VROC

Whitepaper

The Challenges of Implementing Industrial AI - *REVISED*

A lot has happened since the first iteration of this paper - which seems like yesterday but given the speed of technology advancements, 2020 almost feels as far back as 2012! The adoption of artificial intelligence by industries has grown exponentially in since we first drafted 'The Challenges of Implementing AI', and whilst some of the challenges remain the same, there are new issues which organisations need to overcome if they want to reach AI maturity.

Contents

Where are we now?

The end of 2022 saw a dramatic step forward in the world of artificial intelligence, with Open AI's Natural Language processing platform, ChatGPT. Once again, AI was front and centre, this time its potential applications were highlighted for the world to see, bringing the conversation of AI implementation back to the board room table.

What else has happened?

Diverse AI Capabilities in Action:

Not only has AI adoption more than doubled since 2017[1], the arsenal of AI capabilities employed by organizations has had a remarkable expansion, doubling in scope. From natural-language processing to computer vision, the spectrum of AI applications has broadened, providing a multifaceted approach to problem-solving and optimization.

Proliferation of AI Use Cases:

The increased adoption of AI has resulted in a wider range of use cases; within the manufacturing realm this has included IoT analysis, preventative and predictive maintenance, process improvements, and quality enhancements, reflecting a gradual but deliberate integration of AI into core manufacturing processes.

Efficiency Gains in Model Deployment:

Organizations who are 'AI mature' are making strides in the efficiency of machine learning (ML) deployment. With the number of models put into production experiencing remarkable growth, one data and AI company have indicated that for every three experimental models, one successfully transitions into production.[2] However, this maturity isn't across the board, Accenture still says that 63% of firms are still 'testing the AI waters', and when it comes to manufacturing companies, 57% are thought to be still piloting and experimenting. [5]

Talent Crunch Persists:

Despite the surge in AI adoption, there is a persistent shortage of personnel. Organizations are increasingly recognizing the need for talent to help industrialize AI, with roles such as AI product managers, analytics translators, and software engineers gaining prominence, in addition to the already head-hunted data scientists.

Financial Commitment to AI:

Companies who are more 'AI mature' are demonstrating their commitment to AI by allocating a significant portion—some estimate up to 20 percent—of their digital-technology budgets to AI-related technologies.[1] This financial investment underscores the strategic importance of AI in achieving digital transformation goals.

57% OF MANUFACTURING COMPANIES ARE THOUGHT TO BE STILL PILOTING AND EXPERIMENTING WITH AI.[5]

What does the future look like?

As we stand on the precipice of a transformative era, the future of Industrial AI promises a seismic shift in how industries operate, innovate, and evolve.

Acceleration of Automation and Workforce Dynamics:

By the year 2030, the trajectory of AI is poised to accelerate automation, reshaping the landscape of the workforce. Routine tasks are expected to be displaced, and this evolution calls for a recalibration of skills and roles in the industrial sphere.

Continued Surge in AI Investments:

The commitment to AI is not just a fleeting trend; it's a sustained commitment by organizations to propel innovation and efficiency. A resounding 96% of manufacturing companies, according to a recent survey, anticipate a surge in their AI investments.[3] This robust financial backing underscores the industry's recognition of AI as a catalyst for future growth and competitiveness.

Rise of Natural Language Processing (NLP):

Natural language processing (NLP) is set to become a linchpin of AI applications. Its expansive reach, from the deployment of chatbots to research, fraud detection, and content generation, will redefine how humans interact with machines. The seamless integration of language understanding into AI systems will continue to open new frontiers for communication, making processes more intuitive and user-friendly.

Manufacturing Operations at the Vanguard of AI Benefits:

In the industrial realm, manufacturing production operations are poised to reap substantial benefits from AI integration. The future holds the promise of improved predictive maintenance, fostering more sustainable production operations, driving process innovation, and maximizing asset uptime. These advancements herald a new era of efficiency, where AI becomes an indispensable ally in optimizing production processes.

