Adoption of Cognitive Technology

S. Muni Kumar, Assistant Professor, Dept. Of MCA, KMMIPS
B.Vani, Student, MCA, KMMIPS ,   D. Sree Sravanthi, Student, MCA, KMMIPS

Abstract—Time to move towards the adoption of cognitive technology. When it comes to adoption of cognitive technology, some of the leading companies are progressing rapidly from the pilot project phase to the production application phase. Those on the sidelines would do well to move from interest to adoption of this impressive group of technologies.

Index Terms—Introduction, Why the Rapid Rise, Rapid cognitive take-up, Cognitive Technologies , Cognitive technologies are already in wide use, Why the impact of cognitive technologies is growing ?, Bringing cognitive technologies to life , Cognitive technologies augment human decision-making, . New intuitive experiences and interactions, What are the opportunities?, How an organization can apply cognitive technologies?, Improving performance expands applications, Major investments in commercialization, Emerging applications, Privacy and Security, Qualcomm machine learning platform, What are potential threats and pitfalls, Advances in Cognitive Information Systems, The Future of Cognitive Analytics, Conclusion.

Keywords: AI- Artificial Intelligence, , NLP- Natural Language Processing, ML- Machine Learning, IOT- Internet Of Things, CS- Cognitive Systems CT- Cognitive Technology, CC- Cognitive Computing, AI app- Adaptive Intelligence apps, DL- Deep Learning, NN-Neural Networks, GPUs- Graphical Processing Units, IIA- International Institute for Analytics, API's- Application Program Interfaces.

——————————— ◆ ———————————

1. Introduction

The cognitive computing, often referred to as artificial intelligence (AI), is hardly new, the recent level of interest in it is astounding. The combination of vendor marketing, concerns about job losses, and even discussion of "robot overlords" have prompted massive interest in the media. There is also plenty of substance behind the hype. Cognitive technologies offer the possibility of increased productivity, better knowledge-based interactions with customers, and the ability to solve problems that are too complex for human brains.

While there have been several "AI winters" and "AI springs" over the past 50 years, there is reason to be confident that the flowering this AI spring is changing the garden permanently. However, in order to get value from this impressive set of technologies, organizations should move rapidly from interest to adoption. In many cases, the technology is ready for immediate use, and many large, established companies are moving ahead with production applications.

The current term for AI is "cognitive technology," suggesting an ability to perceive and learn that approaches and sometimes exceeds that of humans.

There are still some obstacles to cognitive technologies assuming their place at the head of the technology table, but determined organizations can overcome them. It's not clear when or if cognitive technologies will ever reach the level of "artificial general intelligence" at which they are better than humans at every kind of thinking we do (also known as "The Singularity"). But it is already having dramatic and, generally, beneficial impacts on businesses and organizations.

2. Why the rapid rise?

Why has this rapid growth in visibility and interest for cognitive technologies taken place, and what are the implications of it? There are both demand and supply factors underlying this trend. On the demand side, there are strategic, tactical, and operational aspects. From a strategic standpoint, companies always want profitable growth, and increased productivity is a common way to achieve it.

Also, on the demand side, there are many situations today in which a traditional human approach to analytics and decision-making is simply impossible. These decisions need to be made with too much data and in too short a time for humans to employ their own brains in the process. Digital advertising, medical diagnosis, predictive maintenance of industrial equipment, and many other realms of business today are impossible to execute well without some form of cognitive technologies.

Finally, in terms of the simple operational aspects of demand, while human labor has many strengths, it remains expensive, and difficult to manage relative to machines. Of course, in many cases smart machines will work alongside smart humans, and that is the best combination in many work settings. But there's no doubt that the siren call of automation is propelling cognitive technology forward.

Cognitive capabilities are available as standalone software, and, increasingly, as embedded capabilities within other types of software. IBM has placed a big bet on Watson as a standalone software offering, although as a series of APIs (application program interfaces) it can also be combined with other programs.

