Engineering Research Showcase:

Cross-disciplinary engineering projects for improving learners' capabilities and community

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Wintec
WAIKATO INSTITUTE OF TECHNOLOGY
Te Kuratini o Waikato

Outline

- Introduction
- Showcase 1: Mechanical Engineering
- Showcase 2: Civil Engineering
- Implication & Conclusion

Introduction

Final Year Engineering Project

- Level 7 Engineering Projects: Final year project for BEng Tech and Grad Dip
- Civil, Mechanical, Electrical, Power and Mechatronics
- Annually 50+ Individual/Group projects
- Theory + Practical + Work-ready Skills

Section 1:
Development of
Cross-disciplinary Engineering Project

Background

Establishing a Cross-Disciplinary Engineering Project

Primary Focus on Student Centered Learning

Development of CME Discipline Based Model

Background

- The absence of models/showcases in Engineering Campuses nationwide, results in traditional theory-based learnings for students and makes it difficult for new students to navigate around the campus and attract in Engineering.
- Development of Engineering Showcase establishes mental connection to people's mind to explore engineering
- Establish the presence of Engineering Applications in technical institutes and universities
- Support academics in their teaching and equip Interactive features for students to learn about Civil, Electrical & Mechanical Engineering

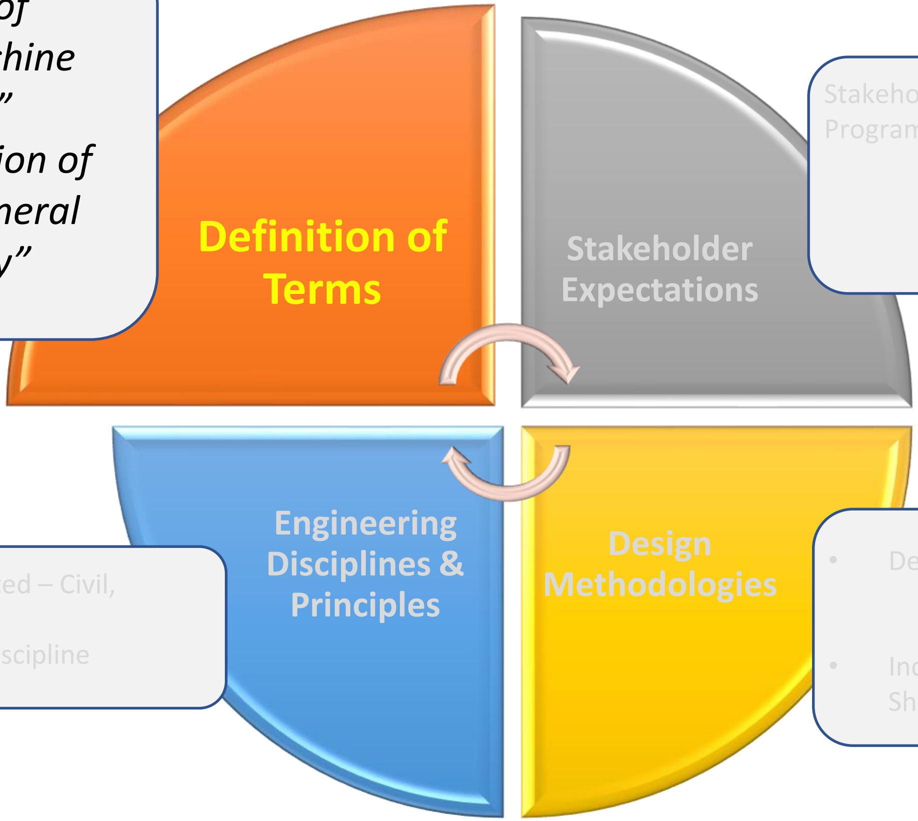
Project Aim

Define & Develop an Interactive Engineering Showcase Concept Design for Educational Sector

The Bucket Fountain is an conic kinetic sculpture in Wellington

Design Process

- *“Interactive” – “An exchange of information between the machine & user, which influences Both”*
- *“Showcase” – “The presentation of Engineering Faculty to the general public in the best possible way”*

