Artificial Intelligence and the Future of Engineering

Addressing the Needs of Today's Industries

All companies today need to be innovative, customer centric, speed to deliver and cost efficient in this digital era. Businesses need to respond to rapidly changing customer needs, put their innovations into production as quickly as possible, and be able to operate and deliver products to their customers more efficiently. The life cycle of a product starts with customer driven innovation, followed by engineering and construction of the manufacturing facility, after which comes production and the eventual delivery of goods to customers. Each step in this process must be responsive to the market and its consumers. From the perspective of engineering, this starts with "faster, better, and cheaper" project delivery, and then digitalization which not only captures critical data and draws insights from it to achieve improved output at reduced costs, but also schedules preventative maintenance to minimize downtime and facilitates accurate inventory planning to prevent stockouts.

Current Challenges

Engineering and construction of capital project has become the bottleneck of the value chain. The capital project timeline is not getting shorter and more efficient – in fact," Study of 800 major projects (those of value over $1 billion) found that, on average, projects were one year behind schedule and 30 percent over budget. But what's true for major projects is similarly true for projects of various sizes, even projects as small as $10-$20 million."(Mckinsey&Company: Capital project value improvement in the 21st century: Trillions of dollars in the offering)This is deeply rooted in the industry's slow adoption of advanced technology, especially in digitalization.

In today's industries, so much historical engineering data is not digitalized – instead, they are still in paper or PDF format and stored in silos, using traditional file management systems. All of this unstructured data makes it difficult to search for information, and poses a formidable challenge for those wanting to consolidate this data into a systematic and standardized knowledge base. Furthermore, much of this data is no longer current, and contain conflicting information. This not only poses significant risk in operational safety and reliability, but also results in wasted time and resources. In the case of capital project engineering, extracting relevant historical data for new investments is a time-consuming undertaking and very often depending on expertise who have done previous projects, and many are retired or retiring). When a company embarks on a new project, non-digitized data or erroneous as-builts drawings, force engineers to reinvent data, reconstruct engineering standards for each project, recreate numerous drawings, and regenerate many specifications. All of this manual data transfer creates an unnecessarily lengthy and error-prone front-end process. The digital transformation process is no less extensive, with significant effort and manual work required to organize historical information in order to establish digital twins or digital platforms for existing facilities.

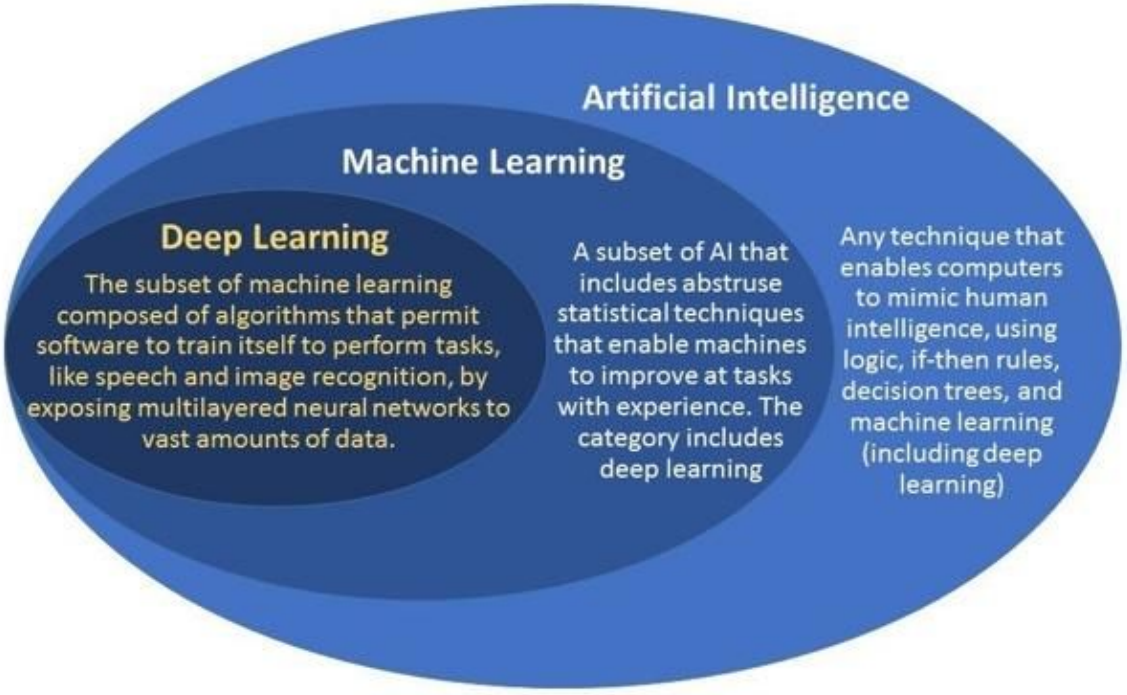
In addition, in today's engineering work process, there are still many non-value-added activities such as manual data transfer, interoperability with different design tools, and platforms.

