ARTIFICIAL INTELLIGENCE MEETS AUGMENTED REALITY

Redefining Regular Reality

CHITRA LELE

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Artificial Intelligence Meets Augmented Reality

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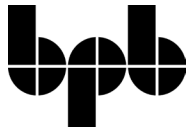
By
Chitra Lele



FIRST EDITION 2019

ISBN: 978-93-88511-33-9

Distributors:

BPB PUBLICATIONS
20, Ansari Road, Darya Ganj
New Delhi-110002
Ph: 23254990/23254991

BPB BOOK CENTRE
376 Old Lajpat Rai Market,
Delhi-110006
Ph: 23861747

MICRO MEDIA
Shop No. 5, Mahendra Chambers,
150 DN Rd. Next to Capital Cinema,
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Ph: 22078296/22078297

DECCAN AGENCIES
4-3-329, Bank Street,
Hyderabad-500195
Ph: 24756967/24756400

Published by Manish Jain for BPB Publications, 20, Ansari Road, Darya Ganj, New Delhi-110002 and Printed by Repro India Pvt Ltd, Mumbai

Acknowledgements

My book, while an individual work, benefited from the insights and direction of several people. I use this opportunity to express my heartfelt thanks to all those who supported me in one way or the other during the completion of this book project.

Special thanks to my exceptional Publishers, the BPB Publications team, for the valuable support provided throughout the entire process. The ceaseless cooperation by the team is greatly acknowledged.

What I have learned over the years comes as a result of being a daughter of wonderful parents—Mrs. Asha Lele and Mr. G. Lele. They have been the motivation that has helped me to maintain laser-sharp focus on my goals. Thanks to them for their on-going support and endless encouragement.

I owe my deepest gratitude to Prashanth H. Southekal for writing the scholarly Foreword for my book. I tender my heartfelt thanks to Prashanth Sir for evincing keen interest in my book.

I offer my deep gratitude to the divine essence within me for bestowing on me the strength to follow my heart.

While developing the manuscript, my discussions and debates with experts from the fields of artificial intelligence and augmented reality helped me to develop insightful and thought-provoking content for the book. I am thankful to them for their time and inputs.

I owe my sincere gratitude to my company colleagues who gave me the time and space to complete this book. Their ceaseless cooperation in adjusting to my software project work schedule and book writing schedule helped me to maintain balance between these two aspects.

A very special thank you must go to you all, my readers, for investing your time in reading my book.

Last but not least, I beg forgiveness of all those who have been with me over the course of the years and whose names I have failed to mention. Your support and encouragement is deeply appreciated.

Chitra Lele

Preface

Artificial Intelligence Meets Augmented Reality: Redefining Regular Reality is a unique book as it presents the new technology paradigm of Artificial Intelligence (AI) and Augmented Reality (AR) and its full transition, right from major advantages that enhance entire change-driven sectors and industries to changing how the world operates at various levels. New worlds will emerge in the context of our existing world through a combination of AI-AR. One will go beyond just consuming data and information—one will become immersed in these new realities generated by data and information. The current ways of doing business and meeting customer requirements will change drastically, and this involves the application of the combination of AI-AR to various business dynamics for handling a broad range of business scenarios, right from lean and augmented data needed for machine learning to moving virtual assistants deeper into the business workflows.

My book is an earnest attempt to bridge the gaps in knowledge and to help the readers understand the deeper dynamics of the AI-AR duo. Whether you are a chief executive officer, technology specialist, project manager, user experience designer, marketing manager or a computer science student, this book guides you through the complex web of intricacies brought about by the convergence of AI-AR. This book will help to chart out a path where there is no trail yet and get you started on developing AI-AR solutions and experiences in bettering the world in an ethical manner.

Whether singularity (due to technologies like AI, AR, and so on) is near or far, utopian or dystopian—this very concept raises some critical philosophical, ethical and pragmatic questions, forcing us to re-think seriously about what we want as a species in terms of technology. The book not only presents the positive side of the AI-AR duo, but it also discusses the stark aspects of such transformative technologies. Many believe that as these technologies advance, people will lose the ability to think for themselves and they will lose the deeper connection with themselves as well as others. This book presents both the bright and bleak sides in order to give a holistic view and help us to decide how we are going to leverage such technologies—and whether their disruptive or transformative nature—will mar or make the future of our world!

The book believes in the concept of *teach by example*. All the tools needed to facilitate quick understanding of complex concepts are provided in this book:

- Definition of key terms
- Industry studies, research statistics, etc., that clarify concepts
- Spotlight sections
- A Word of Caution sections
- Chapter summaries
- Questions for reflection
- And much more

Enlightened engineers are needed to use a combination of technology and spirituality to keep the inner spark of humanity ignited while travelling in this fast lane of technology. A workforce of enlightened engineers is the key to designing and developing AI-AR solutions with responsibility in order to achieve the greater good of the world. Through the book, I have explained a multidisciplinary, integrated approach as to how we can minimize barriers and blend AI and AR without destroying our natural settings. Using technology with responsibility involves the process of enduring some pain and learning some key lessons along the way.

The book provides a doable roadmap with signposts that guide in building a large-scale research and knowledge exchange partnership across multiple disciplines in order to spread the wave of enlightened engineering that builds a culture of care and collaboration through transformative technologies like the AI-AR convergence across the globe in a responsible and ethical manner.

Chitra Lele

Foreword

When the young software consultant and record-setting author, Chitra Lele, called me to write a foreword for her book on Artificial Intelligence (AI) and Augmented Reality (AR), I was extremely delighted and honored to write a foreword on such an exciting field!

In 2017, the Economist magazine said the world's most valuable resource is no longer oil, but data. While it took from the dawn of civilization to 2003 to create 5 exabytes of data, we now create the same volume of data in less than 2 days! Faced with overwhelming amounts of data, organizations—both profit and non-profit across the globe are looking at ways to use data for improved performance. In this backdrop, two promising technologies—AI and AR offer a completely new way of interacting with the physical world using data and technology. Fundamentally, AI technologies such as machine learning and deep learning sit at the heart of AR platforms.

However, for the AI and AR technologies to work together, one should have a solid understanding of the AI and AR technologies along with the knowledge of the complete ecosystem. Today, the technology landscape is increasingly moving towards ecosystems—a set of interdependent entities that work together to provide holistic services. These ecosystem entities could be technology, external stakeholders, internal users, data, processes, regulators, the development community to name a few. Given that AI-AR is about data consumers and their experiences, Chitra Lele's book ***Artificial Intelligence Meets Augmented Reality: Redefining Regular Reality*** provides a holistic and a practical approach for an integrated, scalable and holistic AI-AR ecosystem. This book explains in detail the fundamental concepts of AI and AR before dwelling into the details on integration, security, privacy and ethical aspects. Apart from the inner workings of the AI-AR solutions, this book also offers valuable insights to integrate new experiences across diverse devices and platforms.

Chitra's comprehensive book is an earnest attempt to bridge the gaps in knowledge and to help the readers understand the deeper dynamics of the AI-AR duo. Whether you are a chief executive officer, technology specialist, project manager, user experience designer, marketing manager or a computer science student, this book guides you through the complex web of intricacies brought about by the convergence of AI-AR. This book

will help to chart out a path where there is no trail yet and get you started on developing AI-AR solutions and experiences in bettering the world in a responsible and ethical manner.

Today AI and AR technologies are providing limitless opportunities for individuals and organizations to look at new ways of interacting with the physical world using data and technology. I strongly believe this book will help readers for designing, building, and operating holistic AI–AR solutions. Great job Chitra and thank you very much for giving me an opportunity to write the foreword on such a wonderful topic! All the best!

Prashanth H. Southekal, PhD

Managing Principal of DBP-Institute (Canada),
Digital Transformation Strategist and Best-Selling
Author of *Data for Business Performance*

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PART 1

Dynamics of Artificial Intelligence and Augmented Reality

CHAPTER 1

Introduction to Artificial Intelligence and Augmented Reality

The world currently seems full of two-letter acronyms, especially AI (artificial intelligence) and AR (augmented reality). The *Terminator* film franchise portrays a future where AI is an integral part of day-to-day life; and yes, after all these years we are on that path right now. AI, or machine intelligence, is the simulation of human intelligence by machines like computer systems. AR is a technology that brings elements of the digital world and overlays them into the real world thereby enhancing our sensory perception of the same. And a combination or convergence of AI and AR can produce mind-boggling ideas, possibilities and results.

A few years ago, our virtual lives revolved around desktop computers and then the focus shifted to devices that landed right in our palms. A few years from now, the hub of our digital lives and all our activities will no longer be just limited to our IPhones or smartphones, but also involve new devices and interfaces driven by the AI-AR combination that will blur the line between what is real and what is not.

The year 2016 has been a breakout year for AR. The launch of the Pokémon Go game in the year 2016 developed by Niantic (it is an American software development company best known for developing AR games like Pokémon Go) set the stage for AR and provided a direction of how AR and its applications can be applied to other industries like tourism, retail, etc., (apart from games and entertainment). Today, successful implementation of AI and AR applications like Cortana, Alexa, TechSee, etc., are adding unique value to the way our world operates. AI-AR startups are beginning to emerge in substantial numbers. One such example is Connectar's MRO.AIR, which provides an AR display that makes use of AI-enabled image recognition to facilitate the complex maintenance procedures in

the aviation industry. Another application of AI-AR is TechSee, which revolutionizes customer support and service by providing a live virtual platform powered by the AI-AR convergence that allows customer support representatives to solve problems through interactive visual assistance.

Spotlight

The combination of AI and AR is going to power up the next generation of tools, applications, services, experiences, and so on. Immersive computing with this convergence is going to change the way we work, live, entertain, educate, communicate, learn and share. Several industries stand to gain by this merger. For example, this combination can be used by the education industry where AI is used to deliver learning content, programs and tools through learning assistants and AR is used to provide an immersive and interactive environment to enhance the learning process of the learners and students. There is an endless universe of possibilities.

1.1 Artificial Intelligence

The term Artificial Intelligence (AI) often evokes mind-blowing images from fantasy books and science fiction movies. However, AI isn't science fiction at all; it is here and happening in the world and gaining more and more traction day by day. According to the International Data Corporation (IDC is the premier global provider of market intelligence, advisory services and events for the information technology, telecommunications and consumer technology markets) estimates, the AI market will be worth 47 billion US dollars by the year 2020.

According to John McCarthy, the father of Artificial Intelligence, AI is *The science and engineering of making intelligent machines, especially intelligent computer programs. Forbes* (it is a global media company focusing on business, investing, technology, entrepreneurship, leadership and lifestyle) defines **AI** as *the broader concept of machines being able to carry out tasks in a way that we would consider 'smart'*.

Artificial is something that is not real; it is something that is synthetic and simulated. Intelligence is the ability to acquire knowledge and apply it; it is a sum total of various factors like problem-solving, logic, creativity, self-awareness and self-learning, and so on. Hence, AI is the simulation and emulation of human *intelligence* by machines and computer systems.

AI makes it possible for machines to learn from experience and historical data using simple and/or complex algorithms and patterns.

AI is based on several disciplines like Biology, Mathematics, Engineering, Language, Computer Science, etc., and there are different types of technologies involved in AI research and applications like Deep Learning, Machine Learning, Virtual Agents and more.

1.1.1 History of AI

AI has come a long way from ancient mythology and anecdotes to its modern-day avatar in the form of robots, driverless cars, and so on. In fact, there has been no age, era or civilization without a mention of AI. Many ancient myths and legends speak about artificial entities and mechanical men. Greek myths talk about Hephaestus (a Greek god) who built giant robots, for example, Talos who was a programmed warrior to protect the island of Crete. Apart from Talos, Hephaestus had developed several other such mechanized systems that could feel and think like humans. An ancient philosophical book called *Yoga Vasistha also* dealt with the topic of artificial intelligence in the form of war machines and robots. Ancient automata appear in various tales of Medea, Jason, etc. It is interesting to see that the concepts and ideas of AI originated from ancient mythologies.

In 1920, Karel Čapek, a Czech playwright and writer, published a science fiction play named *Rossumovi Univerzální Roboti* (R.U.R = Rossum's Universal Robots), and this play introduced the word *robot*. This play was about artificial people called robots who first worked for normal people and then they revolted against normal people which led to the extinction of normal humans. Pamela McCorduck**,** an American author, writes, AI began with *an ancient wish to forge the gods*.

The modern history of AI started around 100 years ago. Its origins date back to the work of Alan Turing, Allen Newell and Herbert Simon. Allen Turing, an English computer scientist, philosopher and mathematician, suggested that humans use information as well as reason in order to solve problems and make decisions, so why can't machines do the same thing? In 1950, Alan Turing proposed and developed the *Turing Test for Intelligence* as a measure of machine intelligence and it is still used today as a way to determine a machine's ability to think like a human. In 1943, the foundation for neural networks was laid down by a paper titled '*A logical calculus of the ideas imminent in nervous activity,* in the *Bulletin of Mathematical Biophysics'* published by Warren McCulloch and Walter

Pitts.

In the first half of the 20th century, science fiction popularized the concept of artificial intelligence robots among the general populace. In the year 1958, Herbert Simon, an American economist and political scientist, had declared that, within ten years, machines would become world chess champions if they were not barred from international competitions.

Before 1949 computers lacked a key requirement for intelligence and that is they could not store commands, they could only execute them. They lacked the required computational power. In other words, computers could be told what to do but couldn't remember what they did. Moreover, computing was extremely expensive. Due to these reasons, AI found limited growth during this time period. In the 1940s and 1950s, a handful of scientists, engineers, philosophers and mathematicians contemplated about the possibility of creating an artificial brain.

The term *Artificial Intelligence* was coined in 1956 by John McCarthy, the father of *Artificial Intelligence, at* the historic Dartmouth Conference, the first ever artificial intelligence conference. It is from this conference onwards that AI and its progress kicked off; it triggered the next twenty years of AI research. In 1958, McCarthy developed the Lisp (an acronym for *list processing*) computer language, which became the standard AI programming language and continues to be used even today and also it made voice recognition technology possible. This is the period when AI became a genuine science. But during this period, the AI algorithms were basic and not that efficient.

By the mid-1960s, the progress in this field had slowed down and AI had received bad press for about a decade. Funding for AI research was cut down. This period was called the (first) AI Winter. During such a period or hype cycle, interest in AI would begin with a boom in research and funding and end with a bust period of reduced research and funding. The research still continued but in a new direction. Now, its focus shifted to simulating the psychology of memory and the mechanism of understanding through computers. From the period 1957 to 1974, several promising developments in machine learning algorithms occurred, for example, Joseph Weizenbaum, a professor at the Massachusetts Institute of Technology, created the first chatterbot program called Eliza that

could mimic human conversation. A breakthrough in AI, especially in neural network research came in the form of backpropagation algorithm by the scientist Paul Werbos in 1974. These developments led to the introduction of expert systems, which were further developed in the 1980s. The first AI Winter ended with the introduction of Expert systems. Expert systems are programs that help to find answers to problems in a specific domain.

The second AI Winter came in the late 80s and early 90s after a series of financial setbacks. Thereafter, AI interest began to gain traction and interest again. Technical progress led to the development of machine learning algorithms, which led to further developments in this field where several disciplines were used to produce hybrid systems that were used in industrial applications like speech recognition, fingerprint identification, and so on. David Rumelhart and John Hopfield popularized *deep learning* techniques which allowed computers to learn using experience.

During the 1990s and 2000s, many of the major milestones and goals of AI were achieved. In 1997, Gary Kasparov, the reigning world chess champion and grand master, was defeated by IBM's *Deep Blue* (a chess playing computer program). In the same year, speech recognition software, developed by Dragon Systems was implemented on *Windows*. Over time, as computer storage and processing speed increased exponentially, AI and its capabilities got better and better and they are reflected everywhere, right from technology to entertainment and from banking to finance.

The last two decades have witnessed a tremendous growth in AI. In 2017, the AI market had reached the 8 billion US dollars mark. In present times, tech giants like Google, Microsoft, etc., are studying, researching and implementing a wide range of artificial intelligence projects.

A Word of Caution

Behind these techno-wonders, lies a search for perpetual life and the incessant quest of immortality. There is a strong possibility that the concept of *Posthuman* may replace organic consciousness completely with synthetic artificial intelligence.

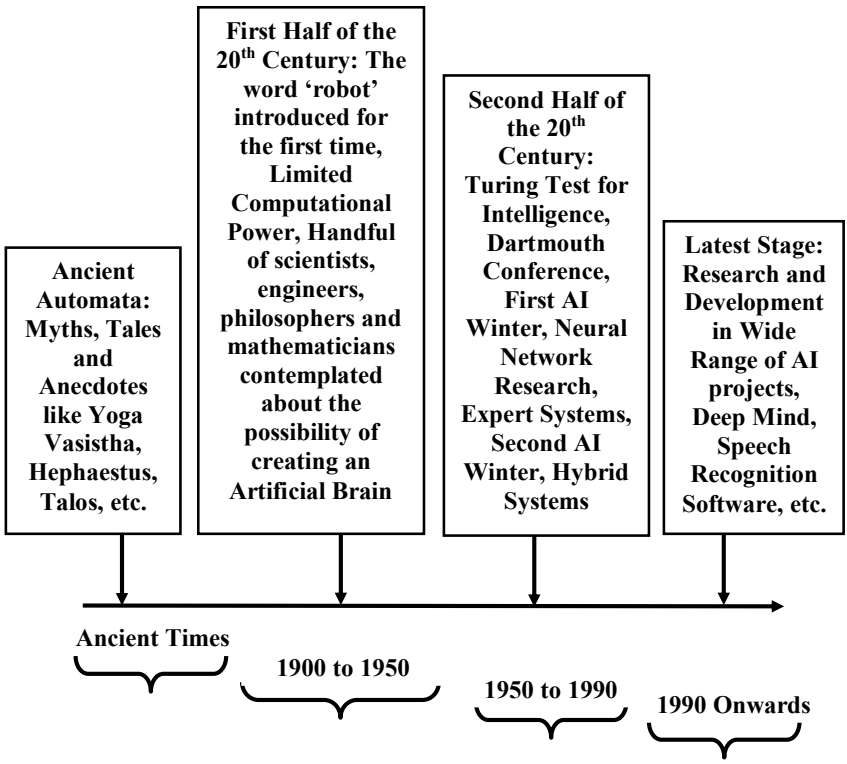

Figure 1.1 History of Artificial Intelligence

1.1.2 AI and the Fourth Industrial Revolution

AI has been described as the Fourth Industrial Revolution or Industry 4.0. The earlier industrial revolutions (mechanization, mass production, digital, and now fourth is about the merging of physical, biological and digital domains) were about automating mundane tasks of the workforce. But AI is about automating intelligent labor. With the Fourth Industrial Revolution powered by AI, it is about automating complex tasks that require tons of data (which human beings are incapable to scour through and analyze the same). Several industry experts are of the opinion that most data-information-rich type of white collar jobs will be replaced very soon. Now the trend in the fourth revolution is that of moving away from the automated towards the autonomous. And this trend is viewed differently by different nations; the non-Western nations' attitude towards the new technologies, including AI and AR, often differs from those of the

Western nations. One thing is for sure that just like the other revolutions, this revolution will also go through various tumultuous twists and turns.

In 2018, the Future of Humanity Institute (FHI is a multidisciplinary research organization) at the Oxford University released a study that claimed AI will outperform humans in many activities in the next ten years. AI is no longer limited to capturing and analyzing straightforward data. It has already stepped into developing 'tacit' knowledge, and at the bottom of all this is the phenomenal explosion of data. This data is critical for machine learning and AI as they need it for training, learning and perfecting themselves. The more data there is, the better the applications of AI will be. The merger of AI and Big Data in this fourth industrial revolution is the beginning of the next level of intelligence called *Data Intelligence*. AI and the fourth industrial revolution are about the speed of embracing this *data intelligence* economy. In such a kind of economy, the demand for data professionals is bound to increase.

AI is no longer limited to specific tasks or segments—right from automobiles to self-service checkouts and from language translation to retail—it is making its presence felt. It is already reshaping both local and global markets through the evolution of machine learning. According to the World Economic Forum (it is an independent international organization committed to improving the state of the world through public-private cooperation), "*The individuals who will succeed in the economy of the future will be those who can complement the work done by mechanical or algorithmic technologies, and 'work with the machines'.*" In other words, human resources will need to become agile by developing a new skill-set that will match this new revolution powered by AI.

Mitre (it is an American not-for-profit organization that manages federally funded research and development centers supporting several U.S. government agencies) and leading technology companies are fuelling the initiative called *Generation AI Nexus*. The main aim of this initiative is to provide American students with access to AI training, tools and big data so that they can become AI-ready and overcome the gaps in employment by doing workforce reengineering. This initiative is made possible due to the partnership among the government, companies and academic institutions. This initiative will be supported by Mitre's analytic framework called Symphony that contains a comprehensive set of machine learning and AI tools. This initiative aims to reach out to 400 universities by the year 2024.

India, too, is taking part in the AI-driven fourth industrial revolution. For the past several years, India has been launching various initiatives to boost its *Digital India* movement and to implement the various cutting-edge, emerging technologies, including AI. The Centre for the Fourth Industrial Revolution recently opened in India by the World Economic Forum aims at designing new policy protocols and frameworks for these emerging technologies. According to industry figures, it is expected to be a 1-trillion-dollar industry in the next 5-7 years. Digital India is gearing up for the future.

Some technology analysts view AI and the fourth industrial revolution as a deadly formula for facilitating digital authoritarian and oppressive practices like digitization of propaganda, state control, election rigging, destruction of privacy rights, and so on. Not all technologies have the power to change the status quo, but they fear that AI, AR, etc., do have this power to do so but in a disruptive (and not transformative) way.

In this new industrial revolution, companies need to successfully strike a balance between delivering personalized experiences while also ensuring that their customers are comfortable with how their data is being analyzed, shared and utilized. And for doing so, the one key factor is *customer trust*. Customer trust is about capturing explicit customer consent for using their data and that too within strict data protection guidelines. Another aspect of customer trust is transparency and by sharing with the customers how and why their data will be used will not only increate the trust level but also improve the customer engagement level. Customers must be allowed to share their feedback and opinions on the privacy policies for their data and information.

For the fourth industrial revolution to survive and thrive, international standards and protocols for all aspects of this paradigm are important and they need to develop taking into consideration the inputs of the various stakeholders involved in this revolution: governments, customers, organizations, legal experts, academic practitioners, technology experts, and so on.

Spotlight

The transition towards intelligent, augmented, autonomous development—the key factors that will determine whether this transition will be utopian or dystopian are global standards and regulations, and eventually peoples' perceptions towards these trends and scenarios.

1.1.3 Advantages and Disadvantages of AI

On the positive side, AI can be used to perform monotonous, repetitive jobs in the 24*7 mode with no pay or no break. Human beings are not that consistent with repetitive tasks or activities as they can get easily bored, tired or distracted. AI is able to replace any human task or activity that is repetitive. For example, call center communication is quite a repetitive task and AI chatbots are already taking over the human component in call centers.

Moreover, by using intelligent machines, the error rate can also be reduced considerably, and therefore greater accuracy and precision can be achieved. In a similar manner, dangerous jobs can be assigned to AI, and if they are programmed correctly and tested thoroughly before implementation, they can be used in many critical applications like space exploration and medical surgeries thereby minimizing the risk and damage to human health and safety. AI-driven surgery simulators can be used in training medical professionals.

At times, when critical business decisions need to be made, AI can play a vital role in this process. As there is complete absence of emotions in AI-driven machines, this enables them to think logically and take the right decisions whereas human emotions are associated with mood swings and biases that can affect human volition and lead to faulty decisions. With each application or use case, AI gets better and better, and learns more in order to make better business decisions.

Big data is a growing trend in all fields, right from finance to banking. To manage and organize data growing at an exponential rate, AI is needed. AI can help to make this data more meaningful and contextually relevant, and again AI needs this type of data to build its own intelligence and enhance its own learning algorithms. A survey about Big Data and AI by NewVantage Partners (it is a premier consultancy focused on guiding business and technology executives) found 97.2 percent of executives stated that their companies are investing in, building, or launching Big Data and AI initiatives. Big Data has been the catalyst for the AI-AR convergence.

Some experts believe that humans and AI can act as a single cognitive unit and this aspect can help in bettering ourselves and help us to venture into unknown realms. In a way, AI enhances and extends our evolution and experiences. This cognitive unit can be used in a plethora of applications,

especially in difficult, risky and unknown situations like rescue operations in hostile and far-fetched places, in space and oil exploration, in mining operations, in augmenting the lives of differently-abled people, and so on.

There are potential benefits brought about by AI; however, these potential benefits will only be realized through substantial research. The solution to this research is AI itself. AI has great potential for research and development applications like market research, cognitive analysis, etc. There are several companies already providing research and development systems and services like MeltWater, DeepMind, Iris AI, and so on.

Infusing human thinking capabilities into machines can give rise to a plethora of benefits and problems too. We have discussed several benefits of AI so far, now we will turn our focus towards its downside. AI projects are a costly affair in terms of money and skills; they need huge monetary investment and expertise (which is rare to find) due to their complexity in terms of interoperability and integration with other systems. In case of a breakdown, the cost of repairing AI systems can be very high. Apart from the heavy cost factor, too much dependence on AI will make us pay a heavy price in terms of becoming inert and inactive. In other words, AI can turn out to be a tough competitor for its human counterparts. With too much dependence on AI and machines, humans may begin to lose their innate abilities of creativity, critical thinking, multitasking, and so on.

AI also has many ethical implications in terms of job loss and data privacy loss. Organizations may have to incur costs as they will need to retrain or redeploy their employees to minimize the degree of job loss/job insecurity or else there will be several disgruntled employees that may cause harm to the organization's reputation and brand image. Intelligence is a gift from nature and many people may find it unethical and immoral to infuse it into machines. Moreover, AI cannot fully replace humans (yet). Although they cannot mimic human brains completely, there is fear and speculation that future AI-driven robots may take over the human population.

In terms of data protection, what is private to one person may not be to another, and this makes it more difficult to develop and deploy AI-based systems. AI systems developed and deployed without taking into consideration the data security concerns is a recipe for digital disasters. Such systems along with their algorithms and models are vulnerable to hackers who can reverse engineer user data from these algorithms and models. With the scandal of Facebook-Cambridge Analytica where personal information from millions of Facebook users was harvested

without authorization in 2014 to build a system that could profile individual US voters in order to target them with personalized political advertisements, users have sort of developed *data consciousness* and have become more cautious about how their data is stored and shared.

AI systems and machines are not able to act any different from what they are programmed to do. In the current stage, AI-driven apps and systems can be only as good as their algorithms and learning patterns, and can be definitely affected by the negative element of bias introduced by human beings in the AI systems. They cannot *think outside the box*. If the data we feed to the AI system is racist in nature, it learns from it to become racist in nature.

Moreover, integrating and linking AI systems with other platforms and systems in an organization is a complex and time-consuming process, and requires expert skills. AI and its decision-making mechanism is only as intelligent as the intelligence and insights of its human designers; hence, in critical decisions, AI programs and algorithms cannot act with prudence as there will be limitations and biases of the human designers involved in these programs and algorithms—they will not be able to grasp each and every aspect involved in a particular situation that needs a critical or unusual decision to be made.

Imagine if such cutting-edge technology lands in the wrong hands like terrorists, cyber criminals, and so on. AI can be used as autonomous weapons of mass destruction to commit crimes that can have a global damaging impact in terms of cyber war, loss of life, property damage, and so on. These types of weapons already exist and who knows someday soon they might be capable of autonomous target selection. An AI arms race could lead to the next world war and experts believe that such a war will have far bigger ramifications than those produced by the earlier world wars.

Emotions like care, empathy, etc., and qualities like originality, creativity, etc., cannot be understood or developed by AI-driven systems. The way humans can recall learnings and lessons from past experiences and knowledge, and then apply them to current or new situations in order to solve problems is something that AI is not capable of doing (yet). These inherent emotions and qualities of human beings cannot be augmented or replicated by machines.

After studying the pros and cons of AI—there are always two possibilities for every aspect of AI—lives could be saved, but lives could also be lost; jobs could be created, but jobs could also be eliminated, and so on. For making life and business safe, secure and augmented, risks and limitations

of AI need to be studied carefully and addressed immediately. Both the pros and cons must be weighed carefully before developing and deploying AI systems, machines and solutions.

1.2 What is Augmented Reality

The word *augment* is derived from the Latin word *augmentare* and it means *to increase or enhance* or *to make more intense*. Augmented reality, commonly abbreviated as *AR*, is used to enhance or make better the real world with the help of virtual elements; it combines the real and digital world to provide a unified but enhanced, rich view of the reality.

TechTimes.com (it is an online portal that reports news on latest technology, science and health developments, their interactions with other industries and impact on everyday life) defines **AR** as *the blending of virtual reality and real life, as developers can create images within applications that blend in with contents in the real world. With AR, users are able to interact with virtual contents in the real world, and are able to distinguish between the two*.

AR interfaces virtual/digital components with the real-life environment around us. It overlays sound, haptics, and visual and other sensory stimuli on real-world scenes in real-time through the use of visual devices. It could be your room with a wallpaper of your choice or it could be your street superimposed with Beverly Hills style locale.

AR has been a hot topic of research and discussion for a number of years, but it is getting renewed focus and attention with the advances in mobile computing and with the release of revolutionary products like Google Glass. By 2020, industry statistics reveal that the market for AR will reach 100 billion US dollars.

While AR and Virtual Reality (VR) have many things in common—the one main difference that sets them apart—AR augments reality, but doesn't replace it, whereas VR completely replaces the current environment with a new virtual one.

Spotlight

According to Digi-Capital (a Silicon Valley-based AR/VR/XR adviser) *Augmented/Virtual Reality Report Q2 2015*, the AR/VR market is going to expand up to 150 billion US dollars by 2020. Moreover, the augmented reality market has got the lion's share of the market at 120 billion US dollars.

1.2.1 History of AR

Although AR has become popular in the recent years and there has been a sudden upsurge in public interest due to AR smartphone apps, but the first reference to AR comes from the beginning of the 20th century, especially with reference to books. One such book with the AR theme was *The Master Key* where the famous children's books author, L. Frank Baum, introduces the readers to a Character Marker, a unique pair of spectacles, which the central character in the book receives from a demon, and whenever this central character viewed someone through them, the spectacles would show a letter on that person's forehead regarding their character.

