Advances in the Digitalisation of the Process Industries

Process Engineering Digitalisation Knowledge & Skills:
A survey of industry needs, academic requirements, and practical delivery

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Motivation

Digitalisation

- Arguably one of the most important megatrends of our time

How will it affect process engineering **education?**

- What are the industry needs, academic requirements, and practical delivery aspects?

  - **Curriculum and Delivery?**
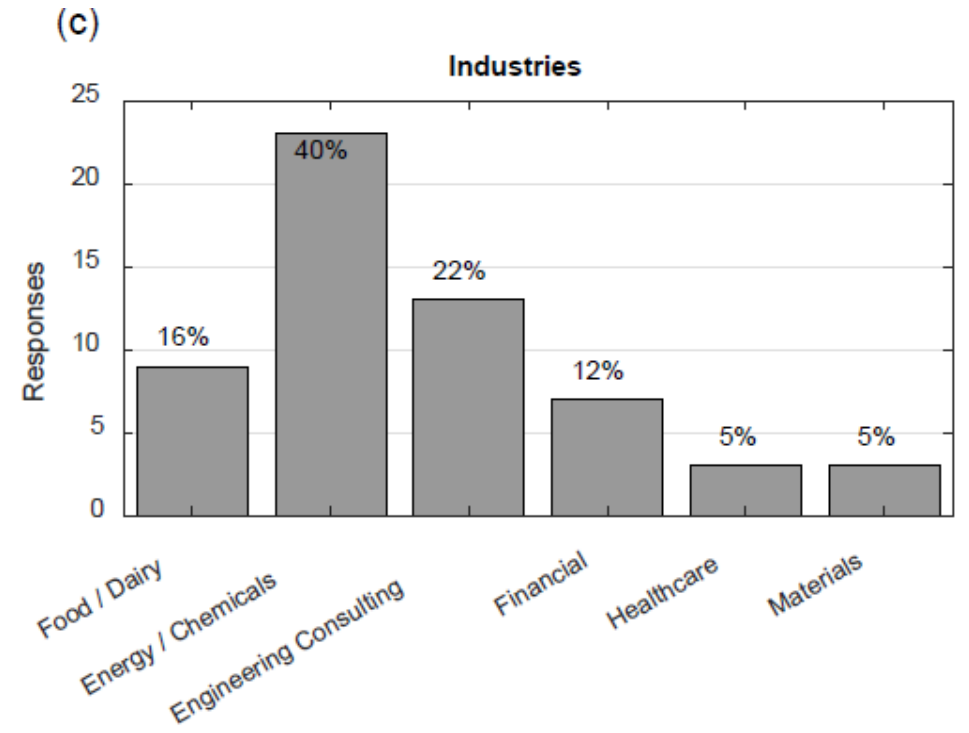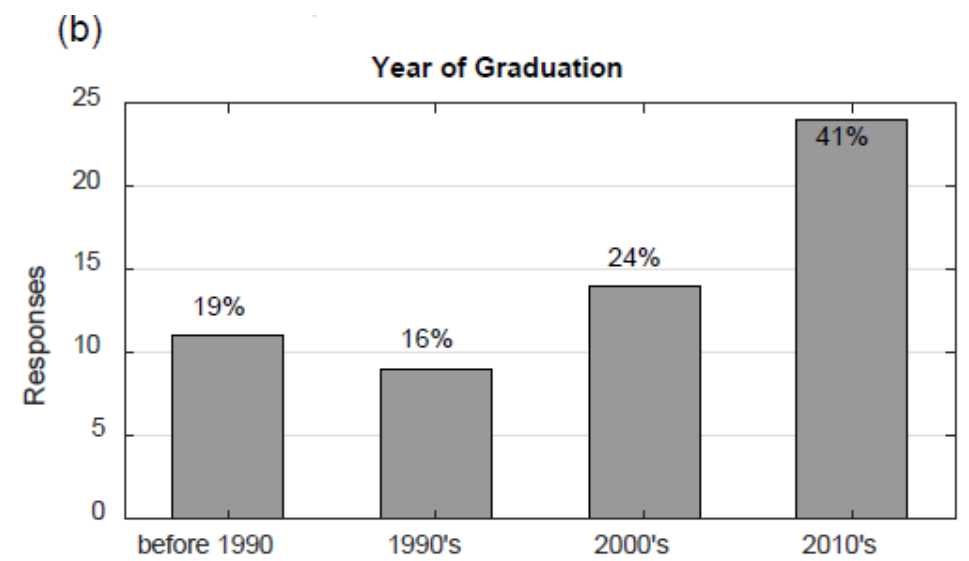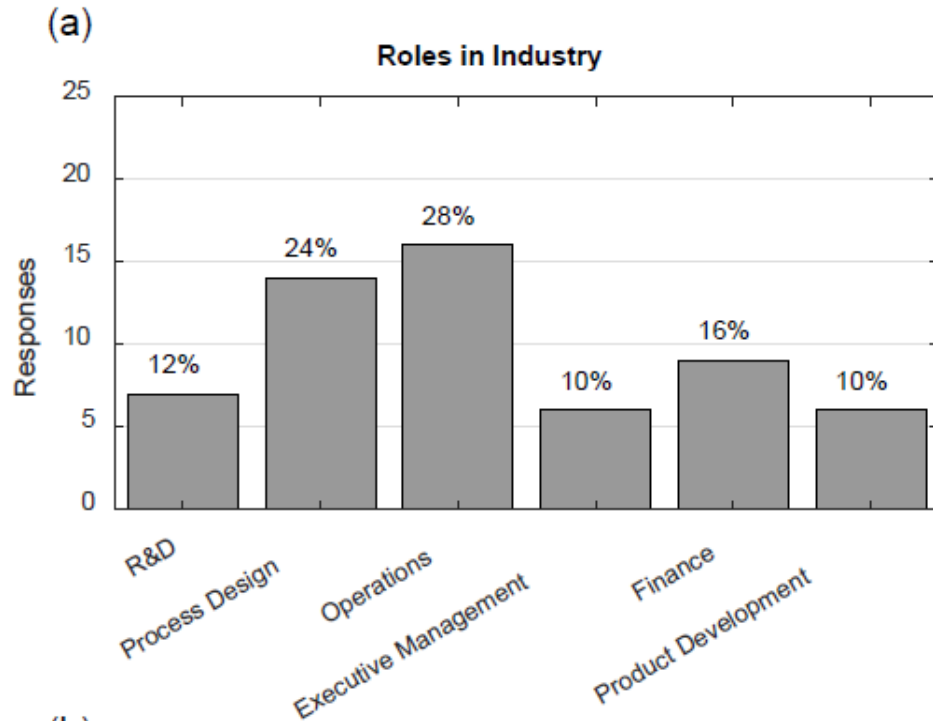
Methodology