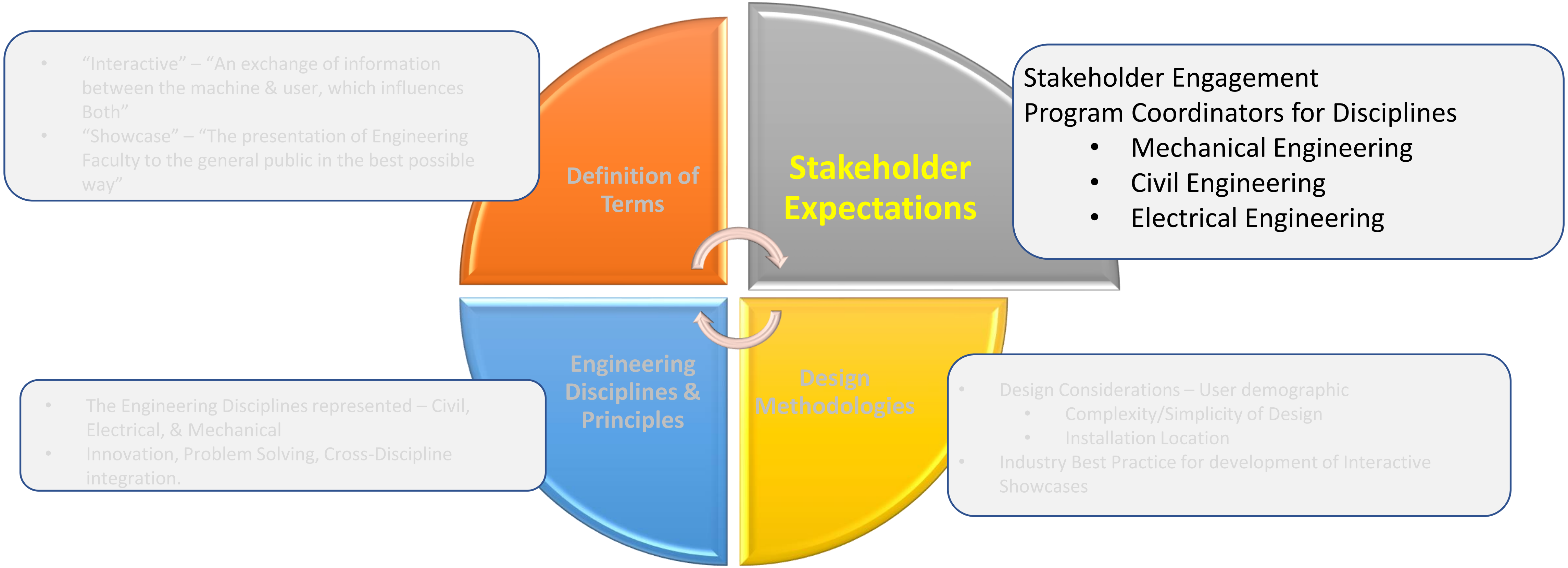


Stakeholder Engagement
Program Coordinators for Disciplines
- Mechanical Engineering
- Civil Engineering
- Electrical Engineering

- The Engineering Disciplines represented – Civil, Electrical, & Mechanical
- Innovation, Problem Solving, Cross-Discipline integration.

- Design Considerations – User demographic
  - Complexity/Simplicity of Design
  - Installation Location
- Industry Best Practice for development of Interactive Showcases

Design Process



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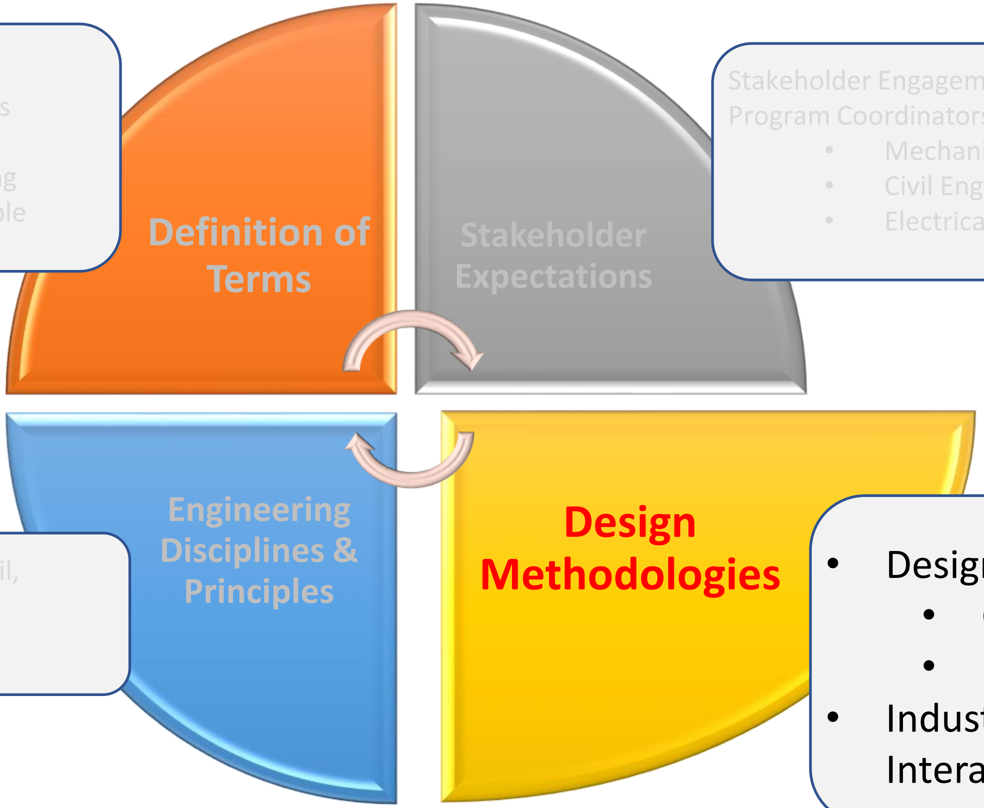