According to AngelList (it is an American website for startups, angel investors, and job-seekers looking to work at startups), there were 1,261 augmented reality startups as of November 2017, whereas at the beginning of January 2017, there were 735+ startups; an increase of over 71 percent in a matter of just 9 months shows the rate at which the augmented reality industry is growing.

AR in the real world gained traction from the late 1960s. In the year 1968, Ivan Sutherland (named the *father of computer graphics*), an American computer scientist and Internet pioneer, developed the first ever VR and AR head-mounted display (HMD) system, called *The Sword of Damocles*. It used computer-generated graphics to show users simple wireframe drawings.

In the following years, AR research and development continued with full gusto and the applications of AR become more advanced in the form of digital displays, wearables, etc., and they were used in various industries like military, aviation, and so on.

In 1980, Steve Mann, widely regarded as *The Father of Wearable Computing*, released the first wearable AR device called the *Eyetap*, and this was a key milestone in this field. Eyetap was mounted in a steel-framed backpack while the display was a CRT viewfinder from a camera attached to a helmet; it records the setting/scene available to the eye and then superimposes computer-generated elements on the original setting/scene. In 1982, AR is seen on television for the first time, and this was possible due to Dan Reitan. He used radar and space-based cameras to map visual graphics during television weather broadcasts; he used geospatial maps to overlay multiple weather radar images to earth images to display weather broadcasts.

In 1990, the term *Augmented Reality* was coined by a Boeing researcher, Tom Caudell. It is from this period onwards, the progress in AR picked up pace. Due to the birth of the Internet, new potential applications became possible. In 1992, Louis Rosenberg developed Virtual Fixtures, which was a pioneering platform in *virtual* reality and augmented reality technologies; it was an extremely complex robotic system that was designed to compensate for the lack of high-speed 3D graphics processing power in the early 1990s. Later in the year 1993, Steve Feiner, an American computer scientist and a pioneer in AR, developed Karma: Knowledge-based Augmented Reality for Maintenance Assistance. KARMA is a test bed system for exploring the automated design of augmented realities that explain maintenance and repair tasks. Another popular AR platform was developed in 1996 and it was called CyberCode, which is a visual tagging system based on 2D-barcode technology. In 1999, NASA uses a special AR dashboard for navigating the experiential re-entry vehicle X-38.

In 2000, ARToolkit, the world's first open source software library for building AR applications, was launched. Also in the same year, ARQuake, the AR version of the popular Quake game was launched. The first commercial AR application appeared in 2008 and it was developed for advertising purposes by German agencies in Munich for engaging customers. Other organizations like Coca-Cola, Disney, etc., also started following this trend. In 2009, The Flash Augmented Reality Toolkit (*FLARToolkit*), the most widely used Flash-based AR library, was launched, which helps developers to display AR content on web browsers. In 2010, the main AR trend was that of letting people virtually *try on* products and this was especially popular with products like jewelry, make-up and watches. In 2012, the most talked about smart glasses, Google Glass, was launched. Google Glass is a *wearable* computer featuring a head-mounted display in the form of AR eyeglasses. In 2016, Pokémon Go the most famous AR, free-to-play mobile app was launched, and it took the whole world by storm. As of September 2018, the game has grossed $2.01 billion worldwide. And in the year 2017, new developments occured like Google launched the ARCore that facilitates the development of augmented reality applications and Apple launched the ARKit that is a software development kit for developers to make augmented reality apps for the iPhone and iPad.

The next phase, which is the current phase of AR history, involves a broader range of applications and uses. The current-day AR apps are moving from their status of laboratory research to real-time applications in

various fields like translation, tourism, environment, and so on. With new use cases of AR, it is certainly going to increase the customers' appetite for digitized content and experiences.

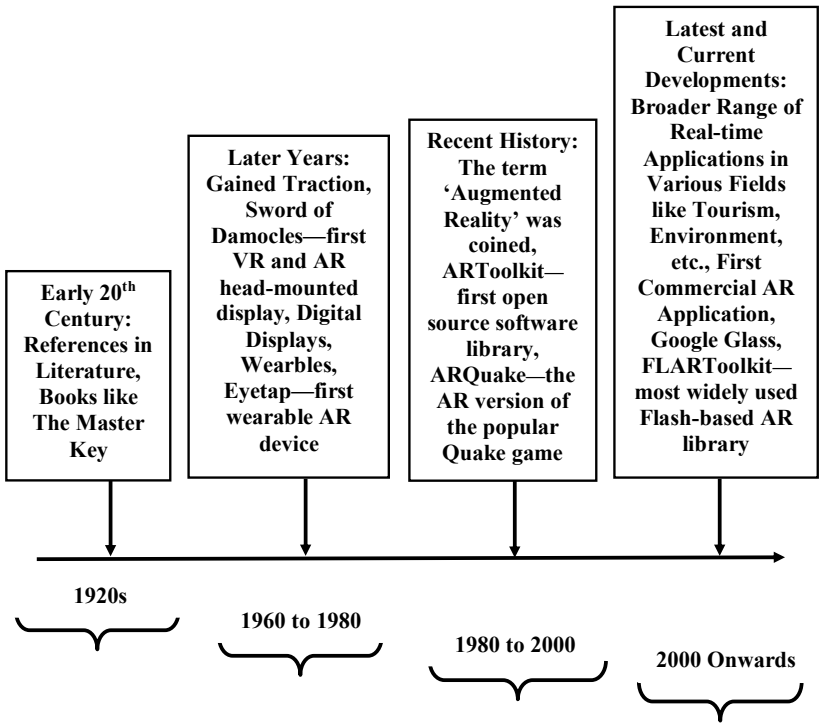

Figure 1.2 History of Augmented Reality

1.2.2 Related Fields

Probably the first thing that comes to mind when we think of AR is the field of gaming. We have come a long way from Xbox to Playstation, and now to AR. AR games are everywhere now and they are typically played on tablets, smartphones, and so on. One of the earliest forays into augmented reality gaming was made in 2012 by Niantic. In the period from 2013 to 2015, DeepMind (it is the world leader in artificial intelligence research) applied reinforcement learning and neural networks to let their AI self-learn various Atari (it is a pioneer in arcade *games*, home video *game* consoles and home computers) games and they also just used the pixels as an input to the agent. Later in 2015, they introduced a smarter agent, which successfully played 49 classic Atari games by itself and also won

several of these games. Reinforcement learning is training by trial and error on a huge scale and this concept can be used to navigate complex AR environments as well.

AR is also used in television, especially in the field of sports. For example, in games like cricket and golf, sometimes a line on the screen is displayed that tracks the flight and trajectory of the ball—this is an AR application—a better and visual way of showing statistics. Even in the Olympic Games, AR is implemented to give the audience a richer, immersive gaming experience. For example, the New York Times brought Olympic athletes and AR together through its mobile-based AR app where users get to experience 3D journalism. Such novel ways of digital storytelling have shrunk down visual journalism to fit the small screen.

AR goes well beyond the old audio tour guides. The concept of storytelling can be enhanced by AR as it can teleport tourists to the exact era and provide a convincing multi-sensory experience. It is as though one is reliving the glorious past in the present time. For example, *Asiatravel.com* launched the world's first digital theatrical tours; it markets and sells digital theatrical tours based on AR and scripted audio dramas. Another example is that of the Eiffel Tower; it also has its own augmented reality application for viewing its construction.

AR can make training exercises and educational classes more effective by providing instant results and this helps in improving the efficiency of candidates and students. It can provide safer ways to simulate training sessions for professionals in fields like medical and military; the element of *risk* is minimized. AR can be used by medical students and trainees to practice surgery in a safe and controlled environment. For example, medical professionals can make use of AccuVein which is a scanner that projects a map of the veins on the surface of the skin and this helps professionals to find the exact vein that needs treatment. Anatomy 4D is a healthcare AR app by DAQRI (it is an American augmented reality company) that allows teachers, students, medical professionals, etc., to take a 4D tour of the human body with the help of their smartphones. The main idea behind using AR-based devices and simulations is to provide realistic, immersive scenarios along with the acquisition of in-depth knowledge, yet provide a safe and secure setup.

Samsung with its Monitorless AR glasses connects to phones or PCs via Wi-Fi and offers remote desktop viewing capabilities as well as the ability to switch between augmented and virtual reality modes using electrochromic

glass. There are several home makeover apps in the market, for example, the Dulux Visualizer allows users to look through their smartphone camera and see Dulux paint colours on their walls instantly; this app allows users to picture how their walls will look in the colors of their choice before getting them painted in reality.

The AR landscape is changing every day. Healthcare, retail, education, etc.,—you name it and you will find an AR application for the same. Scientists, engineers, architects, designers, doctors, project managers, etc., all are gearing up for AR and its trends.

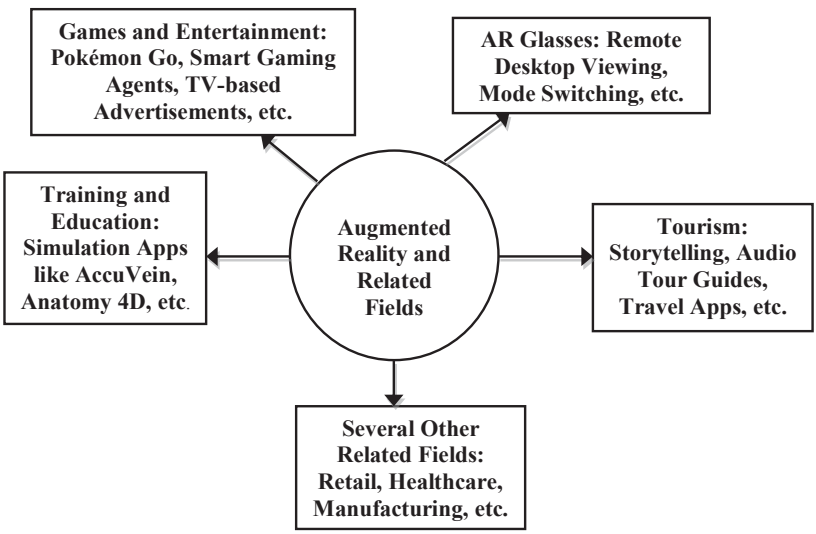

Figure 1.3 Augmented Reality and Related Fields

1.2.3 Promises and Dangers of AR

AR is already revolutionizing and redefining the mobile-based user experiences. AR lets users share their experiences with each other in real time over long distances. Everything, including games, comes to life on people's devices. AR can be the key to successful experiential and digital marketing thereby multiplying the marketing leverage of organizations.

AR can save considerable amount of money for companies by providing the digital equivalent of physical components that can be fully scaled to meet the ever-changing demands of customers. For example, AR digital elements can be used in place of actual training rooms, dressing rooms,

and so on. Such AR applications can in turn boost the return on investment. For example, Banana Flame, an online fashion retailer, through its AR feature allows shoppers to see what a dress might look like on them and this led to an increase in the number of shoppers who put something in their cart by 182 percent.

AR can help to provide rich content and better sales. For example, in the case of online shopping, AR can help customers to visualize the items on sale in their true form and thereby overcome all limitations of poor presentation of the products/items. This makes customers happy as they get the assurance of *what you see is what you get*, and this assurance leads to an increase in sales. This factor also encourages customers to share their positive AR-based experiences on various social media platforms thereby helping to boost brands.

AR can be used to develop better products. It can be used as a tool for developing precise prototypes or initial designs of products so that the designers, engineers and manufacturers can get an idea as to where improvements or enhancements are needed. AR can help organizations to design creative marketing content in order to give customers a firsthand look/interaction/preview at how any appliance/item/product will fit into their reality.

With its novelty factor, AR is playing a fascinating role in the field of advertising. Earlier, customers or consumers of content were satisfied with merely a conventional video or a boring image, but nowadays, they need something more personalized and this is where AR comes into play. Earlier, advertisements were normally displayed in a two-dimensional format, but with AR, people can now view advertisements in their 3D avatar. These aspects of AR, if leveraged properly, can help organizations to grow their business footprint.

AR-based training, simulation, installation, and repair and maintenance in the workplace can provide interactive, real-time, in-moment, visual learning. Just by pointing their devices or smartphones at an organization's product or equipment, employees can receive immersive instructions, live demonstrations or personalized training sessions on the spot; so much more effective than learning from flat 2D images and material. According to industry statistics those who referred to AR-based training material performed 150 percent better than those who used paper-based training material.

Just as a coin has two sides, so does AR: advantages and disadvantages—now let us turn to the downside of AR. If not used with responsibility, AR can hamper our interactions with the real world. Moreover, AR provides new ways of social interaction, but what is feared is the lack of the *emotional* connect factor or face-to-face communication. This may increase the distance between the already far apart human beings. If used extensively without responsibility and accountability, AR can cloud our perceptive ability. Trying to find 'real' value in the fictional world of AR can be meaningless.

AR can also be used to remove objects or persons from a person's view of her/his reality. This concept or application of AR is called *Diminished Reality*. For example, if you have a terrible fight with someone and don't want that someone to appear in your reality then AR-enabled glasses can be programmed to remove the concerned person from your line of vision. But such an application can also lead to extreme apathy, for example, if people don't want to view beggars in their line of vision, diminished reality can be used—but this kind of an AR application would lead to a complete lack of empathy towards fellow citizens of our world.

Another major issue with AR is the lack of data security and privacy. With the current information and data saturation levels, privacy control is a major concern. With the sheer amount of data available in the digital world, AR can open up new physical as well as cyber-attack vectors. Also, AR experiences can be inappropriate in the context of social situations. Imagine people pointing AR devices and phones at someone to get to know them! Or someone walks past by and their personal data is flashed around! Aren't these scenarios scary! And due to such scenarios, AR's social acceptance level will surely be affected in a detrimental manner.

With the constant usage of AR headsets, users tend to blink less compared to the normal frequency of blinking. This results in drying of the eyes, and ultimately straining of the eyes and various disorders as well. With eyes constantly glued to AR devices and apps would lead to more accidents and physical injuries that could turn out to be fatal as the users are completely unaware of the actual objects or elements in the real environment like cars, walls, people, etc., and this may result in accidents or even death. For example, while playing the Pokémon Go game, several players found themselves banging into objects or falling off cliffs, and many players also ended up in bad neighborhoods and got mugged.

A Word of Caution
We as human beings and users of such immersive technologies like AR should certainly reap the benefits of using AR, but at the same time, we need to be mindful of not only the disadvantages of AR, but also we must remember to be mindful of ourselves, the environment and its elements and of course, our 'real' reality.

1.3 Chapter Recap

1. AI, or machine intelligence, is the simulation of human intelligence by machines like computer systems. AR is a technology that brings elements of the digital world and overlays them into the real world thereby enhancing our sensory perception of the same. And a combination or convergence of AI and AR can produce mind-boggling ideas, possibilities and results.
2. AI has come a long way from ancient mythology and anecdotes to its modern-day avatar in the form of robots, driverless cars, and so on. In fact, there has been no age, era or civilization without a mention of AI. The modern history of AI started around 100 years ago. The last two decades have witnessed a tremendous growth in AI. In 2017, the AI market had reached the 8 billion US dollars mark. In present times, tech giants like Google, Microsoft, etc., are studying, researching and implementing a wide range of artificial intelligence projects.
3. AI has been described as the Fourth Industrial Revolution or Industry 4.0. The earlier industrial revolutions (mechanization, mass production, digital, and now fourth is about the merging of physical, biological and digital domains) were about automating mundane tasks of the workforce. But AI is about automating intelligent labor. With the Fourth Industrial Revolution powered by AI, it is about automating complex tasks that require tons of data (which human beings are incapable to scour through and analyze the same).
4. According to the World Economic Forum, "The individuals who will succeed in the economy of the future will be those who can complement the work done by mechanical or algorithmic technologies, and 'work with the machines'." In other words, human resources will need to become agile by developing a new skill-set that will match this new revolution powered by AI.

5. Some technology analysts view AI and the fourth industrial revolution as a deadly formula for facilitating digital authoritarian and oppressive practices like digitization of propaganda, state control, election rigging, destruction of privacy rights, and so on. Not all technologies have the power to change the status quo, but they fear that AI, AR, etc., do have this power to do so but in a disruptive (and not transformative) way.
6. On the positive side, AI can be used to perform monotonous, repetitive jobs in the 24*7 mode with no pay or no break. Moreover, by using intelligent machines, the error rate can also be reduced considerably, and therefore greater accuracy and precision can be achieved.
7. Big data is a growing trend in all fields, right from finance to banking. To manage and organize data growing at an exponential rate, AI is needed. AI can help to make this data more meaningful and contextually relevant, and again AI needs this type of data to build its own intelligence and enhance its own learning algorithms. Some experts believe that humans and AI can act as a single cognitive unit and this aspect can help in bettering ourselves and help us to venture into unknown realms.
8. AI projects are a costly affair in terms of money and skills; they need huge monetary investment and expertise (which is rare to find) due to their complexity in terms of interoperability and integration with other systems. With too much dependence on AI and machines, humans may begin to lose their innate abilities of creativity, critical thinking, multitasking, and so on.
9. AI also has many ethical implications in terms of job loss and data privacy loss. Organizations may have to incur costs as they will need to retrain or redeploy their employees to minimize the degree of job loss/job insecurity or else there will several disgruntled employees that may cause harm to the organization's reputation and brand image.
10. In terms of data protection, what is private to one person may not be to another, and this makes it more difficult to develop and deploy AI-based systems. AI systems developed and deployed without taking into consideration the data security concerns is a recipe for digital disasters.
11. AI can be used as autonomous weapons of mass destruction to commit crimes that can have a global damaging impact in terms of

cyber war, loss of life, property damage, and so on. An AI arms race could lead to the next world war and experts believe that such a war will have far bigger ramifications than those produced by the earlier world wars.

12. The word *augment* is derived from the Latin word *augmentare* and it means *to increase or enhance* or *to make more intense*. Augmented reality, commonly abbreviated as *AR*, is used to enhance or make better the real world with the help of virtual elements; it combines the real and digital world to provide a unified but enhanced, rich view of the reality.
13. Although AR has become popular in the recent years and there has been a sudden upsurge in public interest due to AR smartphone apps, but the first reference to AR comes from the beginning of the 20th century, especially with reference to books. AR in the real world gained traction from the late 1960s. In 1990, the term *Augmented Reality* was coined by a Boeing researcher, Tom Caudell. It is from this period onwards, the progress in AR picked up pace. The current-day AR apps are moving from their status of laboratory research to real-time applications in various fields like translation, tourism, environment, and so on. With new use cases of AR, it is certainly going to increase the customers' appetite for digitized content and experiences.
14. The AR landscape is changing every day. Healthcare, retail, education, etc.,—you name it and you will find an AR application for the same. Scientists, engineers, architects, designers, doctors, project managers, etc., all are gearing up for AR and its trends.
15. AR can save considerable amount of money for companies by providing the digital equivalent of physical components that can be fully scaled to meet the ever-changing demands of customers. AR can help to provide rich content and better sales. AR can be used to develop better products. It can be used as a tool for developing precise prototypes or initial designs of products so that the designers, engineers and manufacturers can get an idea as to where improvements or enhancements are needed.
16. With its novelty factor, AR is playing a fascinating role in the field of advertising. Earlier, customers or consumers of content were satisfied with merely a conventional video or a boring image, but nowadays, they need something more personalized and this is where AR comes

into play. AR-based training, simulation, installation, and repair and maintenance in the workplace can provide interactive, real-time, in-moment, visual learning.

17. If not used with responsibility, AR can hamper our interactions with the real world. Moreover, AR provides new ways of social interaction, but what is feared is the lack of the *emotional* connect factor or face-to-face communication.
18. AR can also be used to remove objects or persons from a person's view of her/his reality. This concept or application of AR is called *Diminished Reality*. But such an application can also lead to extreme apathy, for example, if people don't want to view beggars in their line of vision, diminished reality can be used—but this kind of an AR application would lead to a complete lack of empathy towards fellow citizens of our world.
19. Another major issue with AR is the lack of data security and privacy. With the current information and data saturation levels, privacy control is a major concern. With the sheer amount of data available in the digital world, AR can open up new physical as well as cyber attack vectors. With eyes constantly glued to AR devices and apps would lead to more accidents and physical injuries that could turn out to be fatal as the users are completely unaware of the actual objects or elements in the real environment like cars, walls, people, etc., and this may result in accidents or even death.

1.4 Questions for Reflection

1. How can the technology industry accelerate digital transformation to thrive in the AI-AR revolution?
2. What are the opportunities and challenges presented by AR?
3. How should countries prepare for the fourth industrial revolution?
4. Is AI a threat or a blessing?
5. How does machine learning relate to AI?
6. What will the AI-AR duo solve in 20 years, 50 years or 100 years from now?
7. What role would the real world play in the AI-AR experience?

CHAPTER 2
AI and AR Ecosystem

The success of any new technology is often dependent on the ecosystem built around it. For the AI and AR ecosystems to work in tandem, we need the various players and stakeholders to work in unison in order to further their goals and deliver value-added applications, products and services to a broad range of users in an ethical manner. It is about building an integrated and scalable ecosystem that will be able to interface and integrate new experiences, devices and platforms.

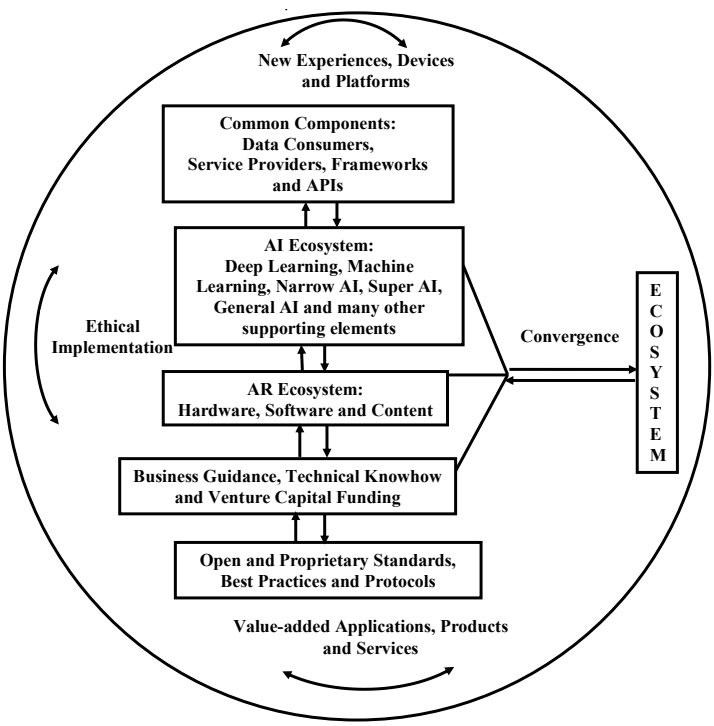

Figure 2.1 AI and AR Ecosystem

Two of the main players of the AI-AR ecosystem are data consumers and service providers. AI-AR is the future of data consumers and their experiences, and organizations need to ensure that they as service providers develop their AI-AR systems strategically in order to engage and retain their users/customers/consumers at every touch point. According to a new global study released by Pegasystems Inc. (it is a software company that develops software for customer relationship management, digital process automation, and business process management), consumers are open to the promise of AI-AR-powered customer experiences but need more transparency, data privacy and a human-like touch to feel more comfortable with machine-powered interactions.

In the past, AR was viewed by data consumers as merely a way of superimposing digital elements over the physical reality. But ever since the release of the Pokémon Go game, people began to realize that AR is capable of providing personalized, immersive experiences. And now with better and advanced location-based capabilities, AR is slowly and steadily providing services that are able to place more accurate information and content (digital elements, products, etc.) around the consumers. The common components of the AI-AR ecosystems like toolkit providers, technology enablers, content providers, clients and end-users fall anywhere in between this spectrum consisting of data consumers and service providers.

The AI ecosystem consists of the main concepts like deep learning, machine learning, narrow artificial intelligence, super artificial intelligence, general artificial intelligence and many other supporting elements. General artificial intelligence refers to the definition of AI that we used in the previous chapter, i.e., intelligence exhibited by machines or computer systems. Now, when we take this definition and apply it to a specific area of human intelligence, for example the game of chess, it becomes narrow artificial intelligence. Another example of narrow artificial intelligence is Alexa which is a virtual assistant developed by Amazon. Narrow artificial intelligence is also known as weak AI as it focuses on one narrow area or task; it refers to a machine or computer's ability to perform a single task extremely well. In narrow artificial intelligence, there is really no genuine self-awareness or intelligence. Super artificial intelligence refers to a machine's or computer's ability that surpasses human intelligence. *Machine Learning* is a category of algorithms that provides computers or machines the ability to become more accurate in predicting outcomes

without being explicitly programmed. Deep Learning is based on neural networks that imitate the functioning of how a human brain processes data and creates patterns for decision making. Deep Learning is a subset of Machine Learning and Machine Learning is a subset of AI.

The AR ecosystem is just as complex as the AI ecosystem. This space is gearing up fast, especially the mobile AR segment. Hardware, software and content are the three main components of the AR ecosystem. AR hardware components mainly include cameras, displays, smart glasses, sensors, 3D tools and software development kits. AR software refers to AR systems and apps that integrate digital content with the real world. According to industry statistics, the first half of 2018 showed the most substantial growth in apps and content targeting mobile phone-based AR platforms from Apple and Google.

Another critical component in the AI-AR ecosystem is that of business guidance, technical knowhow and venture capital funding. Over the last few years, billions of dollars for research and venture capital funding have been invested towards building the AI-AR ecosystems.

The major components that make AI and AR ecosystems and solutions effective are frameworks and application programming interfaces (APIs). Frameworks are the basis of building AI-related applications in various areas like machine learning, and for developing AR apps in various areas like camera orientation tracking, geolocation tracking, etc. APIs are used for several AI purposes like image recognition and classification, cognition, sentiment analysis, etc., and for several AR purposes like projection, face recognition, and so on.

A mix of open and proprietary standards, best practices and protocols are needed to make the AI-AR convergence a success. Their introduction and adoption on a global scale is needed to facilitate the smooth operation of AI-AR ecosystems and to enable knowledge sharing and interoperability among various stakeholders like organizations, application providers, content publishers, developers, and so on. New standards are needed to fill gaps in the AI-AR value chain. As technologies like AI and AR cannot work in isolation, it won't be wise to have just one international standard—there is a need to have a suite of standards, best practices and protocols to bring together the different fragmented markets, technology silos, etc., of the AI-AR ecosystem.

Spotlight

The deepening convergence of AI and AR will need all the above components to work successfully. Plus it also needs to take into consideration the common factor of environment while dealing with the AI-AR ecosystem. The environment could be private (home, office) or it could be public.

2.1 The Next Dimension

The world is well on its way to the next dimension of not only just big data and big information, but also big intelligence and big sensory inputs. Of course, AI and AR will have to go through several stages of evolution before reaching utopian and/or dystopian scenarios. The number of players in the AI-AR ecosystems has more than doubled in the period 2017-18.

Data is an integral aspect of the next dimension of AI-AR. It is definitely the *new currency*. It is the lifeline of the digital economy. This virtual fourth dimension will help to unearth trends and patterns relating to human behaviors, experiences and interactions. According to statistics, the amount of digital data (search history, vehicle data, medical data, etc.) that exists today will go from 3.2 zettabytes to 40 zettabytes by the year 2020. All this data will need AI, AR and its elements so that it can be analyzed and utilized in the proper manner. The data analysis done by AI advances the AR abilities by helping AR in physical space detection, which then it can use to augment it with digital objects and elements.

A strong data and information architecture is needed for the AI-AR ecosystem to function properly and produce actionable intelligence and insights. This architecture should be well designed so that it can help AI-AR to understand, analyze and apply the patterns and trends in the diverse data that is pulled in from various sources like infrared cameras, social media platforms, and so on. This in turn will help AI-AR to utilize these learnings to make predictions like forecast customer needs and engagement levels.

The assistive technologies of AI-AR can help make our lives easier through intelligent automation, contextual data storage, voice recognition and enhanced user experience or can totally disrupt our regular reality. When the systems, apps and devices using AI and AR respectively are combined with mature sensibility and in a responsible manner, this will help to transform these revamped systems, apps, and devices. They will

then help us to take prudent decisions and they too will be able to make decisions on their own within the set parameters, and all this will provide a seamless experience to the users.

The next dimension also includes factors like optimized runtime environments and backend setups for AI-AR to be able to handle intensive problems. Enhanced hardware components and runtime environments are also needed to handle intensive data analysis. AI-based applications need to incorporate *graphics processing unit (*GPU) in order to be able to handle intensive processing requirements and also be able to support its graphically-enhanced technology mate: AR. Adding intelligence to the graphical or visual medium of AR through AI will make it more immersive. It is about building self-learning systems that will be able to build rich realities.

For the AI-AR paradigm to achieve the next dimension of success for its ecosystem, it will not only need to improve the user engagement level, but also achieve high usage frequency. To achieve this goal, the AI-AR duo will need to develop critical, relevant use cases and critical, relevant apps that will attract users to download apps, services, etc., developed by the AI-AR duo. What's to transform through AI-AR is the next dimension of this convergence!

2.1.1 What's to Transform

As the world continues to evolve from 2D to 3D, an entirely new way of organizing, analyzing and finding data will be needed. Just as we use search engines to search for data in the 2D world; the same will be possible in the 3D world through the AI-AR duo. In other words, the world itself will become a massive search engine. For example, the Global Positioning System (GPS) is a global navigation satellite system that provides geolocation and time information to the users, similarly, AR can do so by taking this capability one step further—for example, a user wants to visit a particular part of a particular city, the GPS along with GoogleMaps will be able to only give us a sense of what tourist attractions are there, whereas with AR, the user will be able to get a real-time, context-driven experience of the tourist attractions as well. AI-powered platforms can fuel the growth of AR apps that will provide a seamless transition between human beings and technologies.

AI-based computer vision will play an important role in the growth of AR. Usually AR renders/superimposes digital content through some technical

gadgets like lenses, glasses, etc. AR can leverage the computer vision aspect of AI for displaying relevant and useful content and objects based on the user requirements; it can benefit from concepts like pattern recognition, computer vision and learning techniques of AI. In other words, AI can be used to create fun and creative AR apps; it is about changing the way of how people create and share social content.

