A CONCEPTUAL PHASE

Proposed Smart City, Digital Twin and AI Agenda for Port Moresby City

A delivery mechanism for the NCDC UDP 2030 focused on Urban Mobility and Affordable Housing

Presented by:

Raymond Bure

Strident7 Mapping

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INTRODUCTION

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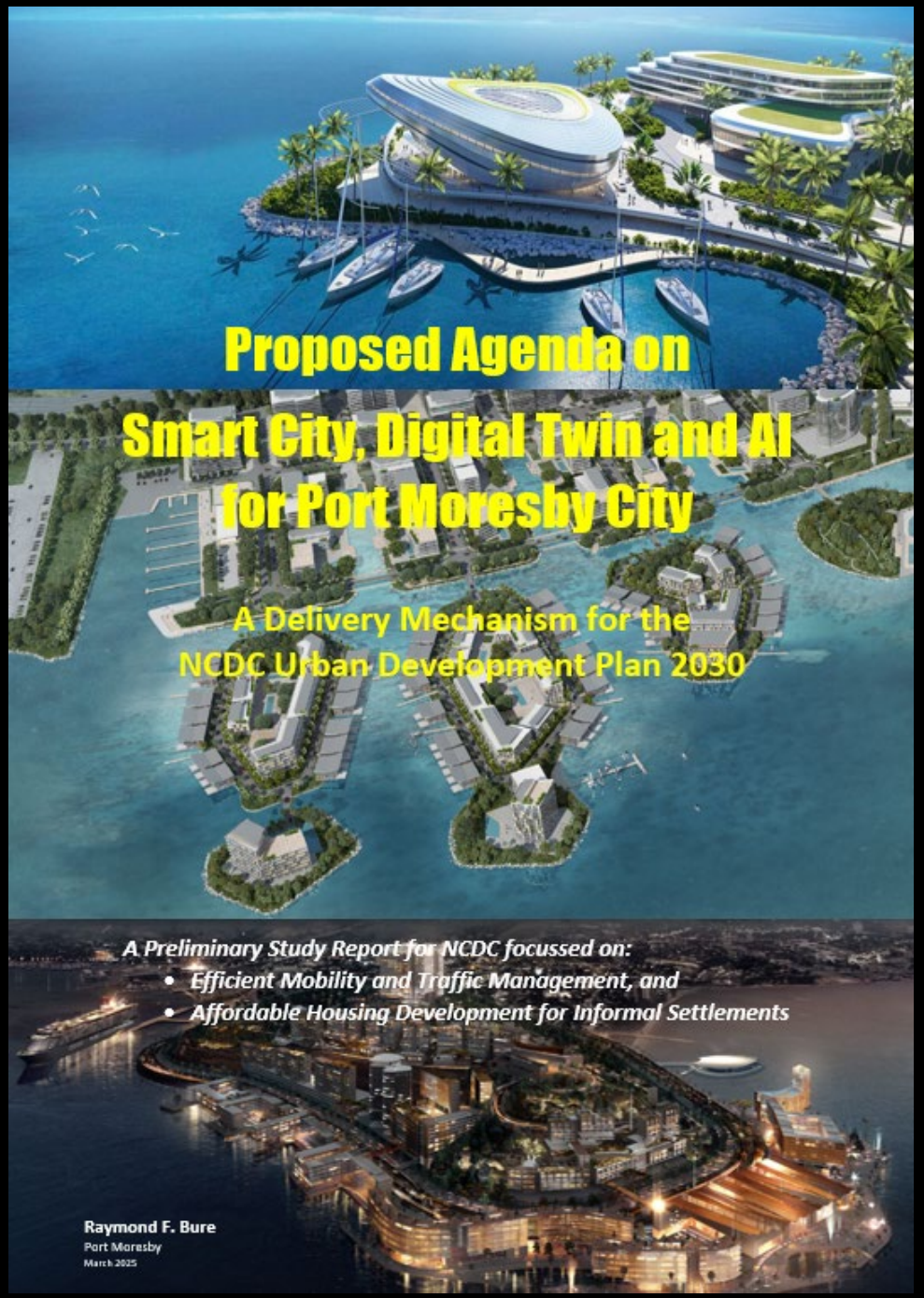