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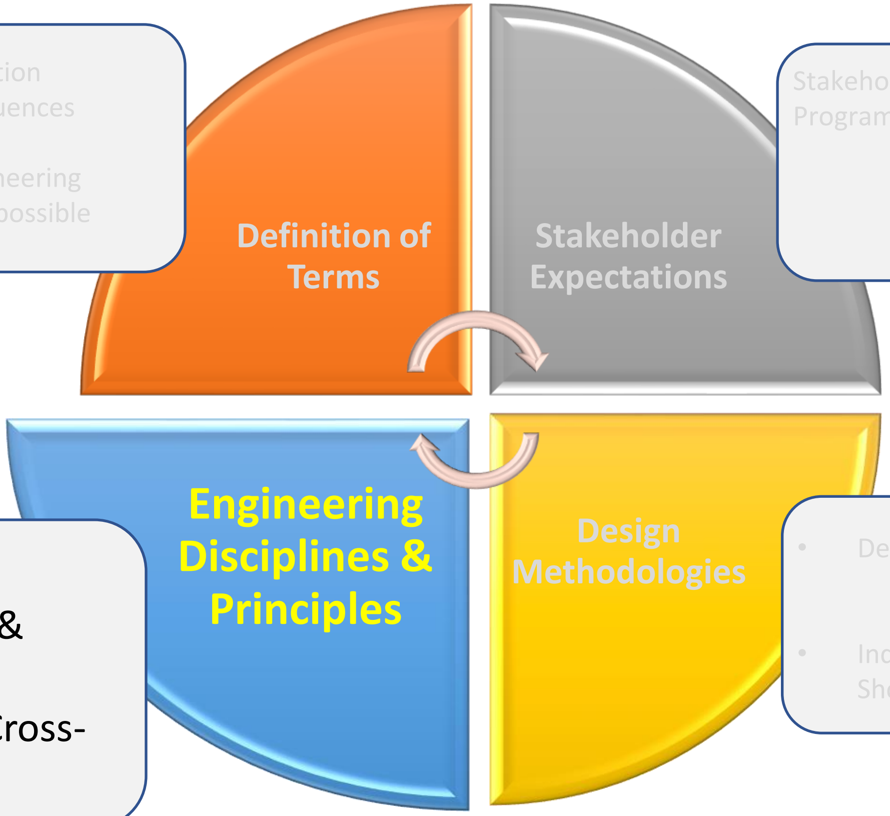

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Project Procedure

Define Parameters & Expectations	Stakeholder Engagement Physical Parameters
Research	Define Terms Design Methodologies
Design Concepts	Design Rubric Individual Design concepts
Design Evaluation	Design Rubric/Stakeholder Input Final Design Selection
Final Design	CAD Designs/Model Finalize Concept
Project Finalized	Report & Presentation Promotional Material

The Working Principle

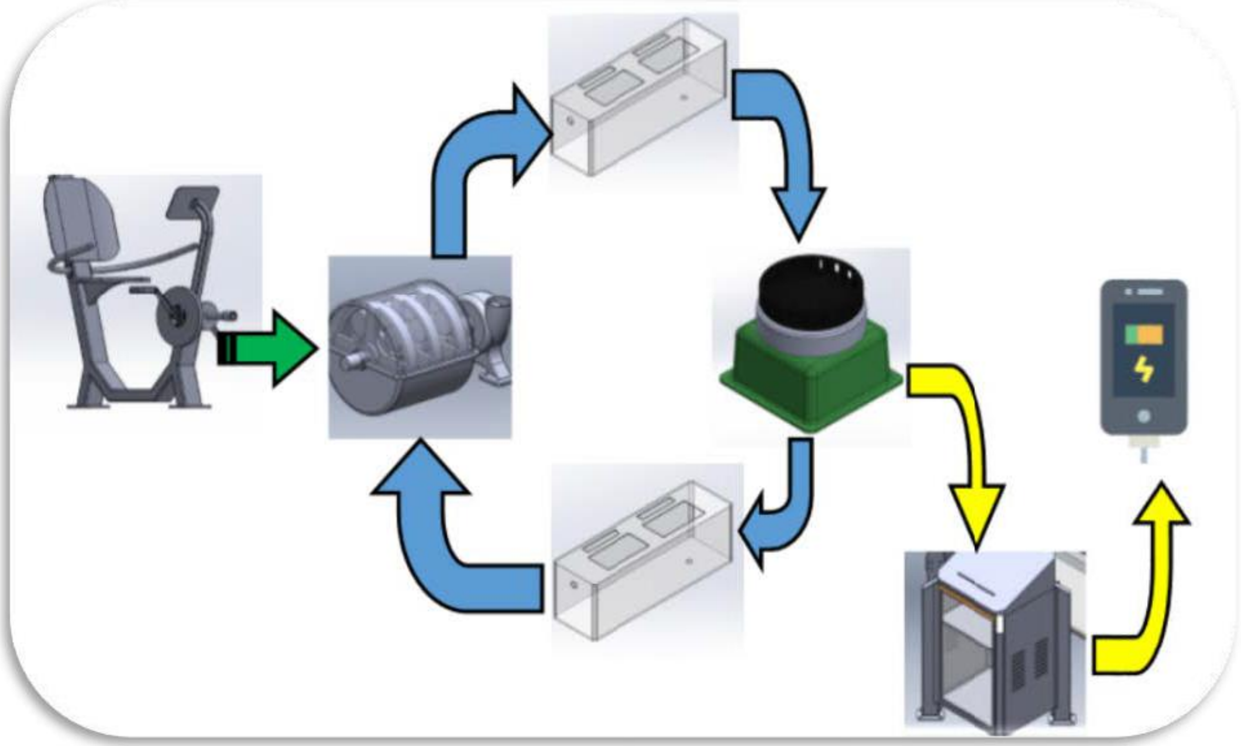
1. The user inputs mechanical rotational energy by pedaling the exercycle.

