join and develop a platform to monitor the progress of the Bangkok

2032 vision and have trust in the honesty of BMA officers and those working in political positions.

- 6) Bangkok as an economic and learning center; the city is projected to be one of Asia's top five commercial, economic, investment, cultural, and convention centers by 2032. The city will progressively transition from an industrial city based on low-wage labor to a city focused on the service sector to add value to the city's economy and become an investment hub. The city is also intended to serve as a tourist destination, attracting visitors from around the world. The GDP of Bangkok is expected to be at least 10% generated by the tourism sector.
- 7) Management Strategies; the BMA seeks to amend the laws to respond to the altering settings, as well as planning and assessment, human resource management, finance and budget, and information technology for the administrative tasks.

Since the BMA hoped to achieve its targets in the first and second phases of the implementation of the strategy, the number of urban development projects and their values have also increased from 2014 to 2020. As above mentioned, Bangkok was supposed to be a safe city by 2017 and convenient, cost-effective, and environmental-friendly by the end of the next five-year phase. According to the available action plans of the BMA four Department, which were the subject of the research's investigation, the 20-year Development Plan was adopted by each of these departments to be implemented. Investments in urban development projects were determined to answer to the sub-dimensions of vision statements¹ to 3, which are to be a safe city, a green and convenient city, and a city for all.

During the fiscal years 2014 to 2016, the Drainage and Sewerage Department delivered about 200 development projects in specific areas worth around 5.8 billion Thai Baht. Most of the projects involved adding equipment for flood protection and improving drainage capacity. There were still a lot of ongoing projects in the city's northern, central, and southern zones, as well as a few efforts to increase drainage capacity in the western (Thonburi) districts. Construction and renovation projects involving the road network were underway in the eastern zone. Many of them are continuation projects from 2014 to 2016. In addition to building roads and bridges back then, the Public Works Department also worked on projects to build hospitals and health services centers. The installation of the CCTV in all 50 administrative districts was continued in 2014 as it had been in 2012. Construction of the Sky Walk and Park & Ride, the flyovers and parking lots which were intended to facilitate access to BTS services, was also conducted by the Traffic and Transportation Department. At that time, the Environmental Department constructed six parks in the suburbs. Compared to 2010 to 2012, fewer development projects are being undertaken to improve the garbage management system.

The patterns of investments in urban development beginning later in 2018 through 2020, the second phase of the 20-year Development Plan, were remarkably consistent with earlier years. As was previously mentioned, there was a slight decline in the number of development projects in 2018. The values of the expenditure budget did not, however, change significantly at that time. The continuation of road construction projects from 2014 in the eastern districts received a considerable amount of financing in 2018. The construction of the geriatric hospital in Bang Khunthain was another specific initiative to promote urban health. A number of new development projects were begun by the Public Works Department in 2020 in parts of central and western Bangkok. Several drainage tunnels were built practically across the city, as well as a flood prevention system. Once more, in 2020, the BMA provided the citywide installation of CCTV. In 2018, there was no investment made to construct parks. Only four park development and improvement projects were undertaken in 2020.

The BMA scored well in terms of urban infrastructure provision, reaching the safe city target of its first phase of development. However, the BMA likely focused on developing the city to be safe rather than convenient, cost-effective, and environmental-friendly as it entered the second phase of development. Indeed, there were a limited number of projects that supported Bangkok's environmental-friendly position. Many of the investment projects that were set were extensions of those from the preceding year. The BMA's urban development in some way remained in the same district. There have barely been any development projects that promote green spaces in the central part of the city, which is the hub of economic activity.

Interviewee E, the urban planner, stated that the reason why there were so few infrastructure development projects was that "the land cost in the inner part of Bangkok is too high, and it is difficult for the BMA to reclaim the land back." Additionally, he said, "In fact, there are still a lot of vacant sites in the city center that need to be developed." He also mentioned that the BMA has a limited budget to spend on infrastructure projects and that in recent years, the most of infrastructure development projects had been carried out in the suburbs since they required less financing.

District-level Development – Distribution pattern of the BMA 50 district offices

Each district has a district office that is a part of the BMA administrative body. Typically, the district offices have the authority to provide basic public services and facilities, such as administration tasks, registration, provision of small-scale public utilities, management of waterways and drainage channels, supervision of educational institutions, and public healthcare. According to the budget documents, the budget distributed to 50-district offices, district-level budgets rose gradually with a 5.29 percent average raise throughout the fiscal year 2008 to 2020, and yet there were minor blips of increase during that time frame (see Table 6).

Table 6: Change in total budget distributed to BMA district offices (the fiscal year 2008-2020)

Change in total budget distributed to BMA district offices (fiscal year 2008-2020)

Fiscal Year	Total Budget Distributed to the BMA 50 District Offices (THB)	Change (%)
2008	14,099,875,900	
2010	15,110,129,000	7.16
2012	16,742,390,000	10.80
2014	18,634,310,400	11.30
2016	18,180,124,500	-2.44
2018	18,016,104,840	-0.90
2020	19,063,619,342	5.81
	Average Increase	5.29

The allocation of the expenditure budget of the district offices was arranged according to their routine tasks. According to GIS-based statistics, a significant portion of the budget is allocated to low-density areas, most of which are in eastern Bangkok and a

few areas in the west. The annual budget distributed to 50 district offices from 2008 through 2020 is shown in Figure 14 as an allocation.

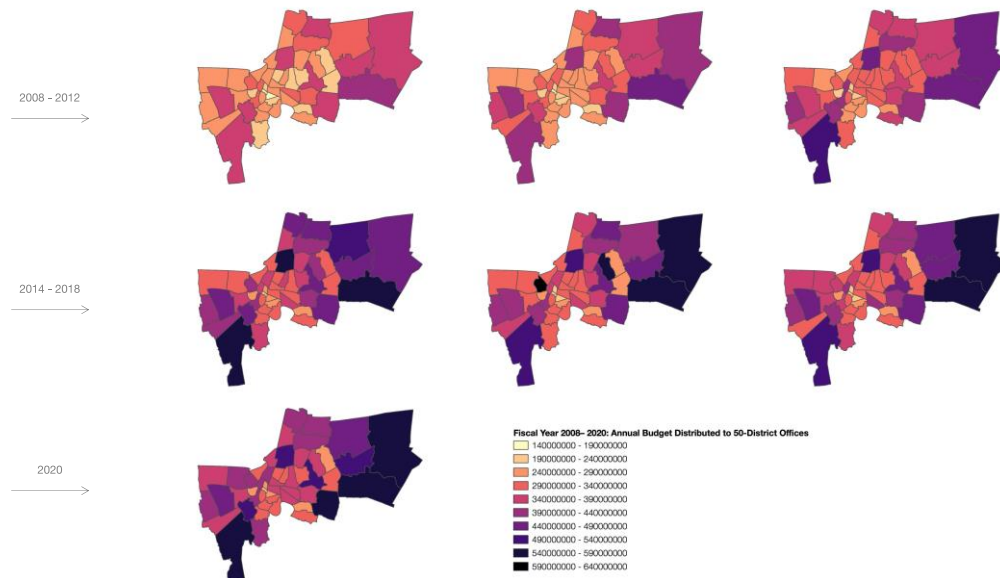


Figure 14: The fiscal year 2008-2020: annual budget distributed to 50 district offices (THB)

The size of each administration district could be one of the significant factors influencing the expenditure allocation, as districts in western and eastern Bangkok are larger than districts in central and southern Bangkok. According to Interviewee B, the former administrative chief of the BMA district office, the size of the 50 BMA administrative districts fluctuates since Bangkok's administrative districts have been divided for long ago when Bangkok did not have a significant population. It is evident that the inner district of Bangkok, which contains historical sites such as Phra Nakhon, Samphanthawong, and Pom Prap Sattru Phai, has a limited area of responsibility. In contrast to the suburbs, agricultural purposes are the origin of land uses.

Each year, a few projects were also carried out at the district level. These district-level projects were making a contribution to the construction and improvement of bridges,

schools, some district offices, and flood protection systems on a limited scale within the district's boundaries. This statement was confirmed by Interviewee B. He mentioned that the district office budgeting criterion is area-based because what the district offices undertake is limited to their district boundaries. Compared to the projects offered by the BMA key departments, each of these projects was smaller in scope and demanded a lower amount of budget. He also stated that the authorities of the BMA department and the district offices were established differently by legislation, resulting in spatial distribution patterns of infrastructure investment expenditures that differ between the department-level and district-level offices. Figure 15 shows the total number of projects completed by district offices since 2008.

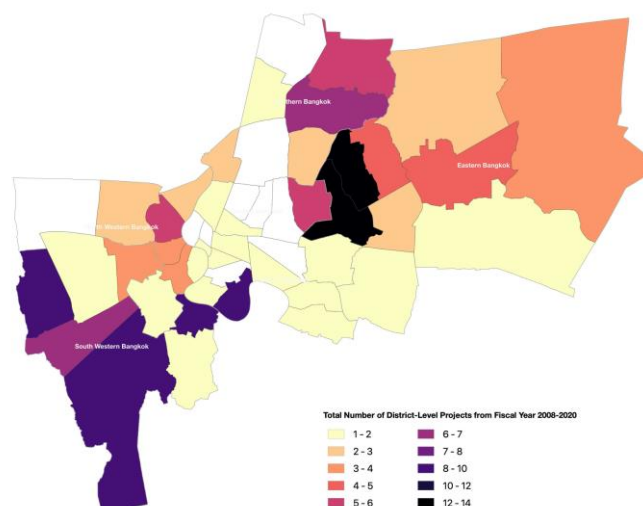


Figure 15: Total number of district-level projects from the fiscal year 2008 to 2020

Interviewee A, a BMA Bureau of Budget official, shared the same viewpoint as Interviewee B. She explained that the allocation criterion was based on the BMA's administrative structure. As a result, the patterns of infrastructure investment expenditures' spatial distribution vary between district-level offices and departments.