The current engineering information management system still based on the traditional concepts of filing or documentation structure, and the absence of digitalized big data prevents the industry from performing future analyses and data mining as well as applying new technologies that would significantly improve productivity to meet today's engineering needs, including deep learning for Engineering automation. The digital transformation of engineering is therefore critical for consolidating industry knowledge, improving efficiency, and fully leveraging the advantages of digitization.

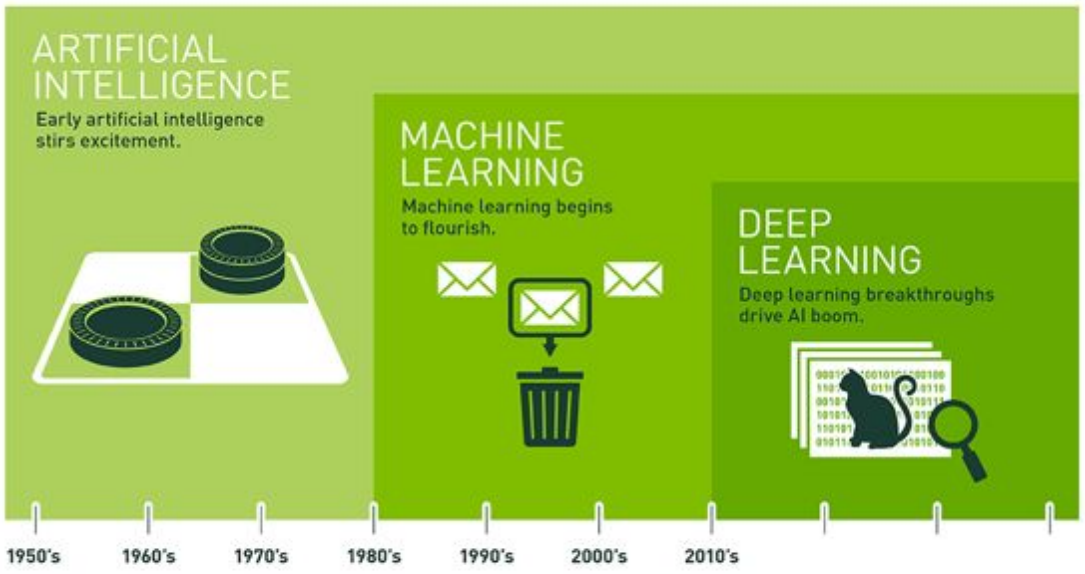
AI: New Technologies, Endless Possibilities

AI and its impact

AI is a system of methods and rules that teaches computers to think and act like humans (Expert System). One of these methods is "machine learning," in which computers acquire decision-making and pattern recognition abilities. Going one step further is deep learning, which sees computers gaining recognition techniques through learning by example (https://www.mathworks.com/discovery/deep-learning.html)



https://medium.com/datadriveninvestor/ai-vs-machine-learning-vs-deep-learning-ba3b3c58c32



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

Key AI technologies

Intro statement

Natural-Language Processing

NLP refers to techniques that enable computers to process and understand human language. In other words, being able to analyze documents with an NLP algorithm will enable computers to process human language and solve NLP tasks such as part-of-speech tagging, semantic analysis, machine translation, question answering, and more.

Computer Vision

Computer vision technologies involve the capture, processing and analysis of digital images, essentially decoding their meaning and context. There are many CV technology areas, including machine vision, optical character recognition, image recognition, pattern recognition, facial recognition, edge detection and motion detection, all of which support the overall CV technology spectrum.

Business Analytics, Data Science, and Decision Making

In the area of business analytics and data science, AI technology sorts through the vast amount of data available, then recognize patterns in the data and make predictions. Artificial intelligence is allowing business decisions to be made much more easily, reliably, and accurately due to the large amount of data that can be collected and studied in much shorter time, in which is impossible for human beings.

Robots and Sensors

Robotics is the branch of technology that deals with the design, construction, operation and application of robots, as well as with computer systems for their control, sensory feedback and information processing for robotics. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior and/or cognition.