By merging AI and AR, organizations and companies find themselves opening up to a plethora of opportunities for new startups and serious applications. AI and AR can also be used to develop new and better ways for disease prediction and treatment. For example in the medical industry, if AI is added to AR applications, medical professionals can detect slight shifts in a patient's medical status and parameters and make accurate changes to their treatment plan accordingly. Another example is that of Apple IPhone's AI and AR capabilities that can do a wide range of things like analyze facial expressions, facial recognition in the dark, etc., through its face recognition feature called Face ID. Whereas in the AR domain, using the ARKit, one popular app that can be downloaded on IPhones is the GIPHY World that lets users to communicate in AR by allowing them to leave digital notes over physical objects like walls. And such features if converged can take the AI-AR duo to the next level by pinning content to people.

If you follow the big companies in the tech world, you will notice that they have been consistently acquiring companies and startups working on AI and AR between the period 2012 and 2016. This trend goes to show that they are onto something big as far as AI and AR are concerned. According to a CB Insights (it is a personalized gateway to smarter, faster, friendlier intelligence on high growth private companies) study, investments in the AR sector mirror this picture—as the number of mergers and acquisitions grow, the year-on-year amount of AR investments increases.

Another area where this collaboration can work wonders: job search. For example, the CareerBuilder (it is an online employment website) mobile app that uses both artificial intelligence and augmented reality aims to simplify the job search process. For job seekers, the AR component of the app shows augmented reality views of job openings available in the vicinity whereas the AI part helps to build personalized resumes. For employers, this app shows the real-time supply and demand trends for the talent they need.

Another area where these two are already creating waves is in generating and augmenting content and this aspect can be used in research, education,

games, and so on. Building AI elements of computer vision in AR devices in the form factor itself will be a game changer for this convergence to become even more successful as this will help them to realize their full potential.

Spotlight

AI and AR will continue transforming every aspect of life. With this extended type of experience, AI and AR are bringing together different types of intelligence and reality that are both shareable and immersive for their users.

2.2 Core Components of the AI and AR Convergence

A few years ago, we needed a camera, phone, pager, etc., for catering to our various needs like communication, learning, etc., and now the same needs are fulfilled by one device, the smartphone or IPhone. Going one step further, now the technological landscape is about merging technologies. Companies are realizing that technologies like AI and AR are complementary and intersecting in nature. Behind the scenes, companies, engineers, scientists and researchers are constantly making new things happen, for enhancing various aspects like position tracking, object detection, etc., through the convergence of AI and AR. They are also working on several unique solutions through this duo. This convergence is poised to create opportunities for enhancing user experiences considerably. This sounds like a very exciting, but unpredictable future.

The ability to create, manipulate, superimpose and move digital objects in real-world scenarios is yet another important aspect of the AI-AR combination. The machine perception aspect of AI is about using sensory inputs to deduce the various aspects of the surroundings and then this knowledge is used by the AR component to overlay digital components in the real environment. As AR devices and products become more and more capable of creating and overlaying digital displays using AI-based computer vision, they will replace the screens in the smartphones.

One of the main components of AI and AR convergence is interfacing of the infrastructure environments, tools and technologies of AI and AR. This interfacing is necessary for them to operate and interact seamlessly in order to get the best balance and get optimum results. This interfacing will bring about new use cases of AI-AR convergence like affective interaction and analysis, AI and machine learning in AR setups, AI in AR games, and so on.

Opportunities for collaboration and incorporating AI and its elements into AR apps and systems are the main ways of bringing together the core components of the AI-AR ecosystem convergence.

Figure 2.2 Core Components of the AI and AR Convergence

2.2.1 Opportunities for Collaboration

Businesses are showing keen interest in the AI-AR combination. Industry experts believe that the AI-AR collaboration is going to be as game changing as the advent of the personal computer and the Internet. Startups in this space are beginning to grow. We can safely say that we are in the midst of an AI-AR awakening. It is all about intelligent and enhanced creation of high-performance teams. While some ideas doing the rounds as far as workplace collaboration is concerned may sound grandiose, but

there is clearly a potential to revolutionize the workplace through the AI-AR collaboration.

Moreover, the availability of big data or large data sets provides the ability to train and enhance AI, and then when this enhanced AI confluences with AR, it provides an augmented interface between the real and digital worlds, and facilitates the data-driven critical business decision-making process. Seamless integration of data and analytics for seamless business decision-making is what AI-AR will bring about. Other aspects like increased ability of processing and storage, real-time speech and image recognition, etc., have led to an AI-AR digital arms race among the top tech giants in the world.

With advancements in AR devices like smart glasses, betterment in optics and sound is now even more needed and this where AI comes into the picture. As more and more AR business use cases are being developed, tested and deployed, AI develops the potential to take AR apps and systems to the next level.

According to Gartner (it is a leading research and advisory company), 85 percent of retail customer interaction will be managed by AI by the year 2020 and as many as 100 million customers will shop through AR apps by the year 2020. Retail is one major area where more and more businesses are implementing AI, AR and a combination of both for engaging their target customers by providing high-value, customer-centric retail experiences, both in the in-store and at-home settings. And this is proven from industry statistics that twenty percent of US consumers made a voice purchase through digital home assistants/voice-controlled devices in 2017, while 1 in 3 plan to do so in 2018.

Workplace meetings consume a huge chunk of one's time while at office. There are several opportunities of AI-AR collaboration that can be used to make meetings effective. According to industry findings, a large percentage of IT and remote workers think that the impact of such technologies will be positive. The reason being that IT workers are already familiar with such type of technologies and as far as remote workers are concerned they find such technologies to provide a more immersive virtual meeting environment. Moreover, the overall attitude of employees towards such technologies is that they will help them to tackle mundane yet taxing meeting tasks like note-taking, transcription, etc., thereby reducing their workload and giving them the time and energy to concentrate on critical work tasks.

Just as the automotive sector was one of the early adopters of automation processes, similarly it is also seen adopting cutting-edge technologies like AI and AR much earlier than the other sectors and industries. The automotive industry is already using this combination, although in a limited manner, in various areas like prototyping, designing, maintenance, production, and so on. For example, the Ford Motor Company (it is an American multinational automaker) uses AR to create 3D models of their vehicles and this enables designers to see their changes on top of an existing physical vehicle and find out any design issues before beginning the work on the actual detailed prototype. Another example is that of Volvo (it is a Swedish luxury vehicle manufacturer), it is using Microsoft's HoloLens to help production line workers to digitally view assembly instructions in real-time while working on assembling the various parts of a vehicle.

Apart from typical business sectors, there are novel applications that are helping and empowering the downtrodden segments of the society. For example, Accenture (it is a leading global professional services company) in collaboration with Grameen Foundation India through their *Tech4Good* initiative has developed applications leveraging the benefits of AI and AR to empower the women segment as well as low-income segment in making prudential choices in regards to financial products and this in turn will improve their financial and social well-being. Social responsibility is a major factor that needs more attention and such technologies should be leveraged for the greater good. This aspect needs more support from the corporate world in order to solve complex global problems.

Experts believe that companies which will use AI-AR to replace/displace employees will have only short-term gains and those that will use a combination of human insight and the collaborative, augmented intelligence of AI-AR will benefit the most. Companies need both the qualitative skills of leadership and teamwork of humans and the quantitative and speed skills of machines to survive in the current age of cut-throat competition. This collaborative, augmented intelligence can be enhanced with AI-AR.

Airtel, India's largest telecom service provider, is in the process of setting a digital innovation lab called *Project Next* that will work on emerging technologies like AI, AR, VR, and so on. This project will also collaborate with startups to co-create systems, apps and solutions in this space. Some of the main segments that this lab is going to focus on are call centers, home automation, and so on.

The opportunities of collaboration for AI and AR have to go beyond the purpose of entertainment for people to understand and appreciate their true value in terms of functional business and consumer purposes. For example this combination is showing real value in some really big industries like automakers, oil rigs, and so on. It is about using hands-free technology that will help humans to perform their jobs in a safe environment, and this is especially true of dangerous jobs or highly skilled jobs.

2.2.2 Incorporating AI into AR Apps and Systems

Industry statistics reveal that worldwide spending on mobile hardware, software, and services will rise in 2018 by 3.2 percent to more than 1.6 trillion US dollars due to AI and AR. An augmented reality app can greatly be enhanced/ augmented by incorporating AI into it; the various AI elements and technologies can help AR to bridge the gap between the everyday reality and the digital dimension. For example, companies like Microsoft, IBM, Unity, etc., are already exploring this new opportunity. Most of the AR systems have at their heart AI and its related technologies.

Although we are still in the nascent phase of merging these two technologies, industry experts believe that in the coming years, AI will play a bigger role in enhancing AR apps and interfaces. AI is already enhancing AR and VR apps and interfaces. The industry experts believe that in the times to come, AI could be used in AR and VR systems to predict the interface a user might want or need and show options for a user interface, or automatically bring up the required user interface.

One of the main uses of AI in AR apps is physical environment mapping where just like Computer-Aided Design (CAD) models that are used for maintenance, marketing, assembly and training purposes, users can use AI-AR apps to experience mapped physical environments in accordance to their needs. AI is definitely helping to expand the presence of AR in the retail space as well. AI will help AR to make the marketing experience more human-like and customer-centric.

As AI merges with AR, one main business application area that will be impacted by this duo is the manufacturing sector. Smart factories due to the fourth industrial revolution can be seen as the next logical step in the manufacturing sector. Several aspects of the manufacturing sector, right from quality to maintenance and from safety to troubleshooting can be enhanced by the AI-AR duo. It will help to create intelligent and augmented employees and workers, and smart workplaces.

Another major use of AI in AR apps is in the military training programs. AI has the power to make complex decisions, and in the military settings where critical decisions have to be made in a split second, AI can be used in AR simulation apps, and this combination can help military personnel to find out the best strategy. Similar such apps can be and are being developed for other critical areas like pilots and firefighters. As AI can provide various simulation scenarios to the military personnel and soldiers, it can make life easier and safer for them on the field. For example, the *ARC4* is an advanced augmented reality (AR) technology that delivers heads-up situational awareness for outdoor on-the-move applications.

Organizations are always looking for ways that can implement AR-driven environments effectively, and this is where the AI elements of speech recognition, machine learning, computer vision, etc., come into play. Also, AI image sensing algorithms can be enhanced by training them based on the visual data that AR apps create and collect. AI can gather up-to-date information from various sources which then can be used to feed AR apps. Such a convergence is about intelligent, augmented reality.

2.3 Chapter Recap

1. The success of any new technology is often dependent on the ecosystem built around it. Two of the main players of the AI-AR ecosystem are data consumers and service providers. AI-AR is the future of data consumers and their experiences, and organizations need to ensure that they as service providers develop their AI-AR systems strategically in order to engage and retain their users/customers/consumers at every touch point.
2. The AI ecosystem consists of the main concepts like deep learning, machine learning, narrow artificial intelligence, super artificial intelligence, general artificial intelligence and many other supporting elements. The AR ecosystem is just as complex as the AI ecosystem. This space is gearing up fast, especially the mobile AR segment. Hardware, software and content are the three main components of the AR ecosystem.
3. Another critical component in the AI-AR ecosystem is that of business guidance, technical knowhow and venture capital funding. Over the last few years, billions of dollars for research and venture capital funding have been invested towards building the AI-AR

ecosystems. The major components that make AI and AR ecosystems and solutions effective are frameworks and APIs. A mix of open and proprietary standards, best practices and protocols are needed to make the AI-AR convergence a success.

4. Data is an integral aspect of the next dimension of AI-AR. It is definitely the *new currency*. This virtual fourth dimension will help to unearth trends and patterns relating to human behaviors, experiences and interactions. A strong data and information architecture is needed for the AI-AR ecosystem to function properly and produce actionable intelligence and insights.
5. The next dimension also includes factors like optimized runtime environments and backend setups for AI-AR to be able to handle intensive problems. Enhanced hardware components and runtime environments are also needed to handle intensive data analysis. For the AI-AR paradigm to achieve the next dimension of success for its ecosystem, it will not only need to improve the user engagement level, but also achieve high usage frequency.
6. As the world continues to evolve from 2D to 3D, an entirely new way of organizing, analyzing and finding data will be needed. Just as we use search engines to search for data in the 2D world; the same will be possible in the 3D world through the AI-AR duo. In other words, the world itself will become a massive search engine. AI-based computer vision will play an important role in the growth of AR. Usually AR renders/superimposes digital content through some technical gadgets like lenses, glasses, and so on. AR can leverage the computer vision aspect of AI for displaying relevant and useful content and objects based on the user requirements; it can benefit from concepts like pattern recognition, computer vision and learning techniques of AI.
7. By merging AI and AR, organizations and companies find themselves opening up to a plethora of opportunities for new startups and serious applications. If you follow the big companies in the tech world, you will notice that they have been consistently acquiring companies and startups working on AI and AR between the period 2012 and 2016. This trend goes to show that they are onto something big as far as AI and AR are concerned. Building AI elements of computer vision in AR devices in the form factor itself will be a game changer for this convergence to become even more successful as this will help them to realize their full potential.

8. The ability to create, manipulate, superimpose and move digital objects in real-world scenarios is yet another important aspect of the AI-AR combination. The machine perception aspect of AI is about using sensory inputs to deduce the various aspects of the surroundings and then this knowledge is used by the AR component to overlay digital components in the real environment.
9. One of the main components of AI and AR convergence is interfacing of the infrastructure environments, tools and technologies of AI and AR. This interfacing is necessary for them to operate and interact seamlessly in order to get the best balance and get optimum results. Opportunities for collaboration and incorporating AI and its elements into AR apps and systems are the main ways of bringing together the core components of the AI-AR ecosystem convergence.
10. Industry experts believe that the AI-AR collaboration is going to be as game changing as the advent of the personal computer and the Internet. Startups in this space are beginning to grow. We can safely say that we are in the midst of an AI-AR awakening. With advancements in AR devices like smart glasses, betterment in optics and sound is now even more needed and this where AI comes into the picture.
11. As more and more AR business use cases are being developed, tested and deployed, AI develops the potential to take AR apps and systems to the next level. Apart from typical business sectors, there are novel applications that are helping and empowering the downtrodden segments of the society. The opportunities of collaboration for AI and AR have to go beyond the purpose of entertainment for people to understand and appreciate their true value in terms of functional business and consumer purposes.
12. An augmented reality app can greatly be enhanced/augmented by incorporating AI into it; the various AI elements and technologies can help AR to bridge the gap between the everyday reality and the digital dimension. One of the main uses of AI in AR apps is physical environment mapping where just like Computer-Aided Design (CAD) models that are used for maintenance, marketing, assembly and training purposes, users can use AI-AR apps to experience mapped physical environments in accordance to their needs. AI is definitely helping to expand the presence of AR in the retail space as well. AI will help AR to make the marketing experience more

human-like and customer-centric. As AI merges with AR, one main business application area that will be impacted by this duo is the manufacturing sector. Another major use of AI in AR apps is in the military training programs.

13. Organizations are always looking for ways that can implement AR-driven environments effectively, and this is where the AI elements of speech recognition, machine learning, computer vision, etc., come into play. Also AI image sensing algorithms can be enhanced by training them based on the visual data that AR apps create and collect. AI can gather up-to-date information from various sources which then can be used to feed AR apps. Such a convergence is about intelligent, augmented reality.

2.4 Questions for Reflection

1. How can business leaders develop strategies and knowledge for the AI-AR ecosystem?
2. How to move from now to the next-level of the AI-AR ecosystem?
3. How can we apply AR in various use cases by converging it with AI?
4. Which industry trends are shaping the AI-AR ecosystems?
5. Why data is considered the *new currency*?
6. How can organizations improve the value of AI-AR collaboration through an integrated ecosystem?

PART 2

Business at the Crossroads of AI and AR

Chapter 3
AI Meets AR in the Business Landscape

AI and AR have been grabbing plenty of press recently and they are at the heart of the ongoing business disruption process. With so many active developments in the years 2016, 2017 and 2018 happening in the AI-AR world, one thing is for sure that AI and AR are shaking up and will continue to shake up and transform the business landscape. The business world can improve both their automated and human resources through the pairing of AI and AR. This duo is definitely redefining regular reality.

All major companies like Apple, Google, Samsung, etc., are already implementing some level and degree of AI and AR in their phones, for example with the Bixby Vision add-on by Samsung, users can identify landmarks, point the phone at a product and get information about it, extract and translate text, and so on. Again all this AI activity can be merged with the AR aspect of all things tech. For example, there can be AR kiosks providing various services at major places where a lot of people gather like shopping malls, sports centers, and so on. Right from building brand awareness to building customer trust, the AI-AR pair is trying really hard to leave an indelible impression on the business world.

AI now has the processing backup for carrying the required search and analysis for business whereas AR now has the ability to move from simple 2D lines to 3D immersive graphics and objects. Over the course of time, this progress is expected to multiply manifold times. These features of AI-AR can enable businesses to deliver marketing content in real time.

What AI and AR have in common as far as the business landscape is concerned is data or rather big data. The AI part of the equation analyzes and derives insights from user engagement metrics whereas the AR part overlays objects and enhances the reality based on these metrics.

A Word of Caution
Organizations that lack the top-tier support for a clear strategy of AI-AR adoption will fall behind in the corporate race and they will not be able to withstand the seismic effects of such technologies. In current times, although organizations are introducing this duo in their processes, offerings, products, etc., there is still a lack of an overall enterprise AI-AR strategy.

A comprehensive strategy for the convergence of technologies like AI and AR is the key here and moreover, this convergence should be accessible to third party developers and manufacturers in such way that they can integrate it into a wider range of apps, services, products, and so on. The bottom line is that for the AI-AR duo to revolutionize any business sector, process or offering in a positive, ethical manner is to include diversity of thought and inputs while building AI-AR apps, systems and projects. Diversity of thought and inputs in all aspects of this paradigm is necessary: design, quality, testing, and so on.

3.1 Advantages of AI-AR for the Business World

By using the AI-AR duo, businesses can gain a competitor advantage. According to *CFO.com* (it is a comprehensive online resource center for senior finance executives), 40 percent of online transactions will be handled via an AI-enabled bot by the year 2020. The Pentagon, the headquarters of the United States Department of Defense, has established the Joint Artificial Intelligence Center (JAIC) to unify its AI research and development and to speed up the adoption of AI tools. *Cutting edge* in the year 2010 meant being mobile-driven, whereas in the year 2020, it might very well mean being AI-AR-driven.

Despite the dire predictions and dystopian scenarios of the AI-AR convergence, several experts suggest that by leveraging the AI-AR duo properly, the business world can generate quality leads and provide operational efficiency. Developing and implementing ethical and governed AI-AR systems should be based on the approach of combining the skills and efficiency of man and machine.

The AI-AR duo has the ability (if leveraged judiciously) to bring about a string of benefits to the business world and the most important benefit is

that they can serve as a financial analyst for organizations. This duo can help businesses to develop prudent financial plans and goals.

In the medical field, the AI part of the equation can be used in performing evaluations before the patient meets the doctor or even during the follow-up visits. Thereafter, the AR part of the convergence equation can be used for diagnosis and for treating or operating on the diagnosed issue. According to a 2017 global healthcare sector outlook by Deloitte, the AI-AR duo is one of top ten technology innovations that will bring more value for less in the healthcare sector. There are already so many successful use cases in the healthcare sector right from intelligent home care systems for the aged to computer vision algorithms to annotating diagnostic images.

Affectiva (it is an emotion measurement technology company) has created an emotion detecting software that can perform real-time automated analysis of the emotions of customers to see if they are frustrated, satisfied, angry, happy, etc., in order to create the right automated response. Automated processes have their advantage of enhancing the speed of a particular business process. But the disadvantage of not being able to apply creativity to solve a problem or make decisions independently reduces their efficiency. This is where AI-AR can step in to fill the gaps. This duo can provide an intelligent, augmented, immersive experience that can allow potential customers to interact with a prototype product/service because of which organizations can gain better insights on customer preferences in terms of their likes and dislikes. Another example of emotion detection and analysis is the intelligent assistant, Zia, built into the Zoho CRM application. Zia can analyze emotions and sentiments from customer data like emails and indicate that a particular customer seems dissatisfied or angry, and based on this analysis the sales representative may realize that some work has to be done to satisfy the client before pushing to pitch a sales renewal.

The AI-AR duo is transforming so many sectors and industries, right from manufacturing to retail. For example, in the fashion industry, this convergence is helping to bring the stores and their products right to the doorstep of customers, right in their homes. Another major problem that can be minimized by the AI-AR duo is the return of unwanted shopped items and goods. First, AI can be used to offer suggestions to customers based on their inputs. Second, based on the inputs and offers, AR can be

used to help customers to see how the items or products look on them or in any other settings. This two-step approach will minimize the placing of online orders that are placed with the intention of a return. Some of the novel apps in this domain that help to reduce the shopping struggles of customers and retailers are MemoMi's Memory Mirror and EyeFitU. MemoMi's Memory Mirror is the world's first high-fidelity, true-vision digital imaging software platform that provides a 360-degree view of various products like outfits, sunglasses, and so on. EyeFitU is a leading fashion and sizing shopping application and platform that provides sizing recommendations for the clothing and shoes industries.

In the education industry, AI can be used in a variety of scenarios like automated assessment, creation of smart content, etc., and with AR, students and learners can be introduced to abstract concepts faster. The AI-AR combination not only has the ability to offer individualized and differentiated learning but it can also help students to increase their personal performance in terms of critical thinking, problem-solving, and so on. This duo needs to be used in such a way that the gaps in teaching and learning are minimized. This duo has the ability to transform the local classroom environment into a global hub of learning catering to all types of students and their needs, including differently-able learners and students and their special needs.

In the manufacturing sector, this duo can help to locate, troubleshoot and repair problems. Companies like Adobe (it is an American multinational computer software company) have added AI-powered features throughout its core applications with an aim to boost the AI-AR duo, for example, the Project Aero, an AR authoring tool, has been launched to enable the development of AR projects without having any coding knowledge.

The pairing of AI and AR can be used in undreamed-of ways. This extended, integrated, intelligent, augmented reality future is not far away.

A Word of Caution
All the AI-AR advantages will be realized only when the components of new business models, visual marketing, customer experience management, and corporate training are taken care of by organizations in a holistic manner. Even one missing or incomplete component could lead to less than optimum results.

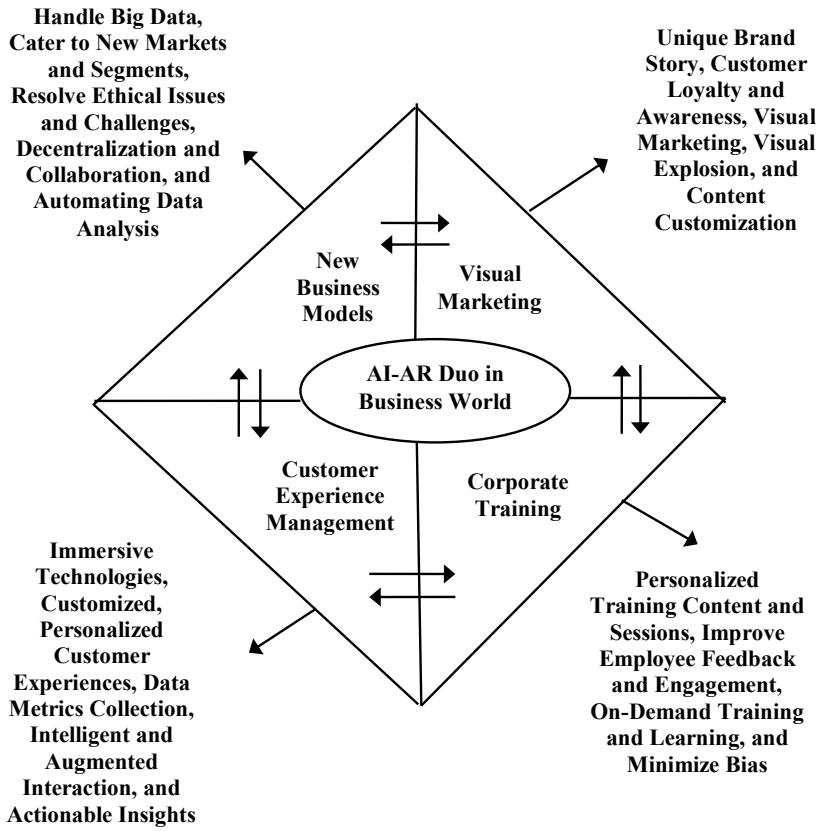

Figure 3.1 The AI-AR Duo in the Business World

3.1.1 New Business Models

According to a recent study from Boston Consulting Group (*it* is a global management consulting firm) and MIT Sloan Management Review, 83 percent of executives believe AI is a strategic priority for their businesses today and 84 percent believe that AI will enable them to obtain or sustain a competitive advantage. All these statistics show that it is time for organizations to develop new business models and processes in order for them to adapt the AI-AR paradigm successfully. The business models

have to support the right mix of automation and augmentation in order to convert data into intelligent content.

The AI-AR convergence caters to many emerging markets and segments like organizations and individual consumers. The new business models will need to support and grow these new markets and segments by providing customer-friendly services, apps and features. Customer-friendly services, apps and features are needed to drive revenues. And more than the revenue aspect, what will keep the AI-AR duo going, is how it impacts customers in a positive manner on a long-term basis. This convergence and the new business models for it is about keeping both customers and organizations in the fold with new trends and experiences.

The new business models and structures will need to be created in such a way that they are able to handle and support the dynamics of the AI-AR paradigm. This is a necessary step for organizations to be able to make better and informed business decisions and generate higher ROI value. These models will need to be flexible enough so that they accommodate changes related to the future trends and market trajectory.

Another main aspect that needs to be incorporated in these new business models is about tackling ethical issues and challenges in terms of security and privacy of their users and customers. These business models need to ensure that the AI-AR systems always act in line with the business core values and customer core values. These business models can maximize this compliance by having comprehensive answers and solutions to the following questions: What are the ethical requirements of customers/users? Will there be any contexts or situations in which the customers/users would want to partially or completely deactivate certain AI-AR features? How can compliance of AI-AR with ethics be monitored? What is the cultural and social background of the customers/users? In what situations can AI-AR trigger privacy or security breaches? How can irrational results or analysis of AI-AR systems be detected and avoided?

Apart from the tech heavyweights even startups will need well-thought-out business models or else they will fail despite innovative ideas. It is difficult for startups to come up with full-fledged business models as they do not have any past data or statistics to learn from. But as one compares the first, second and third wave startups, one notices that there are substantial improvements in business models of startups.

The new business models will need to incorporate a good degree of transparency in their AI-AR systems. And this transparency can be achieved through open-source models of collaboration. Such decentralization and collaboration of the development community helps to understand and implement ethical AI-AR systems, and at the same time, this community is also in a much better position to explain these systems to the common people in a clear and comprehensive manner.

The new business models will need to incorporate automating data analysis for the AI-AR paradigm to work for the business world. Sometimes, humans may not be able to provide meaningful analysis and conclusions from the huge volume of marketing data that any company stores, collects or generates—this is a great place for AI to integrate both online and offline data and present an integrated analysis of the same. Factors like *in what manner AR will enhance human senses even more* and *how AI will make critical decisions for an organization* should be the basis of developing new business models or adding new dimensions to existing ones.

The new business models will need to handle cultural resistance from their employees as many of them would fear these new emerging technologies, mainly in terms of job loss and job insecurity. They will also need to ensure that employees are guaranteed their job security by developing a proper corporate culture that will educate them of how AI-AR can enhance or augment their work and performance, and not replace them or their work.

Spotlight
Finally, all the new business models should be designed in such a way that they can handle the one main aspect that is growing exponentially: volume—volume in terms of data, volume in terms of devices, and volume in terms of users/customers. New business models should be about creating AI-AR-powered revenue streams from all this volume.

3.1.2 Visual Marketing

The combination of AI and AR has the power to create a unique brand story for the organizations and a seamless shopping experience for the customers. Advances in these fields are making e-commerce a lucrative business in terms of visual retailing and personalized services. It is about delivering immersive visual marketing content through intelligent and

augmented applications. According to Deloitte (it is one of the *Big Four* accounting organizations) findings, almost 90 percent of companies with annual revenues of 100 million US dollars to 1 billion US dollars are now leveraging AR as a part of their marketing strategy. These new technologies are building platforms for new types of storytelling that help to build more life-like experiences. Research has proven that users/customers remember 20 percent of what they read but 80 percent of what they see.

Just as weblogs paved the way for the blogosphere, similarly the concepts of voice recognition, image recognition, etc., play a key role in enhancing brand image and customer loyalty and are paving the way for visual marketing. For example, there is IKEA Place doing exactly just that, an AR app based on the Apple ARKit that allows customers to unlock their inner designer by visualizing how furniture items might look like and fit in their homes or any other settings.

Visual explosion or in simple words *images*, especially on the social media, is a big trend as it creates meaningful connections. Many companies are leveraging this factor for promoting their products and services not only on the social media but also elsewhere both in the cyber as well as the real world; examples of such visually-focused organizations are Instagram, Google, Snapchat, and so on. Visual social commerce is the new mode of marketing and the AI-AR duo is powering this trend. Now, even videos are used as a way to attract customers. Essentially speaking with the AI-AR duo, the constant streaming of videos or a clickable image could be turned into a purchasing opportunity. It is about the concept of *try before they (customers) buy*, and that too within the comfort of their homes. Organizations can use this duo to capitalize on the local market by offering special promotions and offers based on insights derived from geolocation data.

Content customization is an important aspect of visual marketing. This is where AI-AR can play an integral role in providing value-added visual marketing services. Some brands are already using image recognition to promote their products to their customers. For example, *Clarifai* (it is an artificial intelligence company that specializes in computer vision) provides advanced image recognition that allows developers and organizations to easily build visual recognition AI into their products and apps. *Clarifai* and *RichRelevance* (it is an American company that offers personalized shopping experiences for large retail brands) formed a strategic tech

alliance and this joint venture lets organizations to use cutting-edge AI personalization strategies like visual AI, machine learning, etc., to deliver unique and relevant shopping experiences to their customers.

Visual marketing as a trend is still in the initial phase; it needs to pick up. There are several aspects that will set the pace in this field—for example, content creation by AI-driven robots, image recognition and prediction, augmented reality content at live events, and so on. For example, ViSenze is an AI startup that optimizes visual search and it has features like product recommendations, augmented product tagging, search by image, and so on. Another player that is optimizing shopping experiences through visual marketing is Stye.ai, which provides services to publishers, retailers and consumers; it uses image recognition which is the basis of the visual search engine that turns an image taken in real-time into a shopable/purchasing opportunity. RoomAR combines the power of AI and AR to take the retail field to the next level; the AI component provides useful recommendations based on photos and images provided by the user whereas the AR components lets users to see a piece of furniture's actual size in their own spaces. RoomAR aims to understand the users' preferences, style, etc., and then provide a unique brand experience based on these aspects.

