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Enterprise AI and the Four Quadrants: From Great Villain to Global Manufacturing Equalizer

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Abstract – "*The best thing about AI is that it thinks the way we want it to*". *If this were to be applied in real life, which, by the way, is true, then it would also be possible to teach AI some basics about Enterprise. Hence the idea of Enterprise AI was born. As the technology was rapidly shaping the Enterprise business, people feared that soon, the AI would be capable enough to replace all the human beings in their jobs and would render them useless. But, as the later studies and the recent trend would reveal, Enterprise AI is the latest adaptation of the industry giants. This has been possible due to the "Four Quadrants" which would be discussed in this paper. Also, from the organization point of view, the AI has to re-skill and re-educate itself to fit the Enterprise norms. Hence the name, "Enterprise AI". This can possibly be the Big Revolution that the globe has to witness in the near future.*

Key Words: **Artificial Intelligence, Enterprise AI, Business Case**

1. INTRODUCTION

When computers were introduced to businesses in the 1950s and 60s, some people looked at them in fear. "They will replace us all," they cried. Today, the computer industry is a pillar of our economy, employing millions and propelling society forward. Ironically, some of the same people who have made billions in those industries are warning us that "we will all lose our jobs to AI and robots," and believe that one of the main sectors under threat is manufacturing.

In the past decade, numerous European and American cities have lost millions of manufacturing jobs.

A recent study by MIT researcher David Autor (published by Jeffry Bartash) sheds light on the issue. According to Autor, the US has vastly overestimated job losses from productivity growth due to automation. Rather, the real culprit is the introduction of low-cost labor countries such as China into the global trading system.

In fact, the widespread introduction of AI and robotics has the potential to change the manufacturing equation in advanced industrialized countries for the better and become the great equalizer of the global industrial landscape.

1.1 AI Manufacturing Trends

AI is poised to have massive repercussions throughout the manufacturing industry, from product consistency to quality control, in the streamlining of manufacturing supply chains and proactive equipment maintenance.

For instance, in quality control, human supervision can only do so much. Machines produce hundreds of products per hour, and humans simply cannot and do not, have the ability to spot each and every imperfection and defect. The machines are moving quickly, and humans only have the ability to focus on such a task for so long, before they become distracted or fatigued. It's not a job easy to keep staffed.

According to IDC, 20 percent of leading manufacturers will rely on AI and other technologies by 2021. And the sooner the better – a report by McKinsey found that 50 percent of companies that embed AI in their data-intensive manufacturing processes within the next five to seven years, will have the chance to double their cash flow.

1.2 Impact on the Global Manufacturing Landscape

While the manufacturing sectors in the U.S. and EU have faced tough competition from low-cost-of-labor countries, the widespread adoption of AI and related technologies, such as robotics, can bring balance back to the equation. When productivity is not only linked to costly human labor but also to software, then the delta in production costs between US/EU and the rest of the world decreases because AI software will augment the productivity of workers irrespective of where they are.

As implementation of AI technology in manufacturing grows, manufacturers will inevitably move their plants out of low-cost labor countries and into new, more automated plants in the U.S. and Europe, where there are more trained technicians able to use, maintain and support AI-based manufacturing equipment. As the cost-benefit factor shifts from low labor cost to AI-driven automation, a premium will be placed on locating factories with access to AI technologies and technicians. Now imagine the added benefit of lower distribution costs of finished product as manufacturers throughout the supply chain adopt AI technology.

This means that AI could provide the much needed "adrenaline shot" for the ailing manufacturing and industrial sector in the U.S. and EU. Moreover, if AI trends continue, the U.S. and EU may be the first regions to massively benefit from AI-powered productivity enhancements, where smart automation will enable and assist humans in producing high-quality products at scale.

And when we look back at these years, we may come to realize that, as with the introduction of computers decades ago, our fears were misplaced.

2. LITERATURE REVIEW

Four Quadrants for the Enterprise AI business case

- **Experiment driven**: Machine Learning and Deep Learning
- **Data driven**: Enterprise Platforms and Data
- **Scale driven**: AI Pipeline and Scalability
- **Talent driven**: AI disruption and Stagnation

Table -1:

Four Quadrants of the Enterprise AI business case

3) Scale driven AI Pipeline and Scalability competitive advantage through scale CICD, Pipeline (with Kafka, Spark), AI deployment at the Edge, containerization, high throughput	4) Talent driven AI disruption (and Stagnation) AI first organization Process alignment with AI at the core IPR AI and humans working together Cobots
1) Experiment driven Machine Learning and Deep Learning ML + DL Model accuracy Single node	2) Data driven Enterprise Platforms and Data Platform strategy, Data driven, Regulation, ERP, Data warehouse, Cloud based (potentially), AutoML, Explainable AI

Background:

Enterprise AI is an abstract concept, interdisciplinary and much-hyped concept. But in any case, the deployment of AI in the Enterprise cannot be viewed in isolation. Within the Enterprise, there already exist systems (like ERP and Data Warehousing). The integration of these will have a role to play in any AI deployment. The word 'Enterprise' can be seen in terms of Enterprise workflows. We also consider the core Enterprise (a non-manufacturing company ex Insurance) and the Wider enterprise (including supply chain). Hence, Enterprise AI could be understanding how workflows change when AI is deployed in the Enterprise.