1. OVERVIEW

Objective – optimize urban planning, project management and asset maintenance as part of NCDC's compliance and oversight responsibilities

- Smart City – utilize advanced technology, big data, analytics and governance for enhanced and better urban living.
- Digital Twin – an advanced technology that replicates real-world objects, processes, or a city for the entire project lifecycle and provides real-time information through IoT sensors.
- AI – provides fit-for-purpose solution of the digital twin models through simulation of multiple scenarios for optimization.

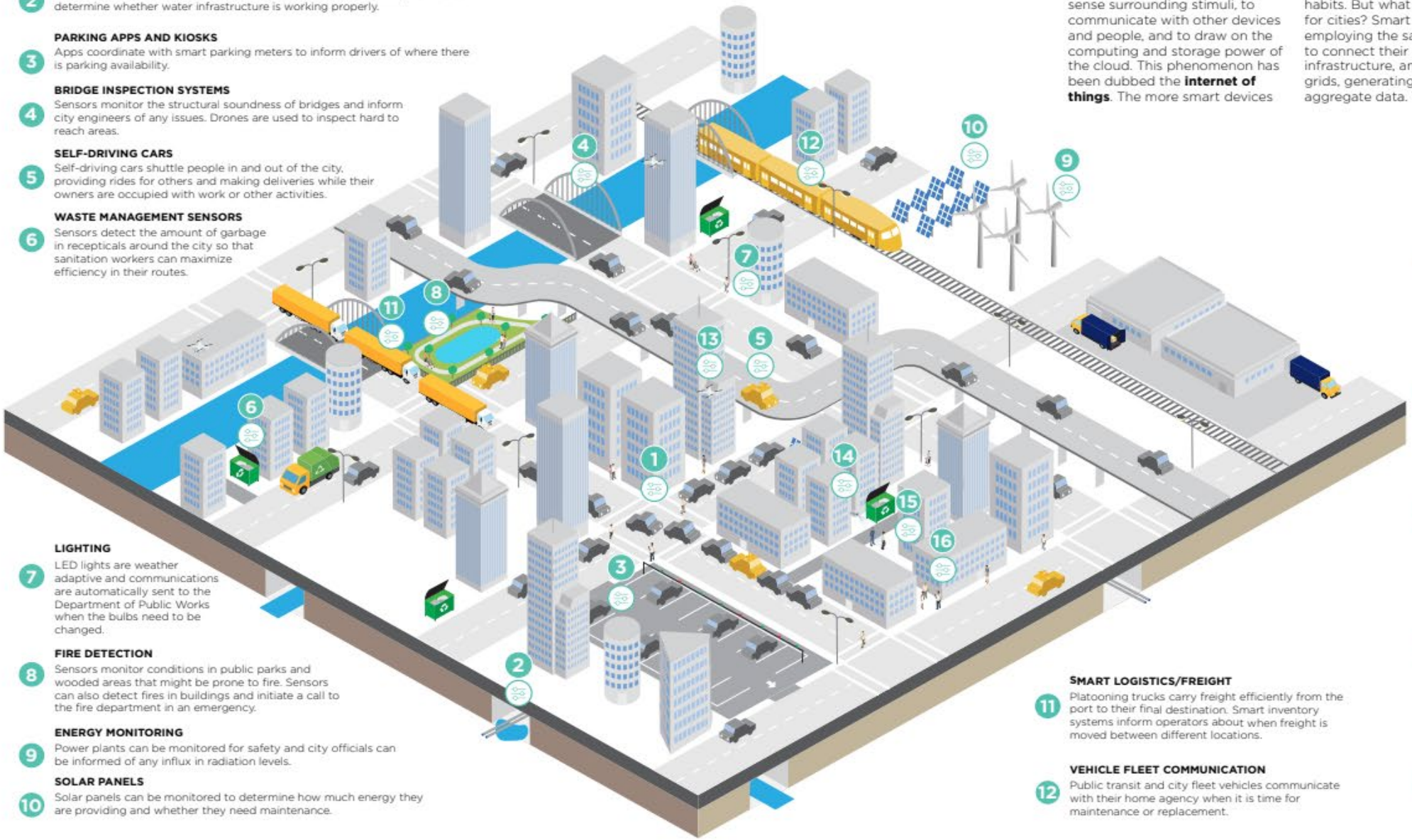
Smart City Concept

- A metaphor for the current urban development growth in Port Moresby:
  - Just like an old computer system – that is functional but slow, fragmented or incompatible, and prone to crashes, Port Moresby's current urban development operates with an outdated approach, legacy infrastructure, informal and disconnected systems.
  - The Smart City approach is the system upgrade – introducing advanced technologies, big data, analytics and governance to boost performance and productivity, connect every part of the city seamlessly and in real-time, and make it more responsive, efficient, and inclusive for all users.

INTERNET OF THINGS IN CONNECTED CITIES

Ref: National League of Cities, 2016

Every consumer product and piece of infrastructure increasingly has the ability to sense surrounding stimuli, to communicate with other devices and people, and to draw on the computing and storage power of the cloud. This phenomenon has been dubbed the **internet of things**. The more smart devices and sharing platforms there are, the more data is generated about consumer's preferences and habits. But what does this mean for cities? Smart cities are employing the same technology to connect their disparate utility, infrastructure, and public service grids, generating real-time aggregate data. This, in turn, can help cities manage their programs and services more effectively and gauge their impact immediately. The city of the future is an interconnected one, where devices communicate with one another in a constant stream of data that provides real-time information to the public and to the municipality.



1. **TRANSPORTATION CONGESTION SENSORS**