Interviewee D, a member of the Bangkok Metropolitan Council, confirmed that the district office can only carry out small-scale development projects like repaving a few

side streets. He stated, "The district office cannot address this issue when it comes to the larger-scale projects like the restoration of the drainage ditches or the main roadways that pass across the city." According to him, the district office is required to present the district development plan to the BMA Bureau of Budget each year. The formation of the district plan includes the participation of the community leader, a community committee, BMC member, and district office officials.

Statistical insights

– addressing the factors statistically contributing to the district offices expenditure budget allocation

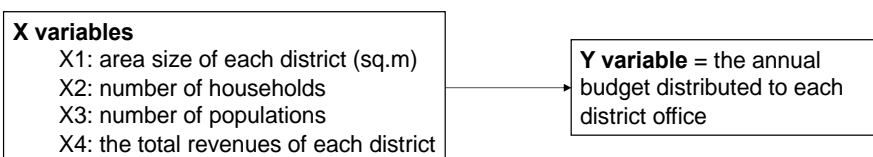
Two out of four interviewees disagree that the number of the registered population and area size are variables influencing the allocation of district office budgets. As a result, multiple linear regression is used to conduct a statistical test to confirm the answer of which factors influence the allocation of district office expenditures.

C. What factors are influencing the expenditure budget allocation of the district offices?

Hypothesis C is that:

H0: There is no association between the annual budget distributed to each district office and area size of each district, number of households, number of populations, and the total revenues of each district

H3: There is an association between the annual budget distributed to each district office and area size of each district, number of households, number of populations, and the total collected revenues of each district



The statistical analysis was repeated from the fiscal year 2008 to 2020 numerical data. For example, to analyze the fiscal year 2016 data, the general form of equation C to predict the annual budget distributed to each district office (Y3) from the area size of each district (X1), number of households (X2), number of populations (X3), and the total revenues of each district (X4) is:

$$\text{Predicted } Y3 \text{ (f.y.2016)} = 166167386 + (662634.093 \times X1) + (705.104 \times X2) + (1102.272 \times X3) + (0.043 \times X4)$$

∴ A multiple regression was run to predict Y3 from X1, X2, X3, and X4. These variables statistically significantly correlate annual budget distributed to each district office (Y3), $F(4, 45) = 18.009$, $p\text{-value} < 0.05$, $R \text{ Square} = 0.616$. Only X1 and X3 variables were statistically significant to the prediction, with $p\text{-values} < 0.05$.

The test result rejects the null hypothesis (H0) at the 5 percent significance level. In other words, changes in population and area sizes, the independent variables, are related to changes in budget distribution at the district level.

This statistical analysis suggests that, despite certain disparities in revenue collection in some districts, the revenue factor has no impact on the allocation of district offices. Interviewee A clarified that the allocation process is not much influenced by the revenues collected by the district offices. The district offices' only responsibility is to collect that revenue. The revenue gathered cannot be spent directly. They must be pooled at the BMA Finance Department. The Finance Department used that obtained revenues to create an estimate for the following year's budget blueprint. However, she added that "if an emergency problem emerges within the district, the district office may request authorization to use their collected revenues to solve the situation promptly."

To summarize, this analysis leads to five major findings;

- I. Infrastructure investment does, in fact, support urban expansion. Most of the expenditures spent each year goes toward the city development projects.
- II. There are wide variations in the spatial patterns of city development and infrastructure investment. Each department of the BMA has a distinct pattern. Additionally, the BMA department's spatial patterns for such investment are different from those of the district offices. The spatial patterns of the infrastructure development projects reflect the authorities of the BMA departments and the district offices which are differently established by the legislation.
- III. There is insufficient data to support the claim that population shift and housing growth are linked to changes in the quantity and value of BMA infrastructure development projects. Even if the BMA plans to expand investment in urban development projects, neither housing growth nor population expansion is the factor causing an increase in the number of urban development projects nor their values.
- IV. The size of the area in each district and the population are significant elements determining the distribution of the budget when it comes to the development or delivery of public services at the district level.
- V. The long-term development plans that were established play a significant role in setting the direction of investment each year in the overall allocation of investment in urban development and infrastructure investment projects. The development plan is typically incorporated into the policy processes by the BMA departments. Thus, the development plan serves as the primary directive for determining annual expenditures.

Chapter 5: Discussion and Conclusion

This study's research results have been presented in detail in earlier chapters. The final chapter of this study focuses on analyses of the research findings and research objectives, as well as discussion for future studies.

Understanding the findings in relation to the research objectives

The overall findings of this study are examined and described below under each of the research objectives, along with a discussion of how they relate to each one.

Objective 1: To analyze the spatial patterns of the infrastructure development projects provided by the BMA.

- a) *To indicate the expenditure budget of infrastructure development projects that emerge in each of the BMA's 50 administrative districts.*

The spatial distribution of city development and infrastructure investment varies greatly between the fiscal years 2008 and 2020. Most of the investments are supporting urban expansion. The Public Works Department, Drainage and Sewerage Department, Traffic and Transportation Department, and Environment Department all contributed to the development of more than 580 urban infrastructure projects spread throughout 50 administrative districts.

- The low-density areas of the city, particularly the eastern part, were where the Public Works Department concentrated the urban development projects.
- Development projects of the Drainage and Sewerage Department were frequently gathered along Bangkok's canal banks, which are largely located east of the Chao Phraya River.
- The Traffic and Transportation Department's investments in city development were divided across the 50 BMA districts based on the department's responsibility of assuring the city's safety.

- The three main garbage-eradication factories were the key locations of the Environment Department's development projects.

For the district-level development, the district offices' distribution of the expenditure budget was set up in keeping with their routine works of providing basic public services and small-scale public utilities. A sizeable amount of the budget, according to the study, was allocated to low-density areas, the majority of which are located in eastern Bangkok and a few others in the west. Additionally, a few projects were undertaken at the district level. These district-level projects were helping to construct and upgrade some facilities on a small scale inside the district's boundaries. Each of these projects had a smaller range and required less financing than the projects provided by the BMA major departments. In fact, the spatial patterns of the infrastructure development projects reflect the authority of the BMA departments and the district offices, which are formed differently by the legislation.

Objective 2: To examine the reasons and factors influencing the spatial allocation patterns.

A key factor influencing the allocation patterns is the development plan. The annual allocation of funds for projects involving infrastructure and urban development is significantly influenced by a long-term development plan. The plan is used as a guideline for city development. In most cases, the BMA departments include the development plan in the policy-making processes. In most cases, the BMA departments include the development plan in the policy-making processes. As a result, the development plan acts as the main framework for determining annual spending.

The geographical size and population of each district are also determining the distribution of the budget of the district offices. The statistical assessment shows that there is evidence to support the claim that changes in the independent variables of

population and area sizes are associated with changes in the distribution of budgets at the district level.

Discussion

As complicated as the study procedure appears to be, it does raise some issues. Various considerations must be made. The following statement may be of interest for future research.

- I. The actual figure of BMA residents is difficult to determine. There are a huge number of unregistered residents. In some aspects, the changes in the number and values of BMA's infrastructure development projects are possibly related to the shift in the entire population, including both the registered and unregistered.

The city is making a concerted effort to thrive, and investment in infrastructure and public utilities is one option for attracting a large number of people to reside there. In any event, the BMA is still planning the city as a whole to address issues that affect the majority of the citizens, such as terrible traffic conditions and flooding. Indeed, solutions to these issues benefit all inhabitants, not just those who have registered.

- II. The BMA did well to meet some of the plan's objectives based on the proposed development plan. Even yet, there are several components that BMA hardly accomplishes. Although the provision of green areas is indicated in the development plan, the study shows that the BMA hardly worked on environmental protection. There were only a few projects that backed Bangkok's environmentally friendly stance. There were a limited number of projects that supported Bangkok's environmental-friendly position. Development projects that encourage environmental protection are few and far between, particularly in the city's central business district.

- III. The BMA's suggested development strategy is rather broad. The vision of becoming Asia's leading capital is such a big one. The plan's sub-dimensions include practically every element, so whatever development project emerges will be aligned with the plan. However, as a result, there is no clear direction for urban expansion and city development. The expansion branched out in various directions. There appear to be no explicit shared development goals.
- IV. Previous investments in Bangkok's infrastructure lacked the dimension of advanced technology and digitalization. As of now, digitalization is a global megatrend and an economic development factor. The digital economy is the world's most vital engine of innovation, competitiveness, and economic growth (Kravchenko et al., 2019). To become Asia's leading capital, technological innovation is required. However, in recent years, the BMA has frequently given "housekeeping" projects rather than technology development. It indicates that the BMA lacks a strategic approach to city development to respond to the fast-changing environment.
- Also, because the BMA's budgeting method is so complicated. Before going through the adoption procedure, the annual expenditure budget must be prepared in advance. As a result, the expenditure each year is not as adaptable to shifting conditions. According to interviewee B, "since the budget list was defined in advance, there are some complications to respond to changing technology, although there is some flexibility for readjustment but not very much."
- V. In actuality, Bangkok is a diverse metropolis. The city's residents come from various backgrounds and have varying social statuses. Urban poverty is one challenge. According to the previous study, most low-income persons or slum dwellers have adequate access to public infrastructure and are satisfied with the

city's services. However, due to a lack of access to public services like water and electricity, as well as a poor level of safety and security in life, their living form has changed (Denpaiboon et al., 2019). This demonstrates that, while the BMA strives to provide such infrastructure on a requirement, there are still some gaps that must be addressed.

The BMA has got a huge backlog of city development to do. These listed issues are such challenges that offer greater room to investigate and remedy these shortcomings. It would be preferable if the BMA started to adjust to its shifting environment. The BMA should be more strategic. Perhaps certain strict requirements need to be relaxed for the implementation's flexibility.

The BMA is not, however, the only provider of public infrastructure and utility services. The city benefits greatly from outside infrastructure facilitators such as the national government and the private sector. The contribution of the entire city development is beyond the hand of the BMA. It is feasible that the BMA may adapt in the near future and act as a facilitator and negotiator so as to avoid taking on financial risk on its own. There is a potential that the BMA will collaborate with significant organizations to improve city planning and invest in city infrastructure. Collaboration could assist not only in resolving city issues but also in delivering better solutions to all urban challenges.