The professional deployment of AI in Enterprises differs from the content in a typical training course. In larger organisations, the Data Science function typically spans three distinct roles: The Data Engineer, the Data Scientist and the DevOps Engineer. The Data Scientist is primarily responsible for developing the Machine Learning and Deep Learning algorithms. The Data Engineer and The DevOps Engineer roles work in conjunction with the Data Scientist to manage the product/service lifecycle. Hence, in an Enterprise, managing the AI pipeline involves the philosophy of CICD (Continuous Improvement – Continuous Delivery). CI/CD can be seen as an evolution of Waterfall and Agile methodologies.

Finally, to clarify some definitions used: Machine Learning: Means systems that can learn from experience (Data); Deep Learning: Implies a system that can perform automatic feature detection based on Deep neural networks; Artificial Intelligence involves machines that can reason.

Enterprise AI Business Case:

With this background, let us explore the four quadrants of the AI business case

Machine Learning and Deep Learning:

We could initially model the problem as a machine learning or a deep learning problem. At this stage, we are concerned with the accuracy, choice and the efficiency of the model. Hence, the first quadrant is characterized by experimental analysis to prove value.

We are also concerned with improving the existing KPIs. For example, if you are working with fraud detection or loan prediction – each of these applications has an existing KPI based on current techniques. The machine learning and deep learning models would be expected to significantly improve the current benchmarks. We are typically working with one node(non-distributed) processing. The Data could be in Time series, Tabular, Textual, Image, Audio or Video based. The applications could involve Computer vision, NLP, Fintech/financial services, Healthcare, Reinforcement learning, Unsupervised learning (ex GANs, VAE), Emotion AI (Affective computing) etc. Deep learning architectures are rapidly evolving. Hence, there is a lot of effort and skill needed at this stage.

Enterprise Platforms and Data

Building on from the first quadrant, the second quadrant is characterized by

1. Managing Data for algorithms
2. Integration with existing systems and platforms (ex: ERP and Data Warehousing)
3. Managing regulatory considerations ex GDPR
4. Estimating costs of resources
5. Working with the Cloud
6. Strategies which simplify AI deployment (ex: AutoML)

Both ERP and Data Warehousing exist in large Enterprises. Apart from integration with existing system and with a Cloud strategy, in this quadrant we have to also consider

1. Regulation – ex GDPR and Payment regulation
2. Explainable AI

3. Strategies like AutoML and Auto-Keras which simplify AI deployment

Marlene Jia creates a landscape of Enterprise AI companies which categorizes AI applications in the Enterprise. We note that the problems are the same or similar as before but are solved more optimally using AI by gaining insights from much larger amounts of (often) unstructured data. The categories include BUSINESS INTELLIGENCE ex Ayasdi; PRODUCTIVITY ex virtual scheduling assistants like X.ai; CUSTOMER MANAGEMENT ex Inbenta's AI-powered natural language search; HR & TALENT Companies ex Entelo; B2B SALES & MARKETING Salesforce's Einstein; CONSUMER MARKETING ex companies like Lexalytics; FINANCE & OPERATIONS ex AppZen which is an automated audit platform that can instantly detect fraud and compliance issues; DIGITAL COMMERCE ex Sentient Technologies analyzes product recommendations for user actions; DATA SCIENCE like RapidMiner; ENGINEERING companies like Diffbot; SECURITY & RISK ex Demisto (incident response); INDUSTRIALS & MANUFACTURING ex GE Predix

The above analysis also demonstrates that AI will impact many areas of the Enterprise but in this Quadrant, **the emphasis is on evolution rather than revolution** where companies integrate with existing applications and also gain experience in AI. The challenges in this quadrant are mostly data related – especially the challenges of finding labelled data.

