Designing a research project that meets industry-defined student learning outcomes

Mohammad Al-Rawi, Sarla Kumari, **Jai Khanna** & Thilanga Ariyarathna

Waikato Institute of Technology

2021 NZDE - BEngTech Joint Forum

Content

- ✓ Mihimihi
- ✓ Pepeha
- ✓ Introduction
- ✓ Design of a Research Assignment
- ✓ Start Easy
- ✓ Start Easy and keep going
- ✓ Journal suits Level 6 and 7 papers
- ✓ Outcomes
- ✓ Conclusion

Mihimihi

Greeting: Tēnā koutou katoa

ONE: E mihi ana ki…. te atua, nāna nei ngā mea katoa
I acknowledge god, the creator of all things

TWO: E mihi ana ki.... te whare e tū nei
I acknowledge the building that stands here

THREE: E mihi ana ki te Kīngi Māori me tōna whare tapu
Greetings to the Māori King and his sacred house

FOUR: E mihi ana ki… ngā mate, haere, haere, haere atu rā
I acknowledge those that have passed on, take care on your journey

FIVE: E mihi ana ki... ngā kaiako mō ngā mahi tika
Thank you to the tutors for the appropriate learning material

SIX: Kia Ora Whanau
I acknowledge to all our family here in the conference

Wintec
WAIKATO INSTITUTE OF TECHNOLOGY
Te Kuratini o Waikato

Pepeha

SEVEN:

Ko ……*Kailash*…… te maunga
Ko ……*Yamuna*……te awa
Ko ……*Diya*……te rau
Ko ……*Hindu*……te iwi
Ko ……*Punjabi*……te hapū
Ko ……*Te Kopu Maania O Kirikiriroa*……te marae
Ko ……Jai ……tōku ingoa

EIGHT:

Closing

No reira, tēna koutou, tēna koutou, tēna koutou katoa.

Introduction

- ✓ Research is in high demand for industry to keep them in up to date with technology development.
- ✓ Cost-wise, saves money for these companies while providing good opportunities for students to develop their skills.
- ✓ Can be used in:
  - ✓ Final Year Project (30 credits) or Final Project Assignment (15 credits)
  - ✓ Papers with no final exam and with 40% Project assignment
    - ✓ Applied Computational Modelling
    - ✓ Energy Engineering
    - ✓ Fluids Power and Advanced Fluid Mechanics papers

Design of a Research Assignment

- ✓ First find the right topic relevant to the paper you are teaching
- ✓ Meeting Research requirements - Industry and Learning outcomes/Graduate Attributes
- ✓ Mapping the learning outcomes for the paper to the Research Assignment
- ✓ Searching for the right students keen to work in the research field - many times you will mentor these students since they are undergraduate students and no experience in research
- ✓ Benefits for students:
  - ✓ Motivation to create a portfolio for Engineering New Zealand membership.
  - ✓ Writing technical reports of 6-8 pages.

Example for Mapping

MG6039 APPLIED COMPUTATIONAL MODELLING - LEARNING OUTCOMES

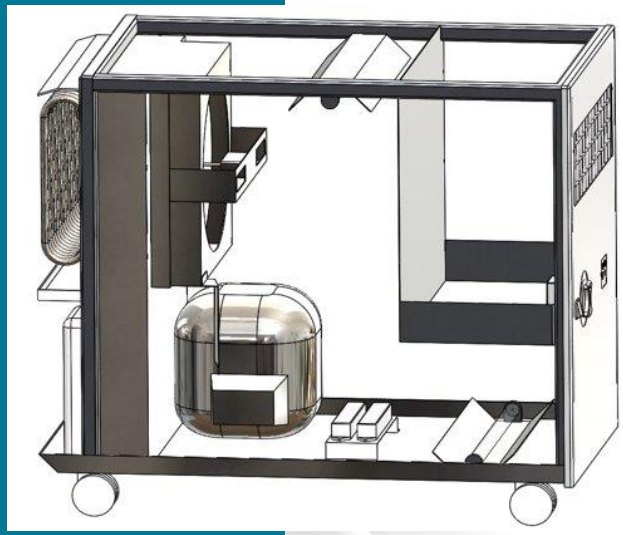
1. Use and apply mathematical software packages to solve problems
2. Use and apply a computer aided design and analysis software package for stress analysis and computational fluid dynamics and compare with real-world measurement
3. Use spreadsheets and databases for advanced engineering computations