Three separate, but related **stakeholder surveys**:

- **Auckland alumni**
  (addressing the need)

- **Global experts**
  (academic requirements)

- **Auckland academic staff** (practical delivery)

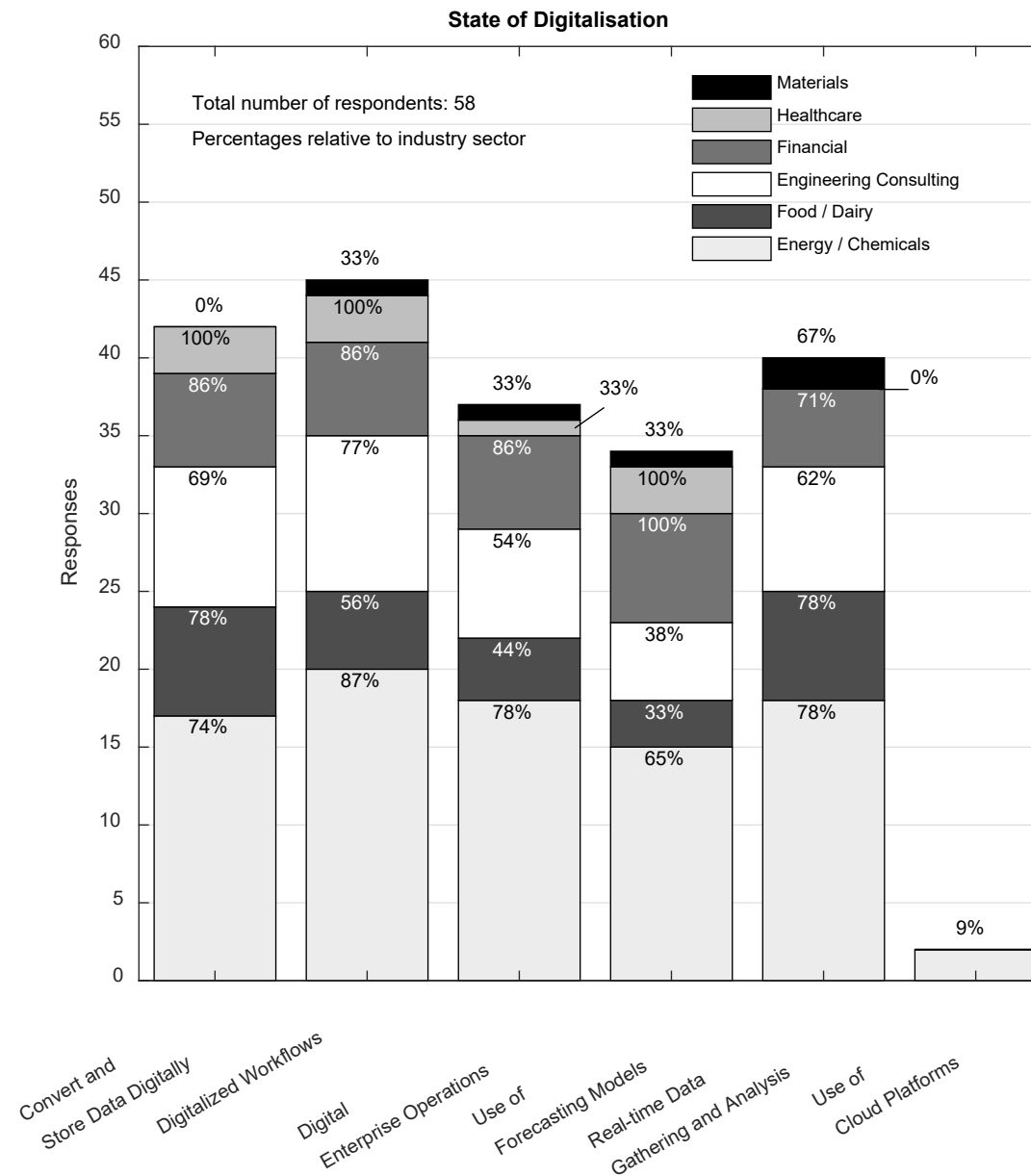Opinion of learning levels, in terms of a
Modified Bloom's Taxonomy