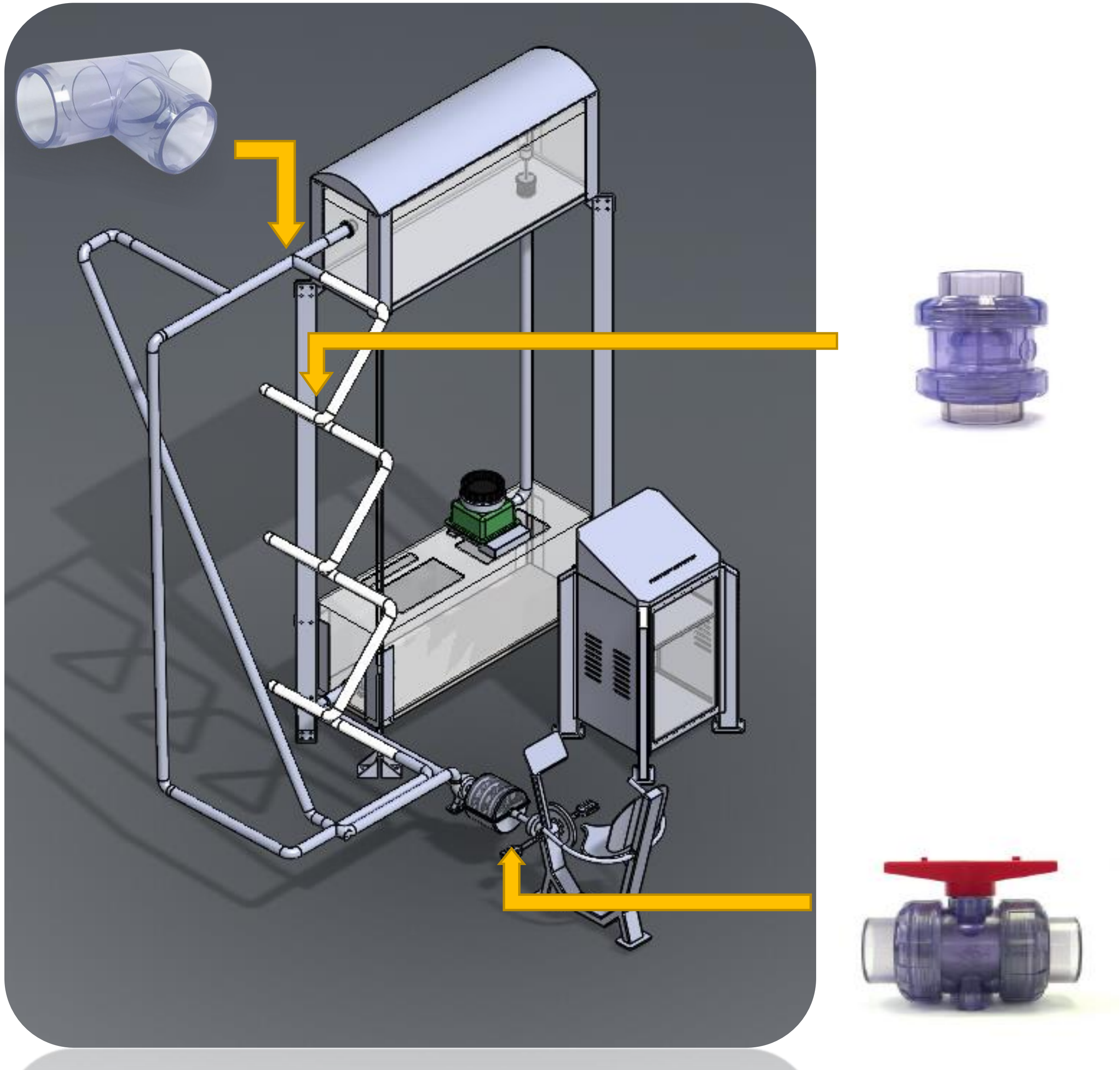
2. The mechanical energy is transfer to the pump via a gear train which converts the user input (30 rpm approx.) to the optimal pump operating speed (2900 rpm)

3. Pump uses water from the lower reservoir to the upper reservoir via one of three flow paths which the user can select by opening or closing flow valves.

4. Once the water reaches a given height, it then flows back to the lower reservoir via a micro hydro generator, which in turn generates electrical energy.

5. The electrical energy is then stored in a power bank and can be used by the user to charge a digital device.





Fluid Flow Paths

All pipe work is to be constructed out of Clear PVC pipe such that the user can observe the flow of fluid through the system.

Additionally the associated valves and fittings are to be constructed out of clear acrylic as to follow the design aesthetic to allow the user to observe fluid flow through the system.

2” Schedule 40 PVC Pipe, (Clear)

