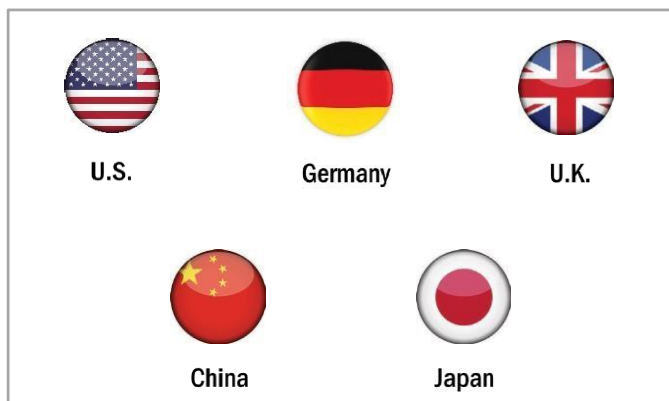


Artificial Intelligence In Healthcare



Executive Overview

Leading research and innovation hub for AI



Market Dynamics that make these countries more lucrative for AI based research and development

- 1. U.S.** - hub of technology evolution, with over 1000+ AI companies (including start-ups and tech giants) and over US\$10 billion in venture capital funds for R&D
- 2. Germany** - Decline in working population and high propensity of automation, of close to 50% potential estimates across industries
- 3. U.K.** - Studies reveal AI implementation in businesses across U.K have a potential to boost productivity by about 30%, bolstering huge investments in collaborative AI research with leading universities and technology companies across the country

4. China - High penchant to technology development with strong government patronage to become an “economic power” backed by skill development and research in technological breakthroughs. China has produced almost twice as many research papers in AI as compared to the U.S.

5. Japan - Dwindling available workforce, highly prone to natural calamities leading to high propensity for automation

Key Takeaways

This paper is intended to answer the following questions -

- Are we ready for artificial intelligence (AI)?
- AI framework and existing data ecosystem
 - What are the most common AI implementation challenges?
 - What are the standard best practices that should be in place?
- Future trends and opportunities for AI in Healthcare (case studies)
- Recommendations -
 - For technology developers
 - For investors
 - For end-users



Artificial Intelligence Readiness



Artificial Intelligence Readiness

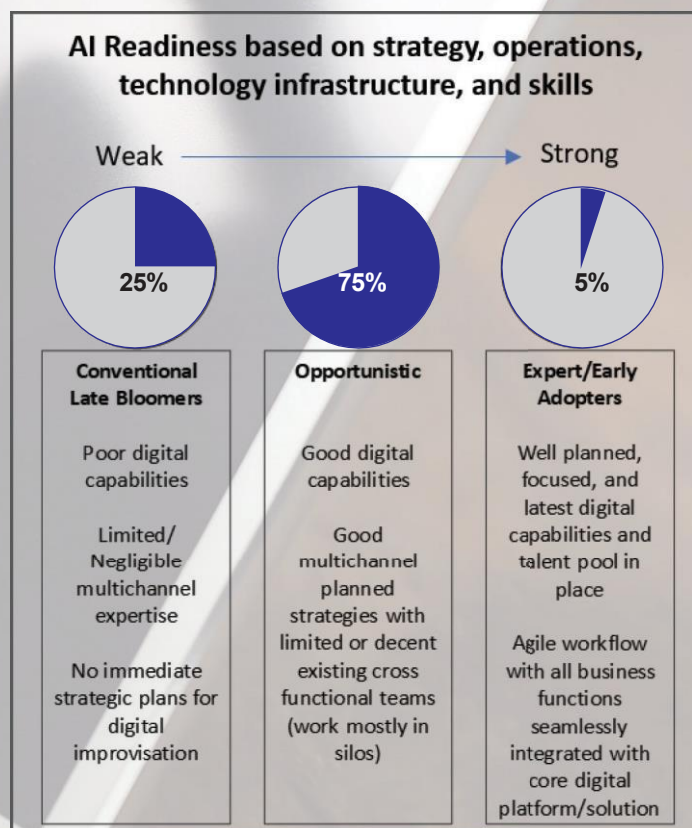
For one moment, let's all assume to be privileged with equal exposure to a set of extremely efficient and desirable AI platforms, ready to be tailored as per our business requirements. Now, to understand and analyse an organization's AI readiness, the following questions are few of the areas that should be taken into considerations –