Organizations and companies need to leverage AI and AR in such a manner that the customers should feel like they are active participants in the intelligent and augmented environment while they are viewing or buying products/services. Customers should be made to feel that they are an integral part of an organization's brand story. Organizations and companies need to act like guides and not directors. Apart from building a strong customer presence, the other factors that will make organizations successful in their visual marketing strategy are allowing the customer to experience authentic and personalized experiences, allowing the customer to add her/his own content to the ongoing visual marketing, live streaming or interactive broadcasting to increase customer engagement and brand awareness, and offering 360-degree visuals to the customer.

3.1.3 Customer Experience Management

In order to adapt to changing customer shopping behaviours, organizations, sellers, manufacturers and retailers need to replace legacy technologies with Digital 2.0 next phase technologies in order to meet the dynamic

expectations of customers. This is where immersive technologies like AI and AR come into play and help to increase the brand loyalty.

On the one hand, several industry experts express their concern of AI taking over jobs and leading to unemployment, and on the other hand several experts believe that if AI is used judiciously, it could free up employees from doing routine tasks and instead concentrate their creativity and efforts on complex tasks. It is believed that if AI is implemented properly, it has the potential to provide customized, personalized end-to-end customer experiences. The North Face (it is an American outdoor product company) uses IBM Watson (it is a supercomputer using AI, natural language processing and other features) to create an expert personal shopper and intuitive interface that aids customers to make optimal purchase decisions.

There are several areas of customer experience management that AI can enhance. The various areas include: enhanced telephonic support, gauging real-time emotional responses and reactions, augmenting message, marketing and sales, etc. For example, EmoBot is a customer care bot that reacts to customer responses in order to create a climate of trust. Call centers and customer service points can no longer afford to be a post-sales service center; they will need to go beyond answering simple queries.

Juniper Research (it offers online and digital market research) predicts that chatbot conversations will be responsible for cost savings of over $8 billion per year by 2022, up from $20 million in 2017. Servion (it enables business transformation for enterprises in the area of customer experience management) predicts that AI will power 95 percent of all customer interactions by 2025. Forerunners like Oracle are leveraging AI for creating epic and compelling customer experiences, for example, the Oracle Customer Experience (CX) Cloud Suite is a comprehensive set of applications that supports the entire customer lifecycle.

Currently there are two main scenarios where AI is used in customer experience management: first, AI-supported setups where customer care representatives are supported by AI and second, front-end bots that handle the entire customer journey. It is all about conversational customer experiences where AI is used for humanizing and personalizing customer experiences, and also for reducing call wait time and call handling time.

AR apps and systems along with AI will help to increase customer engagement through various innovative features and immersive experiences provided through images, sound, 3D visuals, animation, and so on. For example, Snapchat uses AR in innovative ways for providing an

enjoyable customer experience; it offers filters that let users to experiment with their appearance and especially the 3D Bitmoji (it lets you create a cartoon avatar of yourself) filters let users become creative by projecting their 3D avatar in the real world.

Combining AI and AR helps organizations to amplify the results of their traditional customer experience management tricks. Customer experience management can be enhanced only when the process of data metrics collection and the data center analyzing these metrics are enhanced. Here again the power of AI and AR can be used to enhance these two aspects. These metrics lead to insights and these insights lead to strategies of engaging the customers in novel ways, even long after their purchase.

All these aspects certainly indicate a trend towards the rise of intelligent and augmented interaction with customers. For example, retailers can create frictionless customer experiences enabling customers to place orders through Amazon Alexa. Finally, intelligent and augmented customer experience management is about providing actionable insights to improve return on investment.

Spotlight
For the AI-AR convergence to be successful in customer experience management, other aspects like marketing automation, data management (more accurate data = more customer engagement), etc., need to be in place, so that personalized and contextual customer experiences can be created.

3.1.4 Corporate Training

In earlier times of the corporate world, training programs were not so interesting. Gone are the days of boring and limited training sessions. Employees join organizations with different experience levels and skill-sets, and in order to match these aspects with the training needs, organizations need to become vigilant of how AI and AR are transforming the training industry at a fast pace. And by leveraging this convergence in the right way, organizations can improve the efficiency of their employee training programs, and this in turn can improve the productivity of the employees.

AI and AR can provide a training environment that enhances learning by providing a safe yet engaging and adaptive learning experience. This combination can be used to upgrade training programs much more easily

as they can be used to gather information about learner needs, employee feedback and engagement level, and then help organizations to make adjustments to their training sessions in order to improve them. Moreover, there is potential for reduction in the time spent in training program development and delivery.

By offering personalized training content and sessions, organizations can make their employees feel valued and show them they are not just another cog in the corporate wheel. AI and AR can be used to find optimal learning pathways for employees and at the same, AI and AR can be used as a virtual tutoring system. But the success of such setups and systems depends on how well this convergence is able to handle and adapt to new and emerging data patterns.

Video courses are one of the most popular forms of training and learning and companies can use AI-AR to develop this content by including the concept of on-demand training and learning. When out-of-the-ordinary problems occur in any sector, instead of dispatching a backup team, organizations can make use of AI-AR tools, apps and systems where more experienced or expert employees can directly access the problem from their location through such tools, apps and systems. Videoconferencing is yet another area where the effectiveness of meetings and training sessions can be enhanced a lot. With the AI-AR duo the element of *immersion/sense of being in the room* can be introduced thereby making the experience more lifelike.

Moreover, applications like Eolian provide training and simulation exercises of dangerous tasks in a safe and regulated manner. Eolian has been named as one of the top five startups by TandemNSI (it is a national network of over 5,000 innovators and entrepreneurs). Eolian uses a combination of AI, AR and VR for saving lives and through this combination it helps organization to reduce the human error rate.

The AI-AR paradigm can be an advantage if used judiciously. AI and machine learning can learn and adapt by observing what the current employees and workers are doing right and wrong so as to make the current and future AR systems and applications better. With machine learning built into the AI-AR paradigm, training in itself becomes an evolving tool for increasing productivity.

A Word of Caution
One of the main negative elements that need to be eliminated to develop effective learning, development and training programs is bias. AI-AR is finally working on data sets that may have built-in bias in them and this may result in algorithms working in the wrong direction.

The main aspect that needs to be incorporated in AI-AR training systems to minimize bias is to have balance in the source data. Moreover, organizations that work with the AI-AR convergence need to train their teams on how to identify and deal with this bias. This is necessary as only then AI-AR systems will produce bias-free and reliable results.

3.2 The New Workplace Culture

Although on the one hand, with technologies and their convergence such as in the case of AI and AR, workplace culture is changing for the better, on the other hand, less time and efforts are being invested in analyzing their effects on the employees/users in terms of cyber sickness, visual fatigue, and so on.

This combination is already in the process of making employee experience more seamless. For example, AI-driven chatbots are beginning to be used in HR processes like employee recruitment, coaching and training.

As AI and AR become more pervasive, skills like contextualized intelligence and in-the-moment learning will need to be developed by the workforce. As more and more AI-AR apps will be used in the workplace, employees will need to be able to grasp and apply new information and data that are produced by AI algorithms or AR-driven scenarios displayed across their field of vision.

Organizations in order to use the AI-AR combination in the right manner for the common good will need to introduce a positive progressive mindset in their workplace culture. According to the 2017 findings by the Human Resources Professionals Association, 84 percent of respondents believed that AI is a useful tool for human resources. Organizations shouldn't force AI-AR on their employees or customers rather this duo should be a part of building a great workforce and great customer experiences.

Conferences in the new workplace will be a lot more interactive. Companies like Meta offer solutions that let organizations implement

augmented reality in video conferencing to share and interact with 3D virtual holograms. The highly interactive nature of AI-AR makes it apt for training and learning purposes.

Leadership style will also need to undergo a major transformation. Leaders will need to make themselves aware of all the dynamics of AI-AR. Leaders will need to evaluate their current training programs in order to revamp and up-skill their workforce. Leaders will need to understand these new dynamics themselves and then propagate this understanding down the ranks that AI-AR needs to be used for augmenting and automating human insight and judgment and not for replacing these aspects.

Organizations will need to choose wisely as to which business processes and administrative tasks will be left for AI-AR to handle, which of them will need 100 percent human engagement, and which of them will need both AI-AR and human involvement. Leaders and the workforce may have to deal with certain facts that could be uncomfortable for them in the beginning, for example a manager who is used to reporting and monitoring tasks , all of a sudden finds AI-AR-driven robots or apps taking over these tasks, may feel insecure and disgruntled. To avoid such issues, it is important for organizations to clearly demarcate duties, tasks and processes as ones which need human creativity, judgment involvement and discretion and ones which need merely machine assistance, machine learning, decision support, augmented simulation and application of business rules. The new workplace culture should be about assisting its human resources by freeing them up from the drudgery of mundane, repetitive tasks that can be handled by the AI-AR combination.

Empathy towards each other even in the workplace is of utmost importance, and organizations need to make sure that even though they adopt AI-AR, they must never ignore empathy. AI-AR can never ever take the place of human empathy and emotion. These aspects are an integral part of a company's corporate culture and they cannot be replaced with technologies. Moreover, as organizations begin to welcome the AI-AR marriage in their workplace, they will also need to improve their own creativity, coaching and collaboration skills so that they can invest these skills in critical business areas rather than just focus on menial tasks and administrative functions.

Spotlight

Good or bad, there will certainly be a radical culture shift in the corporate world as far as the AI-AR convergence is concerned. Research shows that the productivity benefits of AI, AR and a combination of both depend on how successfully organizations are able to reorganize their core business processes around these new technologies.

The main components that will be seen in the new workplace culture of organizations that adopt the AI-AR convergence are: human computer interaction, content creation, information influx and platforms. They are discussed in the following subsections.

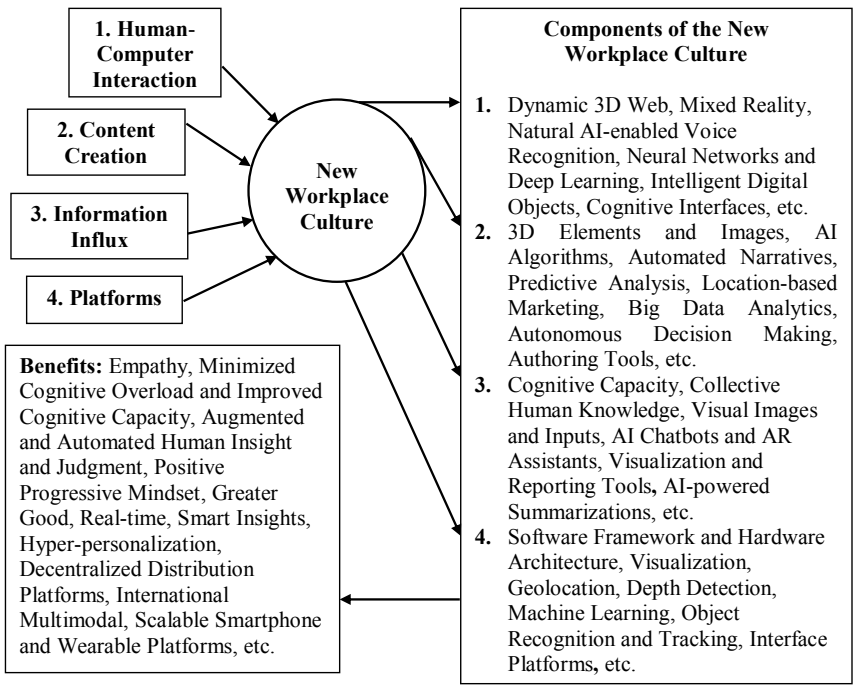

Figure 3.2 The New Workplace Culture

3.2.1 Human Computer Interaction

AI and AR are reshaping Human-Computer Interaction (HCI). HCI refers to the study, design and implementation of interactive computer systems

with a human-centric focus to them. Earlier, computers were treated as the machine component in the HCI equation but now the dynamics have changed. Computers are being treated as virtual humans of this equation. With the AI-AR duo, the world will soon become a dynamic 3D web and the identities of all the users in this web will become further connected with this digital web.

Natural AI-enabled voice recognition and Natural Language Processing is playing an integral role in this dynamic. AI's Natural Language Processing has enhanced voice recognition a lot. All these factors have made voice search popular today and replaced time-consuming, rigid user interfaces with quick, seamless ones. And this is possible due to AI-AR. Neural networks and deep learning are helping to make progress in computer vision. AI-AR convergence-driven experiences can provide more immersive and efficient ways for users to interact with a real or virtual environment through the HCI interface.

This convergence is all about developing novel ways in which humans interact with computers. For example with the help of AR, realistic versions or avatars of AI applications like Alexa, Siri, etc., can be created. According to industry experts, the future of HCI will be multimodal and the shift from mouse clicks or hand motions towards eye sensors and quicker ways of interaction will be facilitated by AI-AR. It is all about making HCI seamless and immediate.

A Word of Caution

But again such immersive setups may make use of more mechanized means than ever whereby we may begin to lose more of our own original identities to get intertwined with the digital identity produced by these setups.

Slowly and steadily, due to this combination, the world is moving away from their 2D flat screen towards the world of 3D Internet. With AI-AR tools and apps, we will be shifting our focus on the pixels on our screens towards intelligent digital objects overlaid on our physical reality. For example, Playstation Eye is a gesture recognition device, similar to webcam that allows its users to control and play games through physical gestures and actions. It uses computer vision and gesture recognition to process images taken by the camera.

As far as AR and HCI are concerned, organizations will need to overcome the hurdle of how to tackle the 3D aspect of AR. Most user interfaces like

touchscreen, camera, etc., are 2D in nature. Trying to interact with a 3D environment involving the element of depth through 2D interfaces will not work.

Mixed reality and AI is a big trend in the HCI domain. Applications and interfaces like Google Home, Amazon Echo, etc., are already making headlines. As AI-AR technologies become more advanced, they will revolutionize the way humans interact with computers such as using motion and gesture tracking devices. According to Juniper Research (it is an organization that specializes in the evaluation of opportunities across the mobile telecoms, content, and applications sectors), by the year 2020, *there will be as many as 492 million motion and gesture tracking devices*.

According to the Association for Computing Machinery (it is the world's largest scientific and educational computing society that discusses the future of computer interaction), several new trends like Pre-touch, SkinTrack, HoloFlex, etc., will rule the HCI scene. Pre-touch sensing is about the device sensing what the user is going to do with the interface. This type of new touchscreen is a device that can detect how a user is gripping the phone and *predict* when and where the user's finger is about to touch the screen. SkinTrack is a wearable system can turn a user's arm into a smartwatch touchpad. HoloFlex offers a new way of interacting with a smartphone without the need for 3D glasses or head tracking; it is dubbed as the first holographic and flexible smartphone.

With the IoT-enabled setup, AI and AR are about human-computer interactions through always-on interactive devices. These new dynamics are about developing cognitive interfaces. But again the downside here is that such interfaces may blur the line between what is real and what is not; they may begin to merge with the human consciousness. But if we can use these same interfaces for bringing humans together to collaborate and work in symphony for the greater good of humanity then we have a win-win situation.

3.2.2 Content Creation

AR-driven content is going mainstream from its original form of digital content generated based on GPS data to its current form of 3D elements and images. For example, the AR app WayfairView allows prospective customers to view furniture pieces and see how they fit into a customer's house. The augmented view appears on the screen through the mobile's

camera. There are several popular AR authoring tools and content designing tools in the market today that make the process of building AR-based experiences easy.

Of course content creation is not only AR's game; it is also done by AI. AI along with machine learning is able to create and analyze content in record-time and in real-time for helping organizations to understand the real needs of their customers. For example, Washington Post's AI app Heliograf has written several articles on topics related to sports, congressional races, and so on. Even other news agencies like Associated Press are giving out machine-generated content. Another popular example is Acrolinx that uses AI to help organizations to create spot-on content for their customers. Several big brands are already investing in creating automated narratives on various social media platforms to reach out to more customers. AI algorithms are also used to schedule social media posts and track web traffic. Tools and solutions like Quill, Sketchfab, etc., make it easier for organizations to create content on the fly without having to invest money in a content creation agency. Just like AI has its own examples, AR too has its share of applications to show off, for example, the *W Magazine* has an augmented AR-powered issue wherein once a user downloads this app, the user can point the device's camera at various parts of the magazine and get to see the AR content related to these parts.

Predictive analysis or predictive intelligence is yet another dimension of content creation achieved through AI-AR. It is a method of creating a customer experience that is unique to one particular customer by monitoring that particular customer's behavior and historical data, and then building a profile of their specific preferences. The AI-AR duo can help organizations to take the educated guesswork out of the content creation process by offering real-time, smart insights into which content will work and which will not.

Chances are you have already read or shared digital content generated by AI-AR apps without even realizing it. AI-AR is set to help more and more organizations in streamlining the content creation process. For example, the BuzzSumo tool is one of the top social media analytics tools, which helps users to locate the most popular content by topic. The AI-AR convergence will reduce the gap between content demand and delivery as the content creation process can be made speedier with this duo.

Adding the power of AI-AR to their content creation process, organizations and marketers can create and optimize content according to user/reader

preferences, can better predict what their users/readers would want to read next, can curate the right content to the right customers, and can keep up with the new patterns and trends of content consumption. Hyper-personalization can be achieved through the power of AI-AR as this convergence can provide a much better picture of what the customers want and are interested in.

Popular content creation platforms like Yamagata see great opportunities in regards to AR in the field of content creation. With apps like Layar (it is a global leader in *augmented reality* and interactive print technology), organizations can combine digital and offline content for their advertisements.

AI-AR can be used for location-based marketing; hence, it will be able to target customers on a large scale, both locally and beyond borders. This helps organizations to expand their business footprint. These apps and systems should be developed in such a way that customers will be open to sharing location-based data in exchange for appropriate content.

The AI-AR duo will help to reduce the gap between content creation and content delivery. Factors like big data analytics, autonomous decision making, authoring tools, etc., will not only help in reducing this gap, but also help in conveying content to all the stakeholders involved in this process in a meaningful manner—they will feel like they are an active participant in this creation process.

Spotlight
AI-AR apps can be used to cut out spam content, junk posts, etc., and help organizations to find out what is working and what is not working for them.

3.2.3 Information Influx

Over the years, the information influx or information overload, and more recently referred to as cognitive overload, has caused humans to lose focus on the task at hand as they have to multitask, by shifting their focus from one task to the other task within the span of a few moments. It is not just the volume of information that has grown exponentially, but also the speed at which it is delivered through a plethora of digital mediums like RSS feeds, emails, webcams, and so on.

At the inherent level, human beings are addicted to the constant ‘feed’ of data and information, and this could lead to dystopian scenarios due to

the clouding of consciousness by various streams of data. Basex (it is a management science research organization) calculated the aggregate cost of cognitive overload in the enterprise to be at least 900 billion US dollars annually due to the loss of workers' ability to *make decisions, process information, and prioritize tasks*.

In an environment where data and content is added to the digital world on a microsecond basis, especially in the business world, it is imperative for companies to keep all the stakeholders in the information loop. This is where AI and AR can help people to be in the know of things. AI-based applications like Slack, Workplace by Facebook, etc., help everyone to deal with the information avalanche. But too much dependence on mere tools can also make people more mechanized and less creative and intuitive in their jobs.

But at the same time, there is also evidence that shows that AI-AR if leveraged properly can help to improve the cognitive capacity of human beings. Up until this point human beings had to learn to survive in two worlds: digital and physical, and as this divergence of these two worlds becomes more and more intense, people start losing focus as they are not able to keep pace with both these settings. But now with AI-AR, if used sensibly, users can minimize cognitive overload in their lives. AI-AR apps and interfaces can be designed in such a way that they filter and contextualize important data and information based on the business requirements or user needs so as to minimize information influx on their senses. Another major aspect that needs to be built into the AI-AR paradigm is offloading of cognitive overload. AI-AR apps need to be able to free users from making decisions when they don't need to do so.

AI and AR, if leveraged properly, can help to harness the power of the collective human knowledge. But if the mountains of this knowledge are not properly structured and analyzed, this could lead to faulty decisions and inefficient business processes. This is where the convergence of AI and AR needs to be leveraged to gather insights from an endless pool of constantly generated data and information. As more and more data becomes available, companies will need to consider how they process and analyze this data to their advantage and this is where the AI-AR ecosystem can help to build and implement a strong data mining strategy.

Spotlight

AI and AR will have to provide more visual images and inputs from the info-glut, and this becomes necessary as humans are able to understand and remember visual content better than the written word. This will help people and organizations to move away from dashboards to real-time insights.

Google's *Smart Reply* (automated response suggestion for email) uses AI-enabled machine learning to understand from a user's/sender's received emails as to what the user/email sender wants to send in the response. Smart Reply saves the user time by suggesting quick responses to the received messages, which then the user can either select from the existing response options and send, or modify an existing response option and then send the response.

According to industry findings, human beings are not able to keep up with the speed at which the information is being generated. That is why more and more businesses are moving towards harnessing the power of AI chatbots and AR assistants to manage their operations. But the best way going forward is to have a combination of human judgment and AI-AR for managing the info-glut.

Recent startups like Agolo aim to help organizations fight the information overload through AI-powered summarizations and it does this by making use of Natural Language Processing. These summarizations help to analyze content, identify different subjects, and draw connections between them. It is pitched as the *world's most advanced summarization software*. Another strong player is *Conversica* which is the leader in AI-powered business conversations that helps in sales conversion. Conversica helps in determining customer intent quickly from the heavy influx of leads thereby saving efforts, time and money in chasing dead leads. A popular AR startup is the ARwall which has created the first AR display that requires no goggles, headsets or any other smart device. It is an AR-based film tool that helps filmmakers and content creators to develop the next stage of content creation for filmmaking. It creates real-time backgrounds that directors, crew members and actors can see while they are shooting scenes.

AI-AR combination needs to be designed and implemented in a sensible manner in critical areas such as visualization and reporting tools,

intelligence analysis and research, and so on. If it fails to present complex data and information in a clear and concise way then the users will be distracted by too many elements in their canvas of reality. The bottom line is that the convergence of AI-AR needs to be combined with the collective human intelligence so that AI-AR systems and applications can help human beings contextually adapt to the constant influx of information.

3.2.4 Platforms

An AI-AR platform is some type of a software framework and a hardware architecture that facilitates the development and deployment of AI-AR applications and programs. These platforms are also an important part of the new business models of organizations that have adopted the AI-AR convergence. These platforms should be able to handle both the volume of data and variety of data, and also be able to connect this data with algorithms in order for the applications to learn and adapt to new scenarios. These platforms must have easy-to-use features and built-in algorithms for novice developers to build and deploy AI-AR apps.

AI and its dynamics are an integral part of AR platforms. AI's capabilities of machine learning, gesture recognition and tracking, voice recognition, object recognition and tracking, etc., are already making AR platforms popular and will continue to make them more multimodal and multidimensional in the years to come. AI is needed to make AR platforms and products and apps developed from them in order to make them a mainstream reality.

There are several popular AI platforms like Microsoft Azure Machine Learning, Vital AI, Google Cloud Prediction AI, etc., and ARKit, DeepAR, ARCore, etc., are some of the popular AR platforms. AI is fundamental to powering AR apps and systems, and these platforms help in this facilitation. Progress in this field is not merely about new devices and products, but also about robust platforms that help to build new user experiences through efficient apps, plug-ins and functionalities.

Apart from tech powerhouses like Microsoft, Google, Apple, etc., other players like Unity, Niantic, etc., are stepping up the game by providing support for various AI-AR scenarios like visualization, geolocation, object recognition, neural network, depth detection, and so on. According to Unity statistics, its platform currently powers 74 percent on HTC Vive, 87 percent on Gear VR, 69 percent of Oculus Rift experiences, and 91 percent of mixed reality experiences on Microsoft HoloLens. Niantic's

Real World Platform is an AR engine that bridges the digital and the physical environments using AI and machine learning. Another popular AR platform is Wikitude that is an augmented reality cross-platform provider for smart glasses, tablets and phones.

Moreover, decentralized distribution platforms will be a trend to watch. Such platforms are needed so as to allow developers, users and content creators to collaborate and share their work easily. One such leader in this space is the publishing industry which is already using AI and AR to help locate and curate content.

The main focus area of AI-AR should be on developing international multimodal, scalable smartphone and wearable platforms. Another area that needs standardization is interfaces. Interface platforms are needed that will help to integrate varied AI-AR platforms in a seamless manner. There have to be more and more organizations that will offer AI-AR software engines and platforms to third-party developers that can be customized according to their organization's business needs and customer-centric goals. These needs can range from cloud-based advanced analytics, knowledge virtualization, motion tracking, digital virtual agents, environment perception, and so on.

A Word of Caution
Most AI and AR platforms need extensive knowledge and intensive development skills to leverage their features in the proper manner or else investment in such platforms without proper knowledge may lead to loss.

3.3 Chapter Recap

1. AI and AR have been grabbing plenty of press recently and they are at the heart of the ongoing business disruption process. What AI and AR have in common as far as the business landscape is concerned is data or rather big data. The AI part of the equation analyzes and derives insights from user engagement metrics whereas the AR part overlays objects and enhances the reality based on these metrics.
2. Despite the dire predictions and dystopian scenarios of the AI-AR convergence, several experts suggest that by leveraging the AI-AR duo properly, the business world can generate quality leads and provide operational efficiency. In the medical field, the AI part of the equation can be used in performing evaluations before the patient meets the

doctor or even during the follow-up visits. Thereafter, the AR part of the convergence equation can be used for diagnosis and for treating or operating on the diagnosed issue. The AI-AR duo is transforming so many sectors and industries, right from manufacturing to retail.

3. The AI-AR combination not only has the ability to offer individualized and differentiated learning but it can also help students to increase their personal performance in terms of critical thinking, problem-solving, and so on. This duo needs to be used in such a way that the gaps in teaching and learning are minimized. In the manufacturing sector, this duo can help to locate, troubleshoot and repair problems.
4. All the AI-AR advantages will be realized only when the components of new business models, visual marketing, customer experience management, and corporate training are taken care of by organizations in a holistic manner. Even one missing or incomplete component could lead to less than optimum results.
5. The AI-AR convergence caters to many emerging markets and segments like organizations and individual consumers. The new business models will need to support and grow these new markets and segments by providing customer-friendly services, apps and features. Another main aspect that needs to be incorporated in these new business models is about tackling ethical issues and challenges in terms of security and privacy of their users and customers. The new business models will need to incorporate a good degree of transparency in their AI-AR systems. They will need to incorporate automating data analysis for the AI-AR paradigm to work for the business world. They will need to handle cultural resistance from their employees as many of them would fear these new emerging technologies, mainly in terms of job loss and job insecurity.
6. The combination of AI and AR has the power to create a unique brand story for the organizations and a seamless shopping experience for the customers. Advances in these fields are making e-commerce a lucrative business in terms of visual retailing and personalized services. Visual explosion or in simple words *images*, especially on the social media, is a big trend as it creates meaningful connections.
7. There are several areas of customer experience management that AI can enhance. The various areas include: enhanced telephonic support, gauging real-time emotional responses and reactions, augmenting message, marketing and sales, and so on. AR apps and systems along

with AI will help to increase customer engagement through various innovative features and immersive experiences provided through images, sound, 3D visuals, animation, and so on.

8. AI and AR can provide a training environment that enhances learning by providing a safe yet engaging and adaptive learning experience. AI and AR can be used to find optimal learning pathways for employees and at the same, AI and AR can be used as a virtual tutoring system. When out-of-the-ordinary problems occur in any sector, instead of dispatching a backup team, organizations can make use of AI-AR tools, apps and systems where more experienced or expert employees can directly access the problem from their location through such tools, apps and systems. The main aspect that needs to be incorporated in AI-AR training systems to minimize bias is to have balance in the source data.
9. Although on the one hand, with technologies and their convergence such as in the case of AI and AR, workplace culture is changing for the better, on the other hand, less time and efforts are being invested in analyzing their effects on the employees/users in terms of cyber sickness, visual fatigue, and so on. Organizations in order to use the AI-AR combination in the right manner for the common good will need to introduce a positive progressive mindset in their workplace culture.
10. Leaders will need to make themselves aware of all the dynamics of AI-AR. Leaders will need to evaluate their current training programs in order to revamp and up-skill their workforce. Organizations will need to choose wisely as to which business processes and administrative tasks will be left for AI-AR to handle, which of them will need 100 percent human engagement, and which of them will need both AI-AR and human involvement. Empathy towards each other even in the workplace is of utmost importance, and organizations need to make sure that even though they adopt AI-AR, they must never ignore empathy.
11. The main components that will be seen in the new workplace culture of organizations that adopt the AI-AR convergence are: human computer interaction, content creation, information influx and platforms.
12. AI and AR are reshaping Human-Computer Interaction (HCI). HCI refers to the study, design and implementation of interactive computer

systems with a human-centric focus to them. Earlier computers were treated as the machine component in the HCI equation but now the dynamics have changed. Computers are being treated as virtual humans of this equation. According to industry experts, the future of HCI will be multimodal and the shift from mouse clicks or hand motions towards eye sensors and quicker ways of interaction will be facilitated by AI-AR. It is all about making HCI seamless and immediate.

13. AR-driven content is going mainstream from its original form of digital content generated based on GPS data to its current form of 3D elements and images. Of course content creation is not only AR's game; it is also done by AI. AI along with machine learning is able to create and analyze content in record-time and in real-time for helping organizations to understand the real needs of their customers. Predictive analysis or predictive intelligence is yet another dimension of content creation achieved through AI-AR.
14. Hyper-personalization can be achieved through the power of AI-AR as this convergence can provide a much better picture of what the customers want and are interested in. AI-AR can be used for location-based marketing; hence, it will be able to target customers on a large scale, both locally and beyond borders. This helps organizations to expand their business footprint.
15. In an environment where data and content is added to the digital world on a microsecond basis, especially in the business world, it is imperative for companies to keep all the stakeholders in the information loop. This is where AI and AR can help people to be in the know of things.
16. According to industry findings, human beings are not able to keep up with the speed at which the information is being generated. That is why more and more businesses are moving towards harnessing the power of AI chatbots and AR assistants to manage their operations. But the best way going forward is to have a combination of human judgment and AI-AR for managing the info-glut. AI-AR apps and interfaces can be designed in such a way that they filter and contextualize important data and information based on the business requirements or user needs so as to minimize information influx on their senses.