MAPPING

	Engineering NEW Zealand Graduate Attributes	OUTCOME	RSEARCH
1	Understanding of Engineering Science		✔
2	Problem Formulation, Analysis and Solution	1,2,3	✔
3	Design, Development and Verification	2,3	✔
4	Research and Experimentation	2,3	✔
5	Evaluation and Management of Risk	2,3	✔
6	Team Work	2	✔
7	Communication		✔
8	Ethics and Responsibility to Society		✔
9	Project and Business Management		
10	Product Synthesis		✔
11	Life-long learning in specialist technologies	1,2	✔

Start Easy

- ✓ We could start with National Conferences
- ✓ **New Zealand Manufacturing, Design and Entrepreneurship**
- ✓ Student: Callan S



Oral Abstracts

MANUFACTURING AND DESIGN FOR BIO APPLICATIONS
Concurrent Conference Session 4 | Great Room 4

Residential Air Quality Improvement Using UV Lights

AL-RAWI, MOHAMMAD (PRESENTING AUTHOR)
CEID/Wintec
Mohammad.Al-Rawi@wintec.ac.nz

SMITH, CALLAN
CEID/Wintec
callansmith100@gmail.com

KHANNNA, JAI
CEID/Wintec
Jai.khanna@wintec.ac.nz

2019

Many New Zealand homes suffer from poor indoor air quality (IAQ). Cold, damp and mould-ridden homes can cause serious respiratory health problems. Poor IAQ can arise due to poor insulation and ventilation, and compounded when residents cannot afford heating. The main aim of this paper is to describe the process and results of modifying an existing dehumidifier to include ultraviolet germicidal UV lights. The modified device was designed to improve thermal comfort by removing moisture and perform UV filtration of the air to address mould and bacteria growth. To achieve these we combined the properties of a dehumidifier with germicidal lights (UV). The device was designed with the purpose of reducing humidity, increasing room temperature and purifying the air. Testing has shown that the modified dehumidifier with UV lights works as planned, with petri dishes showing a reduction in mould growth in most samples taken. Humidity was reduced where the device was used, and approximately 2L of water was removed in a 24-hour period. The temperature was increased where the device was used. The results show that the device reduced mould growth and increased room temperature.

Start Easy (Cont.)

- ✓ **New Zealand Manufacturing, Design and Entrepreneurship / Auckland/ New Zealand**
- ✓ Student: Callan Smith

Oral Abstracts

MANUFACTURING AND DESIGN FOR BIO APPLICATIONS
Concurrent Conference Session 4 | Great Room 4

Residential Air Quality Improvement Using UV Lights

AL-RAWI, MOHAMMAD (PRESENTING AUTHOR)
CEID/Wintec
Mohammad.Al-Rawi@wintec.ac.nz

SMITH, CALLAN
CEID/Wintec
callansmith100@gmail.com

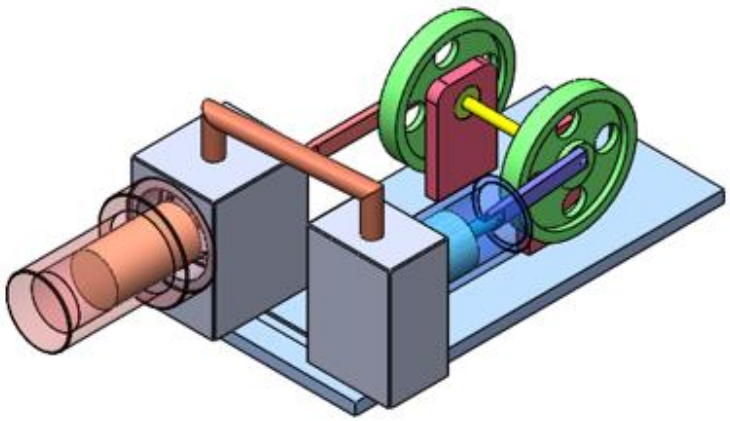
KHANNNA, JAI
CEID/Wintec
Jai.khanna@wintec.ac.nz