- What are the top 2 priorities that your company has or would be willing to invest in, as a part of its AI based digital transformation initiatives?
- Is your organization already using AI driven approach for key business functionalities such as marketing campaigns? If yes, what are the key aspects of this initiative that you believe is making a difference in creating new growth areas for your organization? (choose the relevant options)
 - o Real-time customer support across multiple channels or touchpoints
 - o Understanding behaviour patterns to personalise and enhance customer experience
 - o Understanding behaviour patterns to identifying new customers
 - o Identify and analyse key customer pain points (from emotional cues) to add new/ enhance existing service offerings
 - o Analyse and score key internal performance metrics
 - o To manage and optimize internal operations across business functions
- **On a scale of (1-5, 5 – highest/strongly agree, 1 – lowest/completely disagree, 3 - don't know /indifferent/not sure)** Do you have the right people and skill sets to define the AI roadmap for your organization?
- **On a scale of (1-5, 5 being highest)** How clearly is your AI based digital transformation strategy articulated?
- **On a scale of (1-5, 5 being highest)** How competent is your workforce in understanding the value proposition of AI in context to – setting up a seamless integration between the set customer expectations and across the multichannel client facing environments/ interfaces?
- **On a scale of (1-5, 5 being highest)** How competent is your organization in measuring and clearly articulating the business results of the existing artificial intelligence marketing strategy?
- **On a scale of (1-5, 5 - highest/strongly agree; 1 - lowest/completely disagree; & 3 - don't know /indifferent/not sure)** How prepared is your organization's structure and cultural integrity, in terms of taking a strong transformational step towards creating an agile organizational structure (essential for an effective cross functional collaboration within an AI augmented workflow)?

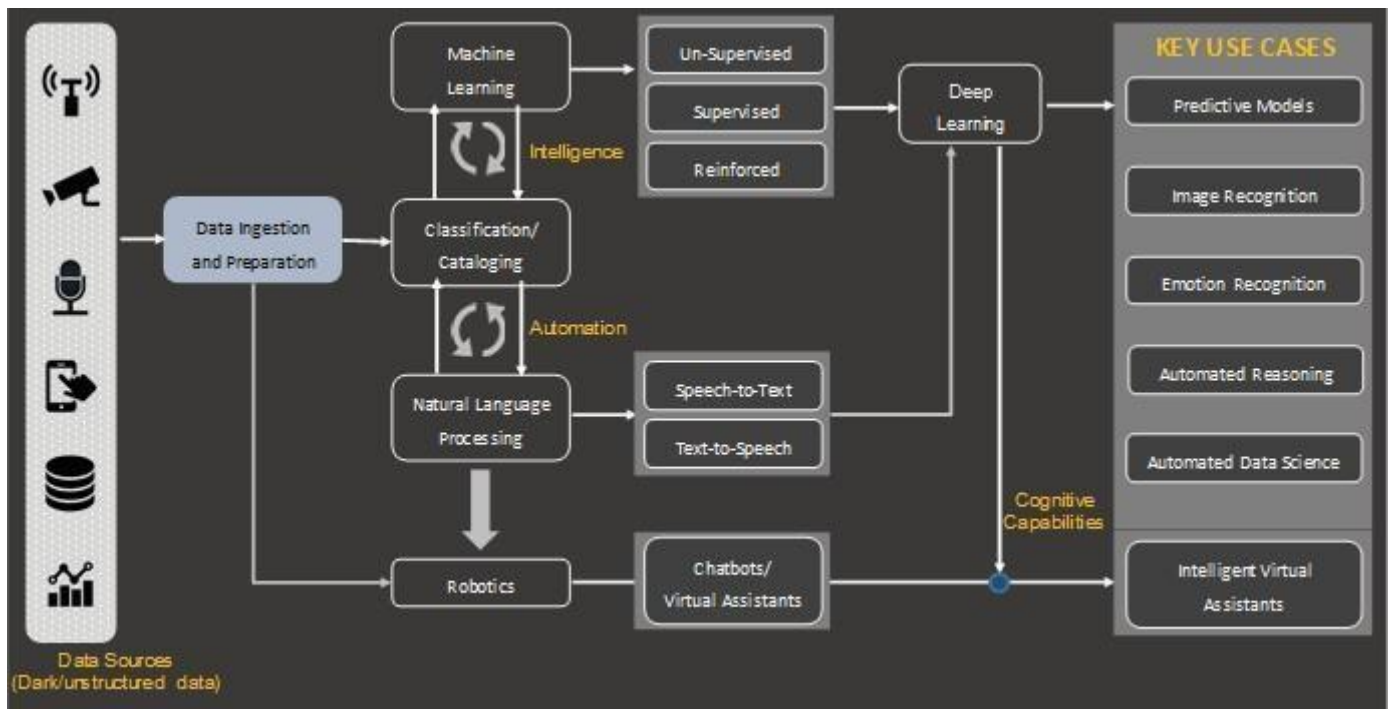
- **On a scale of (1-5, 5 being highest)** How clearly have you identified the redundant processes for your marketing programs that can be handled by your AI based digital transformation roadmap?
- **On a scale of (1-5, 5 - highest/strongly agree; 1 - lowest/completely disagree; & 3 - don't know /indifferent/not sure)** Does your company have a dynamic and scalable technology budget for shifting priorities such as moving to agile and scalable cloud-based infrastructure or investing in multichannel digital experience platform to support AI driven digital transformation?

