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Abstract

Science is always finding a way to make our lives easier. The use of artificial intelligence technology is a prime example of this. There are constant discussions and developments within the energy industry on how artificial intelligence can be implemented more in processes such as monitoring and decommissioning to name a few. Artificial intelligence technology has its benefits; the ability to do jobs humans cannot, withstand extreme conditions and feedback data quickly. However, there are also some negatives such as the potential job losses. It is a topic at the forefront of the developments for the future of the energy sector, more so with the transition to cleaner, greener energy.

Introduction

For more than half a century, artificial intelligence (AI) technology has been under constant development, with new and exciting inventions increasingly making headline news. Minksy and McCarthy are the fathers of the field, describing AI simply as being tasks performed by a machine that would have previously been performed by humans, or human intelligence (1).

The term artificial intelligence was coined at a conference at Dartmouth College, New Hampshire; however developments were far from easy going with funding ceasing in the 1970s. This was known as the 'AI winter' and lasted six year, finally reviving in 1980 with British government funding, in an effort to compete with the Japanese. The following few years saw funding and research rollercoaster, but by 1997 IBM's Deep Blue became the first computer to beat chess champion Garry Kasparov. In 2014, Eugene Goostman, a computer 'chatbot' fooled judges into believing he was a real skin and blood human during a Turing test (2).

It can be seen with only these two examples how far AI technology has progressed and it can only be imagined what the future will hold. An industry which is pushing the use and development of AI technology is the energy sector. As energy supply transitions to a more low carbon and sustainable process, the efficiency of carrying out such activities is also being targeted. Siemens Energy considers the digital transformation to be priority of energy companies, not only to modernise the enterprise but also ensure a secure energy ecosystem (3). Mitsubishi Hitachi Power Systems Ltd, and Electric Corporation, Microsoft Corporation and Honeywell International Inc. are some of the leading companies in the transformation, with energy specific companies such as British Petroleum (BP) and Exxon adopting AI technology too (4).

As AI technology slowly radiates across all aspects of the industry, the effects of its implementation with be felt on a global scale, through the whole energy supply chain. These effects will have the intentions of providing improvements to the system and will succeed, but not without some potential negative impacts. This research aims to explore the positives and negatives of the increased use of AI technology in the energy sector, whilst exploring its current state and the aims energy companies have the future.

AI Technology Use in Oil and Gas

Currently, the oil and gas industry are at the forefront of using AI technology, with the filtering of such uses into the expanding renewables sector. Within oil and gas there are two primary applications of AI; data sciences and machine learning. Machine learning allows a computer system to interpret data without the need for human input, with refined programs designed for specific purposes. Data science utilises the

AI to extract information from the data collected, in order to find linkage and form a more comprehensive picture from the existing information (5).

ExxonMobil and Total have initiated intelligent robots to aid in oceanic and hydrocarbon exploration. The aim is to improve productivity and cost-effectiveness whilst also ensuring a reduction to worker risk (6). Oil and gas rigs can be one of the most dangerous places to work so the digital transformation will significantly help reduce such risk to personnel. AI technology can provide constant monitoring of platforms, all hours of the day and all weathers, with any slight adjustments being recorded and evaluated. The technology can cover 360 degrees and contains thousands of sensors including heat, an important factor to monitor on high risk platforms (7).

However, over the years the oil and gas industry has provided many employment opportunities, although not always secure, there are always some options of job availability. With this increase utilisation of AI technology it has to be considered will AI replace people in the oil and gas industry? Aker Solutions, an energy company at the forefront of the digital transformation has predicted that it will reduce engineering and fabrication man hours by 20% in the next few years (8).

AI technology provides a more unified monitoring process that can occur over numerous platforms and wells, compared to that of humans, therefore this would insinuate a risk of job losses to those who AI could replace for the greater good. Companies do reassure this would not be the case; unfortunately such answers will not be clear until the future (9).

AI Technology Use in Renewable Energy

As renewable energy sources are expanding and providing more of our energy supply to the demand than ever, AI technology is constantly being integrated within the system. There are claims that AI is needed to manage the decentralised grids and that it will be able to balance supply and demand in real-time, whilst optimising the use and storage of energy (10).

There are many investment opportunities for AI within the renewable energy sector, some already benefiting greatly from the technology such as the smart meters and energy management. Currently, AI gathers real time data from homes and cities to operate energy distribution more efficiently and effectively, and make life more convenient. AI can also use this information to forecast achievable production from wind and solar energy, also known as smart energy (11).

Often with renewable technologies the monitoring and maintenance is the largest expenditure, especially with wind farms. Within the 20 to 25 year life expectancy, the first three years and the last five years produce the highest failure rates for the turbines. Quick response is key to potential system failures; this will not only allow for

a more consistent power supply but also prevent anything catastrophic occurring. Some of the original monitoring systems in place for wind turbines were slow, unstructured and often difficult to analyse. AI technology is beginning to combat such issues (12).

Unlike oil and gas rigs, renewable technologies rely more strongly on computer based maintenance and requirements, more so those that require weather elements to produce the energy. Not only this, but personnel do not often have the access to the technologies that they would have on oil and gas infrastructure, they are smaller or have more of an internal process to transform energy to electricity (13).