Conclusion

The BMA's infrastructure investments are for urban expansion. The foundation of the factor determining annual expenditures is the BMA's long-term development plan. The increase in the number of urban development projects and their values is not a result of population change or housing growth. The geographical size and number of registered populations of each district also impact the district-level distribution criteria.

Given that this study may be the first to investigate the underlying causes and contributing factors of the spatial distribution patterns of budgetary allocation for infrastructure investment in the Bangkok area, it may possibly be beneficial to BMA policymakers or the related industry. For urban politics and urban studies, it also provides a clearer understanding of the BMA city development in major infrastructure projects. Additionally, it can result in modifications to city plans and strategies like the comprehensive plan, zoning maps, and BMA regulations.

This study could be seen as an exploratory and investigative endeavor. The findings of this study may be utilized to inform future inquiries into the BMA's geographic expenditure patterns. Bangkok City is a fascinating metropolis that needs to be explored. The city must maximize its potential. Bangkok still has a long way to go before it can assume leadership of the Asian region.



Appendix A: Example of development project sorting table

The fiscal Year 2020 – The Public Works Department budgetary data						
no.	Project list in Thai	Project list in English	Budget Expenditure	Location Specific	Development / Improvement	Operation / Maintenance
1	งานบริหารทั่วไปด้านการโยธา และระบบจราจร	General administration in public works and traffic system	101,301,080			x
2	งานแผนงานและประสานสาธารณูปโภค	Public utility planning and coordination	32,748,900			x
3	งานสำรวจออกแบบ และก่อสร้าง	Survey, design, and construction	218,440,300		x	
4	โครงการก่อสร้างปรับปรุง ซอย พระรามที่ 2 ซอย 82	Soi Rama 2 Soi 82 construction project	52,000,000	x	x	
5	โครงการก่อสร้าง ศูนย์เวชศาสตร์ การกีฬาและเวชศาสตร์ฟื้นฟู หอพักแพทย์ หอพักพยาบาลและ อาคารจอดรถยนต์ โรงพยาบาล เจริญกรุงประชารักษ์	The construction project of a sports and rehabilitation complex, doctors and nurse dormitory, and parking lots of Charoen Krung Pracharak Hospital	254,164,370	x	x	
6	โครงการก่อสร้างอาคารศูนย์ สุขภาพ โรงพยาบาลเวชการุณย์รัศมี	The construction project of the health center at Wetchakarunrasm Hospital	45,522,000	x	x	
7	โครงการจ้างที่ปรึกษา ควบคุม การก่อสร้าง โครงการต่อขยาย สะพานอรุณอมรินทร์ พร้อมทาง ขึ้น - ลงและทางยกระดับ ข้าม แยกศิริราช	Hiring the supervisory consultant to oversee the construction of Arun Amarin Bridge extension	8,571,350	x	x	
8	โครงการปรับปรุงถนน ประชาธรรม ใจ – ถนนมิตรไมตรี	Pracha Ruam Jai - Mitmaitri Road improvement project	158,500,000	x	x	
9	โครงการก่อสร้างปรับปรุงถนนคุ้มเกล้า	Khum Klao Road improvement project	429,313,500	x	x	
10	งานควบคุมอาคาร	Building control	38,605,300			x
11	งานควบคุมการก่อสร้าง	Construction control	52,987,000		x	
12	โครงการก่อสร้างศูนย์บริการ สาธารณสุข 34 โพธิ์ศรี	34 Phosri Public Health Service Center construction project	25,181,200	x	x	
13	โครงการก่อสร้างสะพานข้ามแยก ณ ระนอง	Na Ranong bridge construction project	255,000,000	x	x	
14	โครงการก่อสร้างทางลอด รัชดา - ราชพฤกษ์	Ratchada-Ratchaphruek underpass construction	170,097,100	x	x	

15	โครงการก่อสร้างปรับปรุงถนน สามวา	Sam Wa Road improvement project	27,550,000	x	x	
16	โครงการต่อเชื่อมถนนกาญจนา ภิเษก -ถนนพุทธมณฑลสาย 2	Kanchanaphisek- Phutthamonthon Sai 2 Road connection project	385,000,000	x	x	
17	โครงการก่อสร้างปรับปรุงถนน ศาลาธรรมสพน์ จาก ถนนพุทธ มณฑลสาย 2 ถึงถนนทวีวัฒนา	Sala Thammasop Road construction - from Phutthamonthon Sai 2 to Thawi Watthana Road	92,403,800	x	x	
18	โครงการก่อสร้าง อาคาร ศูนย์บริการสาธารณสุข 3 บางซื่อ	Public Health Center 3 Bang Sue construction project	60,379,700	x	x	
19	โครงการก่อสร้าง อาคาร ศูนย์บริการสาธารณสุข 58 ล้อม - พิมพ์น พักอุดม	Public Health Service Center 58 Lom-Pimsen Fakudom construction project	15,900,000	x	x	
20	โครงการก่อสร้างปรับปรุงถนน และก่อสร้างทางยกระดับ ข้าม แยกถาวรรัชวิทย์และถนน ซอยราม คาแหง 24	Elevated road construction crossing Thavon Thawatch and Soi Ramkhamhaeng 24	30,000,000	x	x	
21	โครงการก่อสร้างปรับปรุง ถนน แสมดำ ช่วงจากถนนพระรามที่ 2 ถึงคลองสนามชัย	Samae Dam Road construction - from Rama 2 Road to Khlong Sanamchai	20,000,000	x	x	
22	โครงการก่อสร้างถนนเลียบบคลอง บางเขน เชื่อมถนนวิภาวดีรังสิต กับถนนพหลโยธิน	Road construction project along Khlong Bang Khen connecting Vibhavadi Rangsit Road and Phaholyothin Road	31,000,000	x	x	
23	โครงการก่อสร้างปรับปรุง ถนน เทิดราชัน Sta.2+935 ถึงถนน เชิดวุฒากาศ	Terd Rachan Road Sta.2+935 to Cherdwuthakat Road construction project	15,000,000	x	x	
24	โครงการปรับปรุงอาคารธานี นพรัตน์ ศาลาว่าการ กรุงเทพมหานคร 2 ดินแดง	Thani Nopparat Building of the BMA City Hall 2 Din Daeng adjustment project	50,000,000	x		x
25	โครงการทางหลวงท้องถิ่น สาย เชื่อมระหว่างถนนวิภาวดีรังสิต กับถนนพหลโยธิน ช่วงที่ 1 จาก ถนนวิภาวดีรังสิต ถึงสะพานข้าม คลองลาดพร้าว	Local highway project connecting Vibhavadi Rangsit Road with Phaholyothin Road, Section 1 from Vibhavadi Rangsit Road to the bridge over the Khlong Lat Phrao	60,000,000	x	x	
26	โครงการทางหลวงท้องถิ่น สาย เชื่อมระหว่างถนนวิภาวดีรังสิต กับถนนพหลโยธิน ช่วงที่ 2 จาก สะพานข้ามคลองลาดพร้าว ถึง ถนนเทพารักษ์	Local highway project connecting Vibhavadi Rangsit Road with Phaholyothin Road, Section 2 from the bridge over the	60,000,000	x	x	

		Lat Phrao Canal to Theparak Road				
27	โครงการปรับปรุงและพัฒนา ศูนย์บริการผู้สูงอายุคืนแดง	Din Daeng Elderly Center improvement project	18,224,000	x	x	
28	โครงการก่อสร้างปรับปรุง ถนน มไตรีจิด ช่วงจาก ซอยมไตรีจิด 38 ถึง ถนนคลองแก้ว	Construction and improvement project on Maitri Chit Road, from Soi Maitri Chit 38 to Khlong Kao Road	40,000,000	x	x	
29	โครงการต่อเชื่อม ถนนพุทธ มณฑลสาย 2 - ถนนพุทธมณฑล สาย 3	Phutthamonthon Sai 2 - Phutthamonthon Sai 3 connection project	155,000,000	x	x	
30	โครงการก่อสร้างอุโมงค์ทางเดิน ลอดถนนหน้าพระลาน	Na Phra Lan Road tunnel construction project	8,000,000	x	x	
31	โครงการก่อสร้างอุโมงค์ทางเดิน ลอดถนนมหาธาตุ	Maha Raj Road tunnel construction project	8,000,000	x	x	
32	งานวิเคราะห์และวิจัย	Analysis and research works	36,112,730			x
33	งานสำรวจและแผนที่ที่ดิน	Survey and land map	32,163,800			x
34	งานจัดกรรมสิทธิ์	Proprietary right	2,587,967,610			x
35	งานก่อสร้างและบูรณะ	Construction and maintenance	1,317,433,000		x	x
36	โครงการปรับปรุงสะพานพระราม 8	Rama 8 Bridge improvement project	33,213,000	x	x	
37	โครงการปรับปรุงทางเท้า ถนน ประชาอุทิศ ช่วงจากถนนสุข สวัสดิ์ถึงสุดเขตกรุงเทพมหานคร พื้นที่เขตราชบุรีบูรณะและเขตทุ่งครุ	Pracha Uthit Road sidewalk improvement project from Suksawat Road to the end of Rat Burana and Thung Khru	34,500,000	x	x	
38	โครงการปรับปรุงถนนบางเข็อกหน้ ช่วงจากถนนพุทธมณฑล สาย 1 ถึงถนนตัดใหม่ พื้นที่เขต ดลิ่งชัน	Bang Chuek Nang Road improvement project from Phutthamonthon Sai Road 1 to the new road Taling Chan area	36,762,100	x	x	
39	โครงการปรับปรุงภูมิทัศน์ ถนน พหลโยธิน ช่วงจาก ห้าแยก ลาดพร้าวถึงอนุสาวรีย์ชัยสมรภูมิ พื้นที่เขตจตุจักร และเขตพญาไท	Landscaping project on Phaholyothin Road, from Lat Phrao Intersection to Victory Monument Chatuchak and Phaya Thai area	38,242,200	x	x	
40	โครงการปรับปรุงสะพานข้าม คลองพระโขนง	The bridge over the Phra Khanong canal improvement project	34,698,000	x	x	
41	โครงการปรับปรุง ถนนหลวงแพ่ง ช่วงจาก คลองพระยาเพชรถึง	Luang Phaeng Road improvement project from	26,439,000	x	x	