Smart transportation systems use sensors to detect congestion and bottlenecks in traffic patterns. They also rely on cameras to enforce speed and traffic infractions. In doing so, these tools gather real time information that can be used by city DOTs to make mobility networks safer and more efficient.

2. **WATER AND WASTEWATER MONITORING**
Monitoring devices can detect leaks as well as changes in water pressure to determine whether water infrastructure is working properly.

3. **PARKING APPS AND KIOSKS**
Apps coordinate with smart parking meters to inform drivers of where there is parking availability.

4. **BRIDGE INSPECTION SYSTEMS**
Sensors monitor the structural soundness of bridges and inform city engineers of any issues. Drones are used to inspect hard to reach areas.

5. **SELF-DRIVING CARS**
Self-driving cars shuttle people in and out of the city, providing rides for others and making deliveries while their owners are occupied with work or other activities.

6. **WASTE MANAGEMENT SENSORS**
Sensors detect the amount of garbage in recepticals around the city so that sanitation workers can maximize efficiency in their routes.

7. **LIGHTING**
LED lights are weather adaptive and communications are automatically sent to the Department of Public Works when the bulbs need to be changed.

8. **FIRE DETECTION**
Sensors monitor conditions in public parks and wooded areas that might be prone to fire. Sensors can also detect fires in buildings and initiate a call to the fire department in an emergency.

9. **ENERGY MONITORING**
Power plants can be monitored for safety and city officials can be informed of any influx in radiation levels.

10. **SOLAR PANELS**
Solar panels can be monitored to determine how much energy they are providing and whether they need maintenance.

11. **SMART LOGISTICS/FREIGHT**
Platooning trucks carry freight efficiently from the port to their final destination. Smart inventory systems inform operators about when freight is moved between different locations.

12. **VEHICLE FLEET COMMUNICATION**
Public transit and city fleet vehicles communicate with their home agency when it is time for maintenance or replacement.

13. **DRONES**
Drones can be used for law enforcement and firefighting, as rural ambulances, for infrastructure inspections, and for environmental monitoring. Commercial uses include precision farming, aerial photography, and in the near future, package delivery.

