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ENGINEERING NEW ZEALAND

NAVIGATING AI'S FUTURE IN ENGINEERING

This document was prepared with the input of our Artificial Intelligence Advisory Committee to inform the Governing Board's decision making on a proposed AI Programme in line with the recommendations below. We are releasing this document to members so they can also benefit from it as we navigate this change together.

Date: May 2024

EXECUTIVE SUMMARY

The engineering profession is on the cusp of a transformation driven by Artificial Intelligence (AI). The AI Advisory Committee of Engineering New Zealand has considered these technologies, identifying their potential to change our profession. This document outlines their thoughts and presents a call to action for embracing AI within our sector.

AI presents opportunities for innovation, efficiency, and addressing global challenges. However, these advancements also introduce significant risks, including the potential obsolescence of traditional engineering roles and a widening gap in global competitiveness. Acknowledging these dual realities, our report emphasises the immediate need for AI literacy, ethical leadership, and collaborative innovation within the engineering community.

Engineering New Zealand needs to guide our profession through this transformative journey. Our recommendations are focused in six critical areas:

1. **Lead and Advocate:** Take the lead on AI integration, raising awareness among members, and advocate for supportive policies and regulations.
2. **Education and Training:** Incorporate AI literacy into professional development and accreditation standards, keeping engineers up to date with technological advancements.

3. **Ethical Guidelines:** Develop a robust ethical framework for AI in engineering covering safety, accountability, transparency, and adherence to global best practices and te ao Māori values.
4. **Innovation and Partnerships:** Form strategic partnerships with academia, industry, and international bodies to advocate for and support our members and relevant stakeholders in developing AI solutions and driving engineering breakthroughs.
5. **Diversity and Inclusion:** Encourage diversity within engineering AI development to ensure equitable and effective engineering solutions.
6. **Oversight and Governance:** Proactively monitor AI advancements to refine our strategies and support New Zealand's position in the global engineering sector.

The AI revolution is upon us. The time to act is now to ensure our profession not only adapts but excels in this new era. The Board's endorsement of the recommendations in this document will mark the start towards positioning Engineering New Zealand as a leader in ethical and innovative AI integration and giving our members opportunities as AI leaders, nurturing a resilient, diverse, and innovative engineering workforce.

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INTRODUCTION

In May 2023, the Engineering New Zealand Governing Board inaugurated the AI Advisory Committee. This multidisciplinary group of experts has considered AI's profound implications for the engineering profession. These findings, bolstered by a literature review spearheaded by committee member Dr Ron McDowall DistFEngNZ ONZM[1], highlight an urgent need for Engineering New Zealand to implement strategies enabling our transition to an AI-driven paradigm.

We believe that AI, particularly with the recent breakthroughs, is set to dramatically reshape the engineering paradigm, affecting how engineers approach design, problem-solving, and innovation. Our profession's capability to navigate this new terrain will significantly influence the relevance, competitiveness, and impact of New Zealand's engineering sector for generations to come.

The recommended actions in this report chart a course for our organisation and members to not just adapt to AI's disruptions, but to lead its trajectory, ensuring New Zealand engineers remain globally competitive, grounded in ethics, and drivers of innovation.

CONTEXT

AI CONCEPTS

Each of the following terms represents a significant facet of the broader field of artificial intelligence, highlighting the diversity and depth of AI concepts and their applications within this domain.

Artificial Intelligence (AI): Computer systems adept at tasks such as perception, learning, and problem-solving, which traditionally required human intellect.

Artificial General Intelligence (AGI): A theoretical AI form where computer systems can understand, learn, and apply knowledge across a wide range of tasks at a level comparable to a human. This represents a significant leap beyond today's AI.

Generative AI: Sophisticated AI capable of generating original content, including text, images, code, and more through exposure to large numbers of patterns during training. These tools are rapidly evolving and reshaping engineering practices.

Predictive AI: A system that analyses historical and current data to make predictions about future events or outcomes. These systems leverage various forms of machine learning and data analysis techniques, including statistical models, pattern recognition, and deep learning, to identify trends, patterns, and relationships within the data.

Machine Learning (ML): A subset of AI where algorithms learn from extensive data to improve predictions and decisions without explicit programming for each task.

Large Language Model: A type of artificial intelligence algorithm that uses machine learning techniques and massively large data sets to understand, summarise, generate, and predict new content.

[1] Artificial Intelligence, Engineering and the Engineer, 2023 Report, Ron McDowall

Appendix A gives a snapshot of AI tools currently available to engineers. Examples of the application of three of these tools are demonstrated in Appendix B. The first example (Autodesk) is of a generative AI tool. Examples 2 (IBM Maximo) and 3 (Simapro) are of a predictive AI tool.

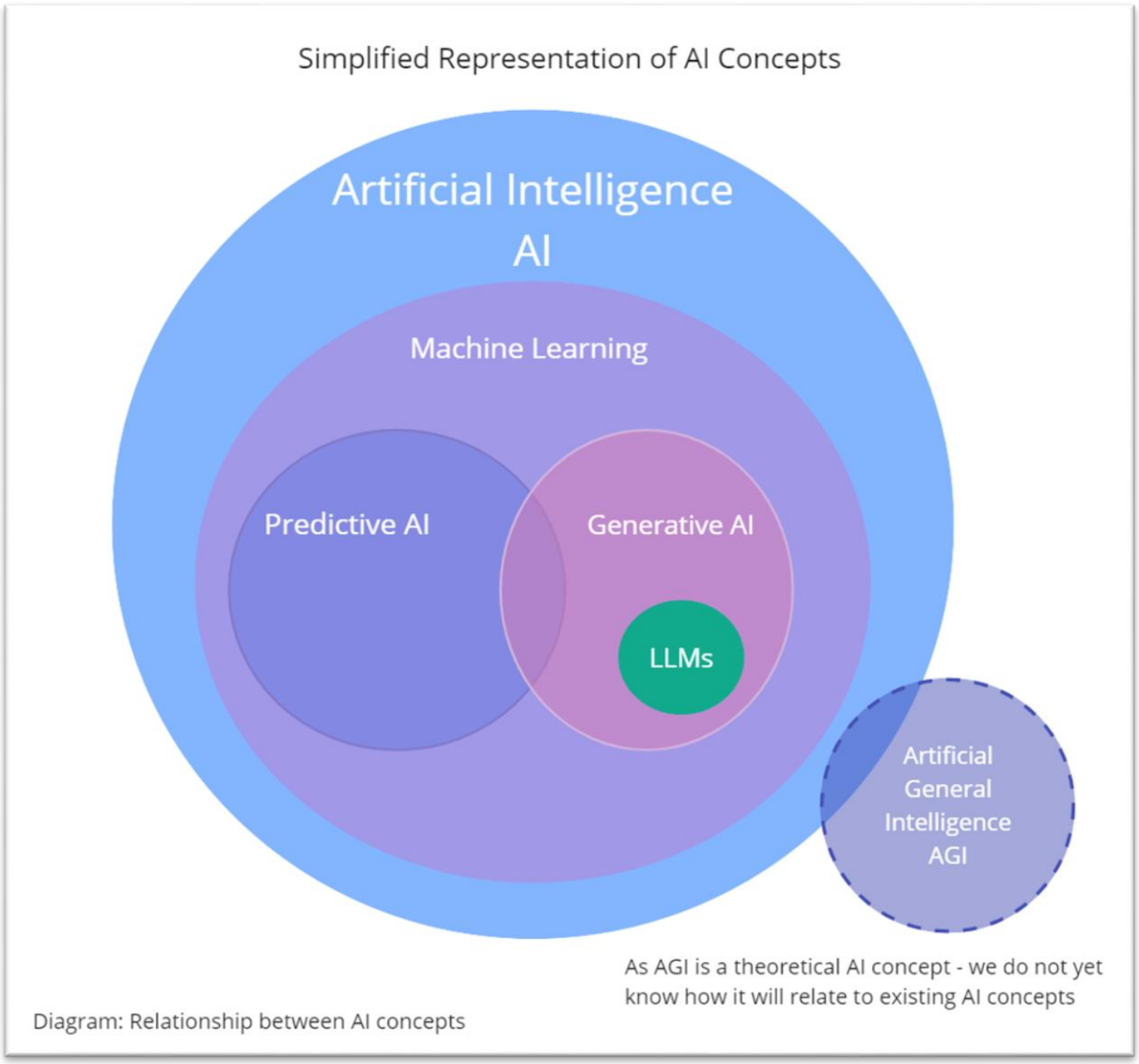

Diagram: Relationship between AI concepts

THE CHANGING ENGINEERING LANDSCAPE

AI will unlock innovation within engineering, redefining what is achievable:

Enhanced Efficiency and Automation: AI technologies enable the automation of routine tasks, optimisation of design processes, acceleration of simulations, and streamlining of complex decision-making, vastly improving productivity and cost-efficiency.

Unleashed Creativity and Innovation: Through generative AI, engineers can explore novel design solutions, alternative concepts, and foster innovation, sparking breakthrough ideas through creative collaboration.

Data-Driven Sustainability: AI empowers engineers to analyse and optimise environmental impacts, improve resource utilisation, and advance sustainable engineering solutions.

Advanced Risk Management: Leveraging AI for predictive analysis helps in identifying potential system failures, enhancing infrastructure resilience, and ensuring more robust project outcomes.

TECHNOLOGICAL TRENDS AND FORECASTS

AI is poised to revolutionise every aspect of engineering, making it imperative to stay ahead of these trends:

Exponential Growth of Generative AI: This technology is making creative tools accessible to a broader audience, accelerating innovation, and changing the engineering landscape. For example, OpenAI's text to video system.

Localised environments: Localised AI models will allow for operations in disconnected environments, presenting new opportunities and challenges for data control and oversight. For example, Samsung's latest cell phones have an imbedded AI.

AI as Design Assistant: Beyond reviewing designs, AI is starting to play a pivotal role in generating design solutions, marking a significant shift in the engineering process. For example, Microsoft's Co-pilot or AutoDesk AI.

Workforce Disruption: While AI promises efficiency gains, there's a risk of job displacement. Adapting to this change requires a focus on reskilling and promoting human-AI collaboration. The International Monetary Fund has estimated that 60 percent of jobs may be impacted by AI.

Limits of Innovation: Despite AI's advancements, significant engineering challenges remain unsolved, underscoring the continued need for human ingenuity and innovation.

Risk of Benefit Capture: There is a risk that there will only be a small number of engineering services providers fully utilising AI and capturing the engineering services market.

BENEFITS AND OPPORTUNITIES

The integration of AI technologies offers unmatched benefits and opportunities for the engineering sector, including:

AI-Driven Data Analysis: Predictive capabilities of AI significantly reduce maintenance costs and downtime by forecasting system failures before they occur.

Generative Design: AI enables engineers to explore an expanded range of design solutions, optimising for efficiency, cost, and environmental impact, thus fostering innovation.

Complex Problem-Solving: AI enhances our ability to tackle multi-dimensional challenges, contributing to global efforts like climate change mitigation and sustainable urban development.

Efficiency and Creativity: By automating routine tasks, AI frees engineers to focus on creative and strategic aspects of their projects, leading to innovative solutions and advancements.

Health and Safety: AI can provide a large range of Health and Safety solutions for the engineering sector.

CONSEQUENCES OF INACTION

The engineering sector faces significant risks if it fails to adapt to the AI revolution:

Loss of Relevance: Engineers without AI literacy may find themselves sidelined as AI tools become integral to design, problem-solving, and optimisation processes.

Competitive Disadvantage: New Zealand engineering firms risk falling behind internationally if they are slower to adopt AI, potentially missing out on business and innovation opportunities.

Data Sovereignty Risks: Without a focus on responsible AI development and data governance, reliance on external AI solutions could compromise New Zealand's values and priorities.

Missed Opportunities: Foregoing the potential of AI to tackle complex societal and environmental challenges would be a significant loss, underscoring the importance of embracing these technologies.

RISK TO THE ORGANISATION – WHAT HAPPENS IF WE DON'T DO ANYTHING

The absence of AI integration in Engineering New Zealand's strategy could lead to several adverse outcomes:

Diminished Competitiveness and Innovation: Without embracing AI in operations, research, and development, Engineering New Zealand risks lagging in innovation, affecting its standing and influence.

Inadequate Member Services and Support: AI technologies can significantly enhance member services, from personalised learning to efficient communication. Ignoring these possibilities could result in unmet member needs and dissatisfaction.

Operational Inefficiencies: By overlooking AI's potential to streamline administrative and operational tasks, the organisation may face unnecessary expenses and inefficiencies.

Ethical and Safety Standards Gap: As AI becomes integral to engineering, establishing ethical guidelines and safety standards is crucial. A lack of engagement with AI could leave the organisation ill-prepared to guide its members in these vital areas.

Educational and Professional Development Shortcomings: AI knowledge is becoming essential. Failure to integrate AI into educational content and professional development could leave members ill-equipped for the future job market.

Limited Influence on Policy and Regulation: With the evolution of AI, there's a growing need for updated regulations. Lack of active engagement could sideline Engineering New Zealand from influencing policy that shapes the profession's future.

Engineering and AI - Programme Vision and Goals

To harness the power of AI while mitigating risks, Engineering New Zealand needs to adopt a comprehensive strategy. This approach will position our members and the organisation well for this era, ensuring we remain globally competitive, ethically grounded, and poised to drive innovation. This section covers some of what we believe needs to be considered.

Programme Vision

Engineering New Zealand and its members are global leaders in the ethical and innovative integration of AI into engineering practices.

Programme Goals

1. **Lead AI Literacy & Advocacy.** Engineering New Zealand needs to take a lead role in integrating AI into engineering practices in New Zealand, emphasising AI as a tool for empowerment, not replacement, ensuring engineers retain ultimate responsibility for their work's integrity and compliance with ethical standards.

   Engaging with government bodies is needed to advocate for appropriate policies and regulations around AI development and usage. The goal is to strike a balance between enabling responsible innovation in AI engineering solutions while managing risks. Policies should foster a supportive environment for New Zealand to remain competitive in the AI domain.

   As a leader in the field, Engineering New Zealand will spearhead initiatives aimed at raising awareness among members about the profound impacts, urgency, and opportunities presented by AI integration. Providing clear communication about the significance of AI adoption for the future of engineering practices will be crucial.

   - **Human-Centric AI:** Emphasising AI as a tool for empowerment, not replacement, ensuring engineers retain ultimate responsibility for their work's integrity and compliance with ethical standards.
   - **Understanding AI's Foundations:** Engineers need to grasp the construction of AI models, the potential for bias, and limitations. This will foster responsible use and critical evaluation of AI outputs.
   - **Sector-Specific Strategies:** Acknowledging varied impacts across engineering disciplines, we recommend developing tailored resources and strategies to address unique sector challenges and opportunities.
   - **Defining the Human** Role: Articulating the indispensable human elements within AI-driven processes is crucial for maintaining trust, creativity, and ethical standards.

2. **Embed AI in Education & Training.** AI literacy needs to be systematically integrated into engineering education curricula at all levels - from undergraduate degrees to professional development for current practitioners.
   - **New Curricula**: Incorporating AI concepts into engineering education ensures graduates are equipped to work alongside AI technologies effectively.
   - **Continuous Learning Opportunities** (CPD opportunities): Offering workshops, courses, and certifications addressing the evolving AI landscape enables current professionals to stay ahead.
   - **CPEng Reassessment and Continuing Professional Development** (CPD): Integrating a foundational understanding of AI principles into the Chartered Professional Engineers (CPEng) assessment process, maintaining the profession's competence in a changing landscape. The Regulatory Authority will need to clearly articulate the responsibility of CPEng qualified engineers in approving AI generated or assisted work.
   - **Promotion of Experimentation**: Encouraging hands-on learning through hackathons and similar events fosters a deeper understanding of AI tools and their potential applications.
   - **Support for Immigrant Talent:** Utilising AI, especially language models, can help bridge the gap for engineers migrating to New Zealand, ensuring their skills are recognized and utilized effectively.
   - **Baseline AI Understanding**: Ensuring all engineers, regardless of their specialisation, have a fundamental comprehension of AI is essential for the profession's future.

3. **Implement a Robust Ethical AI Framework**. A key goal is to promote the ethical and responsible usage of AI in engineering projects and solutions. This means ensuring AI applications uphold principles of accountability, transparency, and fairness. The ethical framework should align with global best practices while also aligning with the indigenous values embodied in Te Ao Māori.

   Comprehensive guidelines governing the ethical use of AI in engineering need to be established, critical areas to address include AI safety, data privacy, mitigating bias, copyright considerations, accountability and analysing environmental impacts. Stringent requirements around transparency are essential for maintaining public trust.

   - **Values-Driven Approach:** Articulating core values guiding the application of AI in engineering, emphasising public welfare, sustainability, and ethical design.
   - **Accountability and Transparency:** Establishing robust requirements for transparency in AI's application in projects, ensuring engineers remain accountable for AI-assisted outcomes. Clear documentation of AI methodologies, data sources, and decision-making processes is crucial. This transparency not only fosters trust but also enables critical evaluation and continuous improvement of AI systems.
   - **Regulatory Collaboration:** Partnering with national policymakers to shape a supportive regulatory environment for responsible AI innovation, drawing on models like the EU's risk-based AI regulation approach[2].
   - **Copyright:** A number of AI tools generate content based on what is already available; inadvertently compromising others copyright.
   - **Sustainability in Regulation:** Encouraging regulations that account for AI's environmental impact, promoting sustainable design and operation of AI systems.
   - **Engineer as Ethical Innovator:** Engineers should view themselves as pioneers of ethical innovation, striving to balance technological advancements with societal values and environmental stewardship. It's essential that we lead by example, demonstrating how ethical considerations are integral to engineering excellence.
   - **Navigating Ethical Dilemmas:** As AI technologies become more complex, engineers will increasingly face ethical dilemmas that challenge traditional norms and practices. We advocate for a proactive approach to ethical education and dialogue, preparing our members to navigate these challenges with confidence and integrity.

4. **Build Partnerships and Drive Innovation**. Engineering New Zealand aims to advocate and support our members and relevant stakeholders in the development of practical, innovative AI tools and solutions specifically tailored for engineering disciplines. Fostering a culture of AI-driven problem-solving and design thinking will be pivotal.

   Strategic alliances and collaborations with technology companies, universities, government agencies, and research institutions should be established. The aim is support the development of cutting-edge, practical AI tools and solutions tailored for engineering applications.

   Maintaining a competitive edge by being at the forefront of technological progress in the AI engineering space is essential.

[2] Artificial Intelligence Act: MEPs adopt landmark law | News | European Parliament (europa.eu)

- **Ensuring Data Quality:** Engineers must recognise how data quality influences AI outputs. We advocate for rigorous data standards and a critical approach to evaluating AI suggestions, ensuring our engineering solutions are based on reliable and accurate information.
- **Promoting Data Sovereignty:** Particularly for projects involving national infrastructure, secure handling of data is paramount. We must strive to maintain control and ownership of data within New Zealand, safeguarding our interests and independence.
- **Emphasising Cybersecurity:** As data becomes increasingly central to our work, upskilling in cybersecurity best practices is essential. This ensures our projects and AI systems are resilient against data breaches and malicious manipulations.
- **Aligning with Local Standards and Needs:** It's crucial for engineers to adapt global AI solutions to New Zealand's specific regulations, standards, and cultural contexts, ensuring our engineering practices resonate with local values and requirements.
- **Maintaining Public Trust:** Ensuring fairness and transparency in AI use is paramount to maintaining trust in both the technology and the engineering profession. We advocate for practices that uphold these values in all AI-related activities.

5. **Prioritize Diversity & Inclusion in AI.** Ensuring that AI solutions are developed by diverse teams and equitably serve all segments of New Zealand society is a core goal. This involves proactively integrating diverse cultural perspectives, especially Te Ao Māori philosophies, into AI development processes and addressing bias that can negatively impact diversity and inclusion. Promoting diversity within the engineering and AI workforce itself is also a priority.

    - **Proactive Bias Mitigation:** We need to equip engineers with the tools and knowledge necessary to detect and address biases in AI algorithms, ensuring our engineering solutions are inclusive and just.
    - **Consideration Beyond Technical Bias:** Recognising that AI can amplify societal biases, our guidelines will stress the importance of considering social, cultural, and environmental impacts, not just economic factors, in AI applications.
    - **Promote Diverse AI Development Teams:** Engineering New Zealand will actively promote diversity within teams involved in developing and deploying AI technologies for engineering. This means amplifying voices from underrepresented groups like women and minorities.
    - **AI and Te Ao Māori:** Integrating Māori perspectives into AI development can lead to more culturally sensitive and effective engineering solutions and is critical to creating equitable and inclusive solutions. By embracing these viewpoints, we enrich our understanding and application of AI in ways that respect and uphold New Zealand's unique cultural heritage.

6. **Ensure Oversight and Governance.** As AI capabilities rapidly evolve, Engineering New Zealand needs to implement mechanisms for monitoring global advancements in AI technology to drive continuous improvement. Assessing the potential impacts and engineering applications of these advancements will inform strategies. Feedback loops from members on their experiences and needs related to AI tools should also be incorporated. This will ensure New Zealand maintains a position of leadership in the realm of AI engineering.

RECOMMENDED ACTIONS

As the profound impacts of AI reshape the engineering profession, Engineering New Zealand must proactively lead our members through this technological transformation and encourage the appropriate utilisation of AI in the practice of engineering.

To realise these strategic priorities, we recommend the following actions for the Engineering New Zealand Board's consideration and approval:

1. LEAD AND ADVOCATE

Actions:

- Spearhead initiatives to raise awareness among our members about the significance and implications of AI in engineering.
- Actively engage with government bodies to advocate for appropriate AI policies and regulations.
- Establish dialogue between engineers and policymakers to discuss AI's future in engineering and ethical considerations.

2. EDUCATION & TRAINING

Actions:

- Develop and integrate AI modules into the CPD programs and CPEng assessment criteria.
- Partner with educational institutions to embed AI literacy and ethics in engineering curricula.
- Launch an annual AI in Engineering[3] symposium for knowledge exchange and updates on emerging AI technologies. This may be done in partnership with technical groups.

3. ETHICAL GUIDELINES

Actions:

- Formulate comprehensive ethical guidelines tailored to engineering practices, including considerations for data privacy, bias mitigation, copyright, and environmental impact.
- Facilitate workshops and seminars to educate members on ethical AI deployment.
- Ensure that Engineering New Zealand review and address ethical dilemmas arising from AI applications in engineering. Developing ethical guidelines, in line with existing policy, addressing bias, explainability, and societal impacts.

4. INNOVATION & PARTNERSHIPS

Actions:

[3] Consider a transdisciplinary format.

- Establish partnerships with tech companies, universities, government, and research institutions to advocate for and support our members and relevant stakeholders in developing AI tools and solutions relevant to engineering.
- Support hackathons, design competitions, and collaborative projects that challenge engineers to solve real-world problems using AI.
- Instigate member AI Awards to recognise and showcase AI in engineering projects.
- Use a digital platform for members to share AI projects, seek collaborations, and access AI resources and tools.

5. DIVERSITY & INCLUSION

Actions:

- Implement a mechanism to gather and prioritise feedback from underrepresented groups.
- Extend the development of ethical guidelines to ensure bias mitigation addresses social, cultural, and environmental impacts, and minimised discrimination.
- Investigate how Te Ao Māori and other diverse perspectives can be integrated into AI development processes and projects.

6. OVERSIGHT & GOVERNANCE

Actions:

- Monitor global AI advancements, assess their implications for engineering, and recommend updates to Engineering New Zealand's strategies.
- Implement a feedback mechanism for members to report on AI tool effectiveness, ethical concerns, and professional development needs.
- Conduct an annual review of AI integration in engineering projects, publishing insights and recommendations for advancing AI competency and innovation within the profession.

CONCLUSION

The journey into an AI-enhanced future is both an opportunity and a responsibility for the engineering profession. By embracing these recommendations, Engineering New Zealand could position itself and its members to lead in the use of AI, ensuring that our profession continues to contribute significantly to societal advancement and innovation.

Adopting these recommendations requires a coordinated effort from Engineering New Zealand's leadership, members, and stakeholders. It involves allocating resources, fostering partnerships, and continuously observing the latest developments in AI technology and ethics. Our role will be to advocate for and support our members and relevant stakeholders in developing AI solutions and driving engineering breakthroughs.

The time for action is now. With the Board's approval, Engineering New Zealand can begin mobilising the resources and stakeholder commitments required to begin this strategy. Proactive leadership will be vital as we usher the engineering profession into an AI-empowered future - one that is innovative, ethical, and inclusive of all New Zealanders. As Engineering New Zealand confronts the technological advancements within AI, our approach must be both pragmatic and forward-looking.

APPENDIX A: TOOLS AND APPLICATIONS

A Snapshot of AI in Engineering: May 2024

The landscape of AI tools available to engineers is diverse and rapidly evolving. These technologies promise to redefine traditional engineering tasks, from design and analysis to project management and beyond. Here's a closer look at examples of some key tools and technologies shaping the future of engineering:

Autodesk Generative Design: This tool leverages AI to explore possible permutations of a solution, quickly generating design alternatives based on specific inputs and objectives. It integrates seamlessly with AutoCAD software, enhancing efficiency and innovation in the design process.

ChatGPT and Large Language Models: Beyond text generation, language models are now sophisticated enough to work with images and videos, draft technical documentation, generate code snippets, and even provide initial troubleshooting guidance. Their ability to process natural language queries can significantly streamline research and development efforts.

Open-Source AI Libraries (TensorFlow, PyTorch): For those seeking to customize AI applications, these libraries offer the flexibility to build and train bespoke models. Whether it's developing predictive maintenance systems or optimising resource allocation, these tools empower engineers to tailor AI solutions to specific project needs.

Simulation and Analysis Tools (ANSYS, SimScale): AI-enhanced simulation tools offer unprecedented capabilities in modelling and analysing complex systems. Engineers can simulate various scenarios and conditions, optimising designs for performance, durability, and sustainability.

Computer Vision for Inspection and Monitoring: Tools like IBM Maximo Visual Inspection automate the analysis of images and videos from project sites, enabling real-time monitoring of construction progress, safety compliance, and infrastructure condition. This technology promises significant improvements in project management and maintenance.

Natural Language Processing (NLP) for Regulatory Compliance: NLP tools can automatically analyse legal documents and regulatory standards, identifying relevant requirements for specific projects. This application of AI streamlines compliance processes, reducing the risk of oversights and project delays.

