

# COS 214 Project by TDP - Till Dev do us Part

(link to Google Doc: [TDP - Report](#) )

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## Task 2: Design

### **Task 2.1: Functional Requirements**

System Components:

- The city will consist of major components including Government & Departments, Economy, Resources, Utilities, Buildings, Citizens and Transportation.

#### 1. Government & Department:

- *Government Entity:* This structure guarantees that all policies, resources and services are consistently managed through a unified government to ensure a single point of control across the city.
- *Department Mapping:* Government has a map of departments, each responsible for a specific domain - Resources, Development, Finance, Social Affairs, Health and Transport.
- *Policy Making:* The system will enable the creation and implementation of city policies that affect various aspects of urban life.

#### 2. Economy:

- *Budget Management:* The Finance Department will support creation and management of the city budget, including tracking income and expenses.
- *Tax Collection:* Taxes will be collected from working citizens and businesses to fund public services, infrastructure, and government expansion.

#### 3. Resources:

- *Resource Tracking & Allocation:* The system will track and allocate resources, such as water, materials and energy, to the respective utility stations.
- *Department Oversight:* The Resource Department will monitor resource levels and, based on city demand, decide whether additional resources are needed.

#### 4. Utilities:

- *Plant Construction:* The system will be responsible for construction of power, water, waste and sewerage management facilities.
- *Plant Maintenance:* Moreover, the system will be responsible for ongoing maintenance of utility facilities to ensure efficient operation.

#### 5. Buildings:

- *Construction:* The system will facilitate the construction of residential, commercial and industrial buildings as well as landmarks.
- *Maintenance & Renovation:* Buildings can undergo regular maintenance and be renovated when necessary.
- *Subdivision into Regions:* The system will divide the city into distinct regions (suburbs, central business districts and industrial areas) to localise resource distribution, transportation, and infrastructure management.

6. Citizens:

- *Daily Interactions:* Citizens will interact with the city's systems, impacting economic and social indicators through activities like working, commuting, and accessing services
- *Reproduction:* Adults may take on the additional responsibility of having children, contributing to the city's population growth.
- *Immigration:* The city welcomes people from other countries to move in and contribute to its cultural and economic diversity.

7. Transportation:

- *Transport Modes:* The system will support the creation of various transport modes, including cars, buses, taxis and trains.
- *Facility Construction:* The system will provide for the creation and upkeep of public roads and railway systems.
- *Transport Station Management:* The system will be responsible for construction and maintenance of facilities such as taxi ranks, bus stops, train stations, and airports.
- *Traffic State Communication:* Transport modes will be able to communicate the current state of the roads - empty, normal, or congested - to help optimise routing and improve travel efficiency.

8. Health:

- *Healthcare Facility Management:* The system will manage the operation and maintenance of various health institutions (clinics, general hospitals and intensive care hospitals) ensuring they are equipped to treat the population.
  - *Patient Care:* Patients should be directed to the appropriate healthcare facility based on the severity of their illness.
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## Task 4: Report

### **Task 4.1: Research Brief**

#### Introduction

Urban development involves the processes and strategies that define the layout and infrastructure of cities. It includes various activities such as planning land usage, housing development, transportation systems, public services, and the enhancement of overall quality of life. Successful city management is based on solid principles that ensure sustainable growth, fair resource distribution and the well-being of citizens. This brief will explore the key principles in urban planning, city management, and the vital roles of various components in a city's functioning, while emphasising their influence on the design decisions.

#### Urban Development

Urban development refers to the process of planning and managing the growth and development of cities. Sustainable urban development can be defined as a dynamic process of synergetic integration and co-evolution among the great subsystems making up a city (economic, social, physical and environmental). This approach aims to ensure that the local population experiences a consistently high level of well-being over the long term, while also preserving the potential for development in surrounding areas. Furthermore, sustainable urban development seeks to alleviate the negative impacts of urbanisation on the biosphere, promoting a healthier and more balanced environment for both current and future generations (Bai, Roberts, Chen, 2016).

#### City Management Principles

1. Sustainability: Urban development should meet the needs of the present without compromising the ability of future generations to meet their own needs. This involves integrating environmental considerations into planning processes (Beatley, 2012).
2. Equity: Ensuring that all citizens have access to basic services, public spaces, and economic opportunities is essential for fostering inclusive cities. Urban policies should prioritise marginalised groups (Talen, 2018).

#### Role of Various Components Within the City

- Infrastructure: This includes transportation networks (roads, public transit), utilities (water, electricity), and communication systems. Well-planned infrastructure enhances connectivity of citizens between different parts of the city (suburbs). (Infrastructure Australia, 2016)
- Housing: Diverse housing options are essential to accommodate different income levels and family structures. Houses, apartments, townhouses all provide a different but common homely feel. (Squires, 2016).
- Public Spaces: Parks, monuments, and shops provide recreational opportunities and promote social interaction. These are crucial for enhancing quality of life and fostering community engagement (Gehl, 2010).
- Economic Activities: Local businesses and industries contribute to economic vitality and employment. Urban development should support a diverse economy by creating conducive environments for entrepreneurship (Florida, 2014).