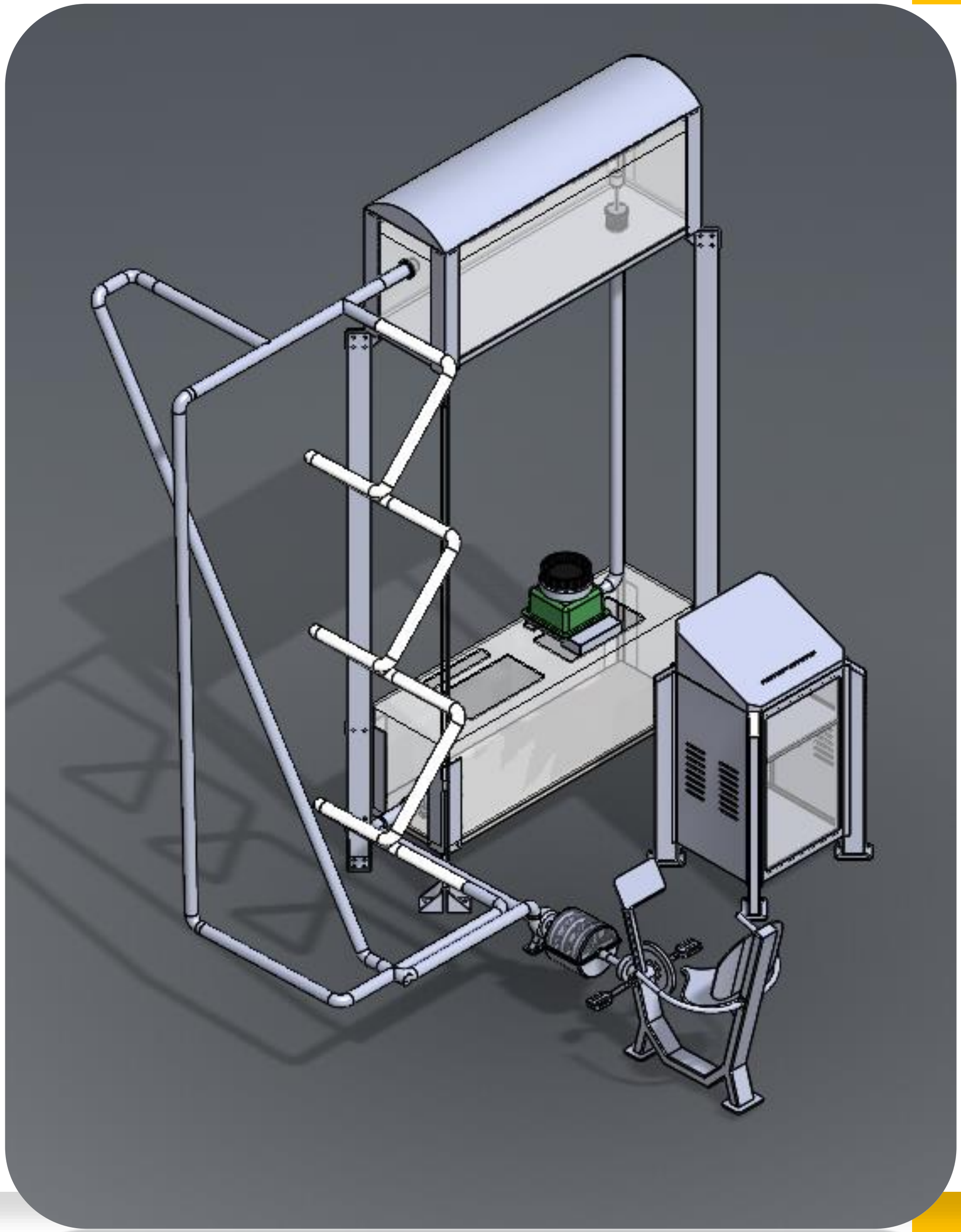
Valves are made from clear Acrylic

Fittings are made from clear Acrylic

Proposed CME Engineering Model

Design Consists of the following Elements:

- Structural Elements of the Model is made from 6mm think Stainless Steel
- Upper & Lower Reservoir tanks
- Multiple flow paths from lower reservoir to upper reservoir.
- Exercycle – (user input)
- Gear Box/Power Train
- Micro Hydro Turbine
- Power Bank (Energy Storage)
  - *3x Batteries*
- Power Control Unit for Batteries
- Power inverter



Further Research and Development

QR Code

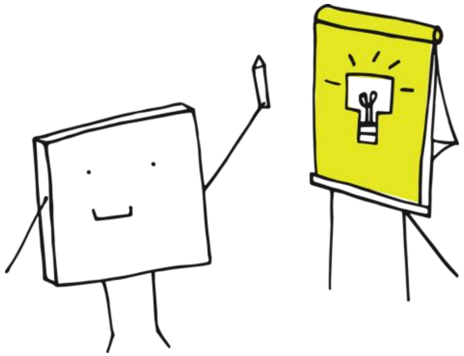
Development of QR Code linked digital content related to model

Web Development

Development of the aesthetic elements of the Showcase location

Teaching Applications

Use of the Showcase as a demonstration case for teaching principles of Engineering