Neural networks, for example, have been available since the 1950s. But current versions of them, some of which are called "deep learning". There are also emerging computational infrastructures that combine multiple processors in a mesh to enable the use of more complex cognitive algorithms.

This combination of hardware, software, and data has already yielded impressive levels of capability. In image recognition, for example, a deep learning algorithm

Figure 1. The field of artificial intelligence has produced a number of cognitive technologies

running on GPU processors first beat human-coded software for computer vision in recognizing Image Net images in 2012. By 2015, it had exceeded not only the best human-written software, but the best human eye in image recognition.

3. Rapid cognitive take-up

All the planets on both the supply and demand sides seem to be aligned for organizations to employ cognitive technology in their businesses, and research suggests they are doing so. In a 2016 survey of 450 US executives from companies with revenues over $1 billion—38 percent of respondents agreed that their companies were "investing in cognitive computing or artificial intelligence to improve business operations, customer service, marketing, or other areas." Almost as many, 36 percent, agreed that their organizations "use machine learning [a branch of cognitive technology] to automatically generate analytical models." And 50 percent of the respondents agreed with two statements that correspond with the use of cognitive tools: "We integrate 'big data' with 'small data' to get business results," and "We mix data science with traditional analytics to get business results." The survey suggests that many large organizations are jumping enthusiastically onto the cognitive bandwagon.

Technologies like "robotic process automation" may not have all the desired cognitive capabilities (they generally can't learn, for example), but they can be implemented rapidly and at low cost to perform many digital tasks. More companies could adopt them now, and would benefit from doing so.

While it is entirely possible that the high expectations for cognitive technologies in business could lead to what Gartner Inc. calls a "trough of disillusionment," any dissatisfaction is likely to be only temporary at worst. Some early use cases were perhaps not appropriate for the technology applied to them, but understanding of the differences and applications of alternative cognitive tools is growing rapidly. These technologies have the ability now to solve pressing problems in business and other types of institutions. They can make scarce knowledge more widely available, and make fast and accurate decisions. They work at all hours of the day and night. They can greatly augment our human capabilities for perceiving our environments and undertaking decisions and actions based on them. We cannot afford to be complacent as we plan our own futures in the workplace, but we also cannot afford to ignore the opportunities that cognitive technologies present.

4. Cognitive Technologies

We distinguish between the field of AI and the technologies that emanate from the field. The popular press portrays AI as the advent of computers as smart as or smarter than humans. The individual technologies, by contrast, are getting better at performing specific tasks that only humans used to be able to do. We call these *cognitive technologies*, and it is these that business and public sector leaders should focus their attention on. Below we describe some of the most important cognitive technologies those that are seeing wide adoption, making rapid progress, or receiving significant investment.

"Cognitive technologies are products of the field of artificial intelligence. They are able to perform tasks that only humans used to be able to do."

- **Machine vision :** The ability of computers to identify objects, scenes, and activities in unconstrained (that is, naturalistic) visual environments
- **Machine learning :** The ability of computer systems to improve their performance by exposure to data without the need to follow explicitly programmed instructions
- **Natural language processing :** The ability of computers to work with text the way humans do—for instance, extracting meaning from text or even generating text that is readable, stylistically natural, and grammatically correct
- **Speech recognition :** The ability to automatically and accurately transcribe human speech
- **Optimization**: The ability to automate complex decisions and trade-offs about limited resources
- **Planning and scheduling**: The ability to automatically devise a sequence of actions to meet goals and observe constraints
- **Rules-based systems**: The ability to use databases of knowledge and rules to automate the process of making inferences about information
- **Robotics**: The broader field of robotics is also embracing cognitive technologies to create robots that can work alongside, interact with, assist, or entertain people. Such robots can perform many different tasks in unpredictable environments, integrating cognitive technologies such as computer vision and automated planning with tiny, high-performance sensors, actuators, and hardware.

5. Cognitive technologies are already in wide use

Organizations in every sector of the economy are already using cognitive technologies in diverse business functions.