AI applications across the industries

Based on Mckinsey's research the potential total annual value of AI and analytics across industries will reach to $9.5T - $15.4T (The executive's AI playbook, McKinsey Analytics) These AI applications already made much changes and values in many industries through work process automation and optimization

- **Banking** – payment fraud, payment automation, risk management, loan approvals, credit scoring, collections, customer acquisition and retention

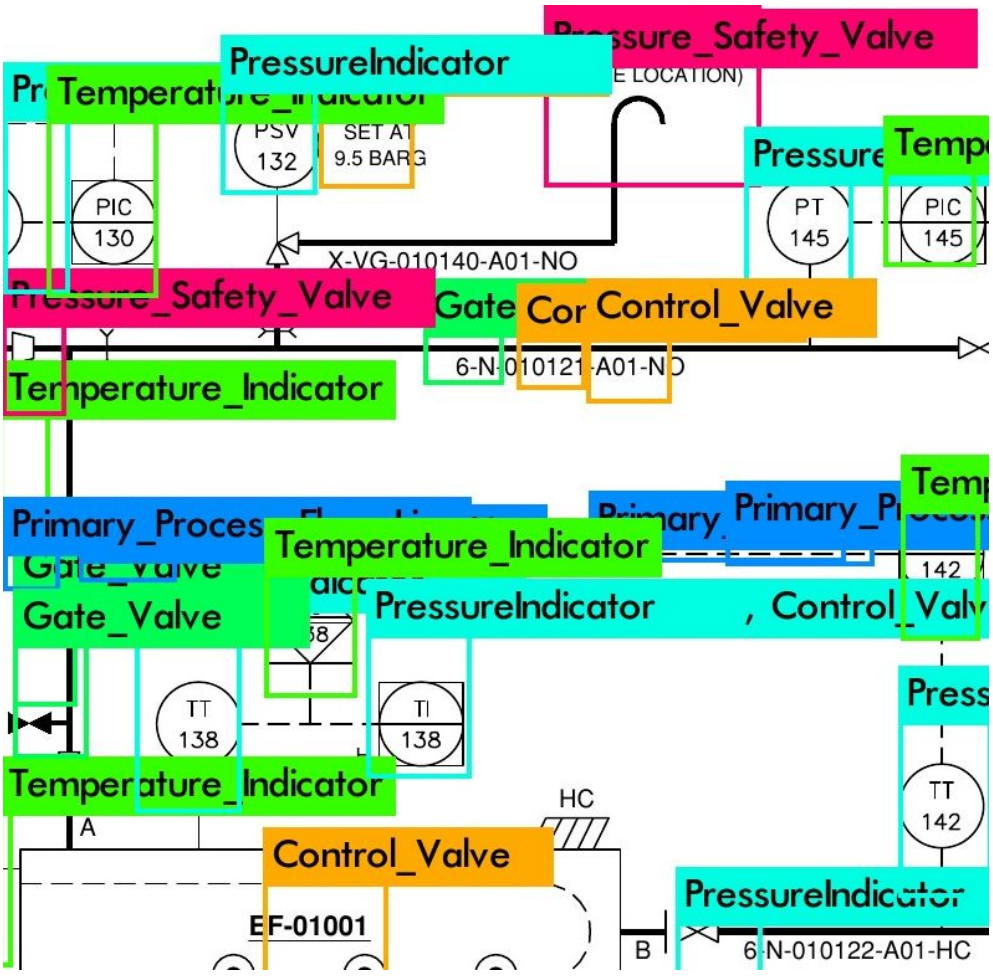
- **Insurance** – automated claims processing, rating engines, claims fraud, document configuration, customer retention, cross-sell / up-sell, and best-fit recommendations
- **Healthcare** – health and wellness evaluations and recommendations, appropriate use criteria, readmissions and outcome management
- **Retail** – upselling/cross-selling, campaign optimization, social media management, next-best offer, customer service
- **Manufacturing and Utilities** – predictive maintenance, asset management, warranty claims
- **Car industry** -autonomous vehicles
- **Legal –** contract management, compliance check

Many of these AI applications can be used in engineering work. For example,

How AI technology will transform engineering and digitalization

Engineering information is essentially presented in the form of drawings, documents and 3D models (either design-built or via point clouds).

The application of AI technology – machine learning, deep learning, text/image/visual recognition and natural language processing – enables computers to "read" and process engineering documents and drawings the way a human would, effectively replacing manual processing, improving engineering productivity and further automating engineering deliverables.



Source?

By applying AI technology, computers can

- digitalize critical engineering drawings and documents;
- provide content searching capabilities;
- perform cross checking;
- consolidate data and knowledge for interaction and conversation with humans; and
- automate engineering deliverables.