The Self-Correcting Loop of AI:

As the future unfolds, the integration of AI into industrial processes is poised to initiate a self-correcting loop, catalysing continuous improvement. The inherent inaccuracies stemming from gaps in the current technological landscape, including legacy systems, inefficient databases, and suboptimal IoT sensors, will serve as a catalyst for transformative upgrades. This will illuminate the need for system-wide enhancements, prompting organizations to re-evaluate and modernize their technological infrastructure.

In the broader economic context, AI is not merely a technological leap; it's a potential economic powerhouse. By 2030, AI could contribute up to $15.7 trillion to the global economy, surpassing the combined output of China and India. Of this staggering sum, $6.6 trillion is projected to result from increased productivity, while an additional $9.1 trillion is expected from consumption side effects.[6]

Furthermore, local economies could experience a remarkable +26% boost in GDP from AI by 2030, with over 55% of all GDP gains arising from labor productivity improvements.[6] This underscores the profound impact AI is poised to have not just on individual industries but on the economic landscape as a whole. The journey to this future reality holds the promise of reshaping industries and economies in ways previously unimaginable.

BY 2030, AI COULD CONTRIBUTE $15.7 TRILLION TO THE GLOBAL ECONOMY [6]

Understanding the Business Case of Industrial AI

In the age of Industry 4.0, the business case for Industrial AI stands as a testament to the transformative power of data-driven decision-making, resource optimization, and the liberation of human potential from mundane tasks.

The Data Deluge:

Industries are experiencing an unprecedented surge in data creation. From manufacturing to energy, the sheer volume of data generated provides a treasure trove of insights waiting to be harnessed. Industrial AI emerges as the key to unlocking the value hidden within this data deluge, turning it from a potential burden into a strategic asset.

Effective Resource Utilization:

The true power of Industrial AI lies in its ability to liberate human capital from repetitive, tedious tasks. By automating routine processes and utilizing AI for data analysis, staff can be redeployed to more strategic, value-added roles. This shift in resource allocation not only enhances operational efficiency but also empowers employees to focus on tasks that require creativity, critical thinking, and a nuanced understanding of the business.

Manufacturing Potential:

In the manufacturing sector, AI adopters can expect to benefit from enhanced monitoring and auto-correction of processes. Industrial AI enables real-time monitoring of manufacturing processes, swiftly identifying deviations and auto-correcting anomalies. This not only enhances product quality but also minimizes downtime and reduces the likelihood of defects. In addition, on-demand production may become a reality with AI. By predicting market trends and consumer demands, manufacturers can tailor production to meet specific needs, minimizing waste and maximizing resource utilization. Lastly, with AI supply chain logistics will be more streamlined and efficient.

42% OF AI ADOPTERS REPORT THE RETURN ON INVESTMENT HAS EXCEEDED EXPECTATIONS [5]

Energy Industry Potential:

In the energy sector, AI presents a paradigm shift in operational dynamics, with business cases such as, smart metering, efficient grid optimisation and storage, and predictive infrastructure maintenance. These advancements will help conserve energy consumption, improve system reliability, and contribute to sustainability goals.

Realizing Benefits Today:

The proof of the pudding lies in the eating, and companies at the forefront of AI adoption are already savoring the results. A remarkable 42% of companies leading the way report that the return on their AI initiatives has exceeded expectations. [5] These trailblazers are experiencing tangible benefits in terms of improved efficiency, reduced costs, and enhanced overall business performance.

How do we get there? - overcoming the challenges

Convinced, in the potential of AI for industry – Great. However, before you realise that potential, you first must navigate the challenges.

Through the remainder of this paper we are going to provide insights into how to overcome the following six challenges;

1. Data Quality and Availability
2. Where should AI be implemented?
3. Defining metrics for successful AI implementation
4. Overcoming inherent biases
5. Collaboration & Trust
6. Skills shortage

Challenge #1 Data Quality and Availability

In the landscape of Industrial AI adoption, one of the paramount challenges is intricately tied to the quality and availability of data. This challenge encompasses various facets, from accessing and formatting data to integrating disparate datasets, establishing reliable connections, and grappling with issues such as poor data quality. Overcoming these challenges is pivotal for the successful integration of AI solutions in industrial settings.