➢ In **banking**, automated fraud detection systems use machine learning to identify behavior patterns that could indicate fraudulent payment activity, speech recognition technology to automate customer service telephone interactions, and voice recognition technology to verify the identity of callers.

➢ In **health care,** automatic speech recognition for transcribing notes dictated by physicians is used in around half of US hospitals, and its use is growing

rapidly. Computer vision systems automate the analysis of mammograms and other medical images.[57] IBM's Watson uses natural language processing to read and understand a vast medical literature, hypothesis generation techniques to automate diagnosis, and machine learning to improve its accuracy.

➢ In **life sciences**, machine learning systems are being used to predict cause-and-effect relationships from biological data and the activities of compounds, helping pharmaceutical companies identify promising drugs.

➢ In **media and entertainment**, a number of companies are using data analytics and natural language generation technology to automatically draft articles and other narrative material about data-focused topics such as corporate earnings or sports game summaries.

>   ➢ **Oil and gas producers** use machine learning in a wide range of applications, from locating mineral deposits to diagnosing mechanical problems with drilling equipment.

>   ➢ The **public sector** is adopting cognitive technologies for a variety of purposes including surveillance, compliance and fraud detection, and automation.

>   ➢ **Retailers** use machine learning to automatically discover attractive cross-sell offers and effective promotions.

>   ➢ **Technology companies** are using cognitive technologies such as computer vision and machine learning to enhance products or create entirely new product categories, such as the Roomba robotic vacuum cleaner or the Nest intelligent thermostat.

As the examples above show, the potential business benefits of cognitive technologies are much broader than cost savings that may be implied by the term "automation." They include:

• Faster actions and decisions (for example, automated fraud detection, planning and scheduling)

• Better outcomes (for example, medical diagnosis, oil exploration, demand forecasting)

• Greater efficiency (that is, better use of high-skilled people or expensive equipment)

• Lower costs (for example, reducing labor costs with automated telephone customer service)

• Greater scale (that is, performing large-scale tasks impractical to perform manually)

• Product and service innovation

6. Why the impact of cognitive technologies is growing ?

The impact of cognitive technologies on business should grow significantly over the next five years. This is due to two factors. First, the *performance* of these

Figure 2. Commercialization and improving performance expand applications for cognitive technologies
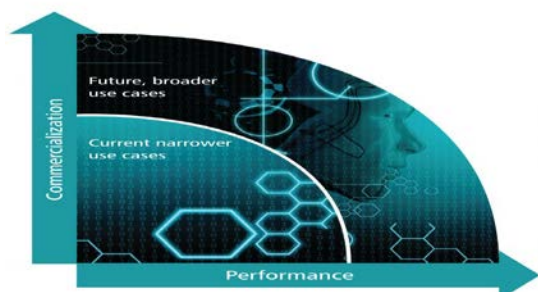
technologies has improved substantially in recent years, and we can expect continuing R&D efforts to extend this progress. Second, billions of dollars have been invested to *commercialize* these technologies. Many companies are working to tailor and package cognitive technologies for a range of sectors and business functions, making them easier to buy and easier to deploy. While not all of these vendors will thrive, their activities should collectively drive the market forward. Together, improvements in performance and commercialization are expanding the range of applications for cognitive technologies and will likely continue to do so over the next several years (fig. 2).
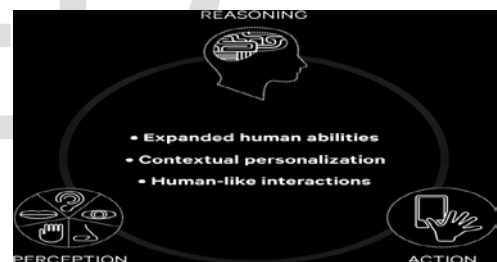
7. Bringing cognitive technologies to life :

Imagine a world where devices, machines, and things are much more intuitive, simplifying and enriching our daily lives. For example, smartphones become more aware of our preferences and surroundings, anticipate our needs, and provide us with relevant information at the right time.

To make this a reality, we are developing cognitive technologies, such as machine learning, computer vision, intelligent connectivity, and always-on sensing.