2019

Many New Zealand homes suffer from poor indoor air quality (IAQ). Cold, damp and mould-ridden homes can cause serious respiratory health problems. Poor IAQ can arise due to poor insulation and ventilation, and compounded when residents cannot afford heating. The main aim of this paper is to describe the process and results of modifying an existing dehumidifier to include ultraviolet germicidal UV lights. The modified device was designed to improve thermal comfort by removing moisture and perform UV filtration of the air to address mould and bacteria growth. To achieve these we combined the properties of a dehumidifier with germicidal lights (UV). The device was designed with the purpose of reducing humidity, increasing room temperature and purifying the air. Testing has shown that the modified dehumidifier with UV lights works as planned, with petri dishes showing a reduction in mould growth in most samples taken. Humidity was reduced where the device was used, and approximately 2L of water was removed in a 24-hour period. The temperature was increased where the device was used. The results show that the device reduced mould growth and increased room temperature.

Start Easy (Cont.)

- ✓ **New Zealand Manufacturing, Design and Entrepreneurship / Auckland / New Zealand**
- ✓ Student: Akhil Mylarapu



POSTER
DESIGN FOR MANUFACTURING

Poster Presentations

Thermal Power Stirling - Green Heat Engine

AL-RAWI, MOHAMMAD (PRESENTING AUTHOR)
CEID/Wintec
Mohammad.al-rawi@wintec.ac.nz

MYLARAPU, AKHIL
CEID/Wintec
AkhmylO5@student.wintec.ac.nz

PAUL, EWART
CEID/Wintec
Paul.Ewart@wintec.ac.nz

2019

Primary energy consumption growth averaged 2.2% in 2017, up from 1.2% in 2016. Natural gas accounted for the largest increase in energy consumption followed by renewable energy and oil. Global oil growth averaged 1.7 million barrels per day, natural gas consumption rose by 96 million cubic metres and coal consumption increased by 25 tonnes of oil equivalent and power generation rose by 2.8%. This caused the Carbon emissions to grow by 1.6% after little or no growth from 2014 to 2016. Carbon emissions pose a great threat to the planet as they are the main contributors to greenhouse effects and global warming. To minimise this, a great deal of money and research is being put into renewable and green sources of energy. One of these renewable sources of energy is solar energy. A Stirling engine provides a cheap and easy way of converting this solar energy into electrical energy while also providing a higher efficiency than gasoline or diesel engines. The aim of this project is to design and build a Stirling Engine which produces electricity using sunlight as the main source of heat energy. The working fluid for this project would be air at atmospheric pressure and the electricity generated would be sufficient enough to do some useful work and would present this system as an alternative form of environmentally friendly electricity generator.

Start Easy and keep going

- ✓ Mechanical Mechatronics students
- ✓ Students:
  - ✓ Fangzhou Ruan
  - ✓ Jordan Burley

Poster Presentations

POSTER
INNOVATION, DESIGN, PRODUCT DEVELOPMENT AND MANUFACTURING IN A GREEN, ENERGY EFFICIENT ENVIRONMENT

Automated bandsawn plywood cladding prime and paint machine

2020

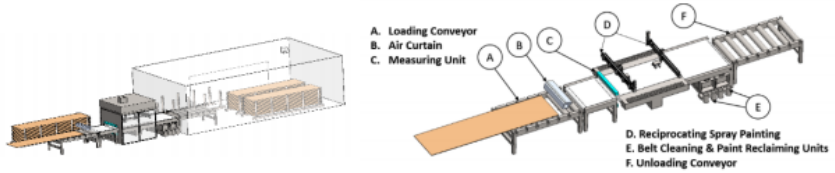
Presenting Author
Al-Rawi, Mohammad
Centre for Engineering and Industrial Design
Waikato Institute of Technology
mohammad.al-rawi@wintec.ac.nz