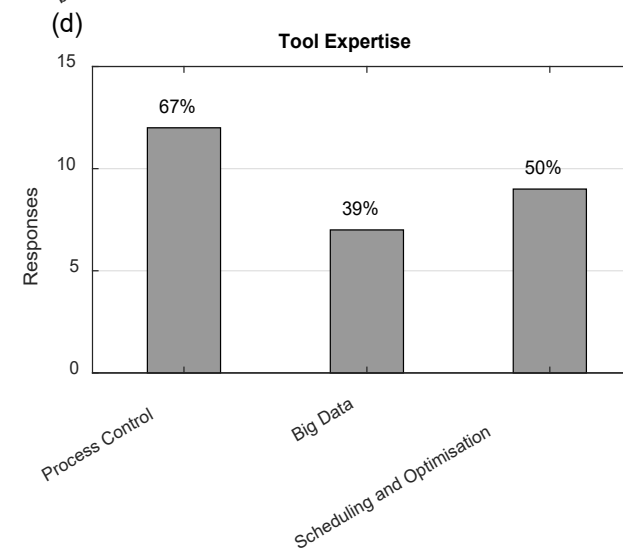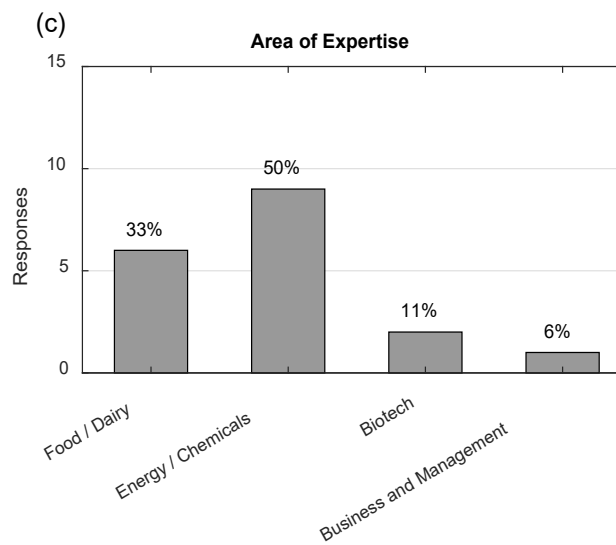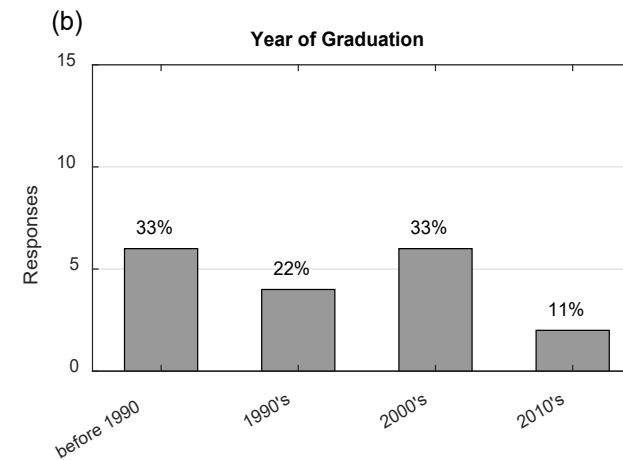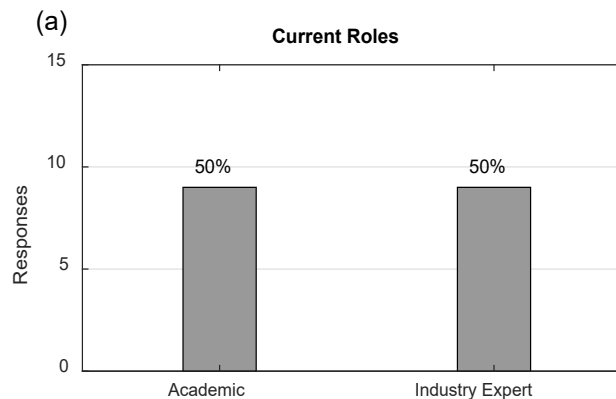# Alumni demographics

(a) Roles in Industry

(b) Year of Graduation

(c) Industries

Alumni views of the need

State of Digitalisation

Total number of respondents: 58

Percentages relative to industry sector

Legend:
- Materials
- Healthcare
- Financial
- Engineering Consulting
- Food / Dairy
- Energy / Chemicals

Y-axis: Responses (0 to 60)

X-axis categories:
- Convert and Store Data Digitally
- Digitalized Workflows
- Digital Enterprise Operations
- Use of Forecasting Models
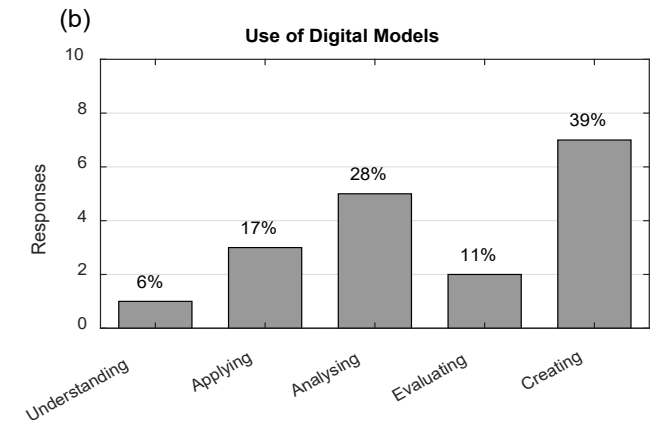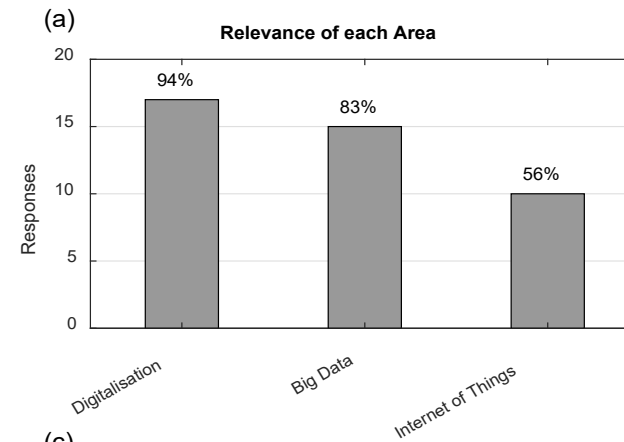- Real-time Data Gathering and Analysis
- Use of Cloud Platforms

