

# Understanding the Artificial Intelligence Business Ecosystem

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**Abstract**—*This technology manager's note piece identifies the major components in the artificial intelligence (AI) business ecosystem and discusses several implications for managers. Specifically, it emphasizes on the designing of AI user scenarios, data acquisition for AI, and building the AI ecosystem.*

**Key words:** Artificial intelligence, business ecosystem, technology management

**A**RTIFICIAL Intelligence (AI) is a general-purpose technology that can have significant social, economic, and political implications. Similar to steam engine or electricity technology, AI will have transformational impacts on many aspects of the lives of human beings. McKinsey Global Institute reported that in 2016 between \$26 and \$39 billion was invested in AI ranging from investment from tech giants and to startups. Total AI investment has tripled since 2013 [1].

AI is disrupting every industry from manufacturing to retail, from agriculture to healthcare. A number of industries lead in AI technology adoption including high tech and telecommunications, automotive and assembly, and financial services industry. Sectors such as healthcare and education are relatively slow in adopting AI technologies due to challenges such as regulatory concerns [1]. However an increasing number of startup investment deals are also being observed in these sectors [e.g., 2–5].

AI business applications can be viewed as an ecosystem. We identify a few key components, with specific examples, of the AI ecosystem.

*Open source software platforms.* Most technological progress depends on technologies that are fundamental

for the development of other technologies. So is the case for AI and its use of open source platforms. For instance, Hadoop is an open source software platform facilitating data management. Salesforce, a cloud based customer relationship management (CRM) suite, has developed its AI functions based on Hadoop. It takes advantage of Hadoop's ability to support extremely large data set processing and storage; providing further efficiency to Salesforce's customers.

*AI core technologies.* There are three types of core technologies that are fundamental to AI. The first are algorithms, which helps build software such as natural language processing. New machine learning or deep learning models are further developed to improve this natural language processing effectiveness.

The second set of technologies relate to big data. This second set includes data assessment, storage, management, and analysis technologies. AI algorithms require massive amounts of data. Natural language processing, for instance, will not be possible without millions of human speech samplings, recorded and broken down into a format that AI hardware can process. To assess data, sensors for sight, hearing, and speech, are needed. Many are embedded in the modern Internet of

things (IoT) devices such as smart phones.

Third are computing power technologies. AI can be viewed as a massive series of math problems that learn to correct their own mistakes. This AI characteristic requires enormous computational power. At the core are semiconductor chips for AI; the latest chips from Intel can run over 10 trillion calculations per second. Cloud computing, the delivery of on-demand computing resources—everything from applications to data centers—over the internet on a pay-for-use basis, are other key facilitators.

*AI open platforms.* Not only are generic software platforms part of the AI ecosystem, but AI specific open platforms are also critical ecosystem components. TensorFlow, a Google-created machine learning platform, allows users to design deep neural networks and execute them on a single smartphone or across thousands of data center computers. It is an operating system for businesses to develop AI applications. IBM Watson lets firms integrate AI into their important business processes; Facebook acquired wit.ai to create an application programming interface (API) for building voice-activated interfaces. The Linux Foundation has also launched a new AI Project, Acumos, a platform and open source framework to help develop, share and deploy AI and machine learning apps. The Acumos code is currently freely available for download. Other examples of open source platforms include OpenAI and GitHub.

*AI Applications.* AI commercial applications are meant to be understood and appreciated by consumers. AI has penetrated a variety of industries including transportation, restaurant, real estate, education, and medical services industries. They provide powerful

tools and perspectives to redefine value propositions and business models in each industrial sector. For instance, Apple's Siri is a pervasive and early AI application. Siri uses advanced machine learning technologies to answer questions, make recommendations, and perform actions by delegating requests to a set of Internet services. In the private sector, according to CB Insights, healthcare startups have raised \$4.3 billion for almost 600 AI deals since 2013; topping all other industries in AI deal activity [6]. These AI startups in healthcare are dedicated to address challenges from diagnostics to new drug discovery to clinical trials.

## IMPLICATION FOR MANAGERS

We identify three major AI ecosystem managerial implications, designing of AI user scenarios, data acquisition for AI, and building the AI ecosystem.

**Design AI User Scenarios** In the AI era firms pay great attention to application uses. For instance, a cell phone may not only be seen as a phone to be sold. What is more important for technology development managers is to understand where and how a customer will use the phone, i.e., the user scenarios. For instance, when a person travels abroad, her phone can become an important tool to help with translation, to provide local shopping guides, and tour guides. The phone becomes a proactive conversational partner, instead of just a reactive device for making calls and searching the Internet. It is important for designers to carefully consider these various user scenarios; especially in which AI can become a crucial facilitator in adapting to these scenarios.