Section 2: Improve transport accessibility for the rural community

A Study on the Introduction of Demand-Response Transport System to New Zealand

Project Background

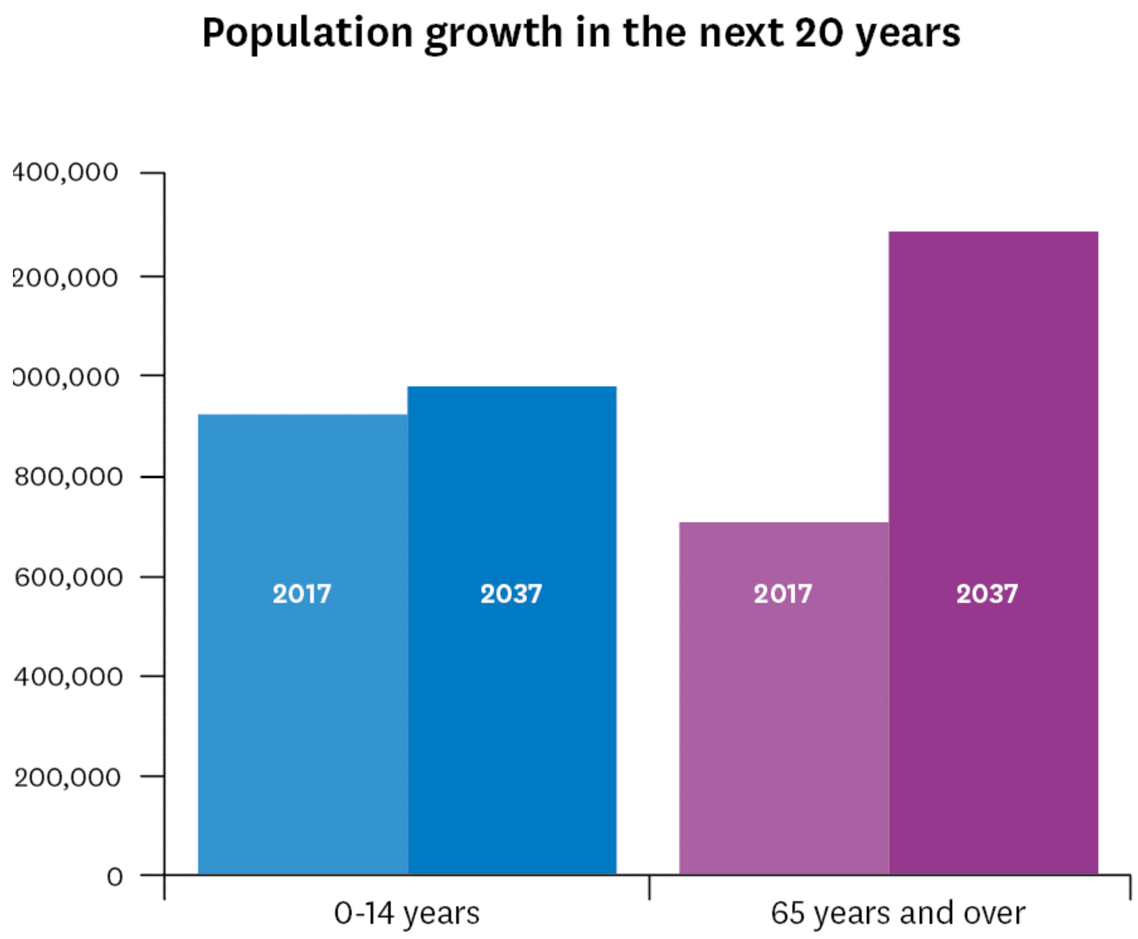
Trend of Elderly Population in NZ

Travel Behavior: Modal Share

Case Study

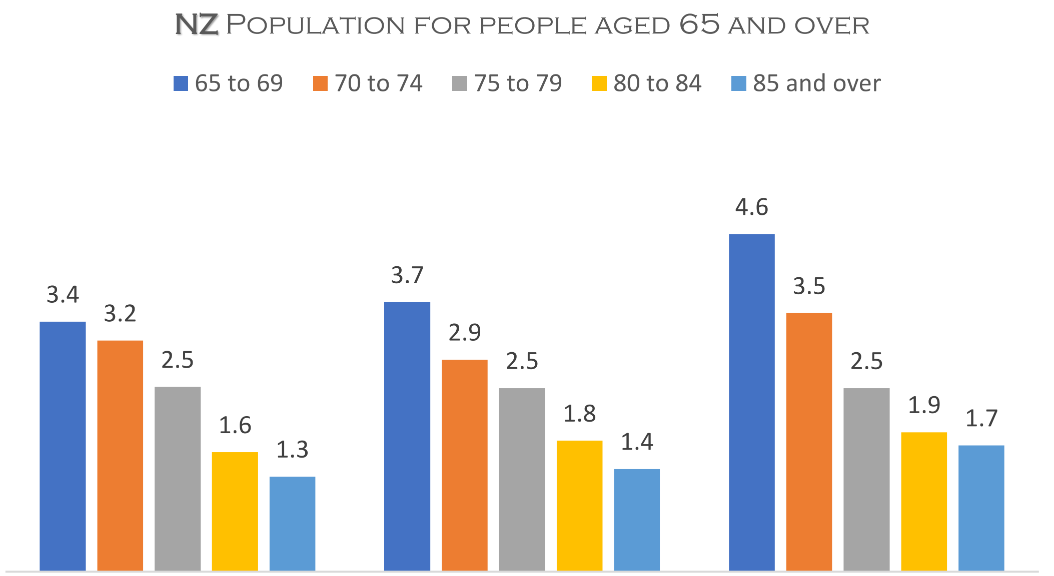
Background

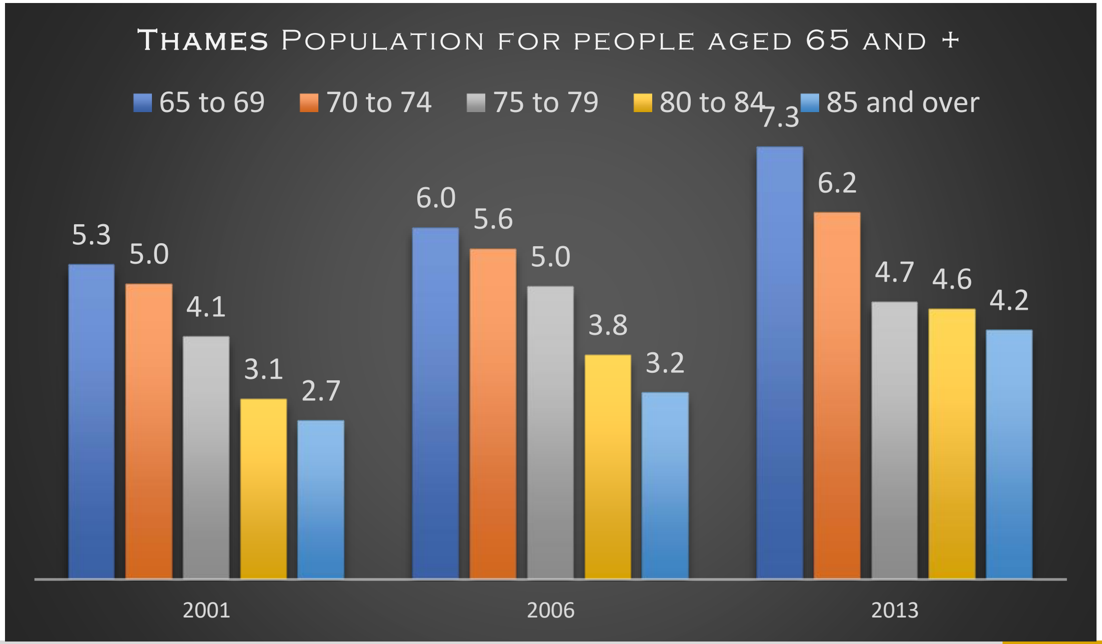
- 14.3% of the total New Zealand population is classified as elderly and will roughly double in 2046 with 1.3 - 1.5 million (or 23 %) of the total population.
- Not many transportation options for elderly people in rural areas or small town in NZ.
- Hard to make normal transportation in rural areas or small town because of low population and funds.
- Demand Responsive Transport (DRT) system is needed in rural areas or small town.