AI Pipeline and Scalability

In the third quadrant, the emphasis is **scaling and in handling real-time transactions**. There are a range of technologies which may be involved here – which mostly come under the category of CICD also a range of initiatives from Enterprise Cloud providers like Azure ML CI/CD

At a simplest level, we can deploy deep learning models using flask but more complex strategies could come into play for example Mlflow from databricks , kafka to take on some functions of Enterprise service bus, use of Jenkins 2.0 AI pipeline models for continuous delivery and others

AI disruption (and Stagnation)

Quadrant four is the most interesting. **It is driven by AI talent who can think strategically and technically**. At this stage, we are looking for AI already integrated into the Enterprise and how AI can be used for disruption. This calls for an AI first company as outlined by William Vorhies and four major AI strategies for AI i.e. Data Dominance, Horizontal, Vertical and Systems of Intelligence. Monica Rogati also talks of an AI hierarchy of needs which also resonates with this approach.

In this quadrant, we are working with issues like Process alignment with AI at the core, IPR, AI and humans working together, Cobots etc. The work is driven mostly by Masters/PhD often implementing ideas directly from research papers to create new IP. This quadrant also involves a change in company culture and role of people within a company.

Emerging AI Business Model Promotes Distributed ML

Pausing at the end of 2019 to take stock of where enterprise AI stands, a new business model floated over the last year encourages distributed model training through the sharing of data.

Depending on the project, the critical question raised by the emerging AI model dubbed "federated learning" is whether corporate rivals would ever be willing to share data? On the flip side, a distributed machine learning framework could create an opening for startups, ultimately improving AI applications.

AI consultant Alexandre Gonfalonieri makes the case that federated learning—that, is a distributed machine learning framework used to build a "collective model" shared among different data owners—represents a viable AI business model.

Some tech vendors have already embraced the federated approach for medical applications that bring with them difficult data privacy issues. For example, Nvidia (NASDAQ: NVDA) this week unveiled a federated learning tool as part of its Clara AI platform designed to promote collaboration while protecting patient privacy.

Aimed at the medical imaging community, Nvidia said its federated approach would enable distributed clients to train deep learning models locally via edge servers, then collaborate to develop accurate "global models" that can be used by clinicians.

Indeed, Gonfalonieri argues that even in heavily regulated markets like medical science, a distributed machine learning approach could yield improved models and compelling AI applications. "In the medical field, [federated learning] could be a synonym for better treatment and faster drug discovery," he argued.

Given recent setbacks such as IBM's (NYSE: IBM) recent withdrawal of its Watson AI drug discovery tools, critics assert that the retreat highlights AI's shortcomings. Still, some observers note that machine learning frameworks show promise in areas like diagnostic imaging where "confirmation bias" and other prejudices remain an issue.

"Centralized [machine learning] is far from being perfect," Gonfalonieri concluded. "Indeed, training the models requires companies to amass mountains of relevant data to central servers or datacenters. In some projects, that means collecting a user's sensitive data."

It is the sharing of data—either competitive or regulated—that appears to be the largest stumbling block to

advancing distributed machine learning as a future AI business model. In some respects, the federated approach is akin to established open source software and hardware development that have been widely embraced by hyper-scalers.

Others have proposed federated learning approaches, including frameworks in which model development is distributed among millions of edge devices. Proponents argue they can ensure data privacy by restricting access to or labeling raw user data.

"We are seeing the beginning of a decentralized AI market, born at the intersection of on-device AI, blockchain, and edge computing" and the Internet of Things, wrote Santanu Bhattacharya, an investor in the federated learning startup S20.ai.

Even AI leaders like Google (NASDAQ: GOOGL) have promoted federated learning as a way of building smarter models while maintaining data privacy. Google has tested the approach in scenarios where mobile phones are able to collaboratively learn a shared prediction model while all training data is stored locally.

Reactions to the distributed machine learning framework have been positive, albeit cautious. Responding to AI consultant Gonfalonieri's blog post, one reader warned that federated learning would encourage data storage on devices, perhaps creating a new cottage industry for hackers selling tools to access local data.

"The security [and] privacy threat models are quite real," noted one reader. "It's important to solve these" along with other data privacy issues.

Fig -1: Source: EnterpriseAI

3. CONCLUSION

This study reveals the development of the **Enterprise AI business case** through a framework of four quadrants. The disruption from AI for the Enterprise will be evolutionary. The first two quadrants are based on incremental changes. But the radical disruption is very real. Hence, the last quadrant involves both disruption and stagnation. AI is a winner takes all game. An alternate working definition of AI is 'processes which improves with experience'. In that sense, the early adopters who will learn from AI will be the future market disruptors. According to the recent trends, as is apparent, the fear that the AI may take over all the human jobs is no longer existent. Instead, the future market disruptors are overcoming the odds and designing AI to overpower it's previous versions and proving it to be a Global Manufacturing Equilizer.

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