14. **SURVEILLANCE CAMERAS**
Cameras ensure security by monitoring activity in areas that are not frequented by public safety officers. Areas that are not open to public access can be monitored to keep unauthorized personnel out.

15. **BODY CAMERAS**
Public safety officers can wear body cameras that capture footage of interactions between themselves and city residents to ensure safety for both parties.

16. **WEARABLE DETECTION**
Cities can build in smartphone and wearable detection sensors so that people can be an active part of the internet ecosystem, communicating with the city, and with each other.

17. **BROADBAND INFRASTRUCTURE**
A reliable internet ecosystem is the glue that holds the internet of things together.

Vision and Objectives

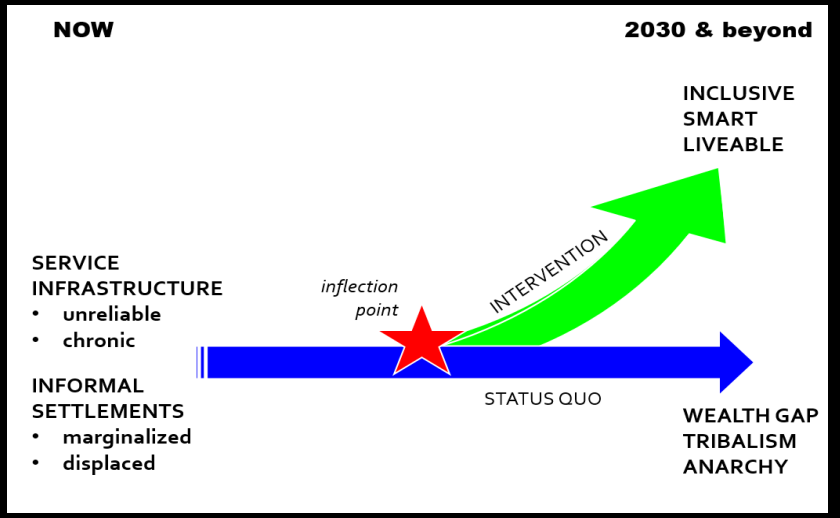
- Vision:

  A smart, liveable, inclusive, and sustainable Port Moresby city that manage and deliver safer, more efficient services and economic opportunities to its residents, businesses and visitors.

- Objectives:

  Transform Port Moresby city into a sustainable, inclusive, efficient, and resilient urban environment by leveraging advanced technologies for data-driven planning, real-time decision-making, and improved quality of life.

2. PROBLEMS



- Current Situation
  - Accelerated population growth
    - projected population of Port Moresby is 1 million by 2030 (Singapore – nearly 6 million people in 2025)
  - Rapid urbanization
    - Inadequate service delivery (utilities, transportation, housing, law & order, education, health)
    - Increased cost of living, high unemployment rates and widespread poverty
  - Adverse climate change impacts
    - natural hazards – flooding, coastal erosion, drought, urban heat, cyclone