Components of the Data Challenge:

1. Accessing Data:
Securing access to relevant and crucial datasets is often a hurdle, particularly when dealing with complex industrial environments where data sources may be distributed or siloed.

2. Formatting Data:
Ensuring that data is not only accessible but also in a format compatible with AI algorithms is a significant consideration. Misaligned formats can impede the training and effectiveness of AI models.

3. Integrating Disparate Sets of Data:
Many industrial operations generate data from diverse sources, which are often managed on multiple different legacy platforms, which cause unnecessary complexity and high costs. Integrating these disparate datasets poses a challenge, especially when they come in different formats or are stored in separate systems.

4. Connection Reliability:
Establishing reliable connections to data sources is vital. Fluctuating or unstable connections can lead to data inconsistencies and hinder the performance of AI algorithms.

5. Poor Data Quality:
Inaccuracies, incompleteness, and inconsistencies in the data can significantly impact the reliability of AI models. Ensuring high data quality is crucial for the accuracy and effectiveness of AI applications.

Overcoming Data Challenges:

To address these data challenges, industrial organizations can adopt a strategic approach:

1. Investing in Data Infrastructure:

Organizations should prioritize investing in robust data infrastructure that supports seamless access, formatting, and integration of diverse datasets. Modernizing data architecture is often a crucial step in overcoming scalability issues and enhancing data accessibility. There are now a wide range of cost-effective data platforms and data warehouses which can be hosted on premise or in the cloud.

2. Implementing Data Governance:

Establishing a comprehensive data governance framework is essential. This involves defining clear ownership, ensuring data quality standards, and enforcing protocols for data security and compliance.

3. Data Quality Control Measures:

Implementing stringent data quality control measures is vital for rectifying inaccuracies, ensuring completeness, and maintaining consistency across datasets. Regular audits and checks contribute to sustained data quality.

4. Collaboration and Integration:

Promoting collaboration between departments and integrating data streams can break down silos and facilitate a more holistic approach to data management. Cross-functional cooperation enhances the availability and accessibility of relevant data.

By addressing these challenges head-on, industrial organizations can not only enhance the quality and availability of their data but also lay a robust foundation for the successful integration of AI technologies in their operations. This strategic approach ensures that AI initiatives are built on reliable, high-quality datasets, maximizing their potential to drive meaningful insights and improvements.

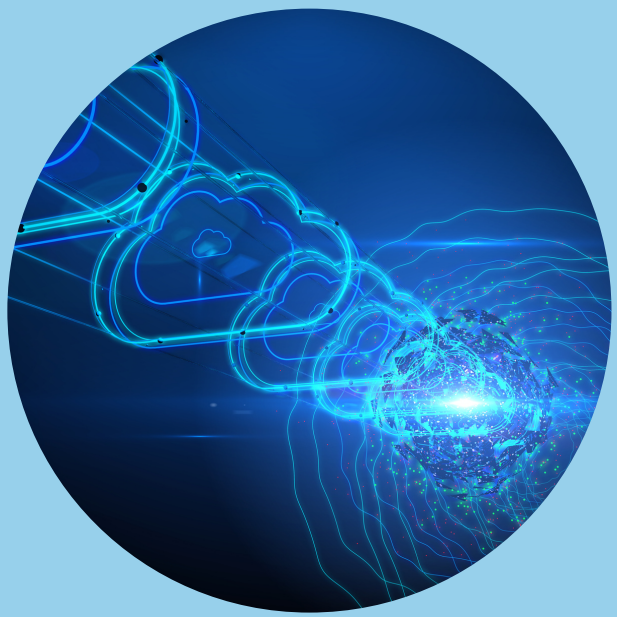
Solving Data Challenges With A Data Warehouse

Data Warehouses, like VROC's DataHUB4.0, provide a modern approach to a traditional process historian, with the integration and storage of timeseries data from a diverse asset base.

Data warehouses often include embedded data quality and integrity monitoring and verification, helping to sustain data quality.