Building on the smartphone foundation and the scale of mobile, we envision these cognitive technologies expanding beyond mobile and powering other devices, machines, and things.

8.

Cognitive technologies augment human decision-making
Future of risk series: Trend one

Advancements in cognitive technologies, AI, and data analytics are helping organizations go beyond traditional ways of managing risks by using smart machines to detect, predict, and prevent risks in high-risk situations. Autonomic computing combines automation and cognitive technologies to make systems self-managing and potentially self-defending and self-healing against risks.

➢ ***Contextual Personalization***

Cognitive technologies personalize our experiences based on where we are, what we are doing, and what we plan to do. When you are in a business meeting, your mobile device will show you relevant information to the meeting, take notes, and even suggest a location and time for your next meeting. When you are at home, it will recognize different family members and present each of them with appropriate content. You will see your work e-mail, while your child will see his favorite cartoon.

> ***Always-on Sensing***

Constantly monitor data from various sensors, observe our behaviors, and intelligently fuse data together.

> ***Contextual Inference:*** Learn, infer context, and anticipate our needs through reasoning and machine learning algorithms.

> ***Taking Appropriate Actions :*** Take the right action based on context and our preferences

9. New intuitive experiences and interactions:

Cognitive technologies enable devices and things to perceive (by seeing and hearing like humans), reason (by inferring context and anticipating needs), and act intuitively based on context. Drawing inspiration from the human brain, cognitive technologies will expand our human abilities by serving as natural extensions of our senses. They will also contextually personalize our experiences, while creating more human-like interactions with devices and things.

10. What are the opportunities?

- Identify use cases that are well-suited for cognitive technology solutions: Where the risk area is critical, large amounts of data are available, and current solutions aren't effective
- Use visualization to analyze and communicate information in a human-friendly way to enable rational decision-making
- Upskill employees so that they are able to more effectively use cognitive technologies to extract insights from data

11. How an organization can apply cognitive technologies?

Cognitive technologies will likely become pervasive in the years ahead. Technological progress and commercialization should expand the impact of cognitive technologies on organizations over the next three to five years and beyond. A growing number of organizations will likely find compelling uses for these technologies; leading organizations may find innovative applications that dramatically improve their performance or create new capabilities, enhancing their competitive position. IT organizations can start today, developing awareness of these technologies, evaluating opportunities to pilot them, and presenting leaders in their organizations with options for creating value with them. Senior business and public

sector leaders should reflect on how cognitive technologies will affect their sector and their own organization and how these technologies can foster innovation and improve operating performance.

Improving performance expands applications

Examples of the strides made by cognitive technologies are easy to find. Computer vision has progressed rapidly as well. A standard benchmark used by computer vision researchers has shown a fourfold improvement in image classification accuracy from 2010 to 2014.Facebook reported in a peer-reviewed paper that its Deep Face technology can now recognize faces with 97 percent accuracy. IBM was able to double the precision of Watson's answers in the few years leading up to its famous *Jeopardy!* victory in 2011.The company now reports its technology is 2,400 percent "smarter" today than on the day of that triumph.

"Many companies are working to tailor and package cognitive technologies for a range of sectors and business functions, making them easier to buy and easier to deploy."

As performance improves, the applicability of a technology broadens. For instance, when voice recognition systems required painstaking training and could only work well with controlled vocabularies, they found application in specialized areas such as medical dictation but did not gain wide adoption. Not all cognitive technologies are seeing such rapid improvement. Machine translation has progressed, but at a slower pace. Professional translators regularly rely on machine translation, for instance, to improve their efficiency, automating routine translation tasks so they can focus on the challenging ones.

13. Major investments in commercialization :

From 2011 through May 2014, over $2 billion dollars in venture capital funds have flowed to companies building products and services based on cognitive technologies.

The following list of cognitive technology vendor categories, while neither exhaustive nor mutually exclusive, gives a sense of this.

> **Data management and analytical tools,** that employ cognitive technologies such as natural language processing and machine learning. These tools use natural language processing technology to help extract insights from unstructured text or machine learning to help analysts uncover insights from large datasets.