The chart below showcases the AI readiness of organizations globally based on multiple surveys done across a balanced spread of large MNCs, small & medium enterprises, and start-ups (Note: this data is for organizations across industries and not specific to healthcare – FYI: healthcare has shown significantly higher readiness than most other industries). The results clearly show that predominantly most companies (categorized as opportunistic) are well balanced to move to the next stage of AI digital evolution, based on their vision, operations, skill sets, and their existing digital infrastructure. This might happen in the near-future or over a period-of-time which will be discussed briefly in the next section. So, each of the categories have their own set of pros and cons in the path of AI driven digital transformation roadmap.

However, before understanding each category in further detail we should understand AI and the important role of data in this transformational journey.



AI Framework And Data Ecosystem



The illustration of the AI framework above, highlights the significance of data ingested into the system for generating reliable and actionable insights. With that said, it can be inferred that data is as important as the algorithms itself and sometimes even more. The machine learning or deep learning algorithms are trained based on several parameters which are data intensive. So, a good training, is invariably dependent on the quality and quantity of data fed, for the process of tuning the system to perform desired functionalities.

Again, as the current business environment is transient, there is constant accrual of new data that can significantly change the desired purview of a given scenario that is being analysed. So, these changes in data should be carefully ingested and classified which can sometimes generate interesting patterns. These patterns reveal crucial information that can help organizations to step ahead of their competitors in terms of providing enhanced customer experience.

Now, this brings us to another aspect of data in this modern digital environment, where we have huge amounts of data in various formats, which can be structured, unstructured or semi-structured. However, unfortunately, still about 80% of the data present is in the form of dark data, which is either not being captured or we do not have the tools and/or right skill sets to capture and analyse the same. This presents a huge opportunity for exploring new frontiers with AI with increasing computing capabilities and big data analytics capabilities

Key Takeaways

- Data holds the key to AI adoption roadmap
- Abundance of data - mostly dark data
- Reliable sourcing and governance of data are critical to successful AI implementation

“ It is a capital mistake to theorize before one has data
Arthur Conan Doyle
(well-known British writer)

“ Good policy is grounded in a robust set of facts and data
Seth Wilbur Moulton
(American politician)

“ Concepts are vindicated by the constant accrual of data and independent verification of data
Stanley Benjamin Prusiner
(M.D., neurologist and biochemist)

“ Data is valuable, so let's be mindful of how we're sharing it
Clara Shih
(CEO and co-founder of Hearsay Social)

Common AI implementation challenges!

The AI evolution concept can be related to the way a child learns. Wrong concepts and misguidance is unfavourable for the child's future while lack of education or training leads to blissful ignorance! Likewise, the training and/or learning process of the machines should be continuous, with data scientists governing the quality of data being fed.

#1 Now this brings in the questions – do we know what data and quantity of data that needs to be ingested for the training process? Do we have enough data scientists to govern the process?

Though repeated experiments are being done to automate this process using neural networks which sounds wonderful, however in theory and in real world application it is extremely complex. The reason being, most theoretical problems

take in a lot of estimations and assumptions, which can be easily solved with linear regression analysis. However, most real-life problems are complex and require non-linear regression. These problems mostly incorporate time series analysis and when you need to automate the thinking process with high speed computation, then we need to consider that the AI model should already know the things that we know. This sounds ok, but we need to also realise that the model is limited to the conceptual modelling for own understanding and thus limited to the extent of how you analyse things (with the benefit limited to only being much faster and possibly more accurate)

#2 So then, this brings to our next set of questions – who conforms to our understanding of a real-life problem as certain problems are relative to individual perceptions?

Now, supposedly if we align our understanding and design our AI strategy for a given set of problems, the above concern could be resolved. However, as we know that most pertinent problems statements and the real-world scenarios for a competitive business environment are transient. Often by the time the problems are resolved, we are intrigued by a new set of mind boggling mysteries to unravel. Now, AI experts have a solution to this problem, where each new instance of problem can be ingested as a new incident in the time series. Moreover, each similar incident can be categorised with well-defined tags that enable the algorithms to build patterns over a course of period.