Travel Behaviour & Case Study

- Driving declines to around 60-65% of mode share and walking and passenger mode share time increases. After age 65, the number of hours travelled/week drops dramatically
- Thames, Waikato is a popular location to live for people aged 65 and over
- The study in transport for the elderly in Thames investigated the option for a Demand Responsive Public Transport (DRPT) service
- Surveyed over 200 elderlies age 65+ in Thames and Tokoroa, Waikato



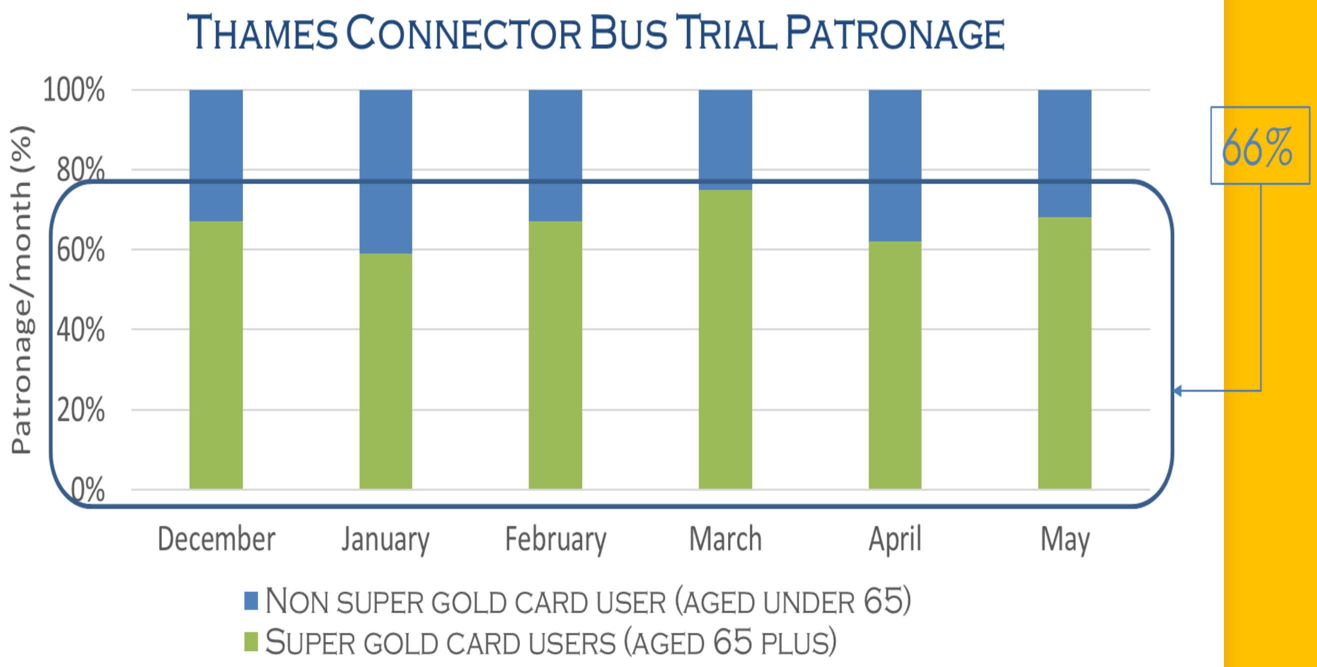


DRT vs PT (Public Transport)

- ✓ Door to Door service
- ✓ No fixed schedule or route
- ✓ Short booking period
- ✓ Suitable for areas of low passenger demand
- ✓ May fully funded or partially funded

(i.e. U.S., U.K., Switzerland, etc.)