Structured, semi-structured and unstructured data can be stored in the data warehouse, and data analytics and AI models can applied directly to the data, eradicating data wrangling and improving collaboration between teams.

Making data accessible, with a future-proof infrastructure, is the first step to utilising data for analytics and artificial intelligence insights.



Challenge #2 Where should AI be implemented?

Embarking on the journey of implementing AI in the realm of industrial processes demands strategic foresight. The challenge lies not only in recognizing the potential of AI but also in pinpointing precise areas where its deployment can yield significant benefits. To guide this strategic decision-making, consider the following key criteria:

Data-Rich Environments:
Identify domains within your organization that generate copious amounts of data. These data-rich environments become the ideal starting points for AI implementation. Seek out scenarios where the sheer volume of data overwhelms traditional analytics approaches, creating an opportunity for AI to reveal hidden patterns, correlations, and predictive insights.

Known Problem Statements with Significant Impact:
Direct your attention to problem statements that have tangible and significant repercussions for your organization. These could be challenges impacting the bottom line, product delivery, excess wastage or other key performance indicators (KPIs), or a combination of these factors.

Beyond Human Capacity:
AI excels in scenarios where the complexity and multitude of variables surpass human processing capabilities. Therefore, target problem statements that go beyond the capacity of human operators and traditional analytics tools, indicating a need for the advanced analytical power of AI. Look for issues that persist despite earnest attempts at traditional troubleshooting, in industrial setting this may look like complex optimization challenges, repeat asset failures or shutdowns.

In essence, by strategically directing AI implementation towards data-rich environments with analytical challenges, and focusing on known problem statements that impact the core of your operations, organizations can unleash the true potential of AI. This approach not only addresses immediate challenges but also positions the organization for sustained success in the era of industrial AI integration.

A Refinery With A 20 Year Old Problem

A global refinery was a prime candidate for AI adoption.

Firstly, with over 170,000 sensors and 44.4 billion data points, it was a data rich environment.

Secondly, it had a tangible problem statement. The refinery had suffered chronic premature filter clogging since it started operation. The problem caused frequent and costly plant shutdowns.

Thirdly, due to the plant's numerous interdependent processing areas and complicated chemical reactions, the team was unable to resolve the issue with traditional analysis.

AI models were built to help identify the root cause of the filter clogging issue. the insights led to the resolution of the problem and resulted in a savings of $100,000 p/mth from reduced maintenance costs and reduced downtime.

Challenge #3 Defining Metrics for Successful Implementation

Implementing AI in an industrial setting requires a meticulous approach to ensure that the deployment aligns with organizational goals, enhances efficiency, and delivers tangible value. Here are key metrics to consider for successful AI implementation. It is important to establish a baseline, and then measure against that baseline to evaluate your success.

1. Operational Efficiency Metrics:
   - Production Throughput
   - Resource Utilization
   - Downtime Metrics

2. Quality and Consistency Metrics:
   - Defect Rate
   - Consistency in Production
   - Compliance Metrics

3. Cost-Effectiveness Metrics:
   - Energy Consumption
   - Material Waste
   - Labor Productivity

4. Predictive Maintenance Metrics:
   - Equipment Reliability
   - Mean Time Between Failures (MTBF)
   - Maintenance Costs

5. Decision Support and Adaptability Metrics:
   - Decision-Making Speed
   - Adaptability to Change
   - User Satisfaction

6. Return on Investment (ROI) Metrics:
   - Cost Savings
   - Revenue Increase
   - ROI Period

Whilst not all metrics are applicable in every application of AI, it is important before you commence an AI project that you establish how you will assess its performance. Being able to show tangible results is critical in gathering continued support, and to scale AI adoption.

Offshore Oil and Gas Platform Showcases AI Success

A South-East Asia Offshore Oil and Gas Platform was able to prove the success of its AI application, harnessing further support for continued adoption of AI throughout the company.

The Platform had a well defined problem statement, a Gas Compressor with recurring reliability problems. They also had one year of historical data available. The team had a clear grasp on the operational cost of this problem, as they had unsuccessfully tried to resolve the issue themselves.