17. An AI-AR platform is some type of a software framework and a hardware architecture that facilitates the development and deployment of AI-AR applications and programs. AI and its dynamics are an integral part of AR platforms. AI's capabilities of machine learning, gesture recognition and tracking, voice recognition, object recognition and tracking, etc., are already making AR platforms popular and will continue to make them more multimodal and multidimensional in the years to come.
18. The main focus area of AI-AR should be on developing international multimodal, scalable smartphone and wearable platforms. Another area that needs standardization is interfaces. Interface platforms are needed that will help to integrate varied AI-AR platforms in a seamless manner. Most AI and AR platforms need extensive knowledge and intensive development skills to leverage their features in the proper manner or else investment in such platforms without proper knowledge may lead to loss.

3.4 Questions for Reflection

1. How will the convergence of AI and AR boost business sales?
2. How should content creators adapt to AI-AR?
3. Is the AI-AR duo on the brink of changing business forever?
4. Should tasks and jobs that can be automated be automated simply for the sake of business benefits?
5. Why is diversity of thought and inputs vital for the success of the AI-AR duo?
6. How will AI-AR build value using new business models?
7. How is the AI-AR duo being enabled at the enterprise level in your company?
8. Why the power of data is worth millions of dollars?

CHAPTER 4

More Dynamics of the AI-AR Convergence

When analyzing technology trends, we cannot study the current trends or predict the future trends in isolation. We need to study a combination or convergence of several technologies in order to be able to deal with the current technological landscape and predict the technological landscape of the future in accurate terms. We need to also look at the deeper dynamics of such technologies so as to not fall for any type of hype.

The AI and AR convergence will take time to come to its full fruition, but it is already well underway. AI now in its current phase has given rise to the concepts and capabilities like chatbots, conversational interfaces, etc., and as far as AR is concerned, it is all about smart digitized environments and immersive experiences. According to the findings shared by the Sloan Management Review, three-quarters of executives believe AI will enable their companies to move into new businesses but only about one in five companies has incorporated AI in some offerings or processes. Moreover, companies with at least 100,000 employees are the most likely to have an AI strategy, but only half have one.

Spotlight

The corporate world and organizations are slowly and steadily moving away from the approach of *using a silo-based approach for solving business problems* towards *convergence of technologies for solving business problems*. The earlier approach resulted in fragmented benefits, and as organizations are slowly and steadily realizing that to reap the full benefits of their investment, time and efforts, they need to implement an approach where all types of technologies can work together in tandem.

Whether your organization works in the manufacturing, military, retail or any other sector, it will need to adapt an integrated approach of all the new-age technologies for it to remain at the top of its game. This seamless

cohesion of technologies is the need of the hour. However, widespread adoption of AI-AR depends not only on hi-tech apps and systems, but also on the readiness of human beings to accept AI-AR in the workplace in particular and in life in general. There will be drastic changes in the employment landscape as well as in the social settings.

Without technologies and developments like machine learning, cloud computing, etc., AI would not have achieved such popularity, and without AI, AR-based systems and apps would not be so effective. For these two to be an effective convergence, barriers and problems related to factors like infrastructure, international standards and protocols, and social, ethical, security and other implications need to be tackled through a multidisciplinary, integrated approach. Let us first discuss these deeper dynamics of AI-AR and then deal with their problems in the multidisciplinary, integrated approach.

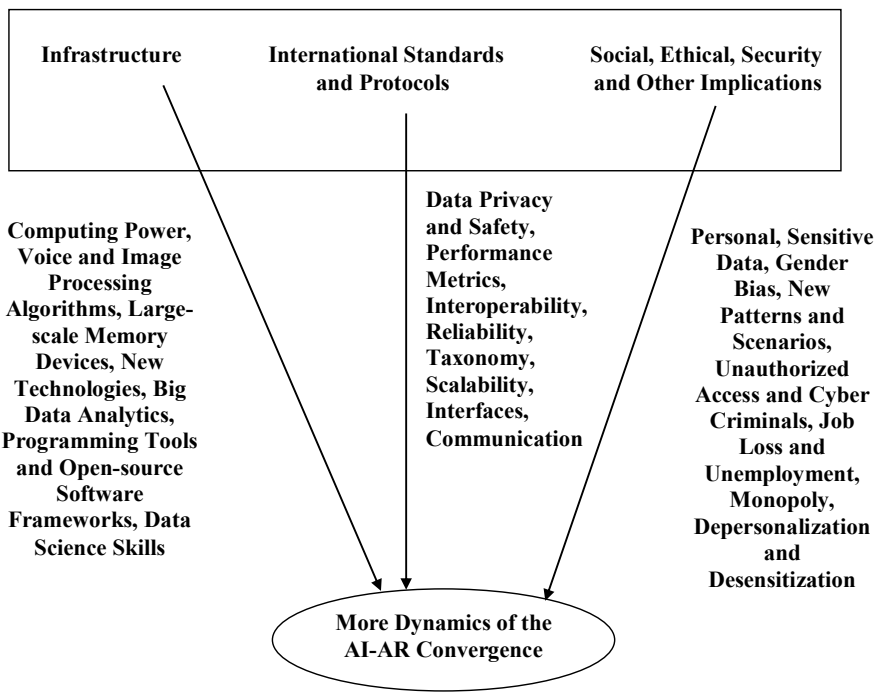

Figure 4.1 More Dynamics of AI-AR Convergence

4.1 Infrastructure: Data and Computing Capabilities and Other Factors

Earlier there were limitations in terms of data and computer capabilities and networking capacity, but now due to advancement in computing power, advanced voice and image processing algorithms, availability of large-scale memory devices, etc., AI-AR is growing by leaps and bounds. But still more processing power will be needed as the data volume continues to grow.

Due to new technologies like machine learning, big data analytics, etc., the scope and future of AI has been changed significantly. All these new developments have led to an increase in data and computing capabilities. Large data sets can now be processed in nanoseconds. Hence, it is now possible to process large amounts of data in real-time to unearth trends and patterns for machine learning purposes in AI-driven applications. And these real-time data updates can be used by AR apps to help organizations to further enhance a particular business process or solve a particular business problem.

Another factor that is growing and making an impact on AI apps is reliable, free programming tools and open-source software frameworks for data analysis. More such tools, platforms, frameworks and software development kits are needed for performing deep data analysis on distributed data sets in order to make AI algorithms more effective.

Developing the AI-AR convergence requires data science skills—skills in which there is large demand and short supply. The talent pool from within organizations is not that well-versed with the deeper dynamics of developing and deploying AI-AR solutions, and hiring external resources becomes a costly affair. Although courses and degrees related to AI and AR have been introduced in educational institutions across the world, but still there are not enough skilled people to meet the industry needs and demands of the AI-AR convergence.

As the days go by, the AI-AR paradigm will need to scale its capacity of storage to handle the massive amount of world-wide data, also this is needed to ensure that pilot AI-AR projects are able to scale up to full-fledged business models, applications and services. The storage requirements depend on the nature of the data source as this decides

whether AI-AR apps will analyze data in the post-processing mode or in the real-time mode.

Cloud computing is another major factor for boosting the growth of AI-AR. It will help to unleash compelling capabilities of this duo and provide parallel processing for big data. AR Cloud is an important component of the AR ecosystem that will help with the vision infrastructure problems. 6D.ai backed by AR visionaries aims to build AR Cloud that equips wearbles with a highly detailed persistent 3D map of the world. The Cloud is an enabler for building the AI-AR knowledge space.

AR and its infrastructure need to improve further in order to provide accurate mapping of the physical world, to bring about massive adoption of mobile AR and to facilitate cross-platform functionality. There is already progress in this area but it needs to gear up. Popular products like Magic Leap, HoloLens, etc., are the main players but now even new players like 6D.ai are able to reconstruct the physical world more accurately and that too using mass market phones. The role of AI in creating accurate AR impressions of the physical world in real-time is an integral component of the AI-AR infrastructure. State-of-the-art AI algorithms based on neural networks, deep learning, etc., are needed to allow users to make digitally augmented enhancements to their world.

4.2 International Standards and Protocols

According to the McKinsey Global Institute's (it is the business and economics research arm of McKinsey & Company) paper *Artificial intelligence: The next digital frontier*?, which included a survey of more than 3,000 AI-aware companies around the world, found that early AI adopters tend to be closer to the digital frontier than other companies behind the trend.

International standards and protocols for AI and AR are in their nascent phase; they are still underway. Standards and protocols are an integral component of the AI and AR ecosystems and they need to be developed and updated with a well-thought-out strategy. Their main aim is to facilitate the smooth operation of such ecosystems, create new capabilities, new systems and applications, and provide enhanced user experiences. Several aspects of these standards and protocols need to be thoroughly developed and tested for their quality and performance, for example, privacy, performance metrics, interoperability, reliability, taxonomy, scalability, interfaces, and so on. There can't be one global standard or protocol, but what is needed is

a suite of standards and protocols to enhance the effectiveness of this duo. And this suite needs to be developed by taking into account the various AI-AR requirements coming from various domains, segments, fields and users.

Spotlight

AI-AR-driven organizations need to shift their focus from the profit line towards human welfare. They should measure and monitor the consequences and changes that these technologies bring and how they affect human welfare.

Communication among the various stakeholders is a must so that learnings and findings can be shared. Collaboration between industry players, standards and protocols bodies and consortia, customers, end-users, developers, etc., is needed to analyze the current standards and protocols' limitations and gaps, and then develop and implement successful standards and protocols in order to fill these gaps. Constant and open communication and collaboration is needed to build and deploy stable AI-AR systems so that the core requirements are fulfilled and a standard lingua franca is developed that can be understood by all the stakeholders. Having a standard description/language/words for describing all the requirements, observations, metadata, use cases, limitations, etc., helps to not only build trustworthiness among all the stakeholders, but also to develop ethical, optimized platforms, frameworks, processes, algorithms, interfaces, devices, and so on.

For developing robust and effective standards, all the stakeholders need to identify key areas or gaps that need international standards, best practices and safety protocols and they also need to be aware of the future trends while developing these standards, best practices and safety protocols. The Institute of Electrical and Electronics Engineers (IEEE is best known for developing standards for the computer and electronics industry) is working on a series of standards for augmented reality in regards to various parameters.

One major element that needs protocols and standards to be ethical in nature are the areas of privacy and safety of data while using AI-AR apps and systems. Especially with new regulations like the General Data Protection Regulation (GDPR is a regulation that unifies and updates data protection and privacy laws for all individuals within the European Union) being implemented, it is essential that the rest of the world too

develops and implements such regulations and legislations. The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems is the most comprehensive, crowd-sourced global treatise created by global cross-disciplinary thought experts and leaders that provides guidelines on developing and implementing applications based on the principles of ethically-aligned design (EAD). EAD is about following standards, policies and protocols that help to build and implement intelligent and autonomous systems and technologies aligned with the principle of safeguarding ethics, moral values and human welfare. EAD is about prioritizing human welfare in the age of AI-AR.

4.3 Social, Ethical, Security and Other Implications

With the AI-AR duo moving closer and closer to human beings and the reality, this starts raising questions at several levels like social, ethical, etc., about what constitutes *reality* when much of one's sensory input is overlaid on the physical reality by AI-AR. The illusion of reality is moving from smart devices towards AI-AR enabled eyewear or implants, and then the next stage would be that of embodying the AI-AR generated illusion into the human body raises important questions: will we have individual choice or how much control will we have over our lives?

Both AI-AR are inherently hungry for data and more data, and this inherent quality of this duo can affect society at all levels negatively. Organizations may go out of line to grab even personal, sensitive data so that they can make those extra millions. Again the apps developed using AI-AR could be developed based on gender-bias, for example bots could be designed to take on male or female characteristics and then male bots could be used for critical tasks and female bots for trivial tasks or vice versa based on gender bias. With such applications, social isolation is another aspect that needs to be studied. As users begin to spend more and more time on such applications, it is believed that this may lead them to neglect their real-world social connections, taking them further away from their human roots. AI-AR apps are already been used for facial recognition and with their growing proliferation, it could be annoying and dangerous as we might never have any real privacy.

AI-AR systems even if fully tested for all the patterns and scenarios can never guarantee that they won't encounter new patterns and scenarios when they go live. This element of surprise can be dangerous for security and life. Especially in the military settings, the future of warfare advances

will almost certainly involve AI-AR, and there is a possibility that this duo might do away with human oversight completely. This is a very dangerous scenario as millions of innocent human lives could be at stake.

Another challenging implication to tackle is the security of augmented, intelligent, connected applications, platforms and systems against unauthorized access and cyber criminals. AI-AR systems won't be perfect in all aspects as they are finally built by human beings and their flaws and limitations are bound to get reflected in the systems they design and implement. And the perpetrators will take undue advantage of these very flaws and limitations. Poor data governance and faulty algorithms can result in data breaches where customers' sensitive and personal data, organizations' trade secrets, etc., can be compromised by malicious cyber criminals.

The next logical step of this convergence is going to be implanting devices inside the human body for generating true-to-life illusions. Such technology scenarios would obviously raise certain ethical questions like: will human beings have a choice to be in control of their lives? will such technologies be misused to manipulate the collective consciousness? etc. The one main social and ethical implication of AI-AR that many experts as well as the common man keep talking about is that of emerging technologies such as the AI-AR duo going rogue and taking control of human beings. Many people across the globe believe that as these technologies advance, people will lose the ability to think for themselves and also lose their human connection with each other. Several people believe in dystopian scenarios like drones hacking private security or robots taking over the world. Such stark scenarios definitely will impact all aspects of life including ethics, moral values, education, employment, social welfare, economic equality, etc.

Another implication is that of how to distribute economic benefits and wealth generated by artificial and augmented computers or machines. As machines and computers take over many critical business processes—this trend is leading to profits which get distributed among fewer people—people who own these machines and computers. Such a trend will widen the gap between the haves and have-nots even more. Moreover tech giants due to their buying power acquire all the startups, and hence become monopoly holders in the market and due to this monopoly they have unprecedented control over monetary resources, data, innovation and technology. This is yet another dystopian scenario where control, power, money and access to data lie in the hands of a few at the cost of the many.

Job loss and unemployment is yet another social implication looming large in the minds of people. For example, there are already autonomous cars taking over the role of a typical physical driver. There is already a steady rise in the usage of robots used for tasks related to production lines. The duo and its applications are replacing several tasks and one of them is hiring: for example the Unitive hiring platform aims to eliminate unconscious bias from the hiring and recruitment processes in order to ensure that the most qualified candidate is chosen irrespective of gender, ethnicity, and so on. Another example is that of Caterpillar which is a predictive maintenance analytics system and used in a variety of applications, right from gas turbines to hydraulic excavators. People believe that such applications, systems, apps and platforms could lead to job loss and role loss.

With the speed at which AI-AR are advancing, it is quite possible that one day there will be a scenario where the reality driven by AI-AR will be so immersive that it will look *more real* than the real thing. But in reality, this artificial and augmented reality is yet another illusion that is playing out in the life of a user, with the distance of the devices used to generate this digital illusion being almost zero. This is a precarious condition—as the immersion level increases—it can lead to depersonalization and desensitization. In depersonalization, users believe that their own physical body is an avatar and develop a *false* sense of accomplishment for all the *digital* feats they have performed in the AI-AR reality. In desensitization, users become emotionally hardened to certain sensory stimuli like violence, destruction, and so on. For example, users who constantly play violent games might become completely insensitive to aspects like violence, damage, and so on. It numbs and shuts down the senses to what the real world has to offer, and in turn shuts the heart hub within humans, making them cold-hearted zombies.

A Word of Caution
If organizations don't develop, train and upgrade their AI-AR systems in the right manner and do not set boundaries around them then the culture of well-being, empathy, connectedness and prosperity will remain a mere dream.

4.4 Multidisciplinary, Integrated Approach to Minimize Barriers

The biggest challenge facing AI-AR is definitely that of an ethical nature. It is the duty of the industry to build AI-AR systems that do not cross any

ethical boundaries and it is also the responsibility of the industry to present these systems and their advantages and disadvantages to the non-experts and laymen in a clear and concise manner. Organizations need to have ethicists or an ethics board in place to monitor the development of the AI-AR duo and its impact on the society and the environment. It should be their responsibility to ensure that the AI-AR convergence is used to enhance the understanding of human behavior so that this convergence can help us to find ways to make the world a better place.

The discretion of whether one wants to sell or lease her/his data (social interaction, security information, emails, and so on) or do neither should lie with the user or customer. Moreover, just as we can claim insurance for all types of damages and also prosecute the offenders, similarly, we as users or customers should be able to apply these dynamics to anyone that we suspect has used or sold our data without our knowledge or permission. The application or usage of our data should be subject to laws and regulations that protect ordinary citizens' data and information from misuse by organizations, developers and the industry. Data privacy and security needs to be thought through from start to finish; these factors can't be an afterthought and they need to be an important aspect on the business agenda. As our online activities increase, improved online security will also need to increase.

Organizations need to develop AI-AR products, services and applications in such a manner that they do not encroach upon the personal space and privacy of their customers and users. Moreover, they also need to be careful that their products, services and applications should be safe and secure, and should comply with industry standards and laws. The governments, policymakers, academia communities, civic societies, customers and organizations need to draft and design a set of social and legal rules and regulations for the protection of the ownership of data and for making it clear where the data can or cannot be used or accessed.

Customer trust has to be the central focus of organizations and their business agenda. Customers do not only look for product prices and advantages, but also focus on social values such as ethics, diversity and inclusion, environment protection, and so on. Companies should consider the social expectations of customers and ensure their business goals are aligned with the social goals of their customers. Customers are also concerned with how their data is used to meet not only their expectations but also social goals.

For the AI-AR duo to be widely implemented and accepted, there needs to be oversight guidelines and standards, but presently there are not adequate internationally established and accepted industry standards. Such standards are necessary and they need to be developed based on the inputs by all the stakeholders involved right from industry players to customers and from civic society to regulatory authorities. We need to have experts that have deep knowledge in various fields related to the AI-AR duo like knowledge reasoning, computer science, communication studies, human-computer interaction, etc., who will be in a position to discuss and solve issues related to cultural implications, privacy issues, design limitations, and so on.

Organizations need to build and develop robust cyber risk-related data-driven approaches for enhancing the collecting and filtering capabilities in order to manage their resources, data and setups related to new technologies and distributed information technology systems. Just as online data management can be a major source of cyber risks and attacks, similarly, with a vigilant and agile approach, organizations can use this very source for acting as an early warning system. Continuous measurement along with unified data management will be more helpful for organizations to ensure that the equation of cyber security and operational risks is well-balanced. To keep this equation balanced, both historical and comparative data is needed to measure and improve the progress of the entire process.

The traditional and after-the-fact system of auditing, reporting and escalating of cyber risks should be replaced with an automated, real-time and dynamic one—again here too the AI-AR convergence can be its own antidote; it can be used to detect and counteract cyber-attacks and thereby minimize data and privacy breaches. Just as cyber criminals will leverage the capabilities of AI-AR to launch greater and effective attacks, similarly, organizations will need to leverage these same capabilities of AI-AR to counteract these malicious players. Several organizations are already implementing this duo for their cyber security strategy, for example, routers, sensors, firewalls, etc., are enhanced with AI-AR safety measures.

Well-researched and tested international standards and protocols are needed to not only develop a robust groundwork for making AI-AR systems more stable and viable, but also for proving them to be *ethically* correct applications of new-age technologies. These standards and protocols need to mandate that the organizations working in this space build their apps and systems in such a way that human characteristics like

emotions, empathy, interactivity, etc., are included in them. Moreover, these standards should be designed and implemented in such a way that technology silos should be able to coexist and interoperate with each other. More and better protocols and standards are needed to bridge the gaps in the areas of interfacing and interoperability, as this will lead to an increase in service providers and data consumers.

The international standardization committee on AI—International Organization for Standardization/International Electrotechnical Commission (ISO/IEC aims to develop, maintain and promote standards in the fields of Information Technology and Information and Communications Technology) Joint Technical Committee (JTC) 1, Information Technology, Subcommittee (SC) 42 is intended to serve as the focus for ISO/IEC JTC 1's standardization program on AI as well as provide support for other JTC 1 committees that develop IEC and ISO standards for AI applications. This committee coordinates with other committees for smart cities, Internet of Things, etc., to acquire comprehensive inputs for building a comprehensive framework for AI. Similar such standards and committees are needed from time to time to streamline the AI-AR convergence and its dynamics.

For dealing with limitations like extensive storage requirement, optimization of algorithms, etc, a crucial step towards overcoming these limitations and enabling wider adoption of the AI-AR duo is the redesigning of hardware components to support such setups.

Research has shown that despite the progress made in such technologies, users/ customers are not interested in blind robotic digitization of their lives. Users/customers are looking for technologies that intertwine with their lives in a seamless yet empathetic manner. Users/customers expect their digital experience to be more human and empathetic in nature. As organizations continue to build their AI-AR portfolio, it is critical for them to weave the elements of emotions and empathy in their systems and apps.

We need to build and nurture responsible organizations. Responsible organizations and their leaders are committed to serving the society, and have authentic concern for individual as well as organizational goals. They are always researching and finding radical new ways of combining subtle and material experiences and interactions that are both locally and globally engaging and fulfilling, especially ones that fulfill the fundamental human need for self-growth, self-expression and self-realization. And one way of doing this is by ensuring that the AI-AR convergence that they implement is transformative and collaborative, and not totally disruptive in nature.

Apart from the above aspects, the two main elements that will bring all these aspects of this multidisciplinary, integrated approach together are enlightened engineers and a culture of care and collaboration. These elements have been explained in Chapter 6.

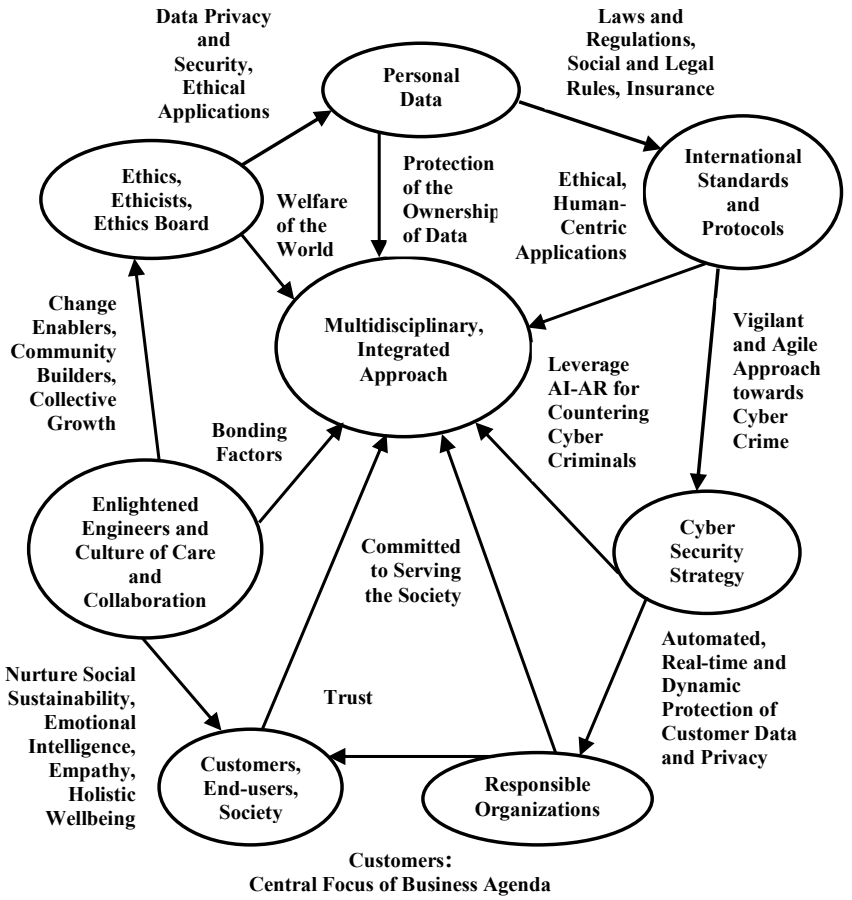

Figure 4.2 Multidisciplinary, Integrated Approach to Minimize Barriers

4.5 Chapter Recap

1. Whether your organization works in the manufacturing, military, retail or any other sector, it will need to adapt an integrated approach of all the new-age technologies for it to remain at the top of its game. This seamless cohesion of technologies is the need of the hour. However, widespread adoption of AI-AR depends not only on hi-tech apps and

systems, but also on the readiness of human beings to accept AI-AR in the workplace in particular and in life in general.

2. Without technologies and developments like machine learning, cloud computing, etc., AI would not have achieved such popularity, and without AI, AR-based systems and apps would not be so effective. For these two to be an effective convergence, barriers and problems related to factors like infrastructure, international standards and protocols, and social, ethical, security and other implications need to be tackled through a multidisciplinary, integrated approach.
3. Due to new technologies like machine learning, big data analytics, etc., the scope and future of AI has been changed significantly. All these new developments have led to an increase in data and computing capabilities. Large data sets can now be processed in nanoseconds. Another factor that is growing and making an impact on AI apps is reliable, free programming tools and open-source software frameworks for data analysis. Developing the AI-AR convergence requires data science skills—skills in which there is large demand and short supply.
4. As the days go by, the AI-AR paradigm will need to scale its capacity of storage to handle the massive amount of world-wide data, also this is needed to ensure that pilot AI-AR projects are able to scale up to full-fledged business models, applications and services. Cloud computing is another major factor for boosting the growth of AI-AR. It will help to unleash compelling capabilities of this duo and provide parallel processing for big data.
5. International standards and protocols for AI and AR are in their nascent phase; they are still underway. Standards and protocols are an integral component of the AI and AR ecosystems and they need to be developed and updated with a well-thought-out strategy. Their main aim is to facilitate the smooth operation of such ecosystems, create new capabilities, new systems and applications, and provide enhanced user experiences.
6. Communication among the various stakeholders is a must so that learnings and findings can be shared. Collaboration between industry players, standards and protocols bodies and consortia, customers, end-users, developers, etc., is needed to analyze the current standards and protocols' limitations and gaps, and then develop and implement successful standards and protocols in order to fill these gaps. One

major element that needs protocols and standards to be ethical in nature are the areas of privacy and safety of data while using AI-AR apps and systems.

7. The illusion of reality is moving from smart devices towards AI-AR enabled eyewear or implants, and then the next stage would be that of embodying the AI-AR generated illusion into the human body raises important questions: will we have individual choice or how much control will we have over our lives?
8. Both AI-AR are inherently hungry for data and more data, and this inherent quality of this duo can affect society at all levels negatively. Organizations may go out of line to grab even personal, sensitive data so that they can make those extra millions. Again the apps developed using AI-AR could be developed based on gender-bias, for example bots could be designed to take on male or female characteristics and then male bots could be used for critical tasks and female bots for trivial tasks or vice versa based on gender bias.
9. AI-AR systems even if fully tested for all the patterns and scenarios can never guarantee that they won't encounter new patterns and scenarios when they go live. This element of surprise can be dangerous for security and life. Another challenging implication to tackle is the security of augmented, intelligent, connected applications, platforms and systems against unauthorized access and cyber criminals.
10. As machines and computers take over many critical business processes—this trend is leading to profits which get distributed among fewer people—people who own these machines and computers. Such a trend will widen the gap between the haves and have-nots even more. Moreover tech giants due to their buying power acquire all the startups, and hence become monopoly holders in the market and due to this monopoly they have unprecedented control over monetary resources, data, innovation and technology. Job loss and unemployment is yet another social implication looming large in the minds of people.
11. It is the duty of the industry to build AI-AR systems that do not cross any ethical boundaries and it is also the responsibility of the industry to present these systems and their advantages and disadvantages to the non-experts and laymen in a clear and concise manner. The application or usage of our data should be subject to laws and

regulations that protect ordinary citizens' data and information from misuse by organizations, developers and the industry. Data privacy and security needs to be thought through from start to finish; these factors can't be an afterthought and they need to be an important aspect on the business agenda. The governments, policymakers, academia communities, civic societies, customers and organizations need to draft and design a set of social and legal rules and regulations for the protection of the ownership of data and for making it clear where the data can or cannot be used or accessed.

12. Organizations need to build and develop robust cyber risk-related data-driven approaches for enhancing the collecting and filtering capabilities in order to manage their resources, data and setups related to new technologies and distributed information technology systems. Just as online data management can be a major source of cyber risks and attacks, similarly, with a vigilant and agile approach, organizations can use this very source for acting as an early warning system.
13. The traditional and after-the-fact system of auditing, reporting and escalating of cyber risks should be replaced with an automated, real-time and dynamic one—again here too the AI-AR convergence can be its own antidote; it can be used to detect and counteract cyber-attacks and thereby minimize data and privacy breaches.
14. Well-researched and tested international standards and protocols are needed to not only develop a robust groundwork for making AI-AR systems more stable and viable, but also for proving them to be *ethically* correct applications of new-age technologies. These standards and protocols need to mandate that the organizations working in this space build their apps and systems in such a way that human characteristics like emotions, empathy, interactivity, etc., are included in them.
15. We need to build and nurture responsible organizations. Responsible organizations and their leaders are committed to serving the society, and have authentic concern for individual as well as organizational goals. They are always researching and finding radical new ways of combining subtle and material experiences and interactions that are both locally and globally engaging and fulfilling, especially ones that fulfill the fundamental human need for self-growth, self-expression

and self-realization. And one way of doing this is by ensuring that the AI-AR convergence that they implement is transformative and collaborative, and not totally disruptive in nature.

4.6 Questions for Reflection

1. Will the AI-AR convergence lead to a decrease in jobs in 5 years time?
2. How do we enforce responsible use of AI-AR platforms, systems and apps?
3. How can we ensure that the training of the AI-AR algorithms is unbiased?
4. How do management protocols affect the AI-AR convergence?
5. How can international standards be used to make AI-AR a success?
6. Does your company have a privacy policy posted and does it enforce it?
7. Is it ethically correct to create replicas of human beings?

PART 3

What does the AI-AR Marriage Hold for the Future of the World

CHAPTER 5

Collaboration of Intelligence and Augmentation in the Real World

Are you looking for ways to boost your business intelligence and achieve augmented reality experiences for your customers? The key to this question is the collaboration of intelligence and augmentation or interconnectedness of AI and AR in the real world. This interconnectedness between diverse technologies is what powers today's digital world.

This interconnectedness is about ease and convenience and of immersive experiences. As we become more used to the AI-AR convergence, we would expect to have more easy and convenient services, products, apps and experiences. This is possible due to new use cases being developed and tested. Here again, the fuel for these uses is the convergence of cutting-edge technologies like AI and AR. This interconnectedness can be enhanced by pinpointing new opportunities and building the appropriate models and ecosystems for realizing these opportunities.