> **Cognitive technology components,** that can be embedded into applications or business processes to add features or improve effectiveness. Nuance provides speech recognition technology that developers can use to speech-enable mobile applications.

> **Point solutions,** a sign of the maturation of some cognitive technologies is that they are increasingly embedded in solutions to specific business problems. These solutions are designed to work better than

solutions in their existing categories and require little expertise in cognitive technologies.

- ➢ **Platforms,** which are intended to provide a foundation for building highly customized business solutions. They may offer a suite of capabilities including data management, tools for machine learning, natural language processing, knowledge representation and reasoning, and a framework for integrating these pieces with custom software.

14. Emerging applications :

If current trends in performance and commercialization continue, we can expect the applications of cognitive technologies to broaden and adoption to grow. The billions of investment dollars that have flowed to hundreds of companies building products based on machine learning, natural language processing, computer vision, or robotics suggests that many new applications are on their way to market. We also see ample opportunity for organizations to take advantage of cognitive technologies to automate business processes and enhance their products and services.

15. Privacy and Security:

To enrich our daily lives without compromising our privacy, cognitive technologies are also making security more robust and intuitive. Robust security starts with a hardware-based solution, which is the foundation of our vision for security:

- ➢ **Seamless Authentication:** Continuous, multi-factor authentication based on biometric and behavioral analysis.
- ➢ **Preemptive Protection:** Early detection of unknown malicious attacks through behavioral analysis.
- ➢ **Enhanced Privacy:** Users control and own their data through data encryption and on-device processing.

On-device processing is key for bringing cognitive technologies to life. By taking an optimal **heterogeneous computing** approach, Qualcomm Technologies is uniquely positioned to support these compute intensive technologies on mobile devices within the power, thermal, and size constraints. Implementing these technologies on-device versus in the cloud has various benefits:

- ➢ **Faster Response:** Processing data on device versus in the cloud provides faster response, which is particularity important for real-time applications.
- ➢ **Enhanced Reliability**

For mission critical applications, on-device processing reduces reliance on network conditions.

- ➢ **Bandwidth Efficiency:** As more data is generated and utilized at the edge, on-device processing reduces unnecessary traffic.
- ➢ **User Privacy :** On-device processing allows us to keep our most personal data on device versus in the cloud.
- ➢ **Reshaping industries and creating new possibilities:**

Imagine the impact of giving more devices, things, and machines expanded human abilities, contextual personalization, and human-like interactions. Mobile is democratizing cognitive technologies, empowering an array of form factors and creating new possibilities
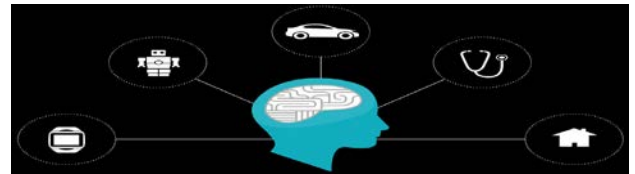
that will reshape industries. For example, robots can assist us in our daily lives, benefiting from the power efficient implementation of cognitive technologies on mobile. They will be able to adapt to our needs and avoid obstacles in their environment through machine learning and computer vision. We are bringing cognitive technologies to life, simplifying and enriching our daily lives.

16. Qualcomm machine learning platform:

To realize our vision of bringing cognitive technologies to life, we are introducing the Qualcomm® Machine Learning platform, designed to provide the foundation for more intuitive experiences and natural interactions through the addition of on-device intelligence designed for a range of key mobile experiences and cutting edge cognitive capabilities.

17. What are potential threats and pitfalls?

- • Difficulty in implementing complex cognitive tools
- • Overhyped technologies unable to deliver on promises
- • Lack of trust and assurance mechanisms for AI
- • Inability to source the right data
- • Human backlash against automated decision-making
- • Unintended consequences of mistaken predictions

18. Advances in Cognitive Information Systems

The development of computer science is now so rapid that we, the readers, in-creasingly receive technology news about new solutions and applications which very often straddle the border between the real and the virtual worlds. Computer science is also the area in which cognitive science is witnessing a renaissance, be-cause its combination with technical sciences has given birth to a broad scientific discipline called cognitive informatics. And it is this discipline which has become the main theme of this monograph, which is also to serve as a kind of guide to cognitive informatics problems.