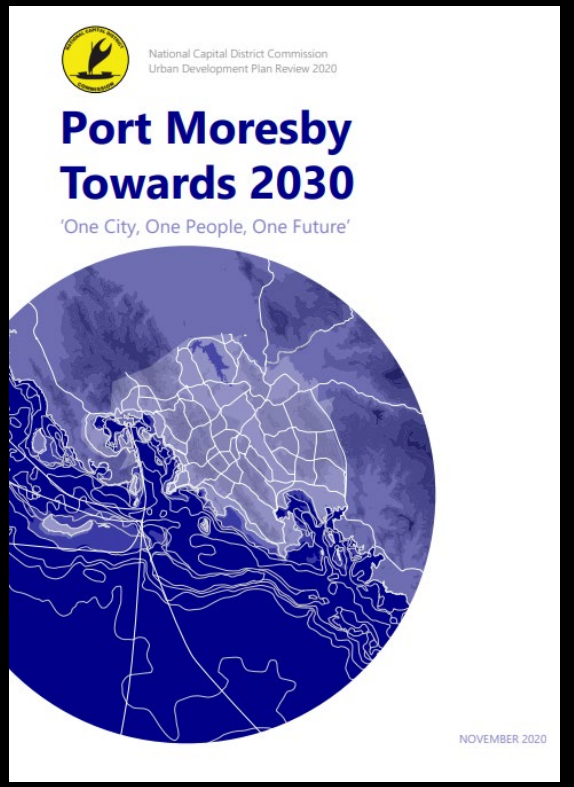
Mobility and Housing Issues

- Urban Mobility (road transport corridor)
  - Poor public transportation system and traffic congestion
  - Limited ring roads to re-distribute traffic flow from high density areas
  - Deteriorated road and drainage infrastructure

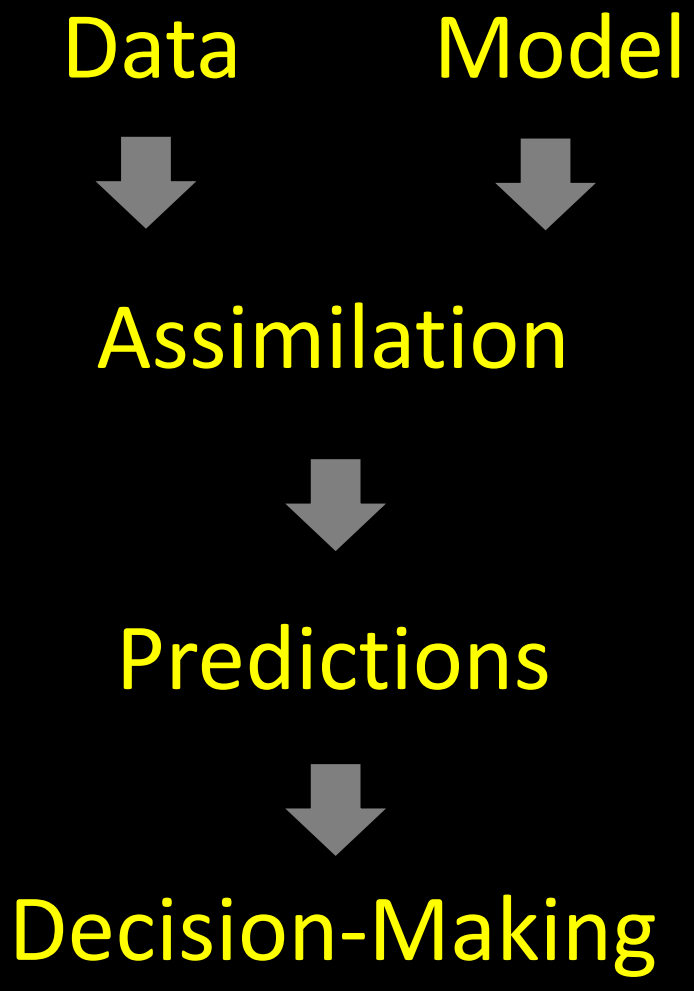
- Affordable Housing (informal settlement)
  - Proliferation of informal settlements with nearly 50 % of Port Moresby's population
  - Lack of legal land tenure, no subdivided parcels, substandard housing, and inadequate basic services
  - Require more accessible land for development to achieve economies of scale

3. CONTEXT

- Smart and innovative solutions aligned with NCDC's UDP 2030 to improve standard of living and quality of life
  - Reducing traffic congestion and road safety by providing efficient transportation routes and better road infrastructure
  - Improving safety and security with smart streetlights, video surveillance and efficient enforcement in real-time
  - Cost-effective, safe, eco-friendly, prefabricated modular homes in subdivided allotments with titles connected to services within newly created and formalized suburbs



Basic elements of Digital Twin Modeling and AI Simulation



- Big Data
  - Static (BIM, GIS, Surveys), Real-time (cloud-based IoT sensors), Contextual/historical (climate, socio-economic, regulatory)
- Model
  - ML and physics-based that encode the governing laws of nature in order to make predictions
- Dynamic Assimilation
  - Integrates big data with models and then continuously update the model to evolve with new current data (IoT sensors)
- Predictions
  - Generates fit-for-purpose solutions providing recommended intelligent foresight based on particular future scenarios
- Decision-Making
  - Make evidence-based decisions instead of trial and error.