	คลองกาหลง (สุดเขต กรุงเทพมหานคร) พื้นที่เขต ลาดกระบัง	Khlong Phraya Phet to Khlong Kalong Lat Krabang area				
42	โครงการปรับปรุง ถนนทวีวัฒนา - กาญจนภิเษก ช่วงจากถนนพุทธมณฑลสาย 3 ถึงซอยทวีวัฒนา - กาญจนภิเษก 30 พื้นที่เขตทวีวัฒนา	Thawi Watthana – Kanchanaphisek Road improvement project from Phutthamonthon Sai 3 Road to Soi Thawi Watthana - Kanchanaphisek 30, Thawi Watthana	24,610,000	x	x	
42	โครงการปรับปรุงและเสริมกำลัง สะพานข้ามคลอง ในพื้นที่ ความรับผิดชอบของศูนย์ก่อสร้างและบูรณะถนน 3 ส่วนก่อสร้างและบูรณะ1	Improvement and reinforcement project of the cross-canal bridge in the area under the responsibility of the Road Construction and Renovation Center 3	43,230,000		x	
42	โครงการจัดหาเครื่องผลิตแอสฟัลต์ชนิดเคลื่อนย้ายได้ (Mobile Asphalt Plant)	Machine procurement project Mobile Asphalt Plant	1,000,000			x
42	โครงการจัดหาเครื่องฉีดล้าง ทาความสะอาดแรงดันสูง ติดตั้งบนเทรลเลอร์ชนิดลากจูง	High-pressure washer mounted on a towed trailer procurement project	1,000,000			x

The fiscal Year 2008 – The Drainage and Sewerage Department budgetary data						
no	Project list in Thai	Project list in English	Budget Expenditure	Location Specific	Development / Improvement	Operation / Maintenance
1	งานบริหารทั่วไปด้านการระบายน้ำ	General administration of drainage	41,286,200			x
2	งานพัฒนาระบบหลัก	Main system improvement	25,853,000			x
3	โครงการก่อสร้างอุโมงค์ระบายน้ำ คลองแสนแสบและคลองลาดพร้าวลงสู่แม่น้ำเจ้า	The construction project of a drainage tunnel for Khlong Saen Saep and Khlong Lat Phrao to the Chao River	125,790,000	x	x	
4	โครงการก่อสร้างแนวป้องกันน้ำท่วมริมแม่น้ำเจ้าพระยาและคลองบางกอกน้อย	The construction project of a flood protection line along the Chao Phraya River and Bangkok Noi Canal	78,800,000	x	x	
5	โครงการก่อสร้างอุโมงค์ระบายน้ำจากบึงมักกะสันลงสู่แม่น้ำเจ้าพระยา	The construction project of a drainage tunnel from Bueng Makkasan into the Chao Phraya River	49,210,500	x	x	

6	โครงการก่อสร้างระบบระบายน้ำถนนแจ้งวัฒนะไปลงสู่คลองบางตลาด	The construction project of a drainage system on Chaengwattana Road to Bang Talat Canal	58,000,000	x	x	
7	โครงการก่อสร้างแนวป้องกันน้ำท่วมริมแม่น้ำเจ้าพระยาช่วงจากคลอง ใ่อ่างถึงท่าหน้าราชวงศ์	Flood protection line construction project Along the Chao Phraya River, from Khlong Ong Ang to Ratchawong Pier	16,006,300	x	x	
8	โครงการก่อสร้างระบบป้องกันน้ำท่วมริมคลองบางกอกน้อยช่วงคลองเพชรศิเดนท์คอนโดถึงวัดสุวรรณคีรี	Flood protection system construction project Along the Bangkok Noi canal between the President Condo canal to Suwan Khiri Temple	12,000,000	x	x	
9	โครงการสำรวจ ออกแบบและจัดทำ แผนแม่บทระบบระบายน้ำในพื้นที่เขต พญาไท ดินแดง และ ห้วยขวาง	The survey, design, and preparation of a master plan for the drainage system in Phaya Thai, Din Daeng, and Huai Khwang Areas	14,200,000	x	x	
10	โครงการก่อสร้างแนวป้องกันน้ำท่วมริมแม่น้ำเจ้าพระยาช่วงจากท่าหน้าราชวงศ์ถึงบ่อสูบน้ำและช่วงจากวัดปทุมคงคาถึงศาลเจ้าโรงเกือก	The construction project of a flood protection line along the Chao Phraya River, from Ratchawong Pier to the pumping well and from Pathum Ganga Temple to Rong Kue Shrine.	1,500,000	x	x	
11	โครงการก่อสร้างระบบระบายน้ำบึงกุ่มตะวันออก	Bungkum East Drainage System Construction Project	16,700,000	x	x	
12	โครงการก่อสร้างเขื่อนค.ส.ล.และป้องกันกรกัดเซาะคลองพระโขนงช่วงจากสถานีสูบน้ำพระโขนงถึงถนนทางรถไฟสายเก่า	The construction of the reinforced concrete dam and the prevention of erosion of Phra Khanong Canal from Phra Khanong Pumping Station to Tang Rodfai Sai Kao Road	1,250,000	x	x	
13	โครงการก่อสร้างระบบระบายน้ำคลองจิกมิตรมหาตไทยตอนคลองจั่น	The construction project of Chik Mitr Mahadh Thai Canal drainage system at Khlong Chan	1,224,000	x	x	
14	โครงการก่อสร้างระบบระบายน้ำคลองวัดตึก	The construction project of a canal drainage system at Wat Tuek	24,000,000	x	x	
15	โครงการก่อสร้างแนวป้องกันน้ำท่วมริมคลองมหาสวัสดิ์บริเวณวัดปุรณาวาส และบริเวณปากคลองขุนศรีบุรีรักษ์	The construction project of a flood prevention line along the Maha Sawat Canal at Wat Puranawat	3,300,000	x	x	

		and around the mouth of Khlong Khun Si Buri Rak				
16	โครงการก่อสร้างแนวป้องกันน้ำท่วมริมแม่น้ำเจ้าพระยาบริเวณชุมชนวัดภคินีนาถ	The construction project of a flood protection line on the Chao Phraya River at Wat Phakininat community	2,150,000	x	x	
17	โครงการก่อสร้างแนวป้องกันน้ำท่วมริมแม่น้ำเจ้าพระยาบริเวณโรงพยาบาลศิริราชถึงวัดระฆังโฆสิตาราม	The construction project of a flood protection line along the Chao Phraya River in the area of Siriraj Hospital to Wat Rakhang Kositaram	3,250,000	x	x	
18	โครงการสำรวจออกแบบและจัดทำแผนแม่บทระบบระบายน้ำในพื้นที่เขตลาดพร้าว และบางส่วนของเขตจตุจักรและเขตบางเขน	The survey, design, and preparation of a master plan for the drainage system in Lat Phrao area and some parts of Chatuchak and Bang Khen	500,000	x	x	
19	งานสารสนเทศระบายน้ำ	Drainage information works	84,099,000			x
20	งานเครื่องจักรกล	Mechanical works	177,023,000			x
21	งานระบบอาคารบังคับน้ำ	The water control building system works	520,047,500			x
22	โครงการปรับปรุงเพิ่มประสิทธิภาพประตูระบายน้ำคลองบางสะแก ด้านถนนเทอดไท	The efficiency improvement project of Khlong Bang Sakae floodgate On Thoet Thai Road	8,208,500	x	x	
23	โครงการปรับปรุงเพิ่มประสิทธิภาพประตูระบายน้ำคลองบางน้ำจืด ด้านถนนเทอดไท	The efficiency improvement project of Khlong Bang Namchon floodgate On Thoet Thai Road	8,215,000	x	x	
24	งานระบบท่อระบายน้ำ	Sewer system works	378,401,000			x
25	โครงการปรับปรุงระบบระบายน้ำถนนระนอง 1 ถนนกำแพงเพชร 5 และถนนประดิษฐ์จากถนนพระราม 6 ถึงคลองเปรมประชากร	Drainage system improvement of Ranong 1 Road, Kamphaeng Phet 5 Road, and Pradipat Road from Rama 6 Road to Khlong Prem Prachakorn	14,792,000	x	x	
26	โครงการปรับปรุงท่อระบายน้ำซอยสุขุมวิท 11 จากถนนสุขุมวิท	Sewer improvement project on Soi Sukhumvit 11 from Sukhumvit Road	5,323,000	x	x	
27	งานระบบคลอง	Canal system works	442,970,300			x
28	โครงการปรับปรุงเขื่อน ค.ส.ล. เดิมเป็นแบบคาน้ำทอคลอง พร้อมวางท่อส่งน้ำใต้คลอง คลองนาของ จากบริเวณซอยรัชดาภิเษก 3	The redevelopment project of the reinforced concrete dam along with laying water pipes under the Khlong Na	33,888,000	x	x	