#3 Well, this sounds great! However, it brings me back to the first question – do we have enough data to start learning future patterns?

Considering that the business-critical functions have been identified, then the processes that have imminent risk of failure, need to be worked upon. For this to be achieved, we can leverage AI driven automation and set up bots which can crawl across numerous functional paths of an organization's digital footprint to highlight mission-critical functions and thereby enable similar incidents to be uncovered which percolates to pattern identification for predicting future anomalies/variance from existing rules.

#4 AI could disrupt the foundations of the digital transformational journey with unclear future implication.

Most transformational journeys, the classic example being the introduction of computers, have created an uproar of impeding employment for masses. However, most technologies have evolved in creating more opportunities along its way of evolution. Similarly, AI could potentially be a boon for mankind in its path of evolution or on the contrary - as predicted by Stephen Hawking: "replace humans altogether". Now, that statement as of now, may seem outrageous but do we know for sure?

Best Practices and Regulations

Knowingly or unknowingly most of us are already being influenced by the implication of AI in our daily lives. Though the foundations of AI dates back to 1950s, however most of us have started to realise the significance of AI in recent years. In fact, over the past 2 years, technology companies have taken substantial strides in manifesting plethora of commercial applications of AI. So, in the build-up of this AI propaganda, organizations need to be careful about some of the following best practices:

- Planned implementation of AI strategy (not just following peers)
- Careful selection of partners in AI journey
- Thorough understanding of data
- Transparent and ethical AI implementation strategy

As AI promises limitless possibilities for organizations with immediate ROI being realized through its benefits in the field of marketing, it is essential to always align the strategic implementation of AI with clear set ethical boundaries. There have already been some well-known instances of organizations having crossed the moral obligation that ownership of data presumably involves. With this in perspective there are a few standards and regulations that organizations have to comply, as a part of their AI best practices -

- **GDPR** (General Data Protection Regulation) - 2018
- **Payment Card Industry Data Security Standard** (PCI-DSS) - version V1 2004 (latest version in 2018)
- **Sarbanes-Oxley (SOX) Act** - 2002
- **Federal Information Security Management Act** (FISMA) - 2002
- **HIPAA** (Health Insurance Portability and Accountability Act) - 1996

Healthcare Applications

AI applications in clinical health can raise more than \$150 billion annual savings for the US healthcare economy by 2026. AI application has incredible potential in healthcare including diagnostic imaging, anti-fraud, resource and asset optimization, readmission prevention, behavioural analytics, medical risk analytics, claims analytics, and many more. Major opportunities of AI in Healthcare industry are pointed below:



More Data for improved ability to Specialize:

AI needs more training data for better interference and results, as almost all AI efforts are limited by data available. Blockchain can be used to publish metadata about data that exists across a consortium of healthcare organizations. This metadata can include pointers to the enterprise systems that store the data, and hashcodes that can be used to verify the integrity of data.



AI-assisted Robotic Surgery

Surgical robots can analyse data from pre-op medical records to guide a surgeon's instrument during surgery, which can lead to a 21% reduction in a patient's hospital stay. Medical robots can use data from past operations via AI to inform new surgical techniques. AI-assisted robotic procedure is resulting in approximate five times fewer complications compared to surgeons operating alone



Improvisation in Nurse Call Systems

Most applications of virtual nursing assistants in the developed countries are regularizing communication between patients and care providers to prevent hospital readmission or unnecessary hospital visits. From interacting with patients to directing patients to the most effective care setting, virtual nursing assistants could save the healthcare industry an estimate of \$20 billion annually. Since virtual nurses are available 24/7, they can answer questions, monitor patients and provide quick answers.



Application in Telemedicine and Image Analysis

Recently, an MIT-led research team developed a machine-learning algorithm that can analyze 3D scans up to 1,000 times faster than what is possible today. This near real-time assessment can provide critical input for surgeons who are operating. Moreover, it is expected that AI can help to improve the next generation of radiology tools that don't rely on tissue samples in the future. Further, AI image analysis could support remote areas that don't have easy access to healthcare providers and even make telemedicine more effective.

This confluence of technology-based products, platforms and solutions is leading to a previously unimagined precision medicine, down to the familial and individual level, which one day may even be able to predict and thereby prevent disease. However, unlike other industries, healthcare's adoption of AI is still in its infancy, in part, due to many providers still updating their tools and processes for the digital age. Starting from AI's data collection and accuracy to concerns about healthcare providers losing their jobs, some remain skeptical and hesitant to jump on board. However, As the healthcare industry continues to turn to a value-based care model, it's easy to believe that providers who utilize and fully understand the unique capabilities of AI solutions will perform above the rest.