Spotlight Tip
With the AI-AR interconnectedness, businesses will be able to tap into new marketing and sales channels. With responsible, compelling use cases, the AI-AR duo can help to identify new channels in order to transform the world for the better.

The following contents describe the various aspects that are needed to define and strengthen the backbone of the AI-AR interconnectedness.

5.1 Interconnectedness

AI has the capacity to tackle big data and AR has the capacity to visualize and present this data on an interactive canvas. What began mainly as a

gaming technology, AR is now expanding its presence in various business domains like retail, healthcare, education, etc. This AR-driven progress is driven by its counterpart AI. The interconnectedness of AI and AR through big data provides opportunities for creating software applications that can provide actionable intelligence, which helps in increasing productivity and better decisions. The interconnectedness of AI-AR is critical when data and information of global magnitude is involved. Data is the most vital aspect of the AI-AR ecosystem and other important aspects of this interconnectedness are cloud computing, network connectivity, infrastructure, devices, interface and research communities.

The combination of AI and AR gives the users the ability to see the unseen. This convergence helps to reduce both tangible and intangible costs. Product manufactures, in the earlier days of manufacturing, made physical models or prototypes of their products and any design changes to these led to heavy costs. But in modern times, with the growing interconnectedness of AI and AR, manufacturers can build digital models of their products and can also easily accommodate any design changes without having to bear heavy costs for such changes. There is savings in terms of money, time, material and efforts. The AI-AR duo has the ability to test assumptions and provide alternative outcomes.

This interconnectedness can be enhanced in various settings, for example AI-driven cloud-based computer vision can be used in recognizing objects in AR-driven experiences. This combination will help the industry to go beyond the current generation of workers, employees and users; it is about building shared learnings and experiences that can be used to educate and train the next generation workforce, employees and users.

According to the survey findings released by Adobe, 47 percent of digitally mature organizations are already having an effective artificial intelligence strategy. There will be around 1 billion augmented reality users by the year 2020. Such statistics show that the AI-AR duo is here to stay. AI is the one to keep track of user behavior and AR is the one to use this user behavior to attract more users. And their interconnectedness will help to spread content beyond the physical domain.

Typically speaking, interconnectedness means global networking opportunities. There has to be a deeper dimension of the AI-AR interconnectedness for it to achieve mass adoption. There needs to be more to this interconnectedness in the '*real'* reality. The current interconnectedness is driven by money and greed, and not by a deep vision.

Contrary to computerized rationalism of the concept of interconnectedness which distances itself from the true nature of things in this world—the '*real'* concept of interconnectedness is that interconnectedness embraces everything—there is no separation. The AI-AR paradigm needs to live by the '*real'* concept of interconnectedness.

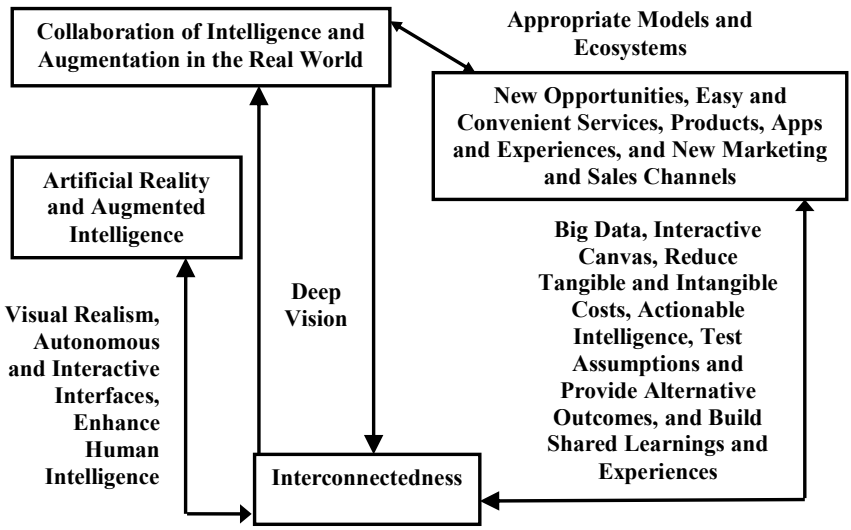

Figure 5.1 Interconnectedness

5.1.1 Artificial Reality

When artificial intelligence and its capabilities are applied to reality, we get artificial reality. The application of intelligent tools, apps and systems, through devices or machines, coupled with their interaction with the world through digitally produced content, has given rise to the dynamics of artificial reality. It is about physical reality and its aspects being infused with artificial reality-based intelligent behaviour.

Artificial reality is all about augmenting the intelligence of objects that are superimposed on the base reality. It is about introducing visual realism in the field of vision of the users and this can be achieved by embedding the necessary properties and the necessary intelligence of how they interact with the user and the environment inside the augmented elements/objects through various AI algorithms. Visual realism is about enhancing AI-AR rendering techniques to blend and render real and digital content and experiences in a coherent way.

Artificial reality goes beyond language content and tries to bring in more of the emotional content through digitally augmented objects and elements by embedding in them the finer nuances of human emotion like gestures, gaze, etc. This is the next logical step in this field. The pace at which this aspect of artificial reality progresses will depend on the complexity of the interaction between the augmented objects and elements and the real people and objects.

Artificial reality allows the users to have one foot in the real world and the other one in an artificial, imaginary place. And due to this novelty factor there is already a wave of applications hitting the shores of the technological landscape. For this wave to sustain its momentum, the elements of this reality will need to be developed in such a way that would allow both autonomous and interactive interfaces and actions.

5.1.2 Augmented Intelligence

AI has received quite a bit of a bad reputation over the years as several people fear and panic that it may lead to mass extinction of humanity. They fear that some artificial entities will take over and this is definitely one of the dystopian scenarios if AI is used without prior thought or deep consideration for its effects on humanity. But Augmented Intelligence or Intelligence Augmentation is another facet of AI that is looked at more positively as it lays stress on enhancing human intelligence rather than replacing it. Other terms that denote this role of enhancing or assisting humans in their life are machine-augmented intelligence and cognitive augmentation.

Augmented Intelligence is a new way of looking at AI. It is about supplementing human intelligence and not substituting it altogether with machine intelligence. For example popular AI applications like Cortana, Alexa, etc., if used judiciously, can help humans by doing mundane tasks on their behalf so that humans can utilize their time and headspace for more critical and creative tasks. According to the definition shared in the Information Age magazine (it is a leading business-technology *magazine* and website), Augmented Intelligence is *not to replace humans, but rather to capitalize on the combination of algorithms, machine learning, and data science to inform human decision-making abilities*. It is about giving access to tools that let them make better everyday decisions for their business. Augmented intelligence is about finding the *who*, *what*, *when* and *where* from the massive amount of data. A human then uses

this analysis and actionable intelligence to determine the *why* and take appropriate decisions.

Apps like the AstroReality's Earth app driven by the AI-AR duo augment our intelligence and understanding about our planet. It is an educational tool that utilizes science, art and technology in order to make knowledge about our planet more accessible in a fun and interactive form. With its in-depth lessons and information, it tells us about our world and its evolution. This is the power of augmented intelligence.

For the business world and its employees, it could mean good news as employees would not need to fear losing their jobs to robots but rather be more benefitted on the job with the aid of Augmented Intelligence-driven tools and applications. For businesses to leverage Augmented Intelligence to their advantage, they need to be aware of its dynamics. Aspects like machine learning, neural networks, data analysis and action-driven decisions are needed to learn about how humans think, work, learn, share, etc., in order to augment their intelligence and judgment. At the same time, organizations also need to understand and realize the importance of the emotional quotient of their employees by valuing their qualities of empathy, intuition, and so on. They need to nurture both the aspects of the equation in order to improve operational gains.

Process automation in the form of bots, analysis of patterns and trends, virtual assistants for customer request and support, and learning systems to develop cognitive computing are some of the major applications of augmented intelligence. Augmented Intelligence is about converging smart data patterns search and analysis with human insight and experience. It is about bringing business processes, employees and computer systems/machines together.

A Word of Caution

There might be a bit of a barrier as far as AI in its new avatar of augmented intelligence is concerned. If organizations fail to convince their employees and customers as to how augmented intelligence is going enhance their work and life rather than replace them then even augmented intelligence will not be willingly accepted.

5.2 Evolution or Revolution

Industry experts and corporate executives believe that for AI-AR to be an evolution, they need to not only teach new skills to their workforce

but also instill a new mindset, as it would not only be about collaborating with colleagues but with also the AI-AR duo. Standing on the cusp of both evolution and revolution, the AI-AR duo has a lot of promise but it needs to keep pace with the changes in our world or it may fall short on delivering excellent products, services, apps and experiences.

A Word of Caution

Technology evolution or revolution should be occurring in the true sense of the term and for the betterment of the world, but with hidden agendas and power structures, quite the opposite is happening in the world today—suppression of knowledge and suppression of sharing beneficial technology. The world population, including the workplace community, should be vigilant of these underlying factors that are largely responsible for the overall decay of the society.

They both will help us to evolve in all aspects thereby revolutionizing the way we live, think, work, act, learn and share. But again the real deal is not how immersive AI-AR will be but rather what kind of practical uses they will bring along with their convergence in the global social shared space. These technologies are a major part of the fourth industrial revolution.

AI-AR's evolutionary and revolutionary effects will also be disruptive in terms of network and data security challenges—these will all lead to intelligent and augmented ways of hi-tech harassment. Data and information hacking and stealing will be a thing of the past. The new cyber-crime attacks will hack and steal human experiences. Apart from ethical implications, technical issues like heavy devices will also not appeal to the masses.

On the transformative side, currently there are several training toolkits like ARCore, AI-One, ARKit, Amazon Web Services, etc., and they are helping organizations, customers and developers in understanding and implementing these technologies. But what is more important is how these developer platforms or training toolkits scale themselves for wide-scale adoption.

Based on current technology trends, in the coming years, mergers like AI-AR will bring about the next wave of computing where the big data will move away from devices and gadgets towards the whole world itself. In other words AI-AR innovations will transform the whole world into a digital interface. This is where smart cities, smart applications and other factors will come into play.

5.2.1 Smart Cities

The AI-AR convergence is about leveraging immersive technologies in the development of smart cities. The emergence of AI-AR is a key component of the Fourth Industrial Revolution. And this convergence will more significantly impact the world of smart cities once the 5G network is rolled out on a global scale. There are also other factors like the Internet of Things (IoT, in theory, is supposed to connect all devices together in a synchronistic symphony enabling them to send and receive data) and the increasing availability of Wi-Fi that will strengthen smart cities through AI-AR.

More and more companies are starting to realize how valuable IoT data is to supply chains and service capabilities, customer experience, partner relationships and much more. As all the data-sprouting devices will be interconnected through the Internet, they will be able to upload data for further processing, download updated software and often be controlled from remote locations. IoT refers to the ever-growing network of physical objects; it is about connecting devices over the Internet. More devices are being created with Wi-Fi capabilities and sensors built into them, and this is definitely making things look bright for IoT. Everyday products are getting an intelligent upgrade to become smart objects. Embedded information technology is making everyday products intelligent and smart, which will possess functionality beyond their basic purpose. Wi-Fi refers to the popular wireless networking technology which plays a key role in building smart cities by connecting citizens, communities and business entities at blazing fast speeds.

Smart cars of the future, smart homes of the future, smart offices of the future, smart manufacturing units of the future, and so many more smart scenarios and smart solutions will be a part of our lives and provide us with continuous connectivity and distributed intelligence. Marketing will also be transformed as customers will be able to have seamless access to digital products from advertisements in the physical world. All this will be fuelled by technologies such as AI-AR.

The planning and running of any city needs a good decision-making process and this is where the AI-AR duo comes into play. The tons of information generated by a city can be used by AI to enhance the decision-making process. AR can be used in tandem with AI for smart applications like simulated readings from garbage bins, streetlights, etc., help in city

maintenance works like repairing pipelines, for improving the safety of citizens, and so on. Only when a successful smart city model can be established based on sharing of appropriate data, knowledge and expertise, then successful smart city projects elsewhere in the world can flourish. It should be about making cities citizen-friendly, safer and cleaner and not just about making millions of dollars. Combining smart AI infrastructure with AR apps can help cities to respond to the dynamic variables of their environment.

By the year 2008 half the world's population began to live in urban areas and this rate continues to grow even today. To sustain such growth, smart cities are needed. But of course such cities need to be developed with their main focus on public health and safety. AI needs to be used judiciously and ethically when implemented to learn on how citizens access and use their city's resources and infrastructure. Deep learning is one aspect of AI that is being used and will continue to be used to create patterns of how people access and use their cities and their infrastructure.

The power to connect everything is definitely one of the most exciting digital developments for the foreseeable future. And this power of connecting everything in a city is only as smart as the data generated by its residents and how it is used by the AR-AI merger for merging the old with the new in order to redefine regular reality.

A Word of Caution
A smart city setup will generally have AI-AR-based devices like cameras, sensors, etc., for it to perform its functions. But again such a pervasive setup makes it very hard for people to go somewhere without being seen or followed. The concept of personal privacy and its sensitive dynamics is something that the world has not prepared adequately for it yet.

5.2.2 Smart Apps

AI-AR NewGen smart apps are the future and the future is here. These are no longer just a part of a fantasy book or a science fiction film. A few years ago these apps were not that user-friendly and they were fragmented, but now with better interfacing and an evolving ecosystem, their accessibility for users has increased. According to the International Data Corporation (IDC is a provider of market intelligence, advisory services, and events for the information technology, telecommunications, and consumer

technology markets) findings, worldwide spending on mobility solutions is forecast to grow 3.2 percent year over year in 2018, reaching more than 1.6 trillion US dollars and this is due to technologies like AI and AR.

Right from Cortana to Pokémon Go and from ELAS Speak to Just a Line, today every business is investing in AI-AR in one form or the other. The top areas that this duo is making headway in are AR-driven immersive experiences, human augmentation, etc., and AI-driven digital assistants, smart robots, conversational user interfaces, etc., and digital platforms like IoT, Blockchain, Digital Twin, etc., are also playing an integral role in the AI-AR ecosystem.

Organizations will need to continue to develop use cases for novel smart apps, which will make life easier for their users or customers, in order to keep them engaged with their brands. For example, the Starbucks app *My Starbucks Barista* app is one really user-friendly app that helps customers to place the order simply by making use of their voice.

For AI-AR smart apps, a proper automated voice interface is needed that will perform automatic speech recognition and for this more and more stable platforms are needed. AI assistants will play an integral role in the development of AR apps and headsets. The various aspects of AI like voice recognition, computer vision, etc., play an integral role in these dynamics. Smart apps based on AI-AR will truly be smart only when they incorporate intelligent voice interfaces. The real smart apps will be the ones that will free up the user's hands and allow her/him to interact with the environment in a seamless manner.

A Word of Caution
A smart app will be appealing only if the devices and gadgets used to deliver it are user-friendly. Currently due to heavy AI-AR-driven devices and gadgets, the masses may not be that ready to embrace the apps even if do *cool* things.

Many people consider AR apps to have only an *entertainment* value, but this is not true. AR smart apps are gaining traction in major sectors like healthcare, military, architecture, and so on. Smart apps like HomeSpotter, MondlyAR, Decolabs, etc., demonstrate that AR apps have it all. Moreover, with AR converging with AI, there will be plenty of opportunities for AR apps to make their presence felt across a spectrum of sectors.

5.3 Chapter Recap

1. Are you looking for ways to boost your business intelligence and achieve augmented reality experiences for your customers? The key to this question is the collaboration of intelligence and augmentation or interconnectedness of AI and AR in the real world. This interconnectedness between diverse technologies is what powers today's digital world.
2. The interconnectedness of AI-AR is critical when data and information of global magnitude is involved. Data is the most vital aspect of the AI-AR ecosystem and other important aspects of this interconnectedness are cloud computing, network connectivity, infrastructure, devices, interface and research communities.
3. Typically speaking, interconnectedness means global networking opportunities. There has to be a deeper dimension of the AI-AR interconnectedness for it to achieve mass adoption. There needs to be more to this interconnectedness in the '*real'* reality.
4. When artificial intelligence and its capabilities are applied to reality, we get artificial reality. The application of intelligent tools, apps and systems, through devices or machines, coupled with their interaction with the world through digitally produced content, has given rise to the dynamics of artificial reality. It is about physical reality and its aspects being infused with artificial reality-based intelligent behaviour.
5. Artificial reality goes beyond language content and tries to bring in more of the emotional content through digitally augmented objects and elements by embedding in them the finer nuances of human emotion like gestures, gaze, and so on.
6. Augmented Intelligence or Intelligence Augmentation is another facet of AI that is looked at more positively as it lays stress on enhancing human intelligence rather than replacing it. Other terms that denote this role of enhancing or assisting humans in their life are machine-augmented intelligence and cognitive augmentation. For the business world and its employees, it could mean good news as employees would not need to fear losing their jobs to robots but rather be more benefitted on the job with the aid of Augmented Intelligence-driven tools and applications.

7. Industry experts and corporate executives believe that for AI-AR to be an evolution, they need to not only teach new skills to their workforce but also instill a new mindset, as it would not only be about collaborating with colleagues but with also the AI-AR duo. Standing on the cusp of both evolution and revolution, the AI-AR duo has a lot of promise but it needs to keep pace with the changes in our world or it may fall short on delivering excellent products, services, apps and experiences.
8. Based on current technology trends, in the coming years, mergers like AI-AR will bring about the next wave of computing where the big data will move away from devices and gadgets towards the whole world itself. In other words AI-AR innovations will transform the whole world into a digital interface. This is where smart cities, smart applications and other factors will come into play.
9. The AI-AR convergence is about leveraging immersive technologies in the development of smart cities. The emergence of AI-AR is a key component of the Fourth Industrial Revolution. And this convergence will more significantly impact the world of smart cities once the 5G network is rolled out on a global scale.
10. The planning and running of any city needs a good decision-making process and this is where the AI-AR duo comes into play. The tons of information generated by a city can be used by AI to enhance the decision-making process. AR can be used in tandem with AI for smart applications like simulated readings from garbage bins, streetlights, etc., help in city maintenance works like repairing pipelines, for improving the safety of citizens, and so on.
11. A smart city setup will generally have AI-AR-based devices like cameras, sensors, etc., for it to perform its functions. But again such a pervasive setup makes it very hard for people to go somewhere without being seen or followed. The concept of personal privacy and its sensitive dynamics is something that the world has not prepared adequately for it yet.
12. AI-AR NewGen smart apps are the future and the future is here. These are no longer just a part of a fantasy book or a science fiction film. A few years ago these apps were not that user-friendly and they were fragmented, but now with better interfacing and an evolving ecosystem, their accessibility for users has increased.

13. Organizations will need to continue to develop use cases for novel smart apps, which will make life easier for their users or customers, in order to keep them engaged with their brands. Moreover, with AR converging with AI, there will be plenty of opportunities for AR apps to make their presence felt across a spectrum of sectors.

5.4 Questions for Reflection

1. What is the difference between Artificial Intelligence and Augmented Intelligence?
2. How can AI-AR be leveraged through smart cities for achieving the greater good?
3. What is required for developing the next generation smart apps?
4. How can smart scenarios and smart solutions enhance the collaboration of intelligence and augmentation in the real world?
5. Which factors will make the interconnectedness of AI-AR strong and stable?
6. What are the evolutionary and revolutionary effects of the AI-AR duo?

Chapter 6
Challenges and Solutions

Technology has progressed rapidly in this century. It has moved from our desk to our lap, and then from our lap into our palm, and now it is slowly and steadily moving onto and in our body. The deeper developments in AI-AR are yet to come and yet with the current state of AI-AR, there is already such a deep impact on all aspects of life, including personal, work and social spheres. Due to this fact, several people are calling for consideration of ethics in implementing the AI-AR convergence. There are polarized opinions coming from various factions of the society. Several academic practitioners and industry experts believe that the convergence of AI-AR and its progress will cause problems in areas like privacy, security, human emotions, and so on. All the disadvantages and cons of AI and AR like security breaches, autonomous weapons, cyber-crimes, etc., (discussed in Chapter 1) are a recipe for dystopian/doomsday scenarios or we can rightly term them as *AIpocalypse* and *ARpocalypase*. We have already experienced some of these disadvantages and they are bound to become bigger in the coming years. Many books and films have already portrayed both the bright and bleak side of AI-AR.

The AI-AR convergence is presently a mix of utopian and dystopian scenarios. Technologies and their wonders is undoubtedly a wonderful thing, and in my software profession, I constantly marvel at these wonders, but there is a balance that needs to be maintained between the real and digital worlds, in order to enhance the utopian scenarios and eliminate the dystopian scenarios. This balance can be achieved with a mix of solutions as discussed in this chapter.

6.1 Cyber Risks

Cyber criminals and adversaries are becoming increasingly organized and complex in developing new and nefarious ways of attacking organizations and individuals. This dark net is going to spread its tentacles of multimodal,

sophisticated attacks. Apart from increase in the attacks like data sabotage, distributed denial of service, ransomeware as a service, etc., cyber security experts and analysts see new technologies like AI-AR as one of the biggest cyber security threats to organizations in the coming years. AR has the ability to blur the lines between the real and virtual worlds, and this ability can give rise to numerous inconceivable ways of harming physical safety and security, damaging digital identity, and so on.

The hyper-connected cyber environment, new technologies and latest trends like the AI-AR convergence, Internet of Things, the Cloud, wearables, etc., expansion of 4G and 5G networks, Smart Cities, mass digitization of data, etc., not only offer the business world with opportunities to create new value, but also open a gateway to a whole new world of complex and unexpected cyber risks. New uses for data are imagined or implemented on a day-to-day basis. There are millions and millions of endpoints, physical devices, data transfers, etc., involving everything from homes to vehicles and from factories to wearable devices. This gives rise to newer vulnerabilities and attack vectors.

The year 2018 was not only a worse year for data breaches, but it was the year of AI-powered cyber-attacks. Such large-scale attacks are a wakeup call for organizations to gear up their cyber risk management efforts. Many experts say that AI is not a silver bullet against cyber threats. There is quite a bit of risk associated with AI as storing and analyzing data requires that it is kept in one place, and this aspect makes such one-point data storage very vulnerable to attack vectors.

As the number of AI-AR apps as well as other apps, customers and devices increase exponentially, so do cyber risks and attacks. The constant connection between the real and digital worlds makes its users and consumers highly susceptible to attacks. With more interconnections and users come more risks. The cyber criminals and their dark net are using highly sophisticated tools and mechanisms to launch attacks on such new technologies, and they also use layers of deception in order to avoid getting apprehended.

Reducing or eliminating the human element out of the decision-making loop in many cases can cause damaging effects, especially in the field of military science and weaponization. As we continue to rely on the AI-AR convergence and its apps and services to do the thinking for us, we will need to ensure that this entire setup is made as safe and secure as possible.

The presence of the AI-AR paradigm and the Internet of Things in each and every facet of life not only aims at making people's lives easier but also aims at introducing new business models. This implies large amounts of personal as well as corporate data stored in the cloud. This also means numerous entry points for cyber criminals. One weak link/spot in this whole system equates to unlimited access and exploitation of vast amounts of critical data. An attack on an AI-AR setup or an IoT setup is not just limited to the private sector, but it could render entire public infrastructure setups like water supply, traffic lights, etc., completely useless and such massive disruption could also cause much deeper damage like loss of life.

Smart cities are mushrooming all over the planet due to rapid urbanization and growth in technology infrastructure. Their main aim is to harness the power and reach of modern technology to create a smart life for people. This is possible because of technologies like AI-AR, IoT, Big Data, and so on. Basically such cities are a network of networks, and due to this vast infrastructure, the attack surface also increases in the same proportion. An attack on a single node/device can open up a set of other devices to penetration or bring down the whole system/network; this is the cascade effect of these new attack vectors. Another risk is that of insecure infrastructure and hardware and moreover, due to the lack of standardization of such new technologies, cyber criminals can cause an entire system to shutdown. Google Glass was hacked once that allowed its video stream to be transmitted to anyone; such a scenario can broadcast anything right from harmless videos to sensitive ones.

As technology, including the AI-AR duo continues to evolve, so do the risks and challenges involved in their usage and application. Risk maturity is about being prepared for new trends that will pose new risks for the business world, anticipating the nature and impact of these new risks, and then introducing and implementing the required tools, policies and procedures to address them. All these aspects of cyber risks are going to continue to progress at breakneck speed and the organizations that will effectively adapt themselves to this progress are the ones who will succeed.

Spotlight

Forward-thinking organizational leaders need to ask and seek the answer to this cyber risk question: *How is our organization exposed further to cyber risks and attacks as a result of advanced technologies?*

6.2 Emotional Disconnect

Despite all the advantages of AI and AR, we need to step back and take a look at the bigger picture. Can this convergence be really emotionally intelligent and enhanced and sensitive in nature? By inherent nature, most people usually prefer to have some kind of an emotional aspect in their communications and interactions. AI-AR-driven systems and apps are currently more of a neutral component of any communication exchange. As AI-AR become increasingly interwoven into the fabric of our world, organizations need to ensure that they develop this duo by harnessing its good side. And this can be done by keeping the user or customer and her/his emotional needs at the center of developing any AI-AR solution, app or system.

Several startups are coming up with several social robot applications to create a robot that looks and sounds like people. For example, *Furhat* Robotics has developed a robotic *operating system based on social artificial intelligence* that can fuel the next generation of humanized robots. But the big question that remains unanswered—will this kind of social robotic interaction be truly emotional or will it only increase the inability of people to connect with each other on an emotional and empathetic level and increase the element of depersonalization.

While dealing with such technologies, we need to understand that a facial expression of an emotion is not in itself an emotion and expecting these technologies to study and reflect facial expressions through their apps is a limited approach to fully understanding the human psyche and the range of human emotions. Facial expressions are just a medium for showing a certain nuance of an emotion.

Although there is a proliferation of emotional AI-AR systems, we need to step back and analyze whether the sentiments and emotions analysis done by these systems really works or not. For example, Beyond Verbal uses AI to cater to the needs of emotional understanding and well-being; its Empath app can measure, track, log and chart emotions and moods. Microsoft HoloLens is used for observing emotion recognition in AR systems. But do all these apps and systems really understand the reason or the *why* element for the emotions expressed by human beings!

Escaping to a reality generated by AI-AR apps may not satisfy social needs and wants as successfully as the '*real'* reality. Although the online world does provide opportunities for satisfying these needs and wants to a

limited extent, but according to several experts these needs and wants are about living life in the real world and connecting with real human beings. And on the other hand, some believe that these digital realities can offer parallel lives filled with endless possibilities to people who are bored with the day-to-day drudgery of their regular reality.

A Word of Caution

The concept of *escapism* which normally people use to escape from mundane and unhappy aspects of life is becoming deeply ingrained in the social psyche. Earlier people would turn to movies and television. But with AI-AR, they will turn to another reality that is artificially intelligent and augmented with digital elements. The concept of living life in an artificial or digital reality is largely seen as an unhealthy one, which can lead to depression, withdrawal and social isolation, and can also cause disconnect with the human element within oneself.

Several industry sources are of the opinion that AI-AR apps and systems are not merely limited to commercial uses; they too can be used for something more humane. For example, emotion enabling AI-AR apps can help to increase emotional empathy and to reduce social barriers. But again there is a downside to this—what happens if artificial intelligence and augmented reality feels '*real'* like regular reality—for example, a virtual friend who feels more '*real'* than a real friend that one connects with emotionally and when one unplugs from this digital reality, there is a good possibility that one may feel more disheartened and this loss can be *harder* to deal with than losing a real friend. This could lead to yet another form of psychosis.

Emotional disconnect caused by AI-AR apps and systems that customers or users access is a major problem that needs to be tackled by the industry. According to research findings shared by Accenture, emotionally connected customers deliver 52 percent more value over and above that from customers who are highly satisfied but not emotionally connected.

6.3 Elimination of Jobs

Due to unexpected and pervasive advances in technologies like the AI-AR duo, people fear job loss at an unexpected pace. Using task-related data from 32 OECD member countries (the Organization for Economic Co-operation and Development is an intergovernmental economic

organization) researchers from OECD estimated that 14 percent of jobs are highly automatable and another 32 have a significant risk of automation.

According to the predictions of Foresight Factory (it is a consumer analytics company and also IGT's research partner), in the next 10 years, jobs in certain sectors with predictable and repetitive tasks will be taken over by automated alternatives, and people previously employed in such jobs will be forced to re-skill.

According to the findings of McKinsey, depending upon various adoption scenarios, new technologies like AI and AR will displace between 400 and 800 million jobs by 2030, requiring as many as 375 million people to switch job categories entirely. Some experts say that not only manufacturing jobs will be on the chopping block but white and blue collar jobs will be at risk too, while some other experts believe that jobs in various industries and sectors will be reduced, but not eliminated.

A two-year study from McKinsey Global Institute suggests that by the year 2030, intelligent agents and robots could do away with as much as 30 percent of the world's human labor. When people fear such a huge loss of employment, there is always a good chance of them registering their fear through violent means. Sophia, an AI-powered robot developed by Hong Kong-based Hanson Robotics was given honorary citizenship by Saudi Arabia in 2017. Citizenship to a robot and that too so early then job loss to a robot or a digital assistant is not a farfetched idea. Such situations may also result in the breakdown of social order and equality. Such a breakdown can further polarize society between high-skilled labor and low-skilled labor, between the haves and the have nots, and so on. According to statistics, over the past quarter of a century the income gap between the richest and the poorest in OECD countries has continued to widen, and technologies like AI-AR are likely to widen this gap even further. If such dire circumstances come true then it may also force the richer countries and elites to resort to authoritarianism methods just like what happened during the period of the Great Depression in the 1930s.

There is also a possibility that job loss could be minimal as human beings could function in the assistive role or will need to work only for limited hours as machines or computer system might end up doing most of the work. In such a scenario, human resources will not be completely eliminated from the work equation.

What is more important for organizations to understand is that they need to identify business processes and tasks that can be delegated to AI-AR

with an aim of ensuring that their employees get to dedicate their time to more critical processes and tasks. Organizations need to concentrate on two main aspects and they need to maintain a balance between these two: finding new ways of making labor/work more efficient and finding new uses of labor/human resources.

