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Chapter 5: Cross-Industry Case Studies: Insights from Healthcare, Finance, Smart Cities, and Defense

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1. Introduction

In today's interconnected and competitive world, cross-industry knowledge transfer is vital for innovation, often yielding superior results to any organization. At the same time, organizations are increasingly called upon to foster inclusive innovation in order to embed fairness for economic and social impact. In this chapter, we provide a backdrop to discussion in the rest of the book, briefly describing our perspective on innovation as a business model design activity. We draw on a number of key, partially overlapping literatures - especially design, innovation, knowledge, sensemaking and business model - to illuminate how organizations can draw on the rich knowledge bases, reflexive practices and inclusive innovation action effects observable in other industries, people and the world around them. These literatures help us to model how the acts of design during the life of a business model can evoke a shared 'sense' of something greater than the individual, potentially transcending a singular industry character. Cross-industry transfer in micro-foundational terms, thus offers researchers and practitioners a heuristic for actively developing principles and practices that draw upon relational knowledge bases and inclusively innovative intent.

The business model concept as a unit of analysis captures the solar properties of all actors' productive and consumptive acts together with the supporting casts of material resources that help form the distinct area of value co-creation and value use [1,2]. Organizations are seen as purposeful systems that channel diverse resources, including people, toward chosen ends that enhance the aviation process while ensuring the capability to perform at least that well over time. In an interdisciplinary book with contributions from political science, process philosophy, economics, management, game theory, social psychology, sociology, and strategy, we aim to show how any industry organization can look to other possible industry organizations to query how they have set about achieving similar or adjacent goals in order to deepen cross-industrial comparability, common-pool awareness and source-user synergies.

2. Healthcare Case Studies

Healthcare domain is thriving with innovations and technologies that promise drastic improvements in how healthcare is delivered and the quality of the healthcare experience for patients and healthcare service providing professionals alike. As the world's economy recovers from the current pandemic, telemedicine has become a staple in modern medicine delivery due to its ability to eliminate many of the logistic roadblocks, especially in a continuing global pandemic environment. This chapter explores details on case studies focusing on telemedicine innovations, the adoption and impact of data analytics in patient care, how AI has made its foray into diagnostics, and the myriad challenges that come with adopting these technologies in a healthcare setting. Telemedicine has existed for a long while, primarily in Velcro-ing the doctor-patient relationship through modalities such as telephone calls and videoconferencing tools. The advent of mobile computing and smartphones have helped healthcare professionals bring telemedicine closer to the patient through mobile apps that provide the same quality of service while removing both the logistical roadblocks and driving down the cost of managing a customer. We present case studies that delve into innovative aspects of telemedicine and how organizations have adopted it to deliver better patient care solutions. Better management of Chronic Care patients has a profound impact on the overall costs associated with Healthcare organizations, driving the adoption of data-driven models. We explore the adoption and impact of data analytics in managing Chronic Care patients using data-driven insights and predicting chronic illness flare-ups. AI continues to make large strides in areas related to diagnostics, be that interpreting MRI scans, X-rays, CT scans, or reading and comprehending data from Pathology and genomics. We explore the various facets of AI adoption in diagnostics in this chapter. Lastly, with the blurring boundaries between the physical world and virtual world through the technology stack described above, Healthcare organizations face many unintended consequences when adopting these novel solutions.

2.1. Telemedicine Innovations

The COVID-19 pandemic momentarily mitigated the challenges of telemedicine at the same time it accelerated its adoption. Its arrival demanded a massive upscaling of the existing offer and the categorical removal of the current regulatory obstacles against its widespread use [3-5]. While countries differed as to how strong or strict these obstacles were, the general trend was one of relaxation. Temporary updates to regulations and policies were developed to assist patients and healthcare providers to safely take care of their health needs while adhering to recommended quarantine strategies. This meant expansion of coverage, including, among others, additional telehealth service types, expanded geographical coverage, temporary removal of provider types restrictions, but also that federal policies allowing states flexibility for the adoption of accelerated telehealth measures were quickly established.

The new scenario tackled most of the existent growth restraints in contactless healthcare service delivery. Thinking beyond the pandemic’s impact, several factors indicate that interested parties in the healthcare industry can look toward a period of accelerated adoption. In addition to addressing the inherent concerns of increased costs and lower quality associated with telehealth solutions, insurers, providers, and healthcare technology companies can look toward a new market reality that supports this expansion. The growing aging population is one of them. Not only are older citizens more likely to have chronic conditions that could be diagnosed remotely by an available telehealth infrastructure, but they also are less likely to engage in face-to-face consulting due to mobility restrictions. The same is true for patients residing in rural and underserved communities, or those with limited access to reliable transportation.

2.2. Data Analytics in Patient Care

The healthcare industry is increasingly driven by data availability and utilization. To strategically advance their missions and serve populations through proactive healthcare delivery, healthcare organizations are fully integrating data into their core business processes and analyses for best and timely decision-making. Data collection and insights generation will potentially create new value streams for healthcare organizations, physicians, patients, and population as a whole [2,6]. These analytic-driven advancements for full 360-degree patient and population views will hopefully enable system solutions to the no-show problem, monitoring adherence to recommended care, chronic disease care, and the aging population.