**Acquiring Data for AI** AI is heavily data reliant to understand customer needs and requirements; and to effectively provide answers and solutions. Data are obtained from various scenarios, as discussed

above. Data have different degrees of complexity and structure. Some data can be very structured, stable and needs low volume such as bank help desks or clinic registration inquiries. Some data are unstructured, volatile and requires high volume for AI to function well, such as in account management. AI machines and algorithms require sufficient data to learn and for various problem solving. Effectively acquiring data and data use AI firm challenges. Devices like Apple phone and watch have been working diligently to collect individual health data through its apps. Thanks to network effects, Facebook, Google, and Amazon have also been able to harvest oceans of data, which they use to continually refine their products and services. That, in turn, earns them even more users and yields even more data. Data management is as important as algorithms in actual AI applications; technology managers who develop, manage, and utilize AI need to develop data management plans in these circumstances.

**Building an AI Business Ecosystem** For AI to be better utilized in business, a systems perspective is necessary. Part of this ecosystem management relates to customer interaction and understanding customer needs. AI can use technologies to sense the world — audio, vision, sensor — and comprehend the information collected through language processing. These technologies may require decision-making processes with support of expert systems.

AI systems can self-learn with machine learning technologies and improve at a speed unmatched by human beings. Using the AI tools well and building this ecosystem can help firms understand customer pain points and provide profound solutions.

Managers need to understand all players and components of the ecosystem. Awareness of the implications of transitioning from existing system to the new AI-based systems is necessary for management. Within the ecosystem landscape, business models in every industry can be affected by AI technological transformations. For example, business processes may be redesigned through reinvention of workflows and layouts for fulfillment centers after an introduction of robots and optimization algorithms based on machine learning. Business models need to be redesigned to take advantage of machine learning systems that, for instance, can intelligently recommend music or movies in a personalized way. Firms need to reevaluate and rebuild their

strategic alliances. For small companies which cannot afford to hire algorithm scientists, they can collaborate with companies providing open source platforms, and use available API to develop application solutions. All these issues, and more, are important in building the broader AI business ecosystem [7–9].

Large tech companies such as Apple, Baidu, and Google are working on various AI technologies. But the list continues to lengthen. Amazon is working on robotics and speech recognition, Salesforce on virtual agents and machine learning, BMW, Tesla, and Toyota on robotics and machine learning for use in driverless cars. Industrial giants such as Bosch, GE, and Siemens are investing in machine learning and robotics,

seeking to develop specific technologies related to their core businesses.

The growth is not always internal, companies are acquiring startups in the AI field. Google, for example, in the past five years, has made many acquisitions on AI related startups such as Deepmind. With those big firms competing to grab a piece of market in the AI-driven future economy, there is still plenty room for small and medium businesses and startups to discover innovative AI solutions and implementations in this burgeoning field. Managers need to be aware of the possibilities for the broader business systems as acquisitions, mergers, intellectual capital, and other concerns emerge in the AI community.

## REFERENCES

- [1] Bughin, J., Hazan, E., Ramaswamy, S., Chui, W. M., Allas, T., Dahlström, P., Henke, N., & Trench, M., (2017). Artificial Intelligence: The Next Digital Frontier? McKinsey Global Institute Discussion Paper.
- [2] Lin, P. H., Wooders, A., Wang, J. T. Y., & Yuan, W. M. (2018). Artificial intelligence, the missing piece of online education?. *IEEE Engineering Management Review*, 46(3), 25–28.
- [3] Shams, R. (2018). Developing machine learning products better and faster at startups. *IEEE Engineering Management Review*, 46(3), 36–39.
- [4] Wenzhu, Z. (2018). Qingfan technology assists personal growth of students via affective computing technology. *IEEE Engineering Management Review*, 46(3), 34–35.
- [5] Zhang, Z., & Zhang, Y. (2018). Automated writing evaluation system: Tapping its potential for learner engagement. *IEEE Engineering Management Review*, 46(3), 29–33.
- [6] AI Trends Reshaping Healthcare (2018). AI Industry Series discussion, CB Insights.
- [7] Brynjolfsson, E., & McAfee, A. (July 2017). The business of artificial intelligence. Harvard Business Review.
- [8] Avent, R. (June 2018) A digital capitalism Marx might enjoy. MIT Technology Review.
- [9] Bataller, C. & Harris, J. (2018) Turning artificial intelligence into business value. Accenture Institute for High Performance Report.

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