The AI insights led to the identification of the root cause, resulting in the following;

- Decision making speed was x2000 faster than their traditional approach
- Reliability increased from max two weeks to four months
- Uptime savings confirmed of $21.7m USD

Challenge #4 Overcoming Inherent Biases

Humans, by nature, are predisposed to inherent cognitive biases—unavoidable aspects of our thought processes. Recognizing this fact is crucial, especially when delving into the realm of AI-driven technology, where the risk of incorporating these biases through poor design decisions looms large.

The proclivity of humans to simplify and deviate from rationality, often employing mental shortcuts known as heuristics, can lead to suboptimal decision-making outcomes. Everyday examples of these heuristics include anchoring, framing effects, hindsight bias, and illusory correlation.

- Anchoring or focalism: Relying heavily on the first piece of information acquired when making decisions.
- Framing effect: Drawing different conclusions based on how information is presented.
- Hindsight bias: Perceiving past events as predictable.
- Illusory correlation: Falsely perceiving a relationship between unrelated events.

While these mental shortcuts are essential for our brains to navigate the vast amounts of data encountered daily, it's imperative not to transfer these biases into the technology we create.

AI's strength lies in its ability to process data impartially, uncovering correlations beyond human cognitive capacity. However, if we curtail this capability by designing bias into our technology—either by restricting inputs or limiting connection points—we risk negating the very advantages AI offers.

Human operators, armed with knowledge and intuition, often exhibit rapid problem diagnosis but may develop biases and blind spots for issues outside their personal experience. When incorporating AI, it's crucial to avoid imposing biases by selectively considering only what we deem relevant. AI's power lies in its capacity to analyze extensive datasets, revealing correlations previously unexplored and offering insights to enhance processes.

Inexplicable Blockages in Filtering Process

A refinery facing inexplicable filter blockages during its solution-filtering process. Numerous theories were posited, all focused on immediate conditions around the filter house. Shutdowns were costly.

Utilizing AI to analyze data across the facility, a correlation emerged: the time since the last maintenance of the crusher significantly correlated with filter blockages.

Further investigation revealed that when the crusher required more passes due to maintenance delays, rocks inadvertently received multiple doses of caustic during the process. This overdosing altered pH levels downstream, causing the filters in a different building to repeatedly block.

The team had not considered the crusher relevant to the issue, AI highlighted the correlation swiftly. Once recognized, the problem's root cause became evident, demonstrating AI's ability to uncover hidden connections and offer valuable insights.

Challenge #5 Collaboration and Trust

Navigating the integration of AI with human processes presents a unique set of challenges, especially when it comes to establishing trust. Change management, inherently complex, becomes even more intricate when the perceived threat of automation looms.

Buy-In from the Top Down:

Securing buy-in from leadership is foundational. From the board to executives and managers, there must be a collective belief in the transformative power of AI enablement. This top-down commitment is instrumental in overcoming resistance and fostering a culture that embraces AI.

Addressing Job Redundancy Concerns:

A common misconception is that AI implementation will render jobs redundant. The challenge lies in convincing individuals that AI is not a threat but rather a powerful ally. AI is adept at handling repetitive and monotonous tasks, augmenting human capabilities rather than replacing them. It excels at tasks beyond human cognitive capability, allowing human operators to focus on higher-order skills such as judgement and nuance.

Complementary Roles of AI and Humans:

While AI exhibits creative potential in a limited capacity, it inherently relies on humans for crucial tasks such as assembling datasets, coding, and applying nuanced judgement. As Dr. Melvin Kranzberg, a technology historian, eloquently illustrates with the analogy of a violinist and his instrument, both elements—the AI and the human touch—are indispensable for creating meaningful outcomes:

"A lady came up to the great violinist Fritz Kreisler after a concert and gushed, 'Maestro, your violin makes such beautiful music.' Kreisler held his violin up to his ear and said, 'I don't hear any music coming out of it.' You see, the instrument, the hardware, the violin itself, was of no use without the human element. But then again, without the instrument, Kreisler would not have been able to make music."