Expert demographics

Expert views on academic requirements

(a) Relevance of each Area

(b) Use of Digital Models

(c) Use of Basic Statistical Tools
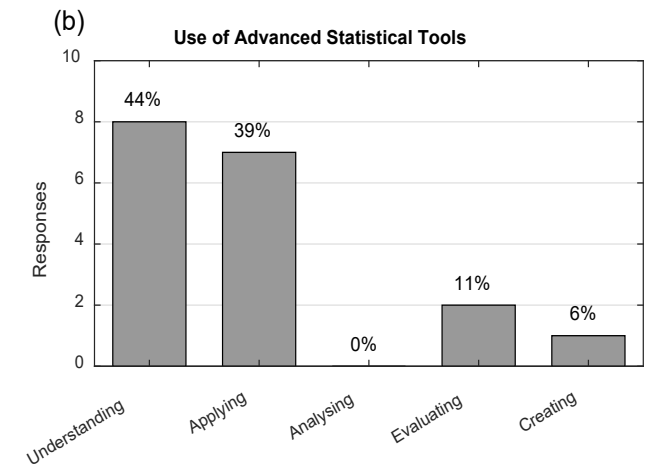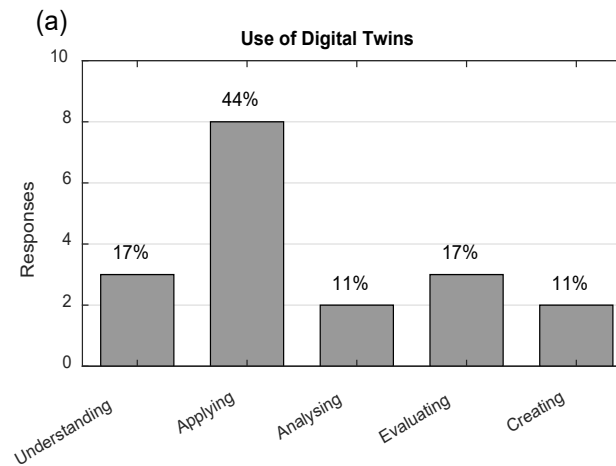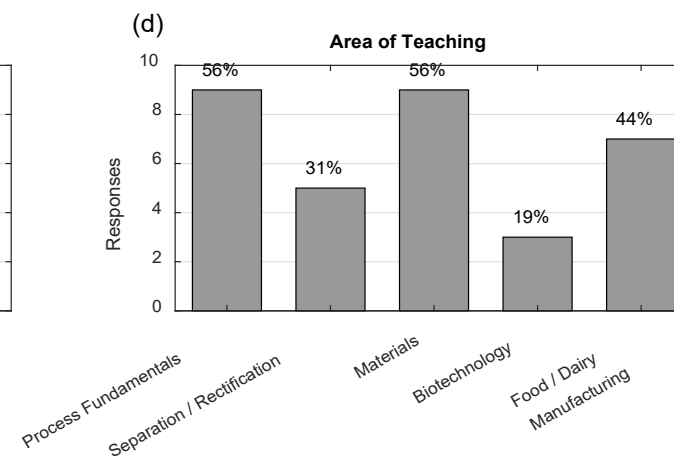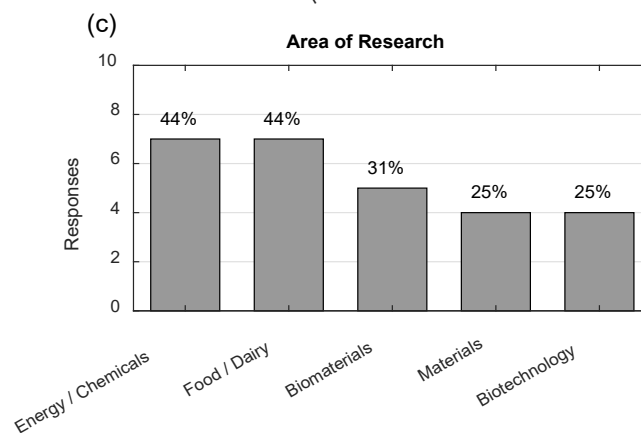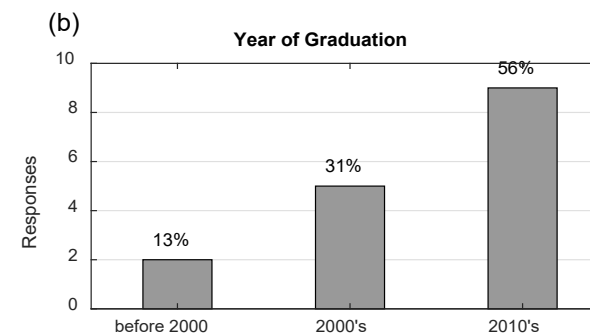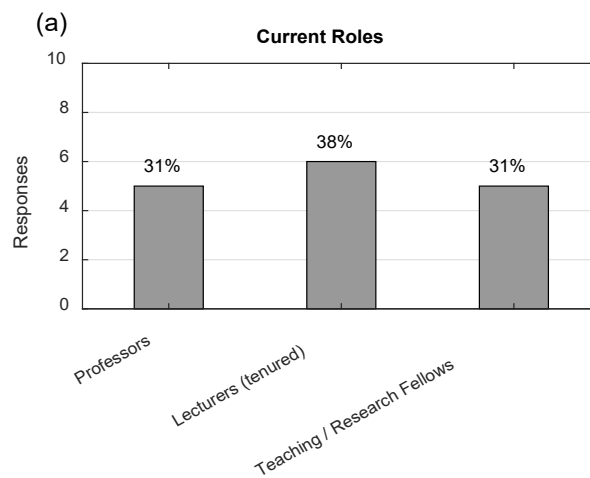
(d) Use of IoT Technology