19. The Future of Cognitive Analytics:

The ability to use new connected tech is essential for future analytics use

Cognitive analytics simulates human thought processes to learn from data in real-time. It uses data mining, pattern recognition, and natural language processing with both supervised and unsupervised machine learning techniques in order to identify patterns and anomalous behaviors that are often unexpected, important, and influential.

The applications for the technology are many, and it's set to transform business, driven largely by an explosion in the adoption of cognitively enriched intelligent machines like IoT and mobile devices. Cognitive systems learn through experience, and apply what they've learned to new inquiries or tasks, making them far better suited for the next explosion of data that connected devices, which traditional algorithm-based systems will struggle to deal with because they are limited by their pre-programmed settings.

The IBM Watson machine is the prototype of this type of computing. Watson has access to a vast store of historical data, which it then applies machine learning algorithms to in order to pinpoint connections and correlations. This forms a so-called 'knowledgebase' which provides an engine for discovery, decision support, and deep learning. It uses this to provide answers to queries at the right time, in the right context.

IBM is clearly confident that Watson is the future, having invested north of a billion dollars in its development. The International Institute for Analytics (IIA) has also predicted that cognitive technology will succeed automated analytics as the next big thing in data. Despite its relative youth as a buzzword, it is already gaining traction in terms of take up. In a recent IBM Institute for Business Value study, 'Redefining Competition: Insights from the Global C-suite Study -

The CEO perspective', 11% of CEOs surveyed said they were already using cognitive computing technology in their businesses. These numbers are promising, but they do not indicate a technology that is simply going to blow up. If it's going to be like other disruptive technologies, it's likely that it will be introduced slowly as people gauge how exactly it can boost their business. This is especially likely because of its ties to IoT, which has yet to take off as many believe it eventually will.

There are numerous applications for cognitive analytics that spring to mind though. Cybersecurity is one that we have previously covered (https://channels.theinnovationenterprise.com/articles/cognitive-computing-takes-on-cyber-security). Healthcare and banking are two others, fields where the amount of data is truly unmanageable and where accurate decisions are required immediately. Even Airbus has identified where it could be of benefit to them, with Laurent Martinez, head of its business unit services, telling IBM's Watson Internet of Things global headquarters in Munich: 'I'm deeply convinced that the future of aviation is about data, it's a big, big future.' He noted that an Airbus aircraft consists of more than 300 million parts, and on many of the newer

models these parts are collecting data throughout flights, which Martinez said offered 'a new generation in terms of understanding how an aircraft will behave.'

"The authors of this monograph hope that it will guide Readers on an interesting and accurate journey through the intricacies of information and cognitive science".

20. Conclusion :

The pros & cons of Cognitive Technology which is a part of Artificial Intelligence are detailed. The different types of Cognitive Technologies and how an Organization can adopt these Technologies have been discussed from this detailed study, it be concluded that the Cognitive Technologies can increase the productivity, enhances the knowledge based interactions with user and solve the problem that are too complex for Human Brain.

References :

1. Augmented intelligence, helping humans make smarter decisions. Hewlett Packard Enterprise. http://h20195.www2.hpe.com/V2/GetPDF.aspx/4AA6-4478ENW.pdf

2. *Denning. P.J. (2014). "Surfing Toward the Future". Communications of the ACM. 57 (3): 26–29. doi:10.1145/2566967.*

3. Kelly III, Dr. John (2015). "Computing, cognition and the future of knowing" (PDF). *IBM Research: Cognitive Computing.* IBM Corporation. Retrieved February 9, 2016.

4. *"Security analytics shores up hope for breach detection". Enterprise Innovation. Retrieved April 27, 2015.*