Fangzhou, Ruan
Waikato Institute of Technology
fanruao6@student.wintec.ac.nz

Burley, Jordan
Waikato Institute of Technology
jorburo8@student.wintec.ac.nz

This design report proposes a solution for an automated linear paint spraying machine of band-sawn finish plywood sheets for TRICLAD, a Hamilton-based company looking to increase their output and quality control. The company wanted a solution that was cost-effective, environmentally friendly, and where possible, New Zealand made. There were already several automated spray-painting machines on the market, but none that TRICLAD felt suitably met their needs. The first part of this process looked into current systems available on the market and alternative ideas for paint application. As a result of this scoping process, it was decided that the base idea was to be a traditional type design, adjusted to meet the specific needs of TRICLAD. The design is illustrated in Figure 1 below. Due to cost and scale issues, a prototype was not built, but the proposed design may be prototyped in future. The proposed design employs mainly off-the-shelf items, for cost-efficiency reasons, and has been developed with flexibility and future add-ons in mind. From here, this design could be handed onto an automation company to refine and produce for use by TRICLAD.

The design used a range of ISO standard parts to ensure the accessibility of raw materials and components. The 304 stainless steel was selected as the core material. Compared to mild steel, stainless steel reduced the production time by saving processes such as coating and treatments. The frame of the machines can be either welded or bolted. The modular subcomponents are bolted for the ease of future maintenance.



Start Easy and keep going

- ✓ Student: Carl Hartley

POSTER
INNOVATION, DESIGN, PRODUCT DEVELOPMENT AND MANUFACTURING IN A GREEN, ENERGY EFFICIENT ENVIRONMENT

Poster Presentations

Development of innovative cross-disciplinary engineering showcase

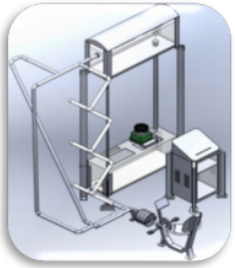
2020

Presenting Author
Khanna, Jai
CEID, Waikato Institute of Technology
jai.khanna@wintec.ac.nz

Al-Rawi, Mohammad
CEID, Waikato Institute of Technology
mohammad.alrawi@wintec.ac.nz

Hartley, Carl
CEID, Waikato Institute of Technology
breen35@hotmail.com

The development of engineering education relies substantially on interactive showcases and practical knowledge. The cross-disciplinary engineering showcase is designed to be fully interactive by having user input, producing a tangible output, and to understand distinct elements from each of the engineering disciplines such as, civil, mechanical and electrical (CME). The showcase operates from the input of mechanical rotational energy by the user pedalling the exercycle. Mechanical energy is then transferred to the pump via a gear train, which converts the user input of 30 rpm to the optimal pump operating speed of 2900 rpm. Further, it is used to pump water from the lower reservoir to the upper reservoir via one of the three flow paths, which the user can select by opening or closing flow valves. Once the water reaches a given height, it then flows back to the lower reservoir via a micro-hydro generator. As a result, it generates electrical energy stored in a power bank that can be used by the user to charge a digital device. Also, the showcase has a QR code to digital media, which will provide an additional explanation/exposition of the presented engineering principles to the user/students. The aim of this project is to develop a cross-disciplinary engineering showcase to enhance student learnings by interpreting the CME engineering principles in schools, institutes and universities.

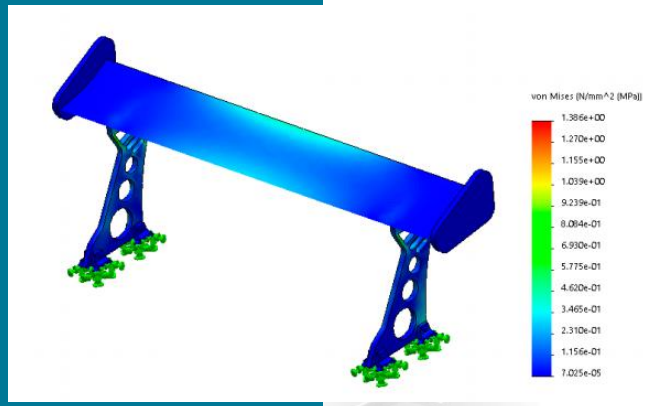


https://cpb-ap-se2.wpmucdn.com/blogs.auckland.ac.nz/dist/a/654/files/2019/08/MaDE2020_A5-Handbook_WEB_V2.pdf

Conference Proceedings

- ✓ **The 13th Conference of the International Sports Engineering Association**

- ✓ Student: Abderrahmane Oumssount



Open Access Proceedings

One-Way Fluid Structure Interaction of a Go-Kart Spoiler Using CFD Analysis†

by Mohammad AL-Rawi [1,*] and Abderrahmane Oumssount [2]

[1] Centre of Engineering and Industrial Design, Waikato Institute of Technology, Hamilton 3240, New Zealand

[2] JP Marshall Engineering, Hamilton 3200, New Zealand

* Author to whom correspondence should be addressed.