Expert views on academic requirements

(a) Use of Digital Twins
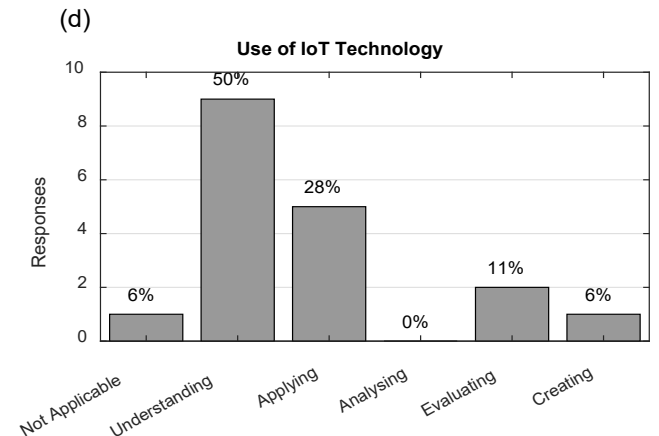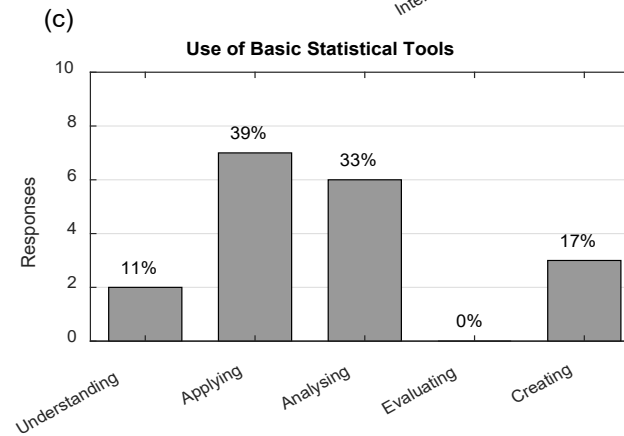
(b) Use of Advanced Statistical Tools