The goal of proactive care through predictive modeling is mainly to improve patient experiences and system efficiency through automation and risk stratification. The predictive models can efficiently identify patients at risk for hospital episodes, monitor post-trigger events for timely response, and appropriately train care managers for intervention and contact. Efficient no-show predictions can help appointment managers to take corrective action. Predictive models for chronic disease progression will help with early intervention and resource allocation during the patient's high-cost or terminal phase. These analytics-inspired innovations create new value propositions for system players. By reaching high-risk patients early during episodes, healthcare systems can either defer triggering the episode with intensive outpatient community resources or intervene early.

2.3. AI in Diagnostics

There is perhaps no field where Artificial Intelligence (AI) has shown more promise than in healthcare diagnostics. From facial recognition to the classifiers behind social media's classification of photos, we interact with AI-based diagnostic technology on a daily basis [7-9]. This is why it was one of the first fields in which a serious push for the application of AI to general problems began. Self-aware agents trying to destroy us is an idea for movies, but algorithms that detect cancer or diabetic retinopathy are real, and they help radiologists and ophthalmologists, respectively.

During the 1960s, the first efforts to investigate if a machine could correctly state what the diagnosis of a patient was began to become a reality. Programs such as DENDRAL and MYCIN, which followed production rules defined by physicians, were the first steps in AI-based diagnosis. They would be successful at returning a diagnosis. However, as other AI-based programs, they were not intelligent as human experts.

Many believe that rather than an agent trying to mimic human reasoning, the true path in AI is to connect what may be seen as dumb programs in the sense that they cannot state the reasoning and what expert knowledge states, embedding this last one in an AI-based system that employs it in a particular logic reasoning. This is probably the approach that many systems are taking today successfully, especially with expert systems and neural networks [10,11]. With regard to neural networks, they appear to be the best option for algorithms searching to perform a diagnostic. On the one hand, their main advantage is accuracy. Research has shown that wellbeing-related areas are some of the most catalytic of the development of neural networks' capabilities.

2.4. Challenges in Healthcare Implementation

As observed from the previous examples, AI and technology-based solutions can improve some healthcare areas. However, there are several important concepts which will hinder the technology from being adopted in the healthcare sector. Some of these concepts are clinical integration, interoperability, static implementation, clinical validation, evidence-based effectiveness, ethical considerations, unfair bias, and algorithms explainability. Each concept is explained in the following subsections.

Clinical integration refers to the need for these new technologies to integrate with existing clinical workflows. Any solution should detect and improve on the existing recommendations by the clinicians using it. Otherwise, it is very likely that clinicians either ignore it or do not use the technology, defeating its purpose. Interoperability is related to the capability of full integration with EHRs. The technology used, including AI models, should be capable of storing and retrieving information from the organization's EHR. If this condition is not satisfied, the technology would incur additional burdens that would hinder its adoption [12-14]. Static implementation refers to the fact that improvements should always be proposed to this technology, with regular updates to optimize its performance. It is known that clinicians resist changing the way they have operated, seemingly whitewashing their methods, with technology. Today, the knowledge in AI is still focused on specific populations: types of techniques, conditions, centers, or others. So, if the predictive model stops being updated, it does not take into account that a particular population may change and the predictions would potentially become less reliable.

In healthcare, clinical validation refers to the scrutiny of how technology and analytics affect the quality of care, quality of life, and patient health outcomes compared to other traditional processes and methods. Clinical validation needs to demonstrate not only short-term clinical proficiency but also provide evidence of long-term impact and effectiveness. Because of that, companies and organizations may need to gather more than a single year of data with patients to be presented with stable results of effectiveness. The obstacles of ethics and unfair bias are connected to all technology analytics. AI-based algorithms need to be developed in a manner that respects, prevents, and presents no bias during their solutions. The ethical concept prevents the use of other patients' data without consent for training. The unfair bias concept refers to the need to build algorithms that do not discriminate against any user group.

3. Finance Case Studies

In recent years, we have witnessed the evolution of Cryptocurrencies from a marginal asset class to a major alternative to traditional investments. The desirability of cryptocurrencies has been manifested by the scale of their market and trading volumes. Starting in concept as a decentralized peer-to-peer value transfer protocol, over time, cryptocurrencies have evolved into complex products and financial assets, often linked to traditional and other financial assets. In addition, the emergence of technological enablers such as Decentralized Finance and Non-Fungible Tokens has expanded the potential use cases for cryptocurrencies.

3.1. Blockchain Technology Applications

Blockchain technology is increasingly recognized as a useful financial infrastructure [3,15-17]. In this case, we explore how three commercial organizations are integrating tokens and smart contracts into their systems by means of a series of detailed interviews. First, we assess a smart contract game that dramatically slowed down the Ethereum network in late 2017. Next, we analyze a strategic project built on the Stellar protocol that plans to tokenize physical gold with the objective of enhancing trading efficiency and counterparty relations [18-20]. Finally, we examine a company dedicated to Security Token Offerings whose regulated tokenized assets enable liquidity to previously illiquid markets. We highlight the intellectual and infrastructural challenges of Blockchain 3