† Presented at the 13th Conference of the International Sports Engineering Association, Online, 22–26 June 2020.

Proceedings **2020**, *49*(1), 51; https://doi.org/10.3390/proceedings2020049051

Published: 15 June 2020

(This article belongs to the Proceedings of The 13th Conference of the International Sports Engineering Association)

Download PDF Citation Export

2020

Abstract

The spoiler on a go-kart is required to prevent the vehicle becoming airborne at speeds of 80 km/h or more. An optimal spoiler design balances this safety aspect with speed and fuel economy. This paper reports the results of a project to improve the aerodynamic aspects of a go-kart spoiler design using CFD Analysis. We investigated the design of a rear spoiler with three proposed angles (θ_1 = 9.5°, θ_2 = 19.5°, θ_3 = 29.5°). The drag force produced by each of the three designs is compared. Different computational results are discussed such as the air flow velocity, pressure and the applied forces in terms of CFD analysis using one-way fluid structure interaction (one-way FSI) to determine the spoiler stress, strain and drag coefficient. The findings of this paper have implications for the leisure and tourism industries, and may be applicable to other recreational vehicles' spoilers.

Keywords: go-kart spoiler; FE analysis; CFD modelling; one-way FSI

Journal suits Level 6 papers

✓ Indian Journal of Science and Technology

Original Article

Optimization of pipeline reducer using computational fluid dynamics (CFD) modelling

Mohammad Al-Rawi[1*], Chetan Sharma[2], Hong Zhou[1]

[1]*Centre for Engineering and Industrial Design (CEID)/ Waikato Institute of Technology (Wintec), Hamilton 3240, New Zealand*

[2]*Strata Precision Plastics Ltd, Hamilton 3204, New Zealand*

***Corresponding Author**

Email: mohammad.al-rawi@wintec.ac.nz

2020

Year: 2020, **Volume**: 13, **Issue**: 45

Received Date:30 September 2020, **Accepted Date:**03 December 2020, **Published Date:**18 December 2020

ABSTRACT

Background/Objectives: Water mains are part of a drainage network that generally supplies fresh water to the households within council (municipal) limits. Most councils set a benchmark minimum water pressure (kPa) and a flow rate (l/min) that must be delivered to households. A typical drainage network may consist of straight pipe with different bends, reducers, expansions and several fittings, all of which contribute to loss of pressure in the fluid system. The main objective of this paper is to compare different gradients of reducers using Applied Computational Modelling techniques. This comparison is performed in terms of pressure drop across the section, the total pressure on the reducing face and regular forces on the inner face of each reducer on two types of reducers, i.e. Concentric and Eccentric. **Methods:** In this paper, computational analyses using CFD tools are applied to a pipe from a typical water mains line consisting of a concentric reducer that generally holds a certain amount of pressure. Comparison between different gradients of reducing face of both