Academic staff demographics

Academic staff views on practical delivery

(a) Digital Mathematical Tools

(b) Digital Models for Unit Operations

(c) Use of Multi-Variate Statistical Tools

(d) Use of Digitalisation Infrastructure

Academic staff views on practical delivery

Incorporating Concepts

Chart showing "Responses" (y-axis, 0 to 10) for three categories:
- Module in a Current Course: 6 responses, 37.5%
- New Standalone Course: 5 responses, 31.3%
- New Standalone + Embedding: 5 responses, 31.3%
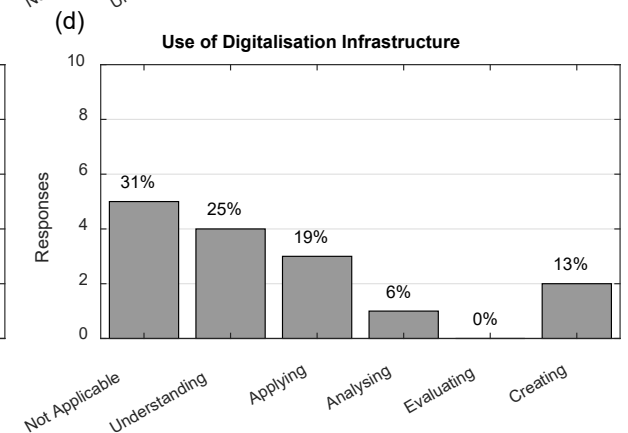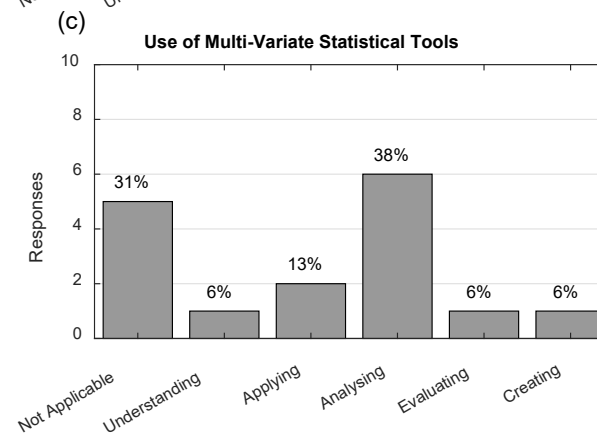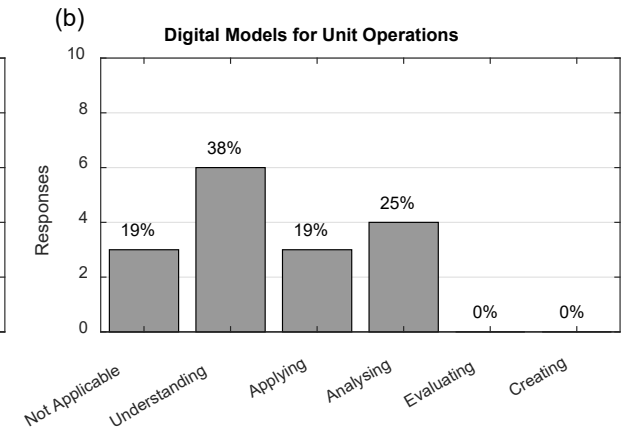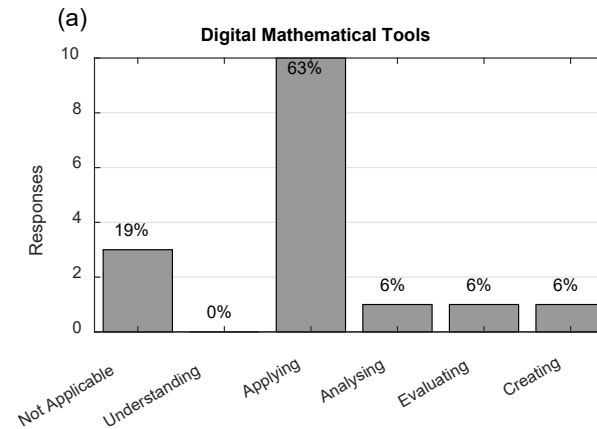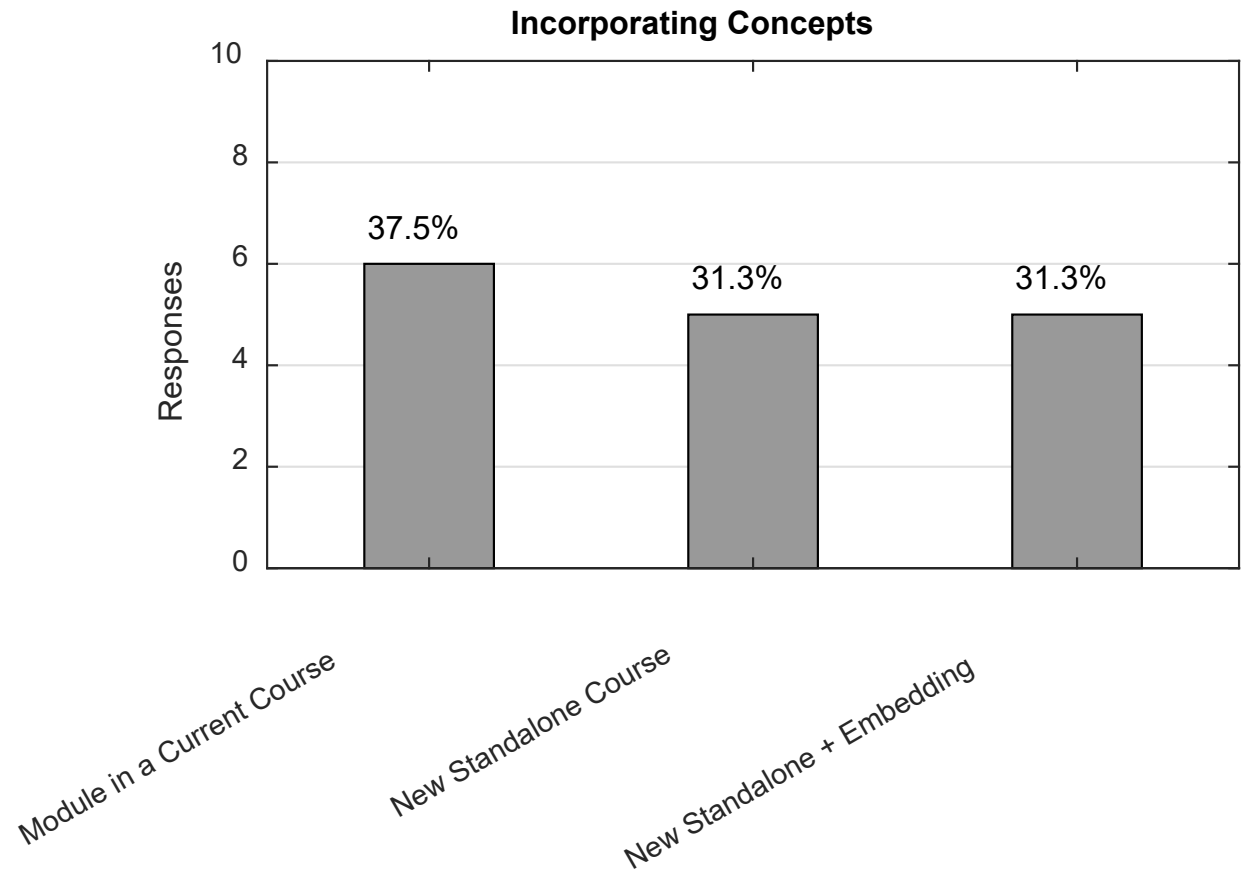
What do we do at Auckland now?

Embedding

- *Mathematical modelling 1, 2 & 3*
  - MATLAB, Python, R
- *Process dynamics and control*
  - Digital model development, IoT introduction

Standalone

- Final year undergraduate / graduate level electives
  - *Industry 4.0 for Chemical Engineering*
    - Digital Twins
    - Mechanistic and Data Driven methods
  - *Food Process Systems Engineering*
    - SPC, DoE, Machine Learning

Conclusions

- Alumni mostly agree importance of digitalisation, but some wary of hype – need for realistic teaching, including limitations

- Experts think some concepts okay to be taught to lower levels of learning (e.g. IoT application), but some can and should be taught to higher levels (e.g. creation of digital twins)

- Staff agree on the need generally, but are split on the need for high level knowledge and skills in certain areas

- Overall positive responses, endorsing a combined embedded and standalone approach to address the implementation challenge

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