✓ Ridership Data from the 6-month trial bus service in Thames



✓ In comparison, % of bus users over 65 in age

- Palmerston North: **4.8%** (50,668)
- Whanganui: **26.4%** (38,396)
- Feilding: **9.9%** (8,686)
- Ashhurst: **12.1%** (676)

Methodology

- Demand Responsive Public Transport (DRPT) Service
- RP & SP Survey
- Econometric Modelling

Analysis: Travel Behaviour

Trip Destination

1. Shopping
2. Social

Use of Mode

1. Own Vehicle
2. Walking

Reasons for stopped driving

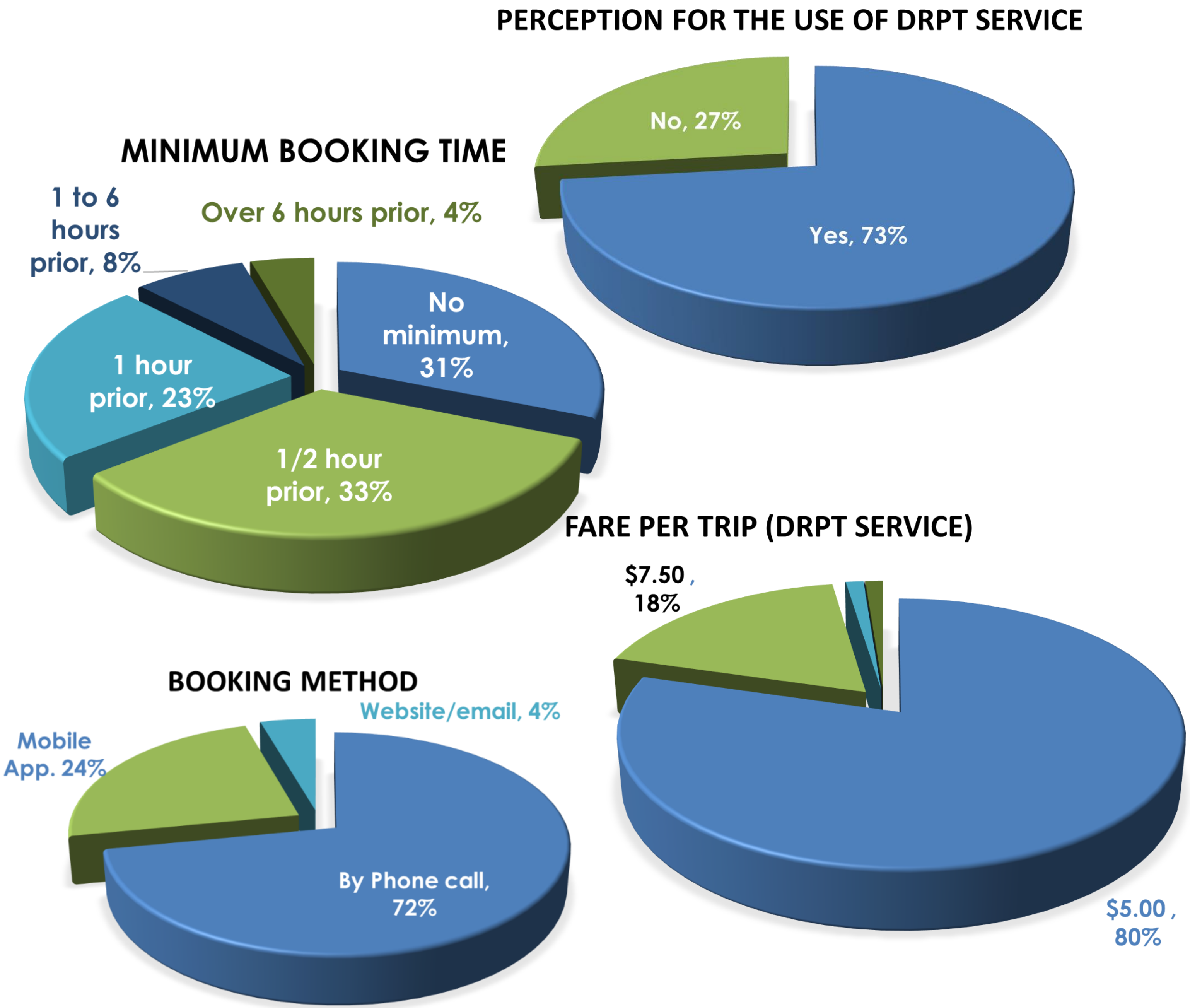
Road Factor: Operating costs of owning a vehicle

Physical Factor: Health reasons (poor eyesight etc)

Perception for use of the Public Transport

1. Accessibility (getting to the stop)
2. Being worried about crime

Analysis: DRT Demand



Conclusion

1. DRT system is needed for elderly in rural areas and small town in NZ.

2. Determine the appropriacy of introducing DRT in New Zealand.

3. In final, project will be concluded reasonably.

4. A further study collaborate with Waikato/ Horizon Regional Council

Conclusion, Limitation, & Future Scope

nzist new zealand institute of skills and technology

Improving learners' ability and extending engineering practice to the community

Limited in Resources, Time and Network

Under the new structural educational Body – NZIST: Can Maximize Synergy & Improve Quality

Further Comments or Inquiries

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