6.4 Technical Challenges

The technical challenges in terms of the actual technology infrastructure and implementation are also needed to be tackled. For example, the initial cost of implementing these technologies is very high which makes it inaccessible for medium and small companies/players to develop or incorporate in their business processes and offerings.

The availability of processing power is still limited although the capacity of the same has increased exponentially in the last few years due to developments like cloud computing. The bottleneck of processing power will still need to be tackled as the amount of data grows exponentially. Therefore, the tech world is constantly looking for ways to enhance the processing power and one of the major ways of doing so is quantum computing, but it has still a long way to go. Moreover, the AI-AR duo will continue to face interfacing issues as new apps and new devices enter the scene—interoperability is still a problem as there is no single or unified comprehensive framework yet that will support interoperability.

AR apps are plenty and they can run on any smartphone but what makes their mass adoption a little unrealistic at this point in time is that the hardware that goes with these apps is still not within the reach of the masses due to the price factor and moreover, the hardware is still heavy and difficult to wear for longer time periods. AR devices and headsets have different content formats—what works on one cannot run on another without significant changes. AR apps also need high bandwidth in order to fulfill the requirement of a higher refresh rate, and this adds to the cost factor of streaming the content.

Who's to be blamed in case of faulty decisions? In earlier times, it was easy to determine whose fault it was. But in the today's times, with the AI-AR duo in the picture, it is difficult to do so as these are *black box* technologies, and their underlying decision models are complex and not that transparent in nature.

The AI-AR convergence will grow only when the interfaces it uses become more invisible and this can happen only when their form factor will be

refined. A reduced form factor is something that users want but again this is a major roadblock for AI-AR as companies in this field have to tackle a lot of tradeoffs. The lack of adequate use cases is another aspect that is slowing down the adoption rate of AI-AR.

6.5 Is the AI-AR Marriage Stable: Utopian or Dystopian

The AI-AR ecosystem, if implemented judiciously, can help organizations to identify and overcome faults in their workflow in a preemptive manner. For example, in the manufacturing domain, AI-AR could be deployed to predict, detect and resolve defects before they occur. Another example could be that of identifying and correcting faulty employee behaviors and actions.

Several industry scholars, futurists and analysts state that AI-AR may also lead to more self-absorption. This will in turn lead to people living 'a less than real life' where they will miss the little joys of life as they will be completely immersed and wrapped in their own little bubble of an augmented yet artificial life.

With the AI-AR combination, the near-future world would come precariously close to the human face, with almost zero distance between this interface and us. And taking this to the next level would be about embedding this interface within the human body. Such a scenario raises several dystopian questions like what happens to human cognition, what happens to human choice, etc. With the interface, data, content, etc., coming out of the human body, it is likely that the users might be given a choice to opt out of such a deeply immersive reality, or may be not! Moreover, these kinds of embedded technologies and interfaces facilitate those who prefer to prioritize the element of evil over good. Our environment has a significant impact on our thoughts, actions and behaviors, and people could easily be manipulated through this environment. The potential for this manipulation through technologies like AI-AR is huge. Criminals and perpetrators can use AI-AR to manipulate the environment through which they can inflict trauma and pain on the users.

When used in the right manner, AI-AR can be used for enhancing human skills and abilities, and this in turn can help to create innovative workplaces and help businesses to push the boundaries for their brands. As the AI-AR duo continues to automate tasks and processes, it will facilitate human resources to focus more on growing and expanding their organizations, and this will help the global society to evolve into a new era of innovation.

The concept of Universal Basic Money (UBI is a model where people will be provided a certain sum of money regardless of their income or employment status) may look great on paper but is it really beneficial as it sounds. Many experts believe that such a system may use the returns generated by AI-AR-driven systems, machines, robots, etc. Moreover, it will be doled out to people for them doing nothing in return. This scenario definitely sounds like communism albeit a computer-controlled one and one which stifles human creativity.

Many experts believe that the collaboration with computers or machines through AI-AR will benefit all of us. Yes this is true may be in the initial years of this convergence, but too much dependency on them may adversely affect us as well, because finally this technology is a black box, and common people do not really understand the deeper dynamics of decision making done by such technologies. This may sound speculative but if we were to apply Moore's law to machine intelligence and enhanced reality then their progress and growth does not seem to halt at all. If the AI-AR duo is left unchecked and unregulated, it might start running amok, and many high profile tech voices state that then the threat of singularity might come to fruition. Singularity is about setting up a self-learning system using Digital 2.0 technologies and its ultimate goal is that of replacing or outperforming humans in everything that they do. Just as Singularity is one of the most feared dystopian scenarios, so is Transhumanism. Transhumanism is the concept of a being that resembles a human in most aspects but who has powers and abilities beyond those of standard humans; it about merging man with machine.

If used judiciously, this cutting-edge duo can be used to contribute benefits at all levels: at the corporate level, it can be used to allow employees to do remote work, achieve competitive advantage, etc., at the customer level, it can offer novel products, services and experiences, and at the world level, it can sensitize human beings to global problems like climate change, pollution, and so on.

Just as there are several benefits of AI-AR, there are pitfalls too and one such major pitfall is the rapid proliferation of the deep web, dark net and dark web as they too use the very same technologies to go mainstream. As they go mainstream, they will attract more and more users who want to engage in dark acts like pedophilia, stolen data, money laundering, arms trafficking, and so on.

According to the survey conducted by the Pew Research Center (it is a nonpartisan American fact tank that provides information on social issues, public opinion, and demographic trends shaping the United States and the world) and Elon University's Imagining the Internet Center (its aim is to explore and provide insights into emerging network innovations, global development, dynamics, diffusion and governance), about 47 percent of the survey respondents predict that individuals' well-being will be *more helped than harmed* by digital life in the next decade, while 32 percent say people's well-being will be more *harmed than helped. And the* remaining 21 percent feel there will *not be much change in people's well-being* compared to now. There is a mixed reaction about how digital life, including the impact of AI-AR convergence, will affect humanity.

The AI-AR duo can be put to good use by developing it in such a way that the intellectual process of human beings improves. This in turn can help human beings in their times of critical decisions and choices. It is about ensuring that the customers/users are fully engaged in terms of their intellect and emotions when it comes to using AI-AR, right from the design to usage of AI-AR apps and systems. By offering new and engaging experiences to the users, organizations will be able to meet both corporate and corporate social responsibility goals.

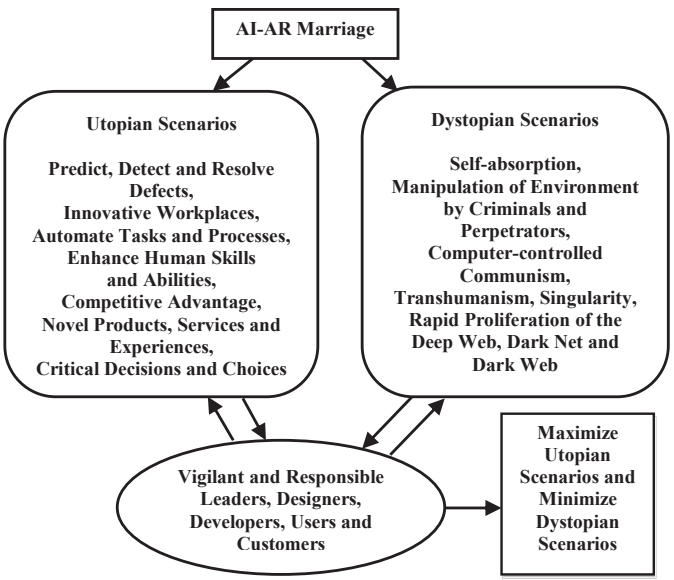

Figure 6.1 The AI-AR Marriage: Utopian or Dystopian

The AI-AR marriage may seem stable at times and not so stable at other times. It is a mix of plus points and negative points. We as vigilant and responsible leaders, designers, developers, users and customers are in a position to define and implement ways in which we enhance the good side and eliminate the negative aspects of this convergence.

6.6 Solutions

The Future of Life Institute (it is a volunteer-run research and outreach organization that aims to lessen existential risks facing humanity, particularly existential risk from advanced artificial intelligence) has drafted an open letter *on making AI more capable, but also on maximizing the societal benefit of AI*. To date, this open letter has been signed by over 8,000 people including certain industry bigwigs. Such corporate social responsibility initiatives need to be launched and made accessible to one and all. Organizations should join such initiatives and pledge to harness the good side of AI-AR to develop systems and apps that improve the emotional connect factor and also help the vulnerable groups (migrants, disabled people, etc.) of society to survive in today's times. The concept of human-centered design is the key to implementing responsible AI-AR systems and apps.

To minimize the challenges brought about by the AI-AR convergence and to be able to operationalize it in the business landscape, what is needed is a stable, agile business intelligence (BI) platform that can be able to integrate these new technologies into existing processes. Another important feature of an agile BI platform is developing uses cases for AI and AR in order to achieve an enhanced workflow. Organizations need to design their BI platform in such a way that it can identify uses cases for existing problems that AI-AR can solve and further to this, the platform should also be able to prioritize these use cases, get a buy-in from management, and assign appropriate resources to these use cases. The most critical aspect of implementing use cases is 'test, test and test again' in order to identify and deal with any ethical, social, legal and technical loopholes upfront.

The AI-AR use cases of the future do have the potential to bring about reality filtering to allow the users to view a different reality—a view which provides a different position relative to the current spot without the user moving. This concept of reality filtering has both pros and cons. But the business community needs to ensure that it implements the good side of it—reality filtering can be the answer to maintaining privacy, especially

in collaborative applications, or helping to focus users' attention more narrowly on the main task in context.

The AI-AR genie is out of the bottle. Although this genie is in its initial stage, it definitely has the potential to sway things away from a utopian fourth revolution towards a dystopian breakdown of society kind of future. The world will need to take up responsibility of developing and adopting the AI-AR marriage in a mature manner. Several industry experts are of the opinion that we all should be working on solutions now, even if some of the dystopian scenarios lie far in the future. For example, rather than introducing Universal Basic Income, governments, academia, educational institutions, civic society and organizations should focus on developing technical education and high-end skills that will help people to work efficiently in the AI-AR setup and reduce their fear of job loss due to automation.

Organizations that work with technologies like AI-AR need to have a comprehensive risk mitigation strategy and framework in place. This strategy should involve: risk identification, risk impact evaluation, risk prioritization, risk mitigation implementation, and monitoring. The various risks and their relationships should be identified through all these steps. Thereafter, probabilities and consequences need to be assessed. Then these risks need to be categorized into priority levels right from least critical to most critical. Medium to most critical risks will need to be tackled through a detailed mitigation implementation plan, whereas least critical risks can be put on the 'watch' list. The most important aspect is that of monitoring this entire process in order to reassess existing risks and spot new ones. Legal and regulatory compliance measures, role of executive leadership and chief information security officer (CISO), industry standards, strategies, regulations, frameworks and best practices, response plans and procedures, and cyber security capabilities are integral components of the mitigation strategy and framework. These components in turn are all components of change, which need to be managed in an iterative manner. This change management process should be fine-tuned on the basis of thorough analysis of how an organization has executed the mitigation strategy and framework against the previous cyber security objectives. A forward-leaning, all-inclusive focus is what will enable businesses and organizations to develop the capability to keep pace with this ever-evolving cyber threatscape.

*Flexibility and adaptability to disruption is the key to survival. B*oth the existing workforce as well as the emerging workforce needs to be trained to be adaptable, dynamic and flexible. They need to develop skills that will change their attitude towards disruption. Organizations need to ensure that their employees never ever feel insecure and rather the organizations need to develop a culture of care, innovation, collaboration and creativity in parallel to the growth of these disruptive (or transformative) technologies.

These technologies can't survive and thrive on their own, and they will need to marry with human creativity and intelligence, in order to sustain the rise of the new data intelligence societies. With such converging technologies leading the way, the workplace culture demands that companies and employees must be willing to alter their old way of viewing and doing things. Re-skilling and up-skilling in the workplace and a radical shift in education curriculum is needed to keep the workforce relevant and active. Skills like critical thinking, entrepreneurship, problem solving, etc., are very crucial to survive and thrive in these competitive times. Skills befitting the new wave of professionals arising from the sea of AI-AR opportunities will need to be developed and nurtured. Organizations will need to develop on-the-job training for these new skills. Building the talent pipeline from within is a less costly affair than hiring specialists from the outside. Several new job titles are being created and will continue to be created on the AI-AR horizon; some of these specialist job titles are computer vision engineer, experiential marketing expert, data scientist, etc. Organizational leaders will need to understand as to how to leverage human abilities in AI-AR age.

Organizations need to leverage AI-AR to build well-being technology in the workplace. They should use the AI-AR duo as an enabler of workplace health and well-being. Similarly, organizations need to use this duo to chart out a career growth plan for each of the employees so that the employees feel valued and also learn to develop trust in these new technologies. If organizations use the AI-AR duo for building employee trust while traversing the landscape of these new technologies then there is bound to be improved transparency and innovation in the workplace.

Apart from the importance of the above aspects in providing solutions to the challenges and limitations of the AI-AR paradigm, the role of enlightened engineers and a culture of care and collaboration is the way forward—these factors will help to minimize the roadblocks even more on the AI-AR tech highway.

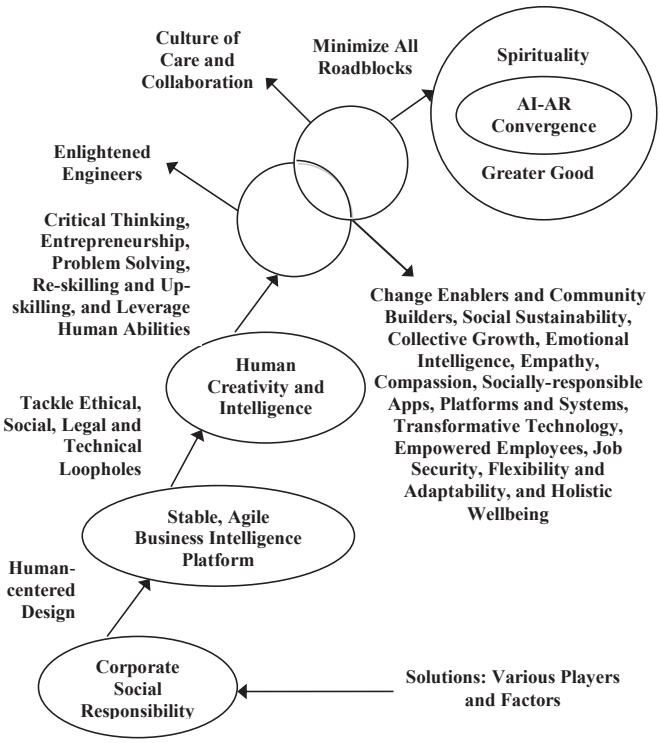

Figure 6.2 Solutions: The Way Forward

6.6.1 Role of Enlightened Engineers

Transforming oneself from *mere* technology engineers to *mindful* enlightened engineers is the key to leading a more meaningful life. We as a collective consciousness need to overcome all the polarities or in technical terms all the binaries—yes/no, on/off, etc. Transcending this dichotomy is a must to move towards a deeper experience and awareness of the intangibles of spiritual progress along with a reasonable level of technological progress by leveraging the AI-AR paradigm. This type of a progressive mindset is needed at all tiers of an organization in order to experience harmonic convergence of knowledge gained from various sources like study, observation or experience from various facets of life, including technological progress. This harmonic convergence can be achieved only when we as enlightened engineers overcome all the binaries of mundane existence.

Thinking about life only in terms of technology is foolishness. Technology platforms, tools, apps, etc., like the AI-AR duo, smartphones, tablets, laptops, etc., are a limited part of our identity and reality. The real software is embedded in one's DNA—the software to format and reprogram one's reality for the better. This software has the code that can free us from learned notions, limitations and preconceived perceptions. These are all externally defined factors that have been imprinted deep in the psyche. Enlightened engineers understand this inherent truth and live by their true calling while designing and deploying new technologies like AI-AR.

Spotlight

At the intersection of the digital era and the spiritual quest, there are dozens of crossroads to take in the form of scores of AI algorithms, endless Facebook pages, thousands of twitter feeds, hundreds of YouTube videos, unlimited AR apps, etc.,—only an enlightened engineer will know from within that wisdom and wellbeing does not really reside on the AI-AR app, or on the IPhone, or in the virtual chat room alone.

Just like the Wisdom 2.0 Conference (it is the premiere gathering focused on exploring the intersection of wisdom and technology) that provides a platform through a series of conferences, meet-ups, and workshops for participants to live with greater wisdom, purpose and meaning, while using technology in ways that create a more open and healthy culture, in a similar manner, we need to upgrade our own inner wisdom. And this next version should provide a human-to-human platform for increasing the number of enlightened engineers.

Technology engineers who are enlightened in the true sense of the term are not mere entrepreneurs or leaders in their organizations, but they are a few steps ahead of their counterparts. They are change enablers and community builders thinking of the next big thing, not just in terms of technology like AI-AR, but also in terms of spiritual configuration that can trigger personal growth, organizational success, and collective progress. They want to build technology, tools and apps that lift people up and inspire people to follow their hearts.

Music, sports, and now ecstasy-generating tools have helped us reach an altered state for years together—to get out of our heads and into the flow of innate discovery. Enlightened engineers do acknowledge these new generation tools, and at times also use the bridge of technology to access the gateway of transformation, but their main focus is eventually on using

their own inner software to do so. On the one hand, they do help to develop tools and apps for bringing meditation and other spiritual practices into the market place, but they also know their responsibility of ensuring that their customers are benefitted by these tools and do not become prey to the culture of competitive consumerism.

Social sustainability is yet another aspect that enlightened engineers tend to focus on, as they have realized that life is not just about economic and materialistic development. It is also about the spiritual dimension. It is not a destination to be reached, but a dynamic process requiring a balance between our inner and outer lives, a balance between society and nature, and a balance between the present and the future potential to maintain this balance. Enlightened engineers have both the skills and willpower to bring about this balance, which then can lead to sustainable self-supporting cooperative communities, both virtual and physical. And this helps them to leverage cutting-edge technologies like AI-AR in the right manner, for the greater good.

Enlightened engineers are the ones who have realized that mere artificial intelligence, augmented reality or a combination of both is not the key to having an overall positive work life experience, but also to transform an individual's outlook on all aspects of life, to nurture emotional intelligence and to develop a real connection with the physical reality are a must. This very philosophy is reflected in their work practices and work output. They are actively seeking ways of promoting the awareness that empathy and compassion can and will be good for business profits, customer satisfaction, and for personal as well as collective growth.

6.6.2 Culture of Care and Collaboration

Organizations need to think in terms of relatedness and connection even as each and every element within the greater scheme of things is distinctive. So when we speak of mission and values integration in relation to workplace spirituality, we can readily see that both efforts strive for the fulfillment of the business mission and the holistic wellbeing of organizations, employees, families and the community as a whole. The culture of care and collaboration is about empowering employees. It also includes developing and deploying socially-responsible AI-AR apps, platforms and systems as well.

Responsible organizations are the ones who take the reins of *Transformative Technology* in their hands in order to actually transform

technology that previously divided or distracted their employees and users into technology that empowers, connects and humanizes the world. This *Transformative Technology* or *TransTech* is the need of the hour. Once it picks up momentum, it will not take much time for it to become a global movement. The Transformative Technology Conference is a groundbreaking community event in the Silicon Valley that brings the ignited and brightest minds in this space under one roof and also provides opportunities for building the next generation of TransTech experts, or should we say enlightened engineers and empowered employees.

It is commonly seen in most organizations that organizational success is driven by profits and competition. This is acceptable to a certain extent, but organizations should not get obsessed by these factors. They need to look beyond mere numbers and finance reports. They need to move from competition to collaboration. They need to replace apathy with empathy. Only then their leaders and teams will follow in their footsteps. Only then they will be able to develop new apps and systems using the AI-AR duo with responsibility and accountably.

In my own software management consultancy over a period of time and with concerted efforts put in by every single employee, we have come to realize that we are more than a team…we are a family…we care for each other and we go above and beyond for each other. I have introduced simple things in my management consultancy to not only cater to cognitive values like teamwork but also to cater to the spiritual and emotional values of my employees. This very approach can then be carried forward to the next level, i.e., into developing AI-AR systems with a sense of moral obligation and social responsibility towards the society.

Spotlight
A large-scale research and knowledge exchange partnership across multiple disciplines is needed to spread the wave of enlightened engineering that builds a culture of care and collaboration through transformative technologies like the AI-AR convergence across the globe in a responsible and ethical manner.

6.7 Chapter Recap

1. Technology has progressed rapidly in this century. It has moved from our desk to our lap, and then from our lap into our palm, and now it is slowly and steadily moving onto and in our body. The deeper

developments in AI-AR are yet to come and yet with the current state of AI-AR, there is already such a deep impact on all aspects of life, including personal, work and social spheres. Due to this fact, several people are calling for consideration of ethics in implementing the AI-AR convergence. There are polarized opinions coming from various factions of the society.

2. The hyper-connected cyber environment, new technologies and latest trends like the AI-AR convergence, Internet of Things, the Cloud, wearables, etc., expansion of 4G and 5G networks, Smart Cities, mass digitization of data, etc., not only offer the business world with opportunities to create new value, but also open a gateway to a whole new world of complex and unexpected cyber risks.
3. The cyber criminals and their dark net are using highly sophisticated tools and mechanisms to launch attacks on such new technologies, and they also use layers of deception in order to avoid getting apprehended. Forward-thinking organizational leaders need to ask and seek the answer to this cyber risk question: *How is our organization exposed further to cyber risks and attacks as a result of advanced technologies?*
4. By inherent nature, most people usually prefer to have some kind of an emotional aspect in their communications and interactions. AI-AR-driven systems and apps are currently more of a neutral component of any communication exchange. As AI-AR become increasingly interwoven into the fabric of our world, organizations need to ensure that they develop this duo by harnessing its good side. And this can be done by keeping the user or customer and her/his emotional needs at the center of developing any AI-AR solution, app or system. Escaping to a reality generated by AI-AR apps may not satisfy social needs and wants as successfully as the '*real'* reality. Although the online world does provide opportunities for satisfying these needs and wants to a limited extent, but according to several experts these needs and wants are about living life in the real world and connecting with real human beings.
5. Emotional disconnect caused by AI-AR apps and systems that customers or users access is a major problem that needs to be tackled by the industry. According to research findings shared by Accenture, emotionally connected customers deliver 52 percent more value

over and above that from customers who are highly satisfied but not emotionally connected.

6. Due to unexpected and pervasive advances in technologies like the AI-AR duo, people fear job loss at an unexpected pace. What is more important for organizations to understand is that they need to identify business processes and tasks that can be delegated to AI-AR with an aim of ensuring that their employees get to dedicate their time to more critical processes and tasks. Organizations need to concentrate on two main aspects and they need to maintain a balance between these two: finding new ways of making labor/work more efficient and finding new uses of labor/human resources.
7. The technical challenges in terms of the actual technology infrastructure and implementation are also needed to be tackled. The bottleneck of processing power will still need to be tackled as the amount of data grows exponentially. AR apps are plenty and they can run on any smartphone but what makes their mass adoption a little unrealistic at this point in time is that the hardware that goes with these apps is still not within the reach of the masses due to the price factor and moreover, the hardware is still heavy and difficult to wear for longer time periods. Who's to be blamed in case of faulty decisions? In earlier times, it was easy to determine whose fault it was. But in the today's times, with the AI-AR duo in the picture, it is difficult to do so as these are *black box* technologies, and their underlying decision models are complex and not that transparent in nature.
8. The AI-AR ecosystem, if implemented judiciously, can help organizations to identify and overcome faults in their workflow in a preemptive manner. Several industry scholars, futurists and analysts state that the AI-AR may also lead to more self-absorption. With the AI-AR combination, the near-future world would come precariously close to the human face, with almost zero distance between this interface and us. And taking this to the next level would be about embedding this interface within the human body. Such a scenario raises several dystopian questions like what happens to human cognition, what happens to human choice, and so on. When used in the right manner, AI-AR can be used for enhancing human skills and abilities, and this in turn can help to create innovative workplaces and help businesses to push the boundaries for their brands.

9. Many experts believe that the collaboration with computers or machines thorough AI-AR will benefit all of us. Yes this is true may be in the initial years of this convergence, but too much dependency on them may adversely affect us as well, because finally this technology is a black box, and common people do not really understand the deeper dynamics of decision making done by such technologies. If used judiciously, this cutting-edge duo can be used to contribute benefits at all levels: at the corporate level, it can be used to allow employees to do remote work, achieve competitive advantage, etc., at the customer level, it can offer novel products, services and experiences, and at the world level, it can sensitize human beings to global problems like climate change, pollution, and so on.
10. Just as there are several benefits of AI-AR, there are pitfalls too and one such major pitfall is the rapid proliferation of the deep web, dark net and dark web as they too use the very same technologies to go mainstream. As they go mainstream, they will attract more and more users who want to engage in dark acts like pedophilia, stolen data, money laundering, arms trafficking, and so on.
11. The AI-AR duo can be put to good use by developing it in such a way that the intellectual process of human beings improves. This in turn can help human beings in their times of critical decisions and choices. It is about ensuring that the customers/users are fully engaged in terms of their intellect and emotions when it comes to using AI-AR, right from the design to usage of AI-AR apps and systems. By offering new and engaging experiences to the users, organizations will be able to meet both corporate and corporate social responsibility goals.
12. The AI-AR marriage may seem stable at times and not so stable at other times. It is a mix of plus points and negative points. We as vigilant and responsible leaders, designers, developers, users and customers are in a position to define and implement ways in which we enhance the good side and eliminate the negative aspects of this convergence.
13. The Future of Life Institute has drafted an open letter *on making AI more capable, but also on maximizing the societal benefit of AI*. To date, this open letter has been signed by over 8,000 people including certain industry bigwigs. Such corporate social responsibility initiatives need to be launched and made accessible to one and all.

14. To minimize the challenges brought about by the AI-AR convergence and to be able to operationalize it in the business landscape, what is needed is a stable, agile business intelligence (BI) platform that can be able to integrate these new technologies into existing processes. Another important feature of an agile BI platform is developing use cases for AI and AR in order to achieve an enhanced workflow.
15. The AI-AR use cases of the future do have the potential to bring about *reality filtering* to allow the users to view a *different* reality—a view which provides a different position relative to the current spot without the user moving. This concept of reality filtering has both pros and cons. But the business community needs to ensure that it implements the good side of it—reality filtering can be the answer to maintaining privacy, especially in collaborative applications, or helping to focus users' attention more narrowly on the main task in context.
16. Organizations that work with technologies like AI-AR need to have a comprehensive risk mitigation strategy and framework in place. This strategy should involve: risk identification, risk impact evaluation, risk prioritization, risk mitigation implementation, and monitoring. A forward-leaning, all-inclusive focus is what will enable businesses and organizations to develop the capability to keep pace with this ever-evolving cyber threatscape.
17. Flexibility and adaptability to disruption is the key to survival. Both the existing workforce as well as the emerging workforce needs to be trained to be adaptable, dynamic and flexible. They need to develop skills that will change their attitude towards disruption. Organizations need to ensure that their employees never ever feel insecure and rather the organizations need to develop a culture of care, innovation, collaboration and creativity in parallel to the growth of these disruptive (or transformative) technologies.
18. These technologies can't survive and thrive on their own, and they will need to marry with human creativity and intelligence, in order to sustain the rise of the new data intelligence societies. With such converging technologies leading the way, the workplace culture demands that companies and employees must be willing to alter their old way of viewing and doing things. Re-skilling and up-skilling in the workplace and a radical shift in education curriculum is needed to keep the workforce relevant and active. Organizational leaders will

need to understand as to how to leverage human abilities in AI-AR age.

19. Organizations need to leverage AI-AR to build well-being technology in the workplace. They should use the AI-AR duo as an enabler of workplace health and well-being. Similarly, organizations need to use this duo to chart out a career growth plan for each of the employees so that the employees feel valued and also learn to develop trust in these new technologies. If organizations use the AI-AR duo for building employee trust while traversing the landscape of these new technologies then there is bound to be improved transparency and innovation in the workplace.
20. Apart from the importance of the above aspects in providing solutions to the challenges and limitations of the AI-AR paradigm, the role of enlightened engineers and a culture of care and collaboration is the way forward—these factors will help to minimize the roadblocks even more on the AI-AR tech highway.
21. Technology engineers who are enlightened in the true sense of the term are not mere entrepreneurs or leaders in their organizations, but they are a few steps ahead of their counterparts. They are change enablers and community builders thinking of the next big thing, not just in terms of technology like AI-AR, but also in terms of spiritual configuration that can trigger personal growth, organizational success, and collective progress. They want to build technology, tools and apps that lift people up and inspire people to follow their hearts.
22. Social sustainability is yet another aspect that enlightened engineers tend to focus on, as they have realized that life is not just about economic and materialistic development. It is also about the spiritual dimension. It is not a destination to be reached, but a dynamic process requiring a balance between our inner and outer lives, a balance between society and nature, and a balance between the present and the future potential to maintain this balance. Enlightened engineers have both the skills and willpower to bring about this balance, which then can lead to sustainable self-supporting cooperative communities, both virtual and physical. And this helps them to leverage cutting-edge technologies like AI-AR in the right manner, for the greater good.

23. Organizations need to think in terms of relatedness and connection even as each and every element within the greater scheme of things is distinctive. So when we speak of mission and values integration in relation to workplace spirituality, we can readily see that both efforts strive for the fulfillment of the business mission and the holistic wellbeing of organizations, employees, families and the community as a whole. The culture of care and collaboration is about empowering employees. It also includes developing and deploying socially-responsible AI-AR apps, platforms and systems as well.
24. It is commonly seen in most organizations that organizational success is driven by profits and competition. This is acceptable to a certain extent, but organizations should not get obsessed by these factors. They need to look beyond mere numbers and finance reports. They need to move from competition to collaboration. They need to replace apathy with empathy. Only then their leaders and teams will follow in their footsteps. Only then they will be able to develop new apps and systems using the AI-AR duo with responsibility and accountably.
25. A large-scale research and knowledge exchange partnership across multiple disciplines is needed to spread the wave of enlightened engineering that builds a culture of care and collaboration through transformative technologies like the AI-AR convergence across the globe in a responsible and ethical manner.

6.8 Questions for Reflection

1. How would we as a society adapt to the AI-AR revolution that could lead to potential job loss?
2. Why are ethics so critical when it comes to technology?
3. How can we avoid unintended consequences of the AI-AR convergence?
4. Has your organization's management formulated a comprehensive cyber risk management program?
5. Has your organization taken proper measures to keep the data safe from the hands of hackers and terrorists?