	ถึงบริเวณถนนประชาสงเคราะห์	Song canal, from Soi Ratchadaphisek 3 to Pracha Songkhro Road				
29	โครงการก่อสร้างเขื่อน ค.ส.ล. คลองโต๊ะยอ และคลองหัวหมาก จากถนนรามคำแหง ถึงเขื่อนเดิม บริเวณสุเหร่าลำสาดี	The construction of the reinforced concrete dam of Khlong Toh Yo and Khlong Hua Mak from Ramkhamhaeng Road to the original dam at Lamsalee Mosque	13,522,000	x	x	
30	โครงการก่อสร้างทางเดินและทางรถจักรยาน ริมคลองแสนแสบจากบริเวณซอยรามคำแหง 39 ถึงบริเวณสะพานมิตรมหาชาติไทย	The construction project of a walkway and bicycle lane along the Saen Saeb Canal from Soi Ramkhamhaeng 39 to the Mitr Mahathai Bridge	22,620,000	x	x	
31	โครงการก่อสร้างทางเดินและทางรถจักรยาน ริมคลองแสนแสบจากบริเวณซอย รามคำแหง ๒๙ ถึงบริเวณวัดศรีบุญเรือง	The construction project of a walkway and bicycle lane along the Saen Saeb Canal from Soi Ramkhamhaeng 29 to Sribunruang Temple	9,000,000	x	x	
32	โครงการปรับปรุงเขื่อนเดิมเป็นแบบคอคบ่อก คลองพร้อมก่อสร้างสถานีสูบน้ำและวางท่อส่งน้ำ คลองบางอ้อยจากบริเวณถนนสุขุมวิทถึงบริเวณสถานีสูบน้ำ คลองบางอ้อย	The renovation project of the former dam to be a canal deck with the construction of a pumping station and laying of a water pipe for Khlong Bang Or Noi from Sukhumvit Road to Khlong Bang Or Pumping Station.	15,500,000	x	x	
33	โครงการก่อสร้างทางเดินและทางรถจักรยาน ริมคลองแสนแสบจากบริเวณซอยรามคำแหง 29 ถึงบริเวณประตูระบายน้ำคลองตัน	The construction project of a walkway and bicycle lane along the Saen Saeb Canal from Soi Ramkhamhaeng 29 to Khlong Tan drainage gate	10,000,000	x	x	
34	โครงการก่อสร้างเขื่อน ค.ส.ล. (คอคบ่อกคลอง) พร้อมประตูระบายน้ำคลองบางบำหรุ จากถนนสิรินธรถึงบริเวณทางรถไฟสายใต้	The construction project of the reinforced concrete dam with a drainage gate on Khlong Bang Bamru from Sirindhorn Road to the Southern Railway	5,451,000	x	x	
35	โครงการปรับปรุงคลองสามเสน จาก ถนนพหลโยธินถึงบึงมักกะสัน	Samsen canal improvement project from Phahonyothin Road to Bueng Makkasan	9,175,000	x	x	
36	โครงการก่อสร้างเขื่อน ค.ส.ล. (คอคบ่อกคลอง) คลองเจ้าคุณสิงห์จากเขื่อนเดิม บริเวณโรงเรียน	The construction project of reinforced concrete dam construction in Chao Khun	5,000,000	x	x	

	บดินทร์เดชา (สิงห์ สิงหเสนีย์) ถึงสถานีสูบน้ำต่อนคลองแสนแสบ	Sing Canal from the former dam Around Bodindecha School (Sing Singhaseni) to the water pumping station at Khlong Saen Saeb				
37	โครงการก่อสร้างเขื่อน ค.ส.ล. (สมัยดี ด้านหลัง) คลองเปรมประชากรจากเขื่อนเดิมบริเวณวัดเสมียนนารีถึงคลองบางเขน	The construction project of reinforced concrete dam construction on Khlong Prem Prachakorn from the former dam around Samian Nari Temple to Khlong Bang Khen	5,000,000	x	x	
38	โครงการบำบัดน้ำเสียคลองเตย	Klong Toei Wastewater Treatment Project	10,000,000	x		x
39	งานจัดการคุณภาพน้ำ	Water quality management	170,428,300			x
40	โครงการจ้างเดินระบบบำรุงรักษา และจัดการบริหารโรงควบคุมคุณภาพน้ำของนนทบุรี	Outsourcing project for maintenance and management Chong Nonsi Water Quality Control Plant	34,400,000	x		x
41	โครงการจ้างเดินระบบ บำรุงรักษา และจัดการบริหารโรงควบคุมคุณภาพน้ำหนองแขม	Outsourcing project for Nong Khaem Water Quality Control Plant maintenance and management	35,600,000	x		x
42	โครงการก่อสร้างศูนย์การศึกษา และอนุรักษ์สิ่งแวดล้อมบางซื่อ กรุงเทพมหานคร	Bang Sue Environmental Education and Conservation Center construction project	10,000,000	x	x	
43	โครงการจ้างเดินระบบบำรุงรักษา และจัดการบริหารโรงควบคุมคุณภาพน้ำดินแดง	Outsourcing project for Din Daeng Water Quality Control Plant maintenance and management	74,000,000	x		x
44	โครงการจ้างเดินระบบบำรุงรักษา และจัดการบริหารโรงควบคุมคุณภาพน้ำจตุจักร	Outsourcing project for Chatuchak Water Quality Control Plant maintenance and management	20,000,000	x		x

The fiscal Year 2014 – The Traffic and Transportation Department budgetary data						
no	Project list in Thai	Project list in English	Budget Expenditure	Location Specific	Development / Improvement	Operation / Maintenance
1	งานบริหารทั่วไปด้านการโยธา และระบบจราจร	General administration of civil works and traffic systems	29,901,300			x
2	งานการขนส่ง	Transportation works	614,332,200			x

3	โครงการบริหารจัดการการให้บริการ รถโดยสารประจำทางด่วนพิเศษ (BRT)	BRT Service Management Project	91,650,000	x		x
4	โครงการก่อสร้างทางเดินยกระดับ (Sky Walk) ลานจอดรถแล้วจว (Park & Ride)	Park & Ride with elevated walkway (Sky Walk) construction project	19,874,100	x	x	
5	โครงการระบบขนส่งมวลชนกรุงเทพมหานครส่วนต่อขยายสายสีลม (ตากสิน - เพชรเกษม) และบริหารจัดการเดินรถ	Bangkok Mass Transit System Project – the Silom Line Extension (Taksin – Phet Kasem)	751,058,500	x		x
6	โครงการระบบรถไฟฟ้ารางคู่ขนาดเบา (Light Rail) สายบางนา-ท่าอากาศยานสุวรรณภูมิ	Light Rail Project, Bangna-Suvarnabhumi Airport Line project	1,000,000	x	x	
7	โครงการระบบรถไฟฟ้ารางเดี่ยว (Monorail) ระยะที่ ๑ จากสยาม - สามย่าน	Monorail Project, Phase 1 from Siam - Sam Yan	1,000,000	x	x	
8	โครงการก่อสร้างทางเชื่อมการเดินทาง ทางน้ำกับระบบขนส่งมวลชน กรุงเทพมหานครบริเวณถนนสาทร	The connector construction for the waterway transportation to the BTS in Sathorn	1,000,000	x	x	
9	โครงการปรับปรุงจุดเชื่อมต่อระบบเดินรถ ขนส่งมวลชน กรุงเทพมหานครสายสีลม บริเวณสถานีสะพานตากสิน	The connection spot improvement of the Bangkok Mass Transit System, Silom Line Around Saphan Taksin Station	1,000,000	x	x	
10	โครงการบริหารจัดการระบบขนส่งมวลชน กรุงเทพมหานคร	Bangkok Mass Transit System (BTS) Project	750,000,000	x		x
11	โครงการปรับปรุงถนนสุขุมวิท จากซอยสุขุมวิท 81 ถึง ซอยสุขุมวิท 103/4	Sukhumvit Road Improvement Project from Soi Sukhumvit 81 to Soi Sukhumvit 103/4	51,284,900	x	x	
12	โครงการศึกษาความเหมาะสมจัดทำแบบเบื้องต้นและจัดเตรียมเอกสารประกวดราคา โครงการรถไฟฟ้ารางเดี่ยว (Monorail) สายสีเทา ช่วงวัชรพล - สะพานพระราม 9	A project for feasibility study, prepare a preliminary model and tender documentation for Monorail, Gray Line, Watcharaphon Section - Rama 9 Bridge	1,000,000	x	x	
13	งานจัดระเบียบจราจร	Traffic regulation	43,285,000			x
14	งานวิศวกรรมจราจร	Traffic engineering	334,503,600			x
15	งานนโยบายและแผนงาน	Plan and Policy	94,394,200			x
16	โครงการก่อสร้างศูนย์ส่งเสริมความปลอดภัยการสัญจรทางน้ำ บริเวณตลาดน้ำตลิ่งชันและชุมชนวัดคูหาสวรรค์	The construction project of a water traffic safety promotion center Taling Chan Floating Market and Wat Khuha Sawan	259,650,000	x	x	

		Community				
17	โครงการจ้างที่ปรึกษาควบคุม การก่อสร้างศูนย์ส่งเสริมความปลอดภัย การสัญจรทางน้ำ บริเวณตลาดน้ำ ดลิ่งชันและชุมชนวัดคูหาสวรรค์	Hiring the supervisory consultant for the construction project of a water traffic safety promotion center Taling Chan Floating Market and Wat Khuha Sawan Community	8,940,000	x	x	
18	โครงการพัฒนาระบบสารสนเทศภูมิศาสตร์ เพื่อสนับสนุนการปฏิบัติงานด้านการจราจร และขนส่ง	Geographic information system development project to support traffic and transportation operations	16,000,000			x
19	งานพัฒนาระบบจราจร	Traffic system improvement	169,286,000			x
20	โครงการจัดหาพร้อมติดตั้งกล้องโทรทัศน์วงจรปิด (CCTV) พร้อมเชื่อมโยงสัญญาณภาพ บริเวณ สวนสาธารณะ ศูนย์เยาวชน ศูนย์กีฬา และห้องสมุดประชาชน ในพื้นที่ กรุงเทพมหานคร	Procurement and installation project of the CCTV with video signal links in parks, youth centers, sports centers, and public libraries in Bangkok area	288,675,000			x
21	โครงการจัดหาพร้อมติดตั้งกล้องโทรทัศน์วงจรปิด (CCTV) ตรวจวัดและรายงานสภาพการจราจร	Procurement and installation project the CCTV to measure and report traffic conditions	180,950,000			x
22	โครงการปรับปรุงระบบกล้องโทรทัศน์ วงจรปิด (CCTV) ในพื้นที่เขตพระนคร และเขตดุสิต	A project to improve the CCTV systems in Phra Nakhon and Dusit areas	98,398,500	x	x	
23	โครงการปรับปรุงระบบกล้องโทรทัศน์ วงจรปิด (CCTV) เพื่อการบริหารจัดการจราจรของกรุงเทพมหานคร	A project to improve the CCTV system for Bangkok traffic management	61,240,000			x
24	โครงการปรับปรุงระบบกล้องโทรทัศน์ วงจรปิด (CCTV) ในพื้นที่ กรุงเทพมหานคร	To improve the CCTV in Bangkok area	138,672,000			x
25	โครงการปรับปรุงระบบการบันทึกภาพ และบริหารจัดการกล้องโทรทัศน์ วงจรปิด (CCTV)	To improve the recording system and manage the CCTV	191,600,000			x
26	โครงการเชื่อมโยงสัญญาณภาพกล้องโทรทัศน์วงจรปิด (CCTV) ไปที่สำนักงานเขตและสถานีตำรวจ ในพื้นที่กรุงเทพมหานคร	A project to link the CCTV to district offices and police stations in Bangkok area	289,800,000			x
27	โครงการเชื่อมโยงสัญญาณภาพกล้องโทรทัศน์วงจรปิด (CCTV) บริเวณ สถานศึกษาและชุมชนไป	A project to link the CCTV in school and community areas to district offices and	614,400,000			x

