# Abstract

NASA Control Room concept is an innovation strategy in Construction under the smart city context. By utilizing the NASA Control Room concept in Construction Industry, it can solve the long lasting problem such as ….. and fulfil the recent work from home concept by enhancing the collaboration between different stakeholders and effectively manage the data during the **design** and **construction** stage. It also provides insight to managers to set-up strategies and policy to enhance the safety during the **construction** and **operation** stage of a construction project. This dissertation is developed under the Mace Group sustainability and development concept.

With the emerging technology IoT (Internet-of-Things), the data of the environment and the human action can be captured for making effective decision. The sensor data is collected by Raspberry Pi from xx-July-2020 to xx-Aug-2020 in a local factory in Hong Kong to demonstrate the entire control room concept. This dissertation also provides different ways to visualise the data captured which can be used as a prototype for different parties in AEC industry for making decisions. It shows that the BIM360 working platform and online viewer can demonstrate the real time environment and collaboration of the site in a simple way. The VR Viewer can let us identify the site constraint remotely….. And the power BI dashboard can provide insight from the sensor data to……….

Besides, this dissertation also discussed what types of sensory data should be captured to make these visualisation techniques more useful. It is found that ………. The potential development of the control room can be much further investigated.

# Introduction

-Current Nature of Construction industry

-> How big and its importance to economy?

-Industry Problem on:

-> Collaboration, Information Management

-> Safety

Construction is a very big industry over the world,

but it has a lot of problems such as high death rate of workers, over budget and poor scheduling of the projects over the years. And it is a fragmented industry, the information is not well-manged. Under the current smart city initiative, digital transformation of different industry has been raised and construction industry is not excluded.

-Smart City Context

-> How smart city context to solve the problem:

Regarding to the recent development of technology such as IoT devices which become widespread and affordable, we can make use of the NASA control room concept to visualise a prototype and collaborate each other in real time (<https://info.expeditors.com/horizon/rise-of-the-digital-twin>) in construction field to solve the long lasting problems with the “digital twin concept, we can visualise the sensor data captured by the IoT device in real-time with the BIM (Building Information Modelling) model so that professionals can collaborate together to ensure the environment is healthy and safe for the workers to work and project manager can make decision based on these data.

-NASA Control Room

->can NASA control room to solve these industry problems?

In the past, people using the NASA control room to rapidly account for changes to the space vehicle exposed to the extreme conditions in space, and with lives on the line. They use the “pairing technology” to simulate the outer space with the mathematical models so that the engineers and different professional can collaborate in the control room and make decision based on the mathematical model.

-Virtual Control Room

Also, regarding to the current unstable political situation such as Brexit, a lot of European professional might not be able to sit together to work in UK and the disruption by the pandemic COVID-19, a work from home (WFH) practice has been raised recently. The Control Room should be in a virtual form so that professionals can access to it anytime and anywhere with internet.

-Research Objective

This dissertation is aimed to answer the below questions:

* What elements of a control room is required to solve the long-lasting problems of a construction project in different stages?
* Compare the control room set-up and visualisation technique with other industry
* What types of visualisation technique can be used to with the sensor data to give insight?
* What types of sensor data should be captured and what data standard should be formulated?

-Research Contribution

This dissertation frames the setting of the control room that contribute in different stages of construction project and use a case study to visualise the data from sensors and mock anonymous data in practice. It provides an overview of the core visualisation technique of a control room that can be used in the construction industry. It focuses on three visualisation techniques with the data: Online model viewer, VR and PowerBI dashboard. Online model Viewer can …… , which is ……. VR can ……. While Power BI can help managers to make decision in advance, so that efficiency can be enhanced.

It also illustrates what data standard should be formulated to improve the data management, which makes a sustainable development of a construction project. This can act as a reference in the construction industry.

-Structure of the Report

# Literature Review

-Smart City

(What is smart city)

Many papers and reports referring the smart city concept arisen from the population growth, urbanisation, and an opportunity to capitalise on the economic return through the growth of using technology. According to (Cosgrave, 2017), optimisation, efﬁciency and control are the core elements of smart city. Besides, there is a view that the more information, the city could be managed better with the “everyware” of the city, suggested by (“Everyware: the dawning age of ubiquitous computing,” 2006) as It allows the society to develop better in a normal way. For example, trafﬁc ﬂow data can help in rerouting vehicles in real time and identify congestion hotspots so that longer-term planning is improved, and citizen science can revolutionise research and virtual learning will transform education practices. Perhaps the greatest promise of all is that the smart city holds the possibility to integrate these systems effectively for the ﬁrst time. By modelling the interrelationships between multiple city systems, the opportunities for efﬁciency multiply.

(Gap of Construction Industry to technology)

There are many emerging technologies in the construction industry. However, ….(ARUP report)

(NASA Control Room

-> Traditional NASA Control Room

-> how control room to fill the gap)

(Other Industry

->How other industry use control room concept?)

(Current development on:

* Real Time Sensory Data
* BIM360 + Forge
* PowerBI Dashboard

How these things to solve the problem)

# Methodology

-System Architecture of NASA Control Room in Construction **(virtual)**

-> How the ecosystem works

-Sensor Data

-> how the sensor to collect the data

-> How the microcontroller works

-Web Server

-> How the Azure database build

->How the endpoint to be build

-Infrastructure for visualisation

-> How BIM360 + Forge: Viewer

-> How PowerBI Dashboard to be built

-Field Test and Data Collection **(physical)**

->Site Description

->how sensor set up and collect data in the factory

->Revit Model Specification

Reference

Cosgrave, E. (2017). The smart city: challenges for the civil engineering sector. *Proceedings of the Institution of Civil Engineers - Smart Infrastructure and Construction*. https://doi.org/10.1680/jsmic.17.00012

Everyware: the dawning age of ubiquitous computing. (2006). *Choice Reviews Online*. https://doi.org/10.5860/choice.44-1568