Journal suits Level 6 papers

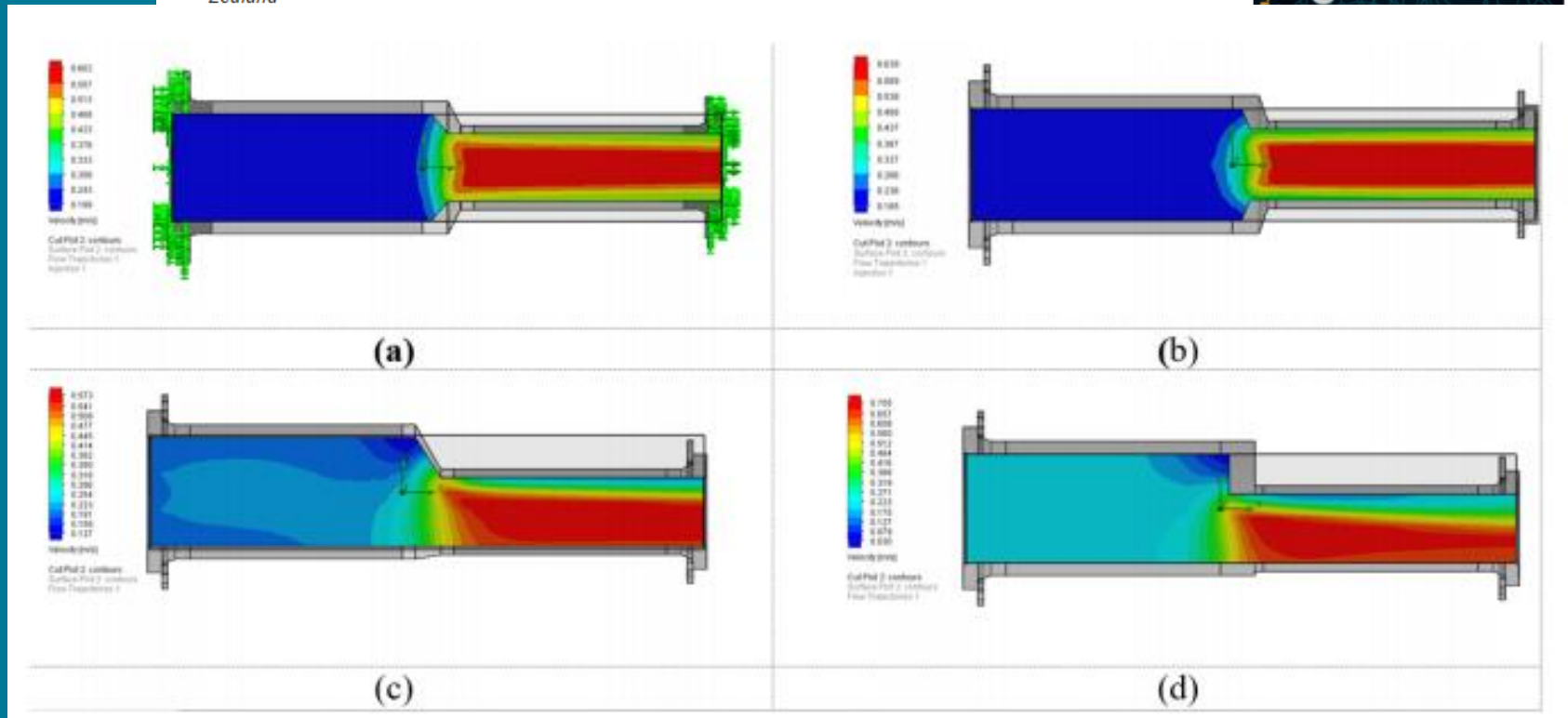
- ✓ **Indian Journal of Science and Technology**

Original Article

Optimization of pipeline reducer using computational fluid dynamics (CFD) modelling

Mohammad Al-Rawi[1*], Chetan Sharma[2], Hong Zhou[1]

[1]*Centre for Engineering and Industrial Design (CEID)/ Waikato Institute of Technology (Wintec), Hamilton 3240, New Zealand*



Outcomes

- ✓ Keeps teaching relevant to industry and technologies
- ✓ Expands our (student and staff) connections with Industry
- ✓ Enhances skills in
  - ✓ Technical writing: Student writing skills improved (writing technical reports 6-8 pages / posters)
  - ✓ Critical thinking (for both the students and the tutors)
- ✓ Peer reviewing is very helpful to students and staff to get detailed and specialized feedback in the field.
- ✓ Now we have examples to share with new students. This will help us to encourage more students and expand our team.
- ✓ We have developed a good relationship with the former students.

Conclusion

- ✓ To achieve 6 research outputs with students and colleagues, you need the following:
- ✓ Support from Managers and the Institute
  - ✓ Time and Funding
- ✓ Motivated team
  - ✓ Students and Tutors (7 students and 3 Tutors)
- ✓ Research at the right level
  - ✓ Experienced leader for the team
- ✓ Relevant to Industry experience
  - ✓ Find the right topic with the right people
- ✓ Industry Connections

Acknowledgment

- ✓ Dr.Trudy Harris and Dr.Shelley Wilson
- ✓ Wintec for Funding and Time
- ✓ Our Industry partners related to research: