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ARTIFICIAL INTELLIGENCE AND CONSULTING ENGINEERING PRACTICE

| **WHITE PAPER**

Association of Consulting Engineering Companies | Canada

Association des firmes de génie-conseil | Canada

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ABOUT ACEC

ACEC is the national voice of over 400 companies that provide engineering and other professional services to both public and private sector clients across Canada and the world. Our members, who range from employee-owned small businesses to some of the largest engineering companies in the world, collectively employ over 60,000 Canadians. Consulting engineering firms are Canada's trusted advisors that are at the forefront of designing and building a more prosperous, sustainable Canada.

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BACKGROUND

Artificial Intelligence (AI) refers to the field of computer science dedicated to creating systems that can perform tasks typically requiring human intelligence, such as learning, recognizing patterns, making decisions, and solving problems. It has been around since the 1960's but is rapidly evolving and topical since advances in 2022.

In consulting engineering, AI can automate routine processes, enhance decision-making, and enable innovative solutions to complex challenges. **By integrating AI, the industry stands to gain significant improvements in efficiency, accuracy, and the ability to tackle increasingly complex projects.**

CONSIDERATIONS

Advantages

AI-powered tools may **enhance productivity and improve the quality of work** by:

- automating repetitive and time-consuming tasks, such as **data analysis, drafting, and compliance checking**, freeing engineers to focus on more complex and creative aspects of their projects;
- analyzing large datasets to identify patterns or potential issues, **offering engineers insights** that might take hours or days to uncover manually;
- **checking work for errors** or inconsistencies, potentially serving as an invaluable second layer of review to meet safety and regulatory standards.

AI may be capable of augmenting engineers' capabilities. While AI systems and tools can handle specific tasks, they lack the critical thinking, context awareness, and nuanced understanding that human engineers bring to a project. AI tools will always require the guidance, oversight, and expertise of engineers to interpret results, make informed decisions, and apply creative problem-solving. **By leveraging AI, engineers can seek to increase their productivity, improve project outcomes, and focus on delivering innovative solutions, knowing that these tools serve as efficient assistants rather than replacements.**

Risks and Liabilities

> The use of an AI-based system or tool during professional activities and work should be approached with caution, and different considerations should be taken into account when the work is generated directly by a professional. As such, additional strategies will likely be required (e.g. additional checking, independent review, audits and continuous monitoring and evaluation to ensure performance).
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> *– EGBC Practice Advisory*

REGULATORS' STANCE

Engineering professionals remain professionally responsible for their work even when it is generated by or includes AI output, including consideration of the risks and legal implications as well as their ability to meet regulatory requirements for documented checking, direct supervision, document retention, independent review, and quality management.

When using AI-based systems as a tool, engineering professionals must assess, understand and manage or mitigate the impact that AI-based systems and tools can potentially cause, either directly or indirectly. A professional must remain familiar with how the AI-based system or tool used is intended to function and exercise their engineering and ethical judgement on a continuing basis as per the Code of Ethics. **Documented risk assessments must be completed for all professional activities or work.**

Engineering professionals should not use or rely on AI outputs for projects involving safety or environmental risks unless they **understand the underlying processes and reasoning behind the AI system's output.** Quality management continues to be a top consideration when using and applying any new technologies.

INSURERS' STANCE

The current insurance industry perspective is to continue observing what liability exposures will be created or eliminated with the use of new AI systems and tools. Future litigation will further define these parameters and the industry will react accordingly.

Exposures related to AI are covered by a Professional Liability Insurance policy as there is currently no exclusion that relates to AI services and use of tools to the provision of professional services. Cyber policies may be involved, particularly if a firm is compromised due to the use of AI-based systems.

Client expectations must be carefully managed, and the scope of services should be clearly defined when incorporating AI systems and tools. Insurers recommend clearly and effectively communicating with your client during the process to ensure their understanding, as well as including detailed documentation, in particular, the justification of decision points throughout a project. Information provided by the client or others should be handled similarly to current processes – responsibility for the accuracy of information used and presented must be documented and continues to lie with the consultant no matter what tools are used.

Adequate and continuously adaptive staff training for effective and appropriate use of AI systems and tools will likely be the biggest challenge for firms. This is equally important for both junior and senior staff as strengths and gaps in knowledge will have a wide spectrum.

INTELLECTUAL PROPERTY

As AI systems and tools evolve, consulting firms must be aware of the use of any Intellectual Property (IP) that engineering staff feed into AI tools and whether any proprietary data is made public or externally available intentionally or inadvertently through the use of technology. This includes any data that is bound by client agreements or non-disclosure agreements with third parties. Publicly available tools are mostly "open source," potentially allowing competitors access to data given to the AI system during use. IP developed by the firm to give it a competitive advantage or other proprietary data can be used with closed internal AI systems and tools at the firm's discretion. **AI privacy tools developed or applied by firms can help mitigate, monitor and restrict what sensitive company data is being shared externally.**

REMUNERATION

As with any technology used by consulting firms, the costs of AI tools are either built-in to hourly personnel rates, added as a disbursement rate, fixed fee or as defined by client contracts. Firms should consider the costs of

Personal Example of Technological Disruption to Consulting Engineering

Digital Revolution of the 1990s

David Evans, Vice President, RVA

This transition happened at a natural gas utility in Ontario - I was managing a drafting group consisting of six people ranging in age from 25 to 60. A decision was made at the corporate level to implement an automated mapping and facilities management (AM/FM) system to replace the existing paper-based records system. A team was created for oversight and a dedicated development/implementation group, who were pulled from existing roles and physically moved to a "skunk works" location to create new tools and systems taking almost four years (an external team was hired for data conversion). IT staff were also hired to manage the procurement, installation, and ongoing maintenance of servers and workstations. My office was chosen as the pilot, and I was the operations contact for development and implementation. Training started early in the process, as the existing staff did not have a computer and some of them had never even used a mouse. The training curve was steep and took quite a while – much more difficult than envisioned. I even had staff take early retirement, as they felt they could not handle the change.

The technology that was being used was changing very rapidly. Initially it was thought that all output from the systems would be printed or output on microfiche, but CD technology was progressing extremely fast and by the end of the project we had pivoted to give field users laptops and CDs with mapping data (requiring more training). This was a dramatic improvement on the project outcomes and had not even been considered at inception.

Data conversion was a very challenging process. The skill required to "read" the old records did not exist at the data conversion level, and more than one false start happened. At the end it was accepted that quality would not meet original expectations, but conversion would happen anyway with the plan that over time the data would gradually be improved through use.

Takeaways

The project did not go as planned and the outcomes, although very successful, were very different than expected. The technology was changing very quickly, and flexibility was very important to get results. The commitment of time and resources was significantly larger than anticipated. It took much longer to integrate the new technology than expected. Giving new tech to a field maintenance technician (a laptop in this case) who had never used it before was a long process. Staff had to be convinced of the need for change.

The skunkworks approach was very effective as the team could get outside the normal operating box to take the best path forward without any strings attached. Senior management support was 100% and critical to success.

any new technologies adopted by teams when submitting proposals or negotiating client service agreements. Clear communication with clients will remain key, as any potential savings in personnel hours may be a result of proprietary AI systems developed or invested in by the firm, and **billing strategies may need to be adjusted to reflect costs appropriately.**

AI ERRORS AND HALLUCINATIONS

AI systems, while powerful, are not infallible and can produce inaccurate or misleading results, often referred to as "AI errors" or "hallucinations." These errors may stem from incorrect training data, algorithmic biases, or limitations in the AI tool's ability to interpret context accurately. All users must remain vigilant when using AI tools, thoroughly reviewing outputs to identify potential inaccuracies or inconsistencies. **Relying on AI without proper oversight can lead to flawed designs, safety risks, and regulatory non-compliance.** To mitigate these risks, firms must:

- **Validate outputs:** Cross-check AI-generated results against established standards and human expertise.
- **Understand limitations:** Recognize the boundaries of AI capabilities and avoid overreliance on automated systems for critical decisions.
- **Document review processes:** Maintain detailed records of quality assurance checks and decisions made during the use of AI tools.

By approaching AI outputs with skepticism and applying rigorous professional judgment, engineers can mitigate the risk of these tools to serve as helpful aids.

AI BEST PRACTICES	
General Principles	■ Comply with regulatory requirements and applicable legislation ■ Perform quality assurance ■ Consult in-house technology leads and subject-matter experts ■ Check AI output for intended deliverables
Suggested Usage	■ Only share publicly available or anonymized information ■ Use the generated content as a starting point, never as final material ■ Use AI for inspiration and/or solutions to repetitive tasks ■ Use common sense when using AI: be selective, skeptical, and critical
Not Recommended Usage	■ Never share confidential personal, firm, third party, or client data ■ Never disrespect intellectual property rights

SUSTAINABILITY

As AI becomes increasingly integrated into consulting engineering, sustainability considerations concerning the energy consumption of large data centres that power AI systems become apparent. AI applications, especially those requiring extensive computational resources, can significantly impact the environment due to the **high energy demands of data processing and storage.** However, AI also presents opportunities to enhance sustainability by optimizing resource use, improving energy efficiency in design processes, and enabling more sustainable infrastructure solutions.

By carefully selecting and managing AI tools, engineering firms can balance the environmental footprint of their digital operations while leveraging AI to drive sustainable outcomes in their projects. It's crucial for the industry to adopt practices that minimize energy use and prioritize the development of AI systems with a lower environmental impact.

MEMBER FIRM EXAMPLES

Many member firms within the consulting engineering industry are already harnessing the power of AI to streamline various aspects of their operations, enhancing efficiency and productivity.

Consulting firms' usage of AI today:

- Leveraging public and in-house AI tools such as:

  Level 1: Public tools (e.g. ChatGPT, Microsoft Copilot, DALL-E, etc.) without any firm-based control on data sharing and integrity

  Level 2: modifications to public tools that don't feed data back to the public system to allow firm-based control on data sharing and integrity

  Level 3: in-house, firm-developed tools built solely for firm-based content

- Public and non-public tools are being used by engineers to handle routine tasks such as writing emails, summarizing meeting notes, and generating reports. These AI tools can quickly draft coherent communications and synthesize complex discussions, allowing engineers to focus on higher-level project work rather than getting bogged down in administrative duties. **By automating routine tasks, firms can improve communication efficiency and ensure that key information is captured and disseminated accurately and promptly.**
- Some firms are pioneering the use of AI to **automate more specialized engineering tasks, such as CAD drafting and drawing reviews.** These AI-driven systems can automatically generate and modify CAD drawings based on input parameters, significantly reducing the time engineers spend on repetitive, tedious design work.
- AI tools are being **used to aid quality assurance checks on drawings**, identifying potential errors or inconsistencies that can supplement the review process.

> Responsibility for the work product rests entirely with the engineering/geoscience professional regardless of whether AI-based systems or tools are used.
>
> *– EGBC Practice Advisory*

As these technologies continue to evolve, they are likely to play an increasingly integral role in the day-to-day operations of consulting engineering firms.

What are realistic goals and implementations for the next 1-3 years?

More conventional uses will continue to be developed to apply machine learning models and artificial neural nets to solve engineering problems in a more efficient and precise way. **Revisiting software tools already in use with a fresh lens of incorporating AI modules could provide significant efficiencies in the short term.**

With the advent of AI, a new host of use cases have opened and are being actively explored. A wider adaption of AI is expected, not just through the use of generic out-of-the-box tools, but also through internally developed, specialised agents, e.g. for assisting with offers, screening tenders, report writing, etc.

Longer term, firms are anticipated to likely move from an opportunistic approach to a more strategic approach. A shift is expected towards internal funding for AI initiatives being channeled into fewer and larger projects that align with each firm's overall strategy. To harvest the full benefits and stay competitive, a more focused approach will be key.

CONCLUSIONS

As with all emerging and advancing technologies, **the business of engineering is expected to evolve and adapt to using new tools**. Consulting engineering firms will continue to weigh the risks of AI systems and tools with their competitive advantages while supporting their staff in fulfilling professional regulatory and ethical obligations.

Managing and mitigating risks will involve engineers' collaboration and consultation with qualified experts that develop and establish specific AI systems or tools in order to be able to harness the advantages and enable professionals to take responsibility for the end product.

Disclosure on the use of AI must be made to clients and the protection of company, client and other parties' data and intellectual property needs to be carefully considered.

Just as the calculator and computers enhanced the effectiveness of engineers without replacing them, AI will similarly become an effective tool for consulting engineering firms and their staff.

AI is expected to increase productivity, and this gain could be used to strengthen consulting firms' position in the market.

REFERENCES

EGBC Practice Advisory (November 2024): Use of Artificial Intelligence in Professional Work

Engineers Canada (2016): Professional practice in software engineering