With this it is not as much of a major concern over job losses as the digital transformation will be for the oil and gas industry. The International Renewable Energy Agency based in Abu-Dhabi has estimated that digitalisation within the renewable energy sector will create 42 million jobs by 2050. This is primarily due to the constant rapid technological updates and changes required to meet a zero-emission economy (14).

A Brief Summary of the Advantages and Disadvantages of AI Technology Use in the Energy Sector

Advantages	**Disadvantages**
A reduction in human error- it is human nature to make mistakes sometimes regardless of how thorough the task has been carried out. AI would reduce this by being programmed with algorithms specifically for tasks increasing the degree of accuracy and precision.	*Cost*- unfortunately, as with any technology, not only the manufacturing but also the maintenance and repair of the technology itself are required throughout its lifetime. They are very complex machines.
Can complete tasks of high risk- an AI robot can withstand higher temperatures and more extreme conditions than humans, therefore task with a more dangerous aspect can be carried out. This could be of benefit during monitoring activities and if processes fail, turning dangerous.	*The effect on humans*- as robots take over more jobs, there is a chance this could advocate laziness in the human population. It has been known for humans to become addicted to such inventions, for example phones, so AI technology completing main job roles could lead to issues for future generations.
24/7 work availability- an average working day for humans is approximately 8 hours and this in including breaks, then more so within oil and gas, shift changes happen. AI technology does not need a break unless down for repair, therefore this increases workload and provides a continuous data supply from the same source.	*Unemployment rates*- although companies state this should not be an issue, robots and other AI technology completing jobs that a human had once complete must have led to unemployment at some point. This has been considered more of a concern within the oil and gas industry, but as the world transitions to cleaner energy this

	concern may be rectified.
Digital and decision assistance- the ability to chat to, and program robots to fulfil a task brings a more accurate and quicker response. There is elimination of any emotional related response. It can also make a unified response, for example weather monitoring for all wind turbines on a wind farm.	*Emotionless and too focused*- there is a limit of emotion required to successfully work as team. AI technology in the energy sector is not designed to compute emotion which could lead to issues in some aspects of the jobs complete. Not only this, but AI completes the tasks it was programmed to do and no other. If it were to malfunction or if an external error was to occur the whole system would crash.

(15)

The Future of AI Technology in the Energy Sector

COVID-19 has sparked a number of daunting challenges within the industry, with increasing pressures from governments to reduce carbon footprints and demands from the general population. Such challenges have led to the Biden Administration endorsing the use of AI to help reduce the fossil fuel consumption and emissions from the energy sector (16). It may take global government intervention with the use of AI technology to control its implementation into producing the energy supply the population requires.

Certain reports state that due to AI cutting energy cost and accelerating the use of clean energy, it could be the answer to aiding those more developing countries who have ambitions to lower emissions but do not have the means to do so. AI managed smart grids have allowed a two-way communication between the consumer and utilities, allowing greater response to the energy demand and surges. Canadian company Sentient Energy is developing AI technology to help with prediction issues aligned with hydroelectricity production. The current state of prediction of hydrology is outdated and AI could provide more real-time reliable data (17).

Synchrophasers are a development that is the size of a briefcase. It is a device that allows a continuous measure of the electricity flow through the grid, communicating with the grid to modify flow depending on peak times. The reduction in electricity flow during off-peak times would trigger the synchrophaser; this then relaxes the workload of the grid and the result would be lower prices for consumers. Google recently adopted similar technology for its data centre and it is in constant discussion to endorse further within the energy sector (18).

Another form of AI technology is robots. These are currently used and being improved for use in wind and solar farms. There are various types of robots with different useful functions: drones, crawling robots, cleaning robots and construction robots. Drones cannot only be used for general inspection of the renewable energy

source but also for mapping out new sites and de-icing the infrastructure. There is ongoing investigation into dry clean robots which are in popular demand due to using less or no water, using large microfiber rotating brushes and being recharged through solar energy (19).

The innovation of technology such as dry clean robots would have its benefits in developing countries. These countries can often lack in clean water sources but have the climate for large solar farms. To further this, AI developments could improve employment rates, providing developers adhere to a just transition and ensure knowledge is transparent and passed on. The largest set back with the use and development of AI technology, which may always present an issue, is cost. Unfortunately, artificial intelligence will naturally cost more than human intelligence due to the manufacturing required to develop and maintain such instruments. Even something as simple as a robot vacuum cleaner can cost over £1000 (20).

Conclusion

Overall, as the world transitions to a low carbon economy, the scientific innovation of AI technology could be of great benefit. However, the main point to consider is that it must remain affordable and adaptable for those developing countries that could utilise the technology also. To ensure a just transition, ‘no man must be left behind’, and this highlights the previous statement but also that if job losses are felt within the oil and gas industry, these must be rectified. AI technology can provide a more safe and reliable option of construction, maintenance and monitoring, with real-time data collection and analysis, potentially preventing catastrophic events occurring.

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