	ที่สำนักงานเขต และสถานีตำรวจในพื้นที่ กรุงเทพมหานคร	police stations in Bangkok				
28	โครงการจัดหาพร้อมติดตั้งกล้องโทรทัศน์วงจรปิด (CCTV) ในพื้นที่กลุ่มกรุงเทพมหานครกลาง กรุงเทพมหานครตะวันออก และกรุงเทพเหนือ	Procurement and install the CCTV in the Central Bangkok, Eastern Bangkok, and Northern Bangkok area	220,045,000	x	x	
29	โครงการจัดหาพร้อมติดตั้งกล้องโทรทัศน์วงจรปิด (CCTV) ในพื้นที่กลุ่มกรุงเทพใต้ กรุงเทพมหานครเหนือ และกรุงเทพใต้	Procurement and install the CCTV in the Southern Bangkok, Northern Thonburi, and Southern Bangkok area	212,800,000	x	x	
30	โครงการจัดหาพร้อมติดตั้งกล้องโทรทัศน์วงจรปิด (CCTV) เพื่อเพิ่มความปลอดภัย บริเวณชุมชนและจุดเสี่ยงภัย ในพื้นที่กรุงเทพมหานคร	Procurement and installation the CCTV to increase safety in community areas and at-risk points in Bangkok	64,433,800			x
31	โครงการติดตั้งระบบวิทยุสื่อสารเคลื่อนที่แบบดิจิทัล (Digital Trunked Radio System)	Installation project of digital radio communication system (Digital Trunked Radio System)	1,000,000			x
32	โครงการจัดทำแผนแม่บทการบริหารจัดการระบบเครือข่ายสื่อสารข้อมูลระบบการเชื่อมโยงสัญญาณและการจัดการข้อมูลของกรุงเทพมหานคร	A project to develop a master plan for the management of the communication network system, the signal linking system, and the information management of the Bangkok	20,000,000			x
33	โครงการจัดหาพร้อมติดตั้งกล้องโทรทัศน์วงจรปิด (CCTV) บริเวณชุมชนใกล้ประตูระบายน้ำ สถานีสูบน้ำและพื้นที่เสี่ยงบริเวณชุมชนในพื้นที่กรุงเทพมหานคร	Procurement and installation project of the CCTV in community areas near drainage gates, water pumping stations and risk areas and risk areas in the community	6,000,000			x

The fiscal Year 2018 – The Environment Department budgetary data						
no.	Project list in Thai	Project list in English	Budget Expenditure	Location Specific	Development / Improvement	Operation / Maintenance
1	งานบริหารทั่วไปด้านการรักษาความสะอาด	General administration work in cleanliness	51,684,400			x
2	งานนโยบายและแผนงาน	Plan and Policy	22,747,700			x

3	โครงการจัดหารถเก็บขนมูลฝอย เพื่อเพิ่มประสิทธิภาพในการเก็บขน มูลฝอยบนถนนสายหลักและสายรอง	Supply vacuum sweepers to clean roads, alleys, and alleys in Bangkok area.	258,328,800			x
4	งานกำจัดมูลฝอย	Solid waste disposal works	167,796,500			x
5	โครงการปรับปรุงภูมิทัศน์บริเวณศูนย์กำจัดมูลฝอยอ่อนนุช หนองแขม และสายไหม	Landscaping improvement project at On Nut, Nong Khaem, and Sai Mai garbage-eradication factories	339,850,000	x	x	
6	โครงการจ้างเหมาเอกชนกำจัดมูลฝอย โดยระบบเตาเผามูลฝอย ขนาด 300 ตันต่อวัน ที่ศูนย์กำจัดมูลฝอย หนองแขม	Private contracting to dispose of solid waste by a 300-ton/day incinerator system factory at Nong Khaem garbage-eradication factory	177,025,000	x		x
7	โครงการจ้างเหมาเอกชน เดินเครื่องจักรและอุปกรณ์กำจัดมูลฝอย ขนาดไม่น้อยกว่า 600 ตันต่อวัน ที่ศูนย์กำจัดมูลฝอยอ่อนนุช	Private contracting of at least 600-ton/day solid waste control machine at the On Nut garbage-eradication factory	134,422,200	x		x
8	โครงการจ้างเหมาเอกชนขนมูลฝอย จากศูนย์กำจัดมูลฝอยอ่อนนุชและนำไปทำลายโดยวิธีฝังกลบอย่างถูกสุขลักษณะ	Private contracting project to transport and destroy old solid waste by the hygienic method from the On Nut garbage-eradication factory	801,034,900	x		x
9	โครงการจ้างเหมาเอกชนขนมูลฝอย จากศูนย์กำจัดมูลฝอยสายไหม และนำไปทำลายโดยวิธีฝังกลบอย่างถูกสุขลักษณะ	Private contracting project to transport and destroy old solid waste by the hygienic method from the Sai Mai garbage-eradication factory	610,681,500	x		x
10	โครงการจัดหาศูนย์การเรียนรู้การบริหารจัดการขยะของเสียชุมชน	Learning center on waste and community waste management provision project	183,200,000			x
11	โครงการจ้างเหมาเอกชน เดินระบบบำบัดน้ำเสียศูนย์กำจัดมูลฝอยสายไหม ระยะที่ 3	Private contracting a wastewater treatment system at the Sai Mai garbage-eradication factory operation phase 3	23,548,000	x		x
12	โครงการจ้างเหมาเอกชนเก็บขนและกำจัดมูลฝอยติดเชื้อ ที่ศูนย์กำจัดมูลฝอยหนองแขม และอ่อนนุช ระยะที่ 2	Private contracting project for transporting and disposing of infectious waste, at Sai Mai, and On Nut garbage-eradication factories phase 2	171,932,800	x		x
13	โครงการจ้างเหมาเอกชนกำจัดมูลฝอยอันตรายระยะที่ 3	Private contracting project to dispose of hazardous solid waste phase 3	5,247,200			x

14	โครงการจ้างเหมาเอกชนขนมูลฝอยจากศูนย์กำจัดมูลฝอยหนองแขม และนำไปทำลายโดยวิธีฝังกลบ อย่างถูกสุขลักษณะ ระยะที่ 4	Private contracting project to transport and destroy solid waste with the new system from Nong Khaem garbage-eradication factory to dispose of in the hygienic method phase 4	714,816,000	x		x
15	โครงการจ้างเหมาเอกชน เดินเครื่องจักรโรงงานกำจัดมูลฝอย ขนาด 1,000 ตันต่อวัน ที่ศูนย์กำจัดมูลฝอยอ่อนนุช ระยะที่ 3	Private contracting project to operate the machine operation for the 1,000 tons/day waste disposal at the On Nut garbage-eradication factories phase 3	95,013,000	x		x
16	โครงการจ้างเหมาเอกชน เดินระบบบำบัดน้ำเสีย ศูนย์กำจัดมูลฝอยอ่อนนุช	Private contracting a wastewater treatment system at the On Nut garbage-eradication	8,117,600	x		x
17	โครงการจ้างเหมาเอกชนกำจัดมูลฝอยอันตราย ระยะที่ 4	Private contracting project to dispose of hazardous solid waste phase 4	1,000,000			x
18	โครงการจ้างเหมาเอกชน เก็บขนและกำจัดมูลฝอยติดเชื้อที่ศูนย์กำจัดมูลฝอย หนองแขม และอ่อนนุช ระยะที่ 3	Private contracting project for transporting and disposing of infectious waste, at Sai Mai, and On Nut garbage-eradication factories phase 3	1,000,000	x		x
19	โครงการจัดหาเตาเผามูลฝอยติดเชื้อ ขนาดไม่ต่ำกว่า 15 ตันต่อเตา จำนวน 2 เต่า พร้อมติดตั้งเครื่องจักร และอุปกรณ์ที่ศูนย์กำจัดมูลฝอยอ่อนนุช	Procurement of 2 incinerators for infectious waste of at least 15 tons per each and install machinery and equipment at the On Nut garbage-eradication factory	1,000,000	x	x	
20	งานจัดการขยะ ของเสียอันตราย และสิ่งปฏิกูล	Waste management, hazardous waste, and sewage works	686,077,500			x
21	โครงการเช่ารถเก็บขนมูลฝอยแบบอัดขนาด 5 ตัน ระยะที่ 5	5-ton compressing garbage truck rental project, phase 5	203,892,800			x
22	โครงการเช่ารถเก็บขนมูลฝอยแบบอัด ขนาด 5 ตัน ระยะที่ 6	5-ton compressing garbage truck rental project, phase 6	157,266,100			x
23	โครงการเช่ารถเก็บขนมูลฝอยแบบอัด ขนาด 2 ตัน ระยะที่ 3	2-ton compressing garbage truck rental project, phase 3	96,718,300			x
24	โครงการเช่ารถเก็บขนมูลฝอยแบบยกภาชนะ รองรับมูลฝอยขนาด 8 ลบ.ม.ระยะที่ 2	Renting containers to support solid waste with a size of 8 cubic meters phase 2	89,207,500			x
25	โครงการจัดหารถเก็บขนมูลฝอยพื้นที่ฝั่งสายไหม	Garbage truck procurement project in Sai Mai area	177,003,100	x		x