6. Can the AI-AR convergence be really emotionally intelligent and enhanced and sensitive in nature?
7. Should we limit automation in the workplace?
8. What types of cyber risks are introduced due to new and emerging technologies?
9. How conscious and mindful are you when you are connected to the digital world?

Chapter 7
Where do We Go from Here

There are some trends that fizz out over time and then there are some that are here to stay and make their presence and impact felt on the world map. As they say the future is now! As the lines between the real, physical and the artificial, augmented worlds blur, each one of us will need to be aware of what benefits do the technologies behind this blurring bring to the business world and to the global community. In the year 2013, a survey was carried out where hundreds of AI experts were asked on when they thought there was a 50/50 chance that human-level AI would be possible. The median answer given in this survey was by 2040. According to AngelList (it is a platform for startups, angel investors, and job-seekers looking to work at startups) statistics, more than 1 billion people are expected to use augmented reality products globally in 2020.

The world of AI-AR convergence is split into two main groups representing the opposite ends of the AI-AR spectrum: optimists and pessimists, as well as people in between. The optimists believe that this convergence will be able to solve many of the global problems that the world is facing today whereas the pessimists believe that this convergence might lead to a Matrix-film-like existence for humanity where machines take over the planet and use humans as their slaves. Although we don't know the exact future landscape of AI-AR, it is quite evident from current development and anticipated trends that our lives will definitely get more intertwined with the AI-AR duo!

7.1 Global Scenarios

Tech companies aren't the only ones to invest heavily in AI and AR. The Chinese government is also doing this and it has also stated that it has planned to reach the level of United States in the field of artificial intelligence by 2020 and become the world leader by 2030. According to Market Research Future (MRFR provides market research studies

by products, services, technologies, applications, end users, and market players for global, regional, and country level market segments), the global augmented reality market is estimated to expand at 39 percent compound annual growth rate during the period 2017-2023. Researchers at Technavio (it is a leading global technology research and advisory company with a focus on emerging technology trends) forecast the global artificial intelligence market to grow at compound annual growth rate of more than 50 percent until 2021. Experts predict by 2040, AI-AR will be embedded in everything and this duo will be everywhere, but of course all this depends on how well the challenges are tackled.

The AI-AR duo will revolutionize the world in various ways; they are already changing and will continue to change the narratives of our lives. This duo will enable 3D automated, augmented avatars that will have the ability to create an immersive environment for communication and other fields like transport, automated driving, and so on. This duo has the power to transform this world into a single world computer. AI-AR can be used in sensory enhancement through expanded sensory channels that could be helpful to people with some kind of sensory impairment.

Nanosizing several industries and functions is doable with AI-AR. For example, Oral Roberts University has created access to 500,000 intelligent learning environments accessible to anyone anywhere in the world thereby creating a truly global campus around the world; voice and text can be added to objects in these learning environments thereby making the lessons complete and interactive in nature. The pairing of AI-AR is already creating waves in product design and manufacturing. Companies and engineers are already using this pair to develop products using 3D modeling software to roll out products that are perfected for functionality, fit and form, and that too at a much lower cost.

Companies are already leveraging the machine learning feature of AI to detect and counteract cyber attacks. Apart from cyber security solutions, AI-driven edge computing is the next big thing. Edge computing is one step ahead of the cloud. It is computing that is done at or near the source of the data in terms of content collection, processing and delivery (whereas the cloud involves multiple data centers). The main aim of Edge Computing is to reduce latency by keeping the traffic local. Making the entire edge computing infrastructure intelligent is where AI comes into picture. One such notable player that builds AI infrastructure for the Edge is SWIM.AI (it is a company that delivers relevant business and

operational insights through its software platform that combines the power of Edge AI, machine learning, digital twin, and so on). Edge AI is on the verge of becoming a trend worldwide. In Edge AI, the AI algorithms are processed locally on a device and the algorithms are using data that is on the device itself. Imagimob has implemented several applications of Edge AI through its motion intelligence system, SensorBeat.

Through their innovative platforms, global giants like Google, Facebook, etc., have already set the stage for others in the tech world. Facebook's AR engine brings real-time AI right to your phone. The Facebook app uses a technique called *style transfer* that helps people to turn their images and videos into works of art. The AR engine is used to implement AI's deep learning system called Caffe2Go (a lightweight machine learning system), which captures, analyzes and process pixels in real-time. Facebook uses Caffe2Go to deliver high-quality AR experiences on Instagram, Messenger, and so on. Facebook is committed to sharing apps, engines, softwares, platforms, etc., with the community in order to develop cross-platform, open and globally connected AI-AR systems. Google has been using AI-AR in its apps, products, services and projects for quite some time now. Google Lens is a good example of blending AI and AR. Google considers Google Lens as the *future of search* where AI and AI-enabled capabilities like natural language processing and computer vision are used to perform an AR-based lookup; it uses your phone's camera to identify objects and then gives you contextual information about these objects. The Google Lens platform promises to offer AI-AR breakthroughs in the coming years.

The collaboration of IBM and Unity goes to show how AI and AR can be combined to provide powerful interfaces like conversational, speech to text, and so on. Working with AI-AR is now easier with the IBM Watson Unity SDK. It adds the power of AI to AR enterprise applications. IBM Watson's effective AI-driven cloud services will help to develop powerful AR apps.

From all these global scenarios, one thing is for sure that organizations are creating customer touch points using AI-AR in all possible fields. Currently, it looks like organizations are focused on building assistive apps using intelligent and augmented apps, touch points and interfaces. From all these scenarios, we can also infer that due to AI-enabled computer vision capability, AI will become AR's eye. It is about transforming physical experiences into a digital world and building a global immersive experience.

A Word of Caution
These global scenarios need to be shaped by the tech industry in such a way that they give rise to a new generation of *knowledge workers* or else these scenarios may bring about the paradigm of *automate and replace*—a dystopian scenario feared by most people.

7.2 Status of AI-AR in India

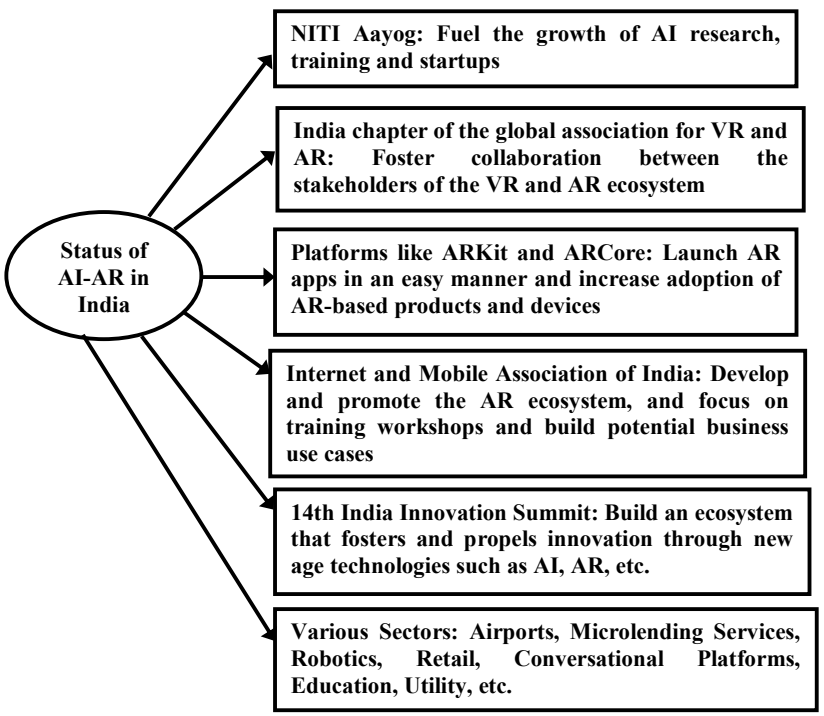

Figure 7.1 Status of AI-AR in India

According to the 2017 statistics shared by Statista (it is an online statistics, market research and business intelligence portal), 78 percent of organizations globally are either using AI or have plans for use in near future. However, adoption of AI in India has been slow. Estimates show that only 22 percent of the firms in India use AI, but things are changing and will continue to pick up pace with the Indian Government's efforts through the NITI Aayog. The NITI Aayog (also known as the National

Institution for Transforming India and it is a policy think tank of the Government of India) has partnered with Google to work on a range of initiatives to help build the AI ecosystem across the length and breadth of India. The main aim of this partnership is to fuel the growth of AI research, training and startups.

Though AI-AR is in the nascent phase in India, it is already trending in India. There are several players in this domain that are in the process of transforming the AI-AR landscape in India. For example, the India chapter of the global association for VR and AR is a global organization that fosters collaboration between the stakeholders of the VR and AR ecosystem by promoting growth, developing industry standards and facilitating education and research. Another example is that of Fluid AI which focuses on combining AI and AR for their customer experience management. AR technology is also part of their AI space and apart from artificial intelligence directing the customers and interacting with them, it facilitates an AR environment where the customers can interact with the technology by virtually putting the customers onto the screen. Xenium Digital (it is a leading experiential and digital marketing agency in India) helps companies build great brands by creating engaging experiences for consumers using AR.

In a country like India where smartphones are becoming common day by day and the user base is growing rapidly, there is considerable scope for AR. Moreover, development platforms like ARKit and ARCore are allowing Indian developers to launch AR apps in an easy manner. Increasing adoption of AR-based products and devices in various fields like consumer electronics, defense, etc., is going to be the driving factor for the growth of market over the next five years.

International airports, including Indian airports are leveraging AI for their operations in order to make air travel easier and convenient. SITA (it is a multinational information technology company providing IT and telecommunication services to the air transport industry) is planning to introduce 100 percent biometric air travel in India. Other developments include chatbot assistants, prediction and warning systems, and so on. For example, the Bangalore international airport uses a robot assistant named KEMPA that has the ability to suggest places to visit in Karnataka, answer flight-related queries, and so on.

The tech giant Accenture has developed AI and AR apps that facilitate microlending services and helps its users to better understand financial

products and services. It has tied up with the Grameen Foundation India with an aim to provide these services to 300 villages in the states of Orissa and Maharashtra. This project and its apps will facilitate the underprivileged segment and the women of India to have more control over their lives

Wipro's (it is an India-based information technology, consulting and business process services company) initiative Wipro TechPubs is working on advanced technologies like AI, AR, and so on. It provides AI-based micro content automation framework to its customers. On the AR front, it provides rich visual interactive experiences to its customers and users; it provides them with service instructions, diagnostic information, etc., in order to resolve problems.

The AI-driven field of Robotics is young but an emerging market in India. Industry statistics predict that there will be at least 24,000 industrial robots in India by the year 2017. According to Accenture statistics, AI has the potential to add 957 billion dollars to India's economy in 2035. The augmented reality and virtual reality market in India is projected to register a compound annual growth rate of 55.3 percent during the period 2016–2021.

A Word of Caution

For India to be a part of the AI-AR game, it needs to up its own game. It needs to slowly cut down its dependence for such technologies on US global tech giants like Amazon, IBM, and so on. If India does not gear up towards developing indigenous frameworks, polices, platforms and solutions, it is bound to lose track in this tech race.

The Internet and Mobile Association of India (IAMAI is a not-for-profit industry body with an aim to provide a unified platform of growth for the businesses operating in the mobile and Internet industry) has formed a new industry expert committee to develop and promote the AR ecosystem in India. It will focus on training workshops, build potential business use cases, and help organizations take advantage of new opportunities emerging from AR.

There are several forerunners in the AI-AR space in India. Myntra (it is a leading Indian online fashion retailer) believes that the AI-AR duo will enhance user/consumer connect. It uses AI to develop machine-generated designs and uses AR to enhance the connect factor with its

customers. Haptik is another major player and it is one of the world's largest conversational AI platforms that builds chatbot applications for publishers, consumers and enterprises. Adstuck is the first Indian company selected for the Katapult accelerator program (it is a startup *program* offering mentorship along with investments) and it uses the power of AI and its related fields like machine learning and AR and its related fields like visual search to design apps for various sectors like education, utility, advertisement, and so on.

India has a great scope for startups that work in the AI and AR space. As the team size of startups is small, the work environment and team collaboration is fluid and so are the results. Thus, the close-knit team culture of a startup results in faster solutions. As these teams work closely with the clients, there is even less re-work to be done and better adherence to the agile requirements of the clients.

The 14th India Innovation Summit organized by the Confederation of Indian Industry (CII is an industry-led and industry-managed business association that works to create and sustain an environment conducive to the growth of industry in India) in India and held in 2018 laid emphasis on building an ecosystem that fosters and propels innovation through new age technologies such as AI, AR, and so on.

The future of the AI-AR landscape in India again depends on some very important factors like data privacy and policies regarding data protection. For both the technologies, there is always going to be some form of reluctance from the customers in regards to their data being breached or misused. Moreover proper platforms for developing AI-AR applications and interfaces are needed. Infosys Nia and Wipro HOLMES are two major AI platforms in India. Similar such indigenous platforms need to be developed for AI-AR. On the one hand, India needs to expand its footprint and presence in these technologies in terms of research (currently it has only a handful of researchers and research laboratories) and on the other hand, things are looking bright for India in terms of increasing data and a growing startup movement. Again here it will need to improve its data quality. The Indian Government has identified five main areas where AI will play a major role in India: agriculture, education, healthcare, urban transport and smart cities. In the year 2018, the Indian Government set up a special task force that came up with recommendations for boosting the AI sector over the next 5-year period.

7.3 Top Trends to Watch

The year 2016 saw the rise of AI-AR. I believe AI-AR advances in development will ramp up in the years 2019 and 2020. These years are just the beginning for this duo to make their impact felt on a global level and they will be involved in doing tasks that are a lot more complex in nature and by the time we reach the 2050 mark, the world would have completely transformed in more ways than one—hopefully for enhancing the welfare of humanity and other species. These technologies show great promise indeed. However, there is still a lot of work to be done in terms of standards, platforms, devices, etc., before they reach mass adoption. The trend is now more about AI-AR models and systems monitoring other AI-AR models and systems, and all this is possible due to better data capture and fusion architectures

The existing smart apps will get smarter. They will be driven by advanced AI-AR dynamics. AR-driven audio visual solutions will become more prevalent. In the AI space, deep learning platforms, process automation, conversational platforms, speech recognition, etc., will become more prevalent. Since AI and AR are complementary technologies, progress in one boosts the other. Robotic process automation will continue to improve and conversational platforms will become more effective. This duo will give its users access to just-in-time, content-dependent information anytime, anywhere. All these aspects will help AI-AR to adapt and personalize experiences and interactions.

AI-AR experiences will turn out to be very immersive in the future in such a way that we will be able to step inside objects like pictures, photos, etc., and be able to relive the experiences. AR as an alternate reality is showing promise across various sectors. For example, it is already being used in unique business use cases like in a warehouse setting where it can be used to get digital data on products that should have shipped. It is predicted that in Japan, by 2025, more than 80 percent of elderly care would be done by robots, and not by caregivers. *Deep.Fish* is an app that uses neural networks to identify fish from photos. For example, AR will be used in meetings and conferences with speakers showing up as holograms. Similar such holograms use cases are already in the process of being developed, for example WOWLab's Hologram project offers online service to add holograms in alternate reality for businesses and their customers.

Driverless cars are already a big trend with major players like Google, Daimler, etc., leading this race. It is predicted that the year 2020 will bring this trend to its next level of fruition. The AR devices used today are chunky and costly, but by the year 2020 and onwards there will be lighter and have a higher battery life, and they will most likely replace or overtake our current smartphones, but until such time smartphones will be the device of choice. Moreover, technological advances like scalable cloud platforms and ubiquitous network connectivity are improving and will continue to improve, and this continuous improvement will take the AI-AR duo to the next dimension.

AR apps and systems are making and will continue to make a marked difference in classroom learning by offering several benefits like personalized attention, contextual relevancy, and so on. For example, FigmentAR helps teachers and educators create imaginative portals and scenes for making their classroom settings more fun, enriching and interactive. Several other areas like interactive E-Books, skills training, etc., will witness tremendous growth.

Computer vision technology will play a major role in bringing AI-AR to the fore. It is much more than just vision but also includes features like navigation, mapping, motion, and so on. All these factors together are helping to propel AI-AR into autonomous applications like drones, driver-less cars, appliances, and so on. And these AI-AR applications are being implemented and will continue to be implemented across four types of environment: land, sea, air and digital. Apart from top tech giants like Google, Apple, etc., startups like Mapillary, Drive.ai, Oxbotica, etc., are also a part of the playing field.

Organizations that are into the field of providing software-as-a-service solutions will tend to adopt more of AI into their solutions. Due to AI, they will be able to provide effective automation and workflow solutions. And by augmenting people and resources with AR support, these solutions will also be able to produce speedy results.

Robotic workforce will be on the rise as the integration of AI with robotics will make robots more efficient. Recently, one Chinese factory replaced 60,000 workers with robots. Robotic workforce and its features like dynamic assist, predictive maintenance, smart workshops, etc., are already in the process of being refined. Explainable AI (XAI) will be a top trend

to watch as it will involve developing models that will enable users to understand, manage and trust their artificial and augmented counterparts. And robotics is one area where companies are using XAI to develop fair and accountable robotics. Cloud robotics is another trend that is looming large on the AI-AR horizon. Several technology leaders and industry analysts believe that cloud robotics will be the next frontier of AI-AR.

Smart speakers and voice assistants will also be on the rise. With improvements in deep learning, natural language processing, neural networks, machine learning and voice recognition, the application areas of smart speakers and voice assistants will continue to grow. But for this growth to continue, such type of applications will need to be made ubiquitous and will need to move from narrow AI to general purpose AI. Moreover the growth of the Edge AI market will propel their growth and also AR-driven headsets will enable the growth of this market segment.

Smart spaces using AI-AR are predicated to mushroom all over the planet, and with the rollout of 5G and IoT sensors this is going to be a real possibility soon. Smart spaces like smart cities or smart workplaces will need lots of data and data analytics for the AI-AR combination to support the sentient smart space setups. For example, the VERSES foundation is building tools for various stakeholders in this field like developers, creators, designers, etc., who can use these tools to create spatial domains for the smart spaces whereby real places become virtual and virtual places become real thereby connecting people, things, objects, places, etc., through an unified, intelligent, augmented network.

Worldwide spending on digital ads is expected to reach over 335 billion US dollars by 2020. No wonder, location-based advertising is an AR area where there will be more apps on the technology horizon. For example, a user walks into a shop or a showroom and immediately the user will view floating offers based on AI-fed data. Location-based ads don't need print images or markers. Such AR ads are interactive and lifelike, and these aspects help to increase the brand awareness. Blippar (it was a London-based AR company and it created the first augmented-reality digital ad platform) had been experimenting with a new ad format called augmented reality digital placements (ARDPs). ARDP is a completely new media format which uses AI, AR and computer vision to deliver immersive and interactive customer experiences directly from digital banner ads without the need for a separate app.

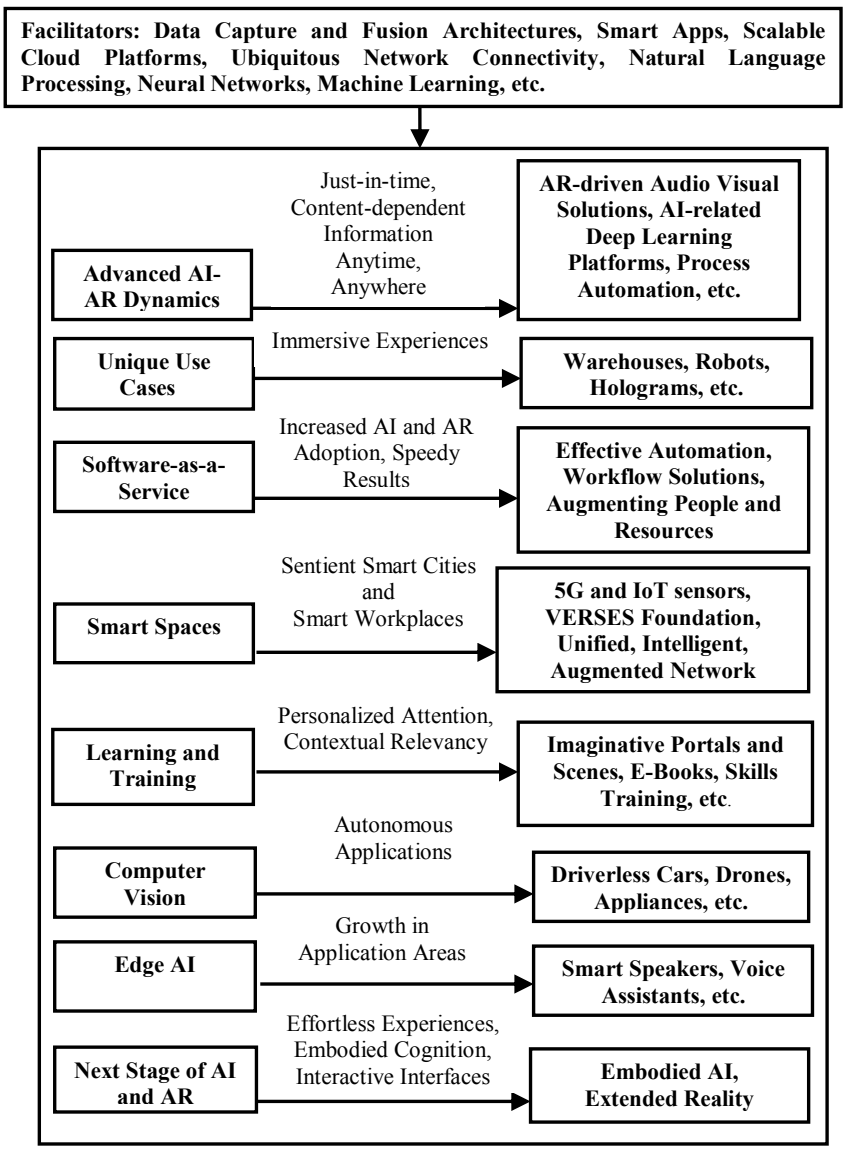

Figure 7.2 Top Trends to Watch

The next stage of AI is embodied AI which is about embedding IoT devices with AI. Embodied AI is based on the theory of embodied cognition. Embodied cognition is a fairly recent development in the fields of cognitive

science and psychology. Embodied cognition is about looking at the entire body of an organism as a vehicle of cognition as opposed to just focusing on the mind and brain. The next stage of AR will be that of extended reality (XR) which is an umbrella term for a mix of technologies like AR, VR and mixed reality (MR). XR has the ability to close the distance between many components like concept and practice, data and data consumers, etc., for all the stakeholders involved in a particular scenario—for example in the medical industry, it can close the distance between health care providers and patients. A convergence of these two next stages has already begun—although still in the initial phase—it will result in effortless experiences through immersive computing and user-friendly interfaces. This next stage convergence is about bridging distances for business and consumer markets and processes right from training to customer experience management. The next stage is about enhancing perception and action of the AI-AR ecosystems. The XR market is currently being fuelled by the best elements of augmented reality, virtual reality and mixed reality, and also AI and its capabilities will help it to grow. The 5G rollout will facilitate the progress of this next stage convergence and will also help to minimize constraints of mobility, network bandwidth and device dependency.

Spotlight

The combination of AI and AR is definitely going strong and for it to cement its position, organizations will need to develop AI-AR apps, projects and systems keeping in mind what content a customer is consuming in order to deliver extraordinary personalized customer experiences.

When the car replaced the horse carriage, the world called it evolution, but what will the world call the replacement of the *car with a driver* with a *driverless car*! Some are calling it evolution while some refer to it as a revolt on humanity. The stark scenarios may or may not occur. And if they do, they will take time to come to fruition. But in that case, human beings might begin to lead a purposeless life, one which is driven or controlled by artificial machines and augmented realities. Finally, any stark scenario that is good at fulfilling its goals as set out by its creators is considered to be a villain, and if those goals are not aligned with the collective good then humanity is bound to suffer.

Just as we use technology apps and systems driven by the AI-AR duo, in the similar way, we as humans need to learn how to hone and use our own higher wisdom to help us navigate the tumultuous maze of life and

the twists and turns on the technology highway. We need to realize that this technology highway is merely a tool and not something that is to be worshipped or idolized.

The collective consciousness should use its self-awareness to figure out what is good and what is bad for humanity. How we should design and implement future human experiences and how we should combine human consciousness and mixed reality is a million-dollar question that we as a collective consciousness need to address. While developing new technologies, all stakeholders should keep in mind that we should develop and use these technologies in such a way that the spark of creativity and passion for learning in human beings are kept ignited and alive. Cutting-edge technologies like AI and AR can enhance our lives in a multitude of ways, but they can also trap us into an alternate but fake reality forever. Will these trends take us beyond the world of illusion or propel us further down the road of delusion? Only time will tell!

7.4 Chapter Recap

1. The world of AI-AR convergence is split into two main groups representing the opposite ends of the AI-AR spectrum: optimists and pessimists, as well as people in between. The AI-AR duo will revolutionize the world in various ways; they are already changing and will continue to change the narratives of our lives. This duo will enable 3D automated, augmented avatars that will have the ability to create an immersive environment for communication and other fields like transport, automated driving, and so on. This duo has the power to transform this world into a single world computer.
2. Nanosizing several industries and functions is doable with AI-AR. The pairing of AI-AR is already creating waves in product design and manufacturing. Companies are already leveraging the machine learning feature of AI to detect and counteract cyber attacks.
3. Apart from cyber security solutions, AI-driven edge computing is the next big thing. In Edge AI, the AI algorithms are processed locally on a device and the algorithms are using data that is on the device itself.
4. Through their innovative platforms, global giants like Google, Facebook, etc., have already set the stage for others in the tech world. Facebook's AR engine brings real-time AI right to your phone. Google has been using AI-AR in its apps, products, services and projects for

quite some time now. Google Lens is a good example of blending AI and AR.

5. The collaboration of IBM and Unity goes to show how AI and AR can be combined to provide powerful interfaces like conversational, speech to text, and so on. Working with AI-AR is now easier with the IBM Watson Unity SDK. From all these global scenarios, one thing is for sure that organizations are creating customer touch points using AI-AR in all possible fields. It is about transforming physical experiences into a digital world and building a global immersive experience.
6. According to the 2017 statistics shared by Statista, 78 percent of organizations globally are either using AI or have plans for use in near future. However, adoption of AI in India has been slow. Estimates show that only 22 percent of the firms in India use AI, but things are changing and will continue to pick up pace with the Indian Government's efforts through the NITI Aayog.
7. Though AI-AR is in the nascent phase in India, it is already trending in India. There are several players in this domain that are in the process of transforming the AI-AR landscape in India. For example, the India chapter of the global association for VR and AR is a global organization that fosters collaboration between the stakeholders of the VR and AR ecosystem by promoting growth, developing industry standards and facilitating education and research.
8. The Internet and Mobile Association of India has formed a new industry expert committee to develop and promote the AR ecosystem in India. India has a great scope for startups that work in the AI and AR space. As the team size of startups is small, the work environment and team collaboration is fluid and so are the results. The 14th India Innovation Summit organized by the Confederation of Indian Industry in India and held in 2018 laid emphasis on building an ecosystem that fosters and propels innovation through new age technologies such as AI, AR, and so on. The future of the AI-AR landscape in India again depends on some very important factors like data privacy and policies regarding data protection.
9. The existing smart apps will get smarter. They will be driven by advanced AI-AR dynamics. AR-driven audio visual solutions will become more prevalent. In the AI space, deep learning platforms,

process automation, conversational platforms, speech recognition, etc., will become more prevalent.

10. The AR devices used today are chunky and costly, but by the year 2020 and onwards there will be lighter and have a higher battery life, and they will most likely replace or overtake our current smartphones, but until such time smartphones will be the device of choice.
11. Computer vision technology will play a major role in bringing AI-AR to the fore. It is much more than just vision but also includes features like navigation, mapping, motion, and so on. All these factors together are helping to propel AI-AR into autonomous applications like drones, driver-less cars, appliances, and so on.
12. Organizations that are into the field of providing software-as-a-service solutions will tend to adopt more of AI into their solutions. Due to AI, they will be able to provide effective automation and workflow solutions. And by augmenting people and resources with AR support, these solutions will also be able to produce speedy results.
13. Explainable AI (XAI) will be a top trend to watch as it will involve developing models that will enable users to understand, manage and trust their artificial and augmented counterparts. And robotics is one area where companies are using XAI to develop fair and accountable robotics. Smart speakers and voice assistants will also be on the rise. With improvements in deep learning, natural language processing, neural networks, machine learning and voice recognition, the application areas of smart speakers and voice assistants will continue to grow.
14. Smart spaces using AI-AR are predicated to mushroom all over the planet, and with the rollout of 5G and IoT sensors this is going to be a real possibility soon. Smart spaces like smart cities or smart workplaces will need lots of data and data analytics for the AI-AR combination to support the sentient smart space setups.
15. The next stage of AI is embodied AI which is about embedding IoT devices with AI. The next stage of AR will be that of extended reality (XR) which is an umbrella term for a mix of technologies like AR, VR and mixed reality (MR). A convergence of these two next stages has already begun—although still in the initial phase—it will result in effortless experiences through immersive computing and user-friendly interfaces. This next stage convergence is about bridging

distances for business and consumer markets and processes right from training to customer experience management.

16. The stark scenarios may or may not occur. And if they do, they will take time to come to fruition. But in that case, human beings might begin to lead a purposeless life, one which is driven or controlled by artificial machines and augmented realities.
17. Just as we use technology apps and systems driven by the AI-AR duo, in the similar way, we as humans need to learn how to hone and use our own higher wisdom to help us navigate the tumultuous maze of life and the twists and turns on the technology highway. We need to realize that this technology highway is merely a tool and not something that is to be worshipped or idolized.
18. Cutting-edge technologies like AI and AR can enhance our lives in a multitude of ways, but they can also trap us into an alternate but fake reality forever. Will these trends take us beyond the world of illusion or propel us further down the road of delusion? Only time will tell!

7.5 Questions for Reflection

1. How is your organization planning for the future of AI-AR?
2. What is the future of AI-AR devices?
3. What are the steps that Indian companies, government and policymakers can take to overcome challenges?
4. Can India become the next AI-AR hub for the developing world?
5. Will we ever be able to achieve true AI?
6. Will China be the next AI super power?
7. Can the AI-AR convergence bring about world peace?
8. What is the path forward for humanity and the AI-AR duo?