Examples of Software Enterprise Platforms

- GIS environmental modeling
  - ArcGIS Enterprise Software tools (ArcGIS Online, ArcGIS Pro, ArcGIS Urban, ArcGIS CityEngine, ArcGIS GeoBIM, ArcGIS GeoAI, ArcGIS Dashboard, etc.)
- BIM engineering design
  - Autodesk Suite (Revit, Civil 3D, InfraWorks, AutoCAD Map 3D, etc.)
  - Bentley Systems (MicroStation, OpenBuildings, etc.)
- Digital twin modeling and AI simulation
  - NVIDIA Omniverse
  - Altair Digital Twin Platform
  - Cityzenith
  - Hexagon – Urban Digital

Recommended Hardware & Specifications

- Processor (CPU) – multiple cores and high clock speeds
  - AMD Ryzen 9 7900x or Intel Core i9-13900K
- Graphics Card (GPU) – accelerates rendering, 3D visualization and AI-based tasks with at least 32 GB of VRAM or more (video gaming)
  - NVIDIA RTX 4070 or AMD Radeon RX 7800 XT
- Memory (RAM) – fast storage, quick boot-times, rapid data access and additional storage
  - Primary (OS and applications) – 1 TB
  - Secondary (Data storage) – 2 TB
- Motherboard – multiple slots
  - ASUS ROG Crosshair X670E Hero or MSI MEG 2790 ACE

4. SOLUTION – SMART CITY APPROACH

- Smart and innovative solutions to improve standard of living and quality of life for all city residents, businesses and visitors
  - Reducing traffic congestion and providing efficient transportation by making it easier and safer to move around
  - Improving safety and security with smart streetlights, video surveillance and efficient enforcement in real-time
  - Improving air quality and open green spaces to make the surrounding environment more liveable and pleasant for improved public health

PNG Government's Commitment to Digital Transformation

- PNG Government Plan 2023 – 2027
  - Accelerate digital transformation – modernize public sector
  - Enhance service delivery – provide integrated public services across digital platforms
  - Promote data-driven governance – evidence-based policy-making, decision-making

- Strategic Partnership with the Chinese Government (MOU, 2024)
  - Alignment with national policies – Digital Transformation Policy 2020, etc.
  - Technology collaboration – AI, IoT, cloud computing, blockchain, smart cities, etc.
  - Infrastructure development – Citizens' eGovernment Portal, NBC's transition, etc.