26	โครงการเช่ารถเก็บขนมูลฝอยแบบอัด ขนาด 5 ตัน ระยะที่ 7	5-ton compressing garbage truck rental project, phase 7	209,062,700			x
27	โครงการเช่ารถเก็บขนมูลฝอยเพื่อเพิ่มประสิทธิภาพการเก็บขนมูลฝอย ในพื้นที่กรุงเทพมหานคร	Garbage collection car rental project to increase the efficiency of solid waste collection in the Bangkok area	132,227,900			x
28	โครงการเช่ารถเก็บขนมูลฝอยแบบกระเบาะท้าย ขนาด 6 ตัน ระยะที่ 2	6-ton dump truck rental project, phase 2	108,227,700			x
29	โครงการจ้างเหมาเอกชนควบคุม โรงงานกำจัดไขมันและแปรรูปไขมัน ที่ศูนย์กำจัดมูลฝอยอ่อนนุช	Private contracting to control fat removal and processing plant at On Nut garbage-eradication factory	73,321,200	x		x
30	โครงการจ้างเหมาเอกชนควบคุม โรงงานกำจัดไขมันและแปรรูปไขมัน ที่ศูนย์กำจัดมูลฝอยหนองแขม	Private contracting to control fat removal and processing plant at Nong Khaem garbage-eradication factory	73,395,200	x		x
31	โครงการจ้างเหมาเอกชนควบคุมโรงงานกำจัดสิ่งปฏิกูลหนองแขม ระยะที่ 5	Private contracting to control fat removal and processing plant at Nong Khaem garbage-eradication factory phase 5	65,880,700	x		x
32	โครงการจ้างเหมาเอกชนควบคุมโรงงานกำจัดสิ่งปฏิกูลอ่อนนุช ระยะที่ 2	Private contracting to control fat removal and processing plant at On Nut garbage-eradication factory phase 2	55,820,400	x		x
33	โครงการเช่ารถกวาดดูดฝุ่นเพื่อทำความสะอาดถนนตรอก ซอย ในพื้นที่กรุงเทพมหานคร	Road cleaning vehicles and road cleaning trucks project	1,000,000			x
34	โครงการเช่ารถ เก็บขนมูลฝอยแบบยกภาชนะ รองรับมูลฝอยขนาด 3 ลบ.ม.	Renting containers to support solid waste with a size of 3 cubic meters	1,000,000			x
35	โครงการเช่ารถเก็บขนมูลฝอยแบบอัด ขนาด 2 ตัน	2-ton compressing garbage truck rental project	1,000,000			x
36	โครงการเช่ารถเก็บขนมูลฝอยแบบยกภาชนะ รองรับมูลฝอยขนาด 8 ลบ.ม.	Renting containers to support solid waste with a size of 8 cubic meters	1,000,000			x
37	โครงการเช่ารถ เก็บขนมูลฝอยแบบอัด ขนาด 5 ตัน	5-ton compressing garbage truck rental project	1,000,000			x
38	งานบริหารสวนสาธารณะ	Park operation works	1,078,117,900			x
40	โครงการเช่ารถบรรทุกน้ำอเนกประสงค์ ระยะที่ 3	Multipurpose water truck rental project phase 3	177,061,500			x
41	โครงการเช่ารถบรรทุกน้ำอเนกประสงค์ ระยะที่ 4	Multipurpose water truck rental project phase 4	96,579,000			x
42	งานจัดการคุณภาพอากาศและเสียง	Air quality and noise management works	106,116,000			x

Appendix B: the SPSS Outputs

A. Predicted Y1: *Do the population shift and the housing increase of 50 BMA districts affect the expansion of the number of BMA's infrastructure development projects?*

the population shift (X1) coded as pop_gr_all

the housing increase (X2) coded as hs_gr_all

the expansion of the number of BMA's infrastructure development projects (Y1) coded as pro_gr_all

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	hs_gr_all, pop_gr_all ^b	.	Enter

a. Dependent Variable: pro_gr_all

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.133 ^a	.018	-.024	218.73935

a. Predictors: (Constant), hs_gr_all, pop_gr_all

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40340.797	2	20170.398	.422	.658 ^b
	Residual	2248804.47	47	47846.904		
	Total	2289145.26	49			

a. Dependent Variable: pro_gr_all

b. Predictors: (Constant), hs_gr_all, pop_gr_all

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	199.690	32.249		6.192	.000
	pop_gr_all	1.809	1.999	.132	.905	.370
	hs_gr_all	.002	.006	.040	.275	.784

a. Dependent Variable: pro_gr_all

- B. Predicted Y2: Do the population shift and the housing increase of 50 BMA districts affect the changes in the values of BMA's infrastructure development projects?

the population shift (X1) coded as pop_gr_all

the housing increase (X2) coded as hs_gr_all

changes in the values of BMA's infrastructure development projects (Y2) coded as va_pro_gr_all

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	hs_gr_all, pop_gr_all ^b	.	Enter

a. Dependent Variable: va_pro_gr_all

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.159 ^a	.025	-.016	8416.12768

a. Predictors: (Constant), hs_gr_all, pop_gr_all

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	86850834.1	2	43425417.1	.613	.546 ^b
	Residual	3.329E+9	47	70831205.2		
	Total	3.416E+9	49			

a. Dependent Variable: va_pro_gr_all

b. Predictors: (Constant), hs_gr_all, pop_gr_all

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3562.034	1240.781		2.871	.006
	pop_gr_all	83.898	76.907	.158	1.091	.281
	hs_gr_all	-.011	.248	-.006	-.044	.965

a. Dependent Variable: va_pro_gr_all

C. Predicted Y3: *What factors are influencing the expenditure budget allocation of the district offices?*

the area size of each district (X1) coded as area

number of households (X2) coded as home_(year in B.E.)

number of populations (X3) coded as pop_(year in B.E.)

the total revenues of each district (X4) coded as revenues_(year in B.E.)

the annual budget distributed to each district office (Y3) budget_(year in B.E.)

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	revenues_51 , home_51, area, pop_51 ^b	.	Enter

a. Dependent Variable: budget_51

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.839 ^a	.704	.677	32003374.2

a. Predictors: (Constant), revenues_51, home_51, area, pop_51

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.094E+17	4	2.734E+16	26.693	.000 ^b
	Residual	4.609E+16	45	1.024E+15		
	Total	1.554E+17	49			

a. Dependent Variable: budget_51

b. Predictors: (Constant), revenues_51, home_51, area, pop_51

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	135818035	17885567.6		7.594	.000
	area	528436.754	126814.623	.377	4.167	.000
	home_51	-2.956	373.293	-.001	-.008	.994
	pop_51	994.795	182.055	.658	5.464	.000
	revenues_51	.086	.028	.268	3.116	.003

a. Dependent Variable: budget_51

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	revenues_53, home_53, area, pop_53 ^b	.	Enter

a. Dependent Variable: budget_53

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.857 ^a	.734	.710	35586511.0

a. Predictors: (Constant), revenues_53, home_53, area, pop_53

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.572E+17	4	3.930E+16	31.034	.000 ^b
	Residual	5.699E+16	45	1.266E+15		
	Total	2.142E+17	49			

a. Dependent Variable: budget_53

b. Predictors: (Constant), revenues_53, home_53, area, pop_53

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	154850598	19924116.9		7.772	.000
	area	611846.288	146651.797	.372	4.172	.000
	home_53	-282.708	369.114	-.077	-.766	.448
	pop_53	1168.539	195.243	.687	5.985	.000
	revenues_53	.044	.033	.107	1.315	.195

a. Dependent Variable: budget_53

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	revenues_55, home_55, area, pop_55 ^b	.	Enter

a. Dependent Variable: bud_55

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.802 ^a	.643	.611	41302613.8

a. Predictors: (Constant), revenues_55, home_55, area, pop_55

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.380E+17	4	3.451E+16	20.227	.000 ^b
	Residual	7.677E+16	45	1.706E+15		
	Total	2.148E+17	49			

a. Dependent Variable: bud_55

b. Predictors: (Constant), revenues_55, home_55, area, pop_55

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	197608332	22311415.6		8.857	.000
	area	549691.347	176048.183	.334	3.122	.003
	home_55	-182.766	391.867	-.054	-.466	.643
	pop_55	1046.739	222.855	.639	4.697	.000
	revenues_55	.050	.033	.141	1.486	.144

a. Dependent Variable: bud_55

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	revenues_57, home_57, area, pop_57 ^b	.	Enter

a. Dependent Variable: budget_57

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.893 ^a	.797	.779	39434684.6

a. Predictors: (Constant), revenues_57, home_57, area, pop_57

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.746E+17	4	6.864E+16	44.139	.000 ^b
	Residual	6.998E+16	45	1.555E+15		
	Total	3.445E+17	49			

a. Dependent Variable: budget_57

b. Predictors: (Constant), revenues_57, home_57, area, pop_57

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	163247928	20540075.0		7.948	.000
	area	489773.026	172420.448	.235	2.841	.007
	home_57	-96.030	347.472	-.024	-.276	.784
	pop_57	1588.773	208.591	.794	7.617	.000
	revenues_57	.075	.026	.206	2.898	.006

a. Dependent Variable: budget_57

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	revenues_59, home_59, area, pop_59 ^b	.	Enter

a. Dependent Variable: budget_59

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.785 ^a	.616	.581	61488513.2

a. Predictors: (Constant), revenues_59, home_59, area, pop_59

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.724E+17	4	6.809E+16	18.009	.000 ^b
	Residual	1.701E+17	45	3.781E+15		
	Total	4.425E+17	49			

a. Dependent Variable: budget_59

b. Predictors: (Constant), revenues_59, home_59, area, pop_59

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	166167386	30994534.8		5.361	.000
	area	662634.093	276029.907	.280	2.401	.021
	home_59	705.104	506.239	.166	1.393	.171
	pop_59	1102.272	319.730	.504	3.448	.001
	revenues_59	.043	.036	.115	1.179	.245

a. Dependent Variable: budget_59

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	revenues_61, home_61, area, pop_61 ^b	.	Enter