Further, combined with advanced technology using laser scan, drone or Lidar technology, companies can re-engineer and updating existing information to reflect the most updated facility information and build digital twins for future data collection and optimization.

Looking to the Future

With the ability to digitalize engineering data, generative AI expands possibilities for human decision making. allowing humans to select the solution that optimally balances scope, cost and scheduling and drastically reduces engineering cost and time. Generative AI also greatly facilitates human and computer interaction for engineering input, review and feedback, including conversation between human and digital twins.

Engineering with Intelligence

At Intelligent Project Solutions, we engineer with intelligence, providing innovative AI solutions to meet the engineering and digital transformation needs of our customers.

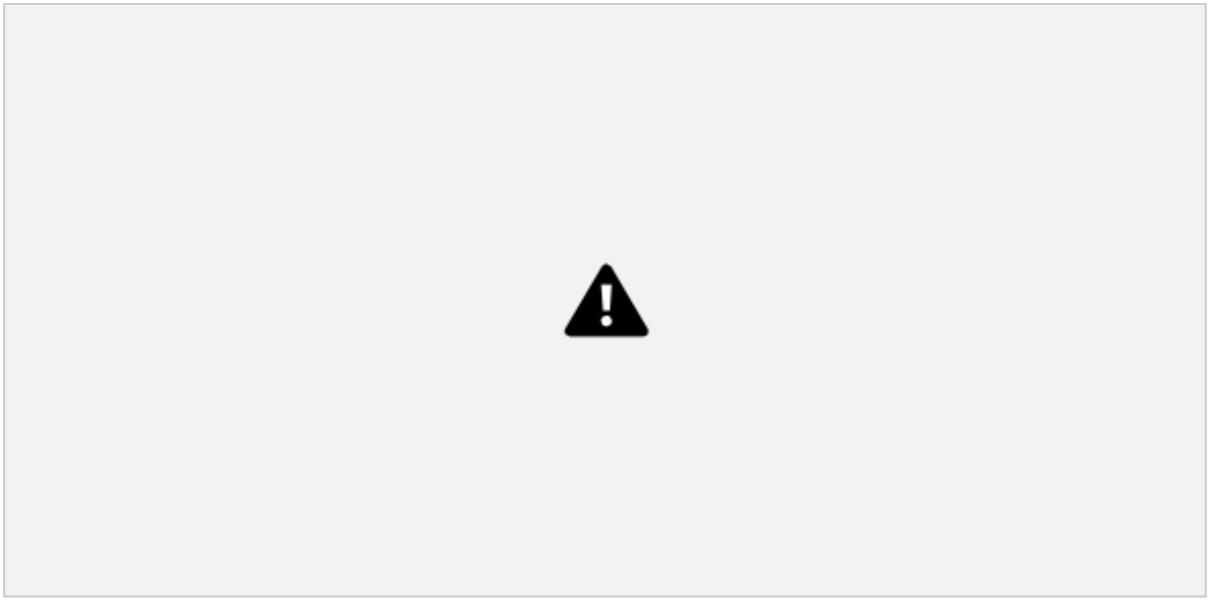
Our demonstrated industry knowledge in engineering and project management, coupled with our AI expertise in deep learning, visual recognition as well as image and natural language processing enable us to provide cognitive AI solutions to fulfill the demands of today's key process industries, including oil, gas and chemical.

IPS is currently developing three AI technologies:

- iENG, an engineering drawing and document "reader";
- iENG Go, search engine designed to improve engineering productivity and knowledge management; and
- iENG Digital, recognition technology that analyzes, consolidates and links digital data from laser scans to digitalized engineering documentations, automate digitalization and eventually move towards generative engineering solutions.

Our mission is to apply AI technology and innovation to deliver significant productivity gains for the engineering industry. We are committed to our vision to transform the future of engineering with our industry-leading AI solutions.

In the future, we believe AI will become an inseparable part of any project and engineering team.



- Move away from non-"intelligent" efforts
- Support human intelligence to promote better engineering, project and business decisions
- Enrich human intelligence through knowledge transformation:
    - Digitalize and consolidate data for better solutions

- Develop new ways of working that offer more freedom to create, interact, and balance work and life

From pilot projects to collaborative partnerships, we provide customized solutions that help you succeed. Work with us today.

Works Cited

Expert System. *Artificial intelligence software definition*. 24 March 2016. 2 October 2018. <https://www.expertsystem.com/artificial-intelligence-software-definition/>.