## How the Components Influence Design

### 1. Resource-Utility Relationship

- The need to manage resource consumption influenced the design of each resource having 100,000 units
- Utility requirements led to creating the consume() function and critical threshold monitoring
- The connection between resources and utilities necessitated the ResourceDepartment class in the Government component

### 2. Citizen Interactions

- Citizens' daily activities shaped how different components connect:
  - Morning routine → Utility consumption (power for shower)
  - Work commute → Transport system design (buses, trains)
  - Workplace → Building system (malls, offices)
  - Income earning → Tax collection system
- This interconnected nature influenced our design to create clear communication channels between components

### 3. Infrastructure Dependencies

- Transport component design was influenced by:
  - Building locations (needed stations near malls)
  - Citizen work schedules (influenced transport schedules)
  - Government oversight (regulation and management)

### 4. Economic Flow

- The need to track citizen finances influenced:
  - Tax component design
  - Government component structure
  - Integration with work and building systems

## Conclusion

Our city simulation models a dynamic, sustainable urban ecosystem, starting with initial government funds and resources. Citizens enter the system through housing allocation. They utilise transport networks to commute between various building facilities - whether for work, shopping, or leisure. The economic cycle is sustained through tax collection from both working citizens and businesses, gradually replenishing government resources. This creates a realistic simulation where citizens' daily activities, from finding employment to using transportation and city services, directly impact the city's economic health through the tax system.

## References

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## Task 4.2: Design Pattern Application Report

The system consists of 8 components, namely Government & Departments, Resources, Utilities, Buildings, Citizens, Economy and Transport. The design patterns applied for these components are explained below:

### 1. Chain of Responsibility:

- *Government & Departments*: The health sector directs citizens to the appropriate medical facilities (clinics, general hospitals, or intensive care hospitals) depending on the severity of their illness. Each facility can handle only specific cases, passing citizens along the chain if necessary.
- ◆ UML Diagram: The Sequence Diagram shows the flow of requests between healthcare facilities.

### 2. Command:

- *Economy*: Encapsulates the request to collect taxes from businesses within the city. It creates a command for the tax collection process therefore making it easier to manage and schedule tax collection requests.
- ◆ UML Diagram: The Communication Diagram shows how the tax collection commands are executed for all businesses.

### 3. Composite:

- *Buildings*: Combines individual building objects into larger structures like suburbs, central business districts (CBDs), and industrial areas. This structure allows the system to manage groups of buildings as single entities while maintaining individual building properties.
- ◆ UML Diagram: The Class Diagram depicts the hierarchical structure of buildings.

### 4. Decorator:

- *Citizens*: Allows adult citizens to acquire additional responsibilities, such as having a baby, without altering the adult citizen class.
- ◆ UML Diagram: The Class Diagram shows how Decorator dynamically adds responsibilities to citizens using delegation.

### 5. Factory Method:

- *Citizen*: Provides an interface for creating citizens - adults or minors.
- *Buildings*: Provides an interface for creating different types of buildings - residential, commercial, industrial or landmarks.
- *Transport*: Provides an interface for creating the transport facilities (roads, railways and airports), transport modes (cars, taxis, buses and trains) and transport stations.
- ◆ UML Diagram: The Class Diagram displays the structure of the factories and their subclasses for creating various types of citizens, buildings, and transport.

### 6. Iterator:

- *Utilities*: Allows access to all the buildings in the city for garbage collection and handling sewerage.
- *Transport*: Allows the transport modes to iterate through their stops and/ or stations.
- ◆ UML Diagram: The Sequence Diagram demonstrates how iterators traverse through the vectors, providing an overview of accessing elements sequentially.

7. Mediator:
  - *Transport*: Allows communication between transport modes, updating each other when there's a state change in the transport facility.
  - ◆ UML Diagram: The Sequence Diagram shows communication flow between transport modes through the mediator.
8. Memento:
  - *Government & Departments*: Stores government policies thus allowing rollback of a new policy if the citizens have a negative reaction to the policy.
  - ◆ UML Diagram: The Sequence Diagram illustrates the process of storing, modifying, and reverting policies, particularly when a policy change needs to be reverted.
9. Observer:
  - *Economy*: Allows a business to link to a WiseBucks app which will be responsible for updating the business's accounts.
  - *Transport*: Allows the citizens to observe the state of a transport facility which will affect their mood depending on the state.
  - ◆ UML Diagram: The Sequence Diagram depicts the notification sequence when observable events occur.
10. Prototype:
  - *Citizen*: Facilitates the creation of new citizens by cloning an existing prototype.
  - *Buildings*: Facilitates the creation of new buildings by cloning an existing prototype.
  - ◆ UML Diagram: The Object Diagram shows instances of citizen objects created via cloning from a prototype.
11. Singleton:
  - *Government & Departments*: Ensures a single, accessible instance of the city's government, thus centralising control and resource access.
  - ◆ UML Diagram: The Class Diagram displays the Singleton's global access point and restricted instantiation.
12. State:
  - *Buildings*: To track the states of a building during its lifetime - under construction, completed construction or dilapidated.
  - *Citizen*: Allows citizens to react according to their moods - content, neutral or distraught.
  - *Resources*: To manage the distribution of resources depending on their states - surplus, balanced, shortage or critical.
  - *Transport*: To manage the transport facilities (roads, railways and airports) depending on their states - empty, normal or congested.
  - *Utilities*: To alter the behaviour of utility productions and service utilities depending on their states - operational, outage or maintenance.
  - ◆ UML Diagram: The State Diagram captures state transitions within components, thus illustrating the behavioural changes based on states.

13. Strategy:

- ➔ *Economy*: Applies the correct tax calculation strategy for a business based on the registration type with the WiseBucks app.
- ◆ UML Diagram: The Class Diagram shows the Strategy interface with concrete strategies for different tax calculations.

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## Task 5: Development Practices

### **Task 5.1: Git Branching Strategy**