a. Dependent Variable: budget_61

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.869 ^a	.756	.734	40690301.8

a. Predictors: (Constant), revenues_61, home_61, area, pop_61

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.305E+17	4	5.763E+16	34.809	.000 ^b
	Residual	7.451E+16	45	1.656E+15		
	Total	3.050E+17	49			

a. Dependent Variable: budget_61

b. Predictors: (Constant), revenues_61, home_61, area, pop_61

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	203378409	20298975.5		10.019	.000
	area	737471.758	187010.295	.376	3.943	.000
	home_61	-239.959	307.567	-.073	-.780	.439
	pop_61	1156.337	206.706	.657	5.594	.000
	revenues_61	.055	.021	.200	2.573	.013

a. Dependent Variable: budget_61

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	revenues_63, pop_63, area, home_63 ^b	.	Enter

a. Dependent Variable: bud_63

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.845 ^a	.714	.689	50297595.0

a. Predictors: (Constant), revenues_63, pop_63, area, home_63

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.844E+17	4	7.110E+16	28.106	.000 ^b
	Residual	1.138E+17	45	2.530E+15		
	Total	3.983E+17	49			

a. Dependent Variable: bud_63

b. Predictors: (Constant), revenues_63, pop_63, area, home_63

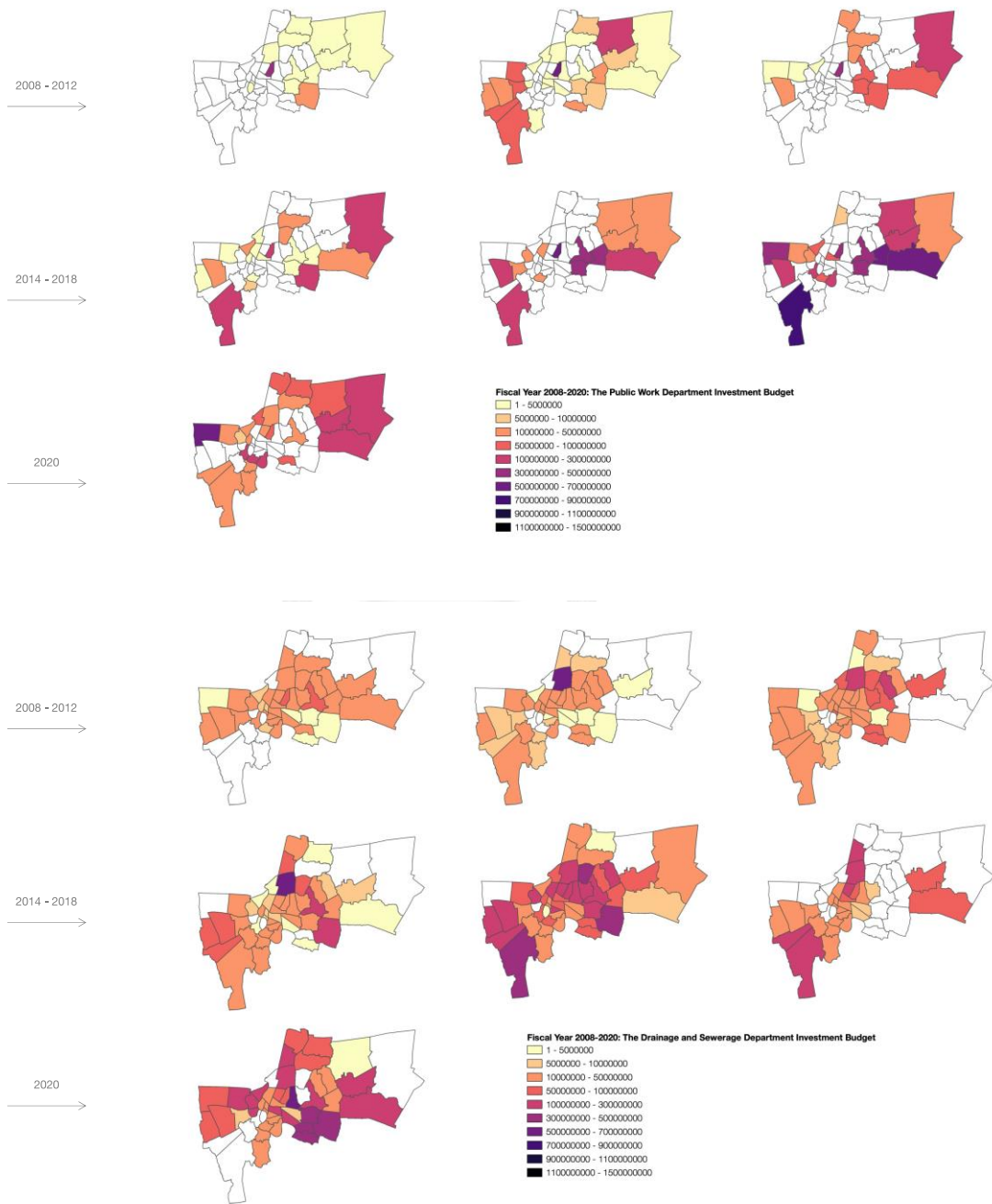
Coefficients^a

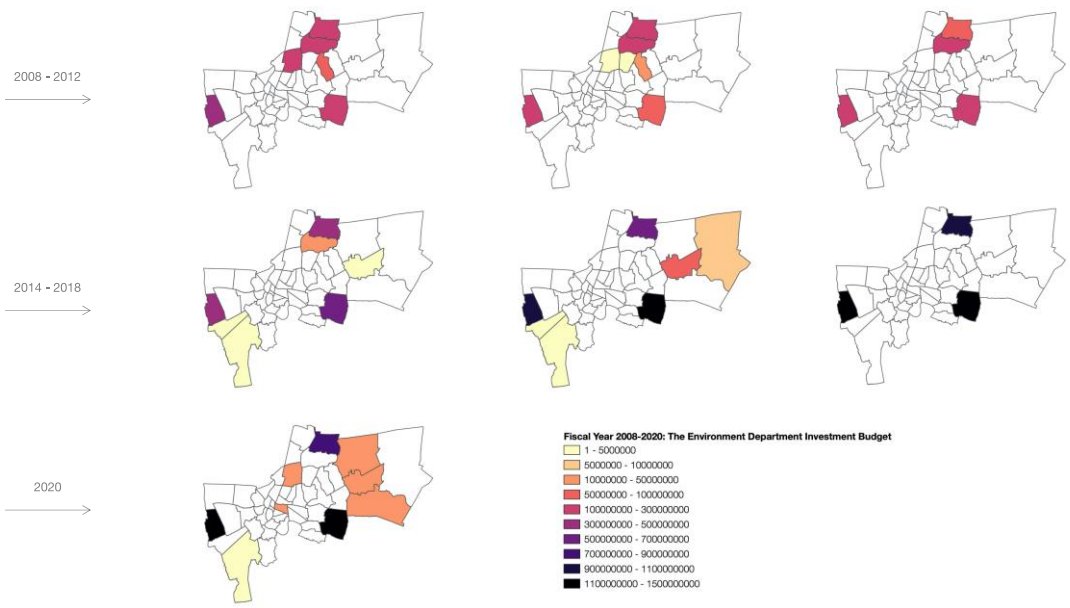
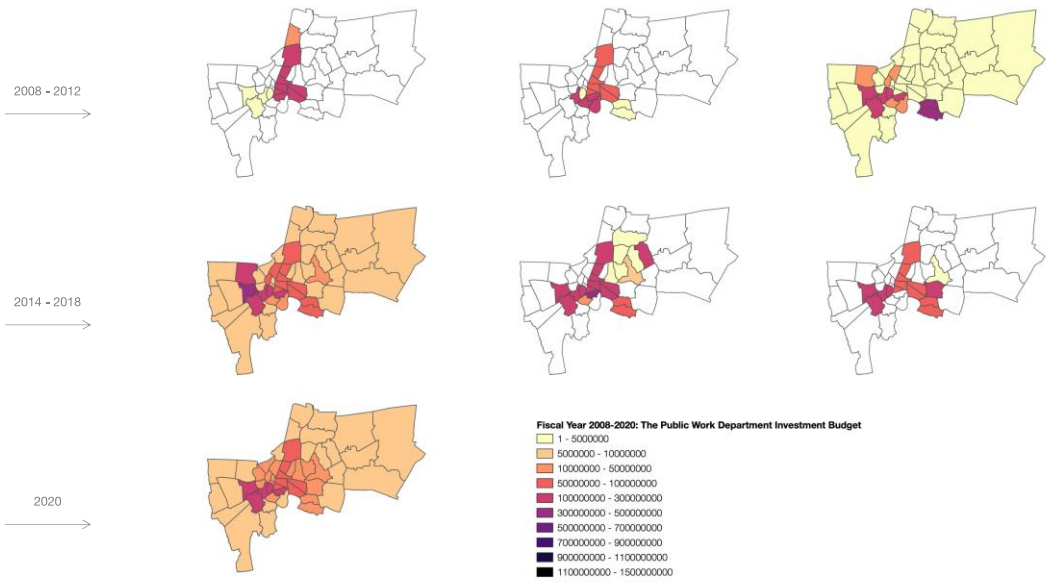
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	222332045	20899579.1		10.638	.000
	area	813942.330	255147.606	.363	3.190	.003
	home_63	-72.743	730.320	-.021	-.100	.921
	pop_63	1094.831	437.624	.567	2.502	.016
	revenues_63	.230	.132	.199	1.748	.087

a. Dependent Variable: bud_63

Appendix C: The BMA 4 departments location specific investment budgets

The GIS-based illustrations below show the annual investment budget, which included both urban development and maintenance expenses, from the fiscal year 2008 to 2020 of each department.





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VITA

NAME Sitanun Anandarangsri

DATE OF BIRTH 17 October 1997

PLACE OF BIRTH Chonburi

INSTITUTIONS ATTENDED Faculty of Political Science, Chulalongkorn University

HOME ADDRESS 485/3 Sri Ayudhya Rd. Thanon Phaya Thai, Ratchathewi,
Bangkok 10400