Key Intervention Area 1 – Urban Mobility

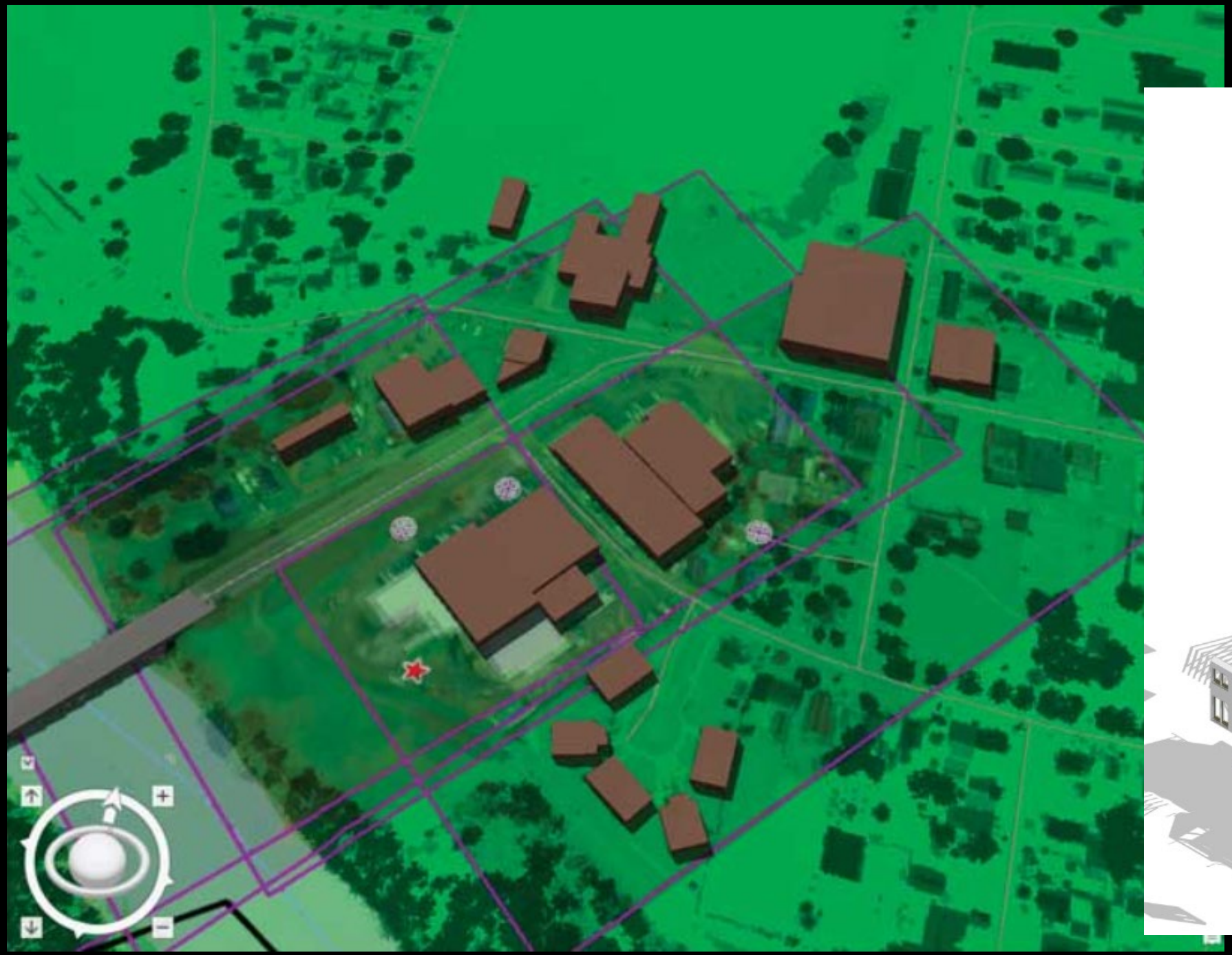
- Efficient Mobility – enhance NCDC's Integrated Transport Master Plan
  - A digital twin of the transport network to simulate multiple/different mobility scenarios, allowing planners and engineers to test policies before actual implementation
  - A smart city mobility framework that integrates digital twin, IoT, AI, BIM and GIS technologies for real-time monitoring and decision-making
  - Big data analytics and AI-driven simulations can predict peak-hour traffic trends to optimize road use and vehicle flow
  - Using GIS mapping and IoT sensors, the system can monitor physical road conditions and detect potholes for faster maintenance, track carbon emissions to enforce environmental policies, etc.