Digital Twins and IoT Integration: Creating digital replicas of physical assets allows engineers to monitor, analyse, and optimize systems in real time. IoT sensors feed data into AI models, enabling predictive maintenance and operational efficiencies previously unattainable.

Robotics and Automated Construction: AI-driven robots and drones are beginning to play roles in construction, performing tasks from material delivery to structural assembly and even inspection. These technologies promise to enhance safety, efficiency, and precision on construction sites.

APPENDIX B: EXAMPLES - AI TOOLS USED FOR ENGINEERING APPLICATIONS

May 2024

EXAMPLE 1: GENERATIVE DESIGN FOR EARTHQUAKE-RESILIENT INFRASTRUCTURE

Scenario: A New Zealand engineering firm is tasked with designing a new community centre in Wellington, a region prone to seismic activity. The goal is to optimize the design for earthquake resilience, sustainability, and cost-efficiency, incorporating community feedback and Te Ao Māori principles.

AI Tool: Autodesk Generative Design

Autodesk | 3D Design, Engineering & Construction Software. This is an example of a generative AI tool.

Application:

Inputting design constraints related to seismic resilience, material sustainability, cost limits, and community values into the software.

The software generates several design options, each evaluated for its earthquake resistance, environmental impact, and alignment with local cultural values.

The team collaborates with local iwi representatives to select a design that not only meets technical requirements but also respects Te Ao Māori by incorporating elements that reflect local history and culture.

Visuals and Documentation for Report:

- Visual comparisons of generated designs, highlighting features that enhance seismic resilience and cultural relevance.
- Analysis graphs showing the sustainability and cost-effectiveness of each design.
- Testimonials from community members and iwi representatives on the selected design's significance.

EXAMPLE 2: PREDICTIVE MAINTENANCE IN NEW ZEALAND'S DAIRY INDUSTRY

Scenario: A dairy processing plant in the Waikato region aims to improve operational efficiency and reduce equipment downtime, crucial for maintaining high-quality production standards in one of New Zealand's leading export sectors.

AI Tool: IBM Maximo for Predictive Maintenance

Predictive Maintenance - Maximo Application Suite | IBM. This is an example of a predictive AI tool.

Application:

Deploying IoT sensors across key machinery to collect performance data.

Using predictive maintenance software to analyse this data, the system forecasts potential equipment failures, allowing for timely maintenance interventions.

This proactive approach minimizes downtime, ensures consistent production quality, and extends the lifespan of costly equipment.

Visuals and Documentation for Report:

- Diagrams of the predictive maintenance workflow, from sensor data collection to maintenance alert.
- Case examples highlighting instances where the system prevented significant downtime.
- Data charts illustrating improvements in operational efficiency and maintenance costs.

EXAMPLE 3: ENVIRONMENTAL IMPACT ANALYSIS FOR COASTAL EROSION MITIGATION

Scenario: Faced with coastal erosion threats in the Bay of Plenty, local government and engineering consultants seek sustainable solutions to protect the coastline without harming the marine ecosystem, aligning with both environmental and Māori community interests.

AI Tool: Environmental Impact Analysis Software (e.g., SimaPro)

SimaPro | LCA software for informed changemakers). This is an example of a predictive AI tool.

Application:

Analysing potential solutions such as sea walls, artificial reefs, and beach nourishment, considering their impact on local wildlife, carbon footprint, and cultural sites.

The software evaluates each scenario's long-term sustainability and environmental impact, facilitating an informed decision-making process that respects both scientific and cultural considerations.

The selected strategy incorporates traditional Māori knowledge of the land and sea, alongside modern engineering practices, to develop a holistic and sustainable solution.

Visuals and Documentation for Report:

- Process flowcharts detailing the environmental impact analysis of proposed mitigation strategies.
- Comparative impact assessments, visually presenting the benefits and drawbacks of each approach.
- Feedback from local communities and iwi, emphasizing the collaborative approach to selecting the most appropriate solution.