Building trust between humans and AI involves not just demonstrating its capabilities but also fostering an understanding of their complementary roles. Successful collaboration hinges on acknowledging the unique strengths each brings to the table, ultimately creating a symbiotic relationship that enhances efficiency, innovation, and the overall effectiveness of industrial operations.

A Little Healthy Competition

One of our customers, is proactively encouraging company wide adoption of artificial intelligence. AI adoption is supported from senior members of the organisation, down to operational managers.

One example of how they foster AI adoption, was the hosting of their own AI modelling challenge. They gathered various disciplines for a day, divided into teams and worked to solve optimisation problem statements using VROC's AI platform.

The result? Collaboration, problem solving and increased confidence in their ability to produce models, visualise and interpret results. And of course, the crowning of a champion (nothing quite like some healthy competition!).

Challenge #6 Skills Gap and Workforce Transition

In the realm of Industrial AI adoption, a significant obstacle looms large: the ever-expanding gap in skills and the necessity for workforce transition. The manufacturing industry, in particular, grapples with concerns about a lack of internal expertise to navigate and support AI deployments successfully. This internal expertise deficit poses a barrier to the seamless integration of AI into manufacturing processes.

Tech Talent Shortage and Growing Interest in Industrial AI Roles:

The persistent shortage of tech talent compounds the challenge, and organizations are increasingly recognizing the need to hire personnel specializing in industrializing AI. Roles such as AI product managers, analytics translators, and software engineers are in high demand, reflecting the growing complexity of integrating AI into industrial processes.

Reskilling as a Strategic Imperative:

A strategy to bridge the skills gap is the reskilling of existing employees. As technology evolves, reskilling programs become paramount to equip the workforce with the knowledge and expertise required for managing and leveraging AI technologies effectively.

As Nayur Khan, of McKinsey aptly puts it, "Organizations that are willing to continuously learn and adapt their processes, ways of working, and technology to industrialize ML will succeed in building the muscle needed to leverage AI at scale and unlock its value."

This quote underscores the critical importance of fostering a culture of continuous learning and adaptability within organizations. The dynamic nature of AI technologies demands a workforce that is not only adept at current practices but is also agile enough to evolve with emerging trends.

Navigating Workforce Transition:

Addressing the skills gap and facilitating workforce transition requires a multi-faceted approach:

1. Investing in Training and Development:

Organizations must invest in comprehensive training and development programs to upskill employees in AI-related competencies. This involves providing access to relevant courses, workshops, and certifications.

2. Strategic Hiring and Role Definition:

Strategic hiring should focus on bringing in individuals with specialized AI skills, and well-defined roles such as AI product managers and analytics translators should be integrated into organizational structures.

3. Cross-Functional Collaboration:

Encouraging cross-functional collaboration between existing domain experts and newly skilled AI professionals fosters knowledge exchange and accelerates the integration of AI into industrial processes.

4. Building a Learning Culture:

Cultivating a learning culture within the organization encourages employees to continuously acquire new skills. This not only addresses the current skills gap but also prepares the workforce for future advancements in AI and related technologies.

By proactively addressing the skills gap and prioritizing workforce transition, industrial organizations can position themselves to not only overcome current challenges but also thrive in the ever-evolving landscape of Industrial AI adoption.

[BONUS] Industrial AI Readiness Checklist:

Answered ‘yes’ to the following checklist? You are ready to embark on your AI journey, and should be positioned for success.

1. Is your data warehoused in a central location?
2. Do you have access to at least 2 years of past data?
3. Is binary data available?
4. Have you established a data governance framework?
5. Do you have a clearly defined problem statement? Ideally a problem that has occurred at least twice in the past calendar year?
6. Have you retained all data points both prior to and surrounding the problem?
7. Do you have a quantification of the problem cost or impact to your business?
8. Do you have buy-in from the c-suite?
9. Do you have a senior project sponsor?
10. Do you have a plan to encourage collaboration and trust with your staff?
11. Have you prepared a development plan to upskill staff?
12. Do you have a communications plan to share project milestones and achievements?

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