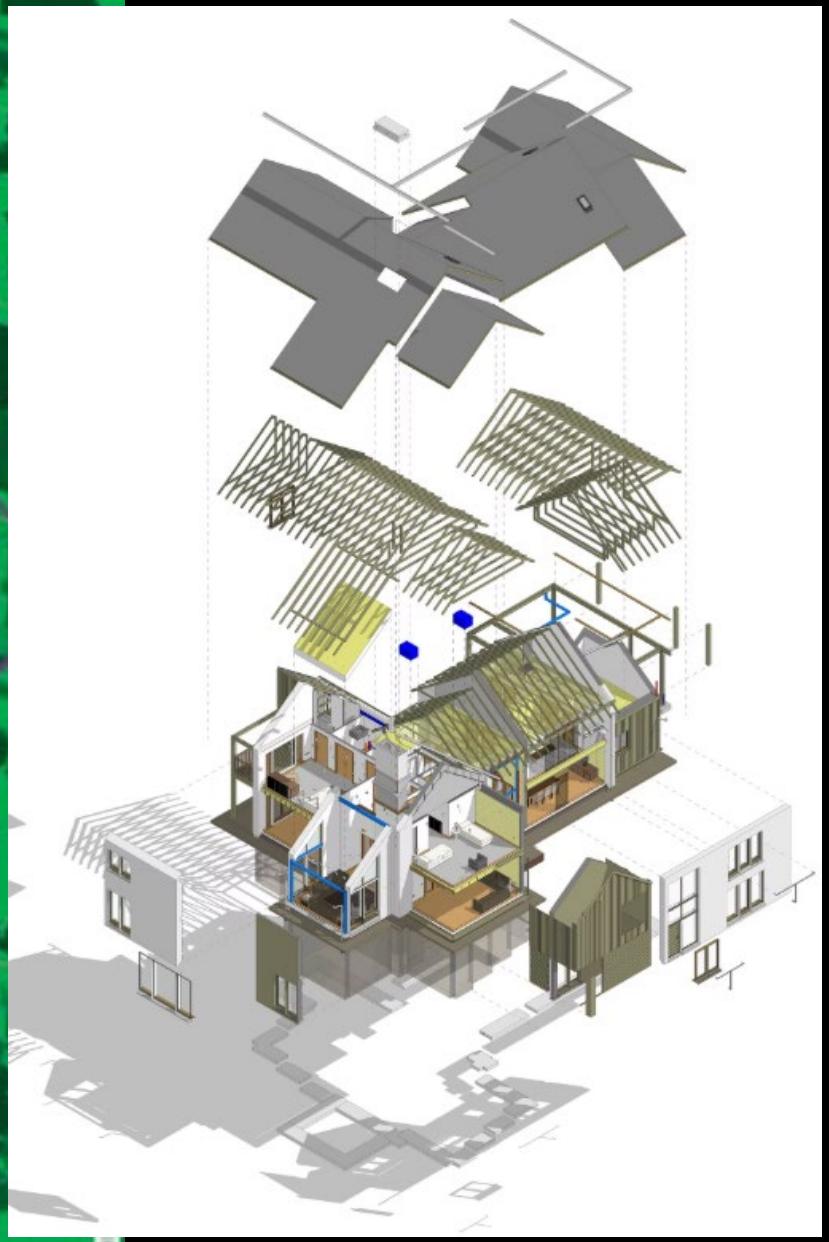
Digital Twin of a Road Infrastructure

Key Intervention Area 2 – Affordable Housing

- Affordable Housing – development upgrade under NCDC's Settlement to Suburbs Program
  - BIM design of prefabricated modular homes for onsite construction, scheduling and project costing
  - GIS environmental modeling of vulnerability to natural hazards especially flooding, zoning/building policies to determine site suitability for subdivision planning
  - Blockchain-based land registry to administer land tenure of subdivided land parcels
  - BIM – GIS integration to build digital twins for the affordable housing development
  - Using digital twins and AI-driven simulations of multiple scenarios to generate fit-for-purpose solutions to enable construction to take place

Digital Twin of an Informal Settlement





5. RECOMMENDATIONS

Launch NCDC's Smart City Working Group

- Engage with key stakeholders and development partners
- Assess possible opportunities for smart city project funding and technology procurement
- Undertake pilot projects of key intervention areas in urban mobility and affordable housing
- Assess a proposed framework of the smart city strategy for Port Moresby city
- Determine a possible roadmap for investigation, adoption and implementation of the Smart City, Digital Twin and AI agenda for Port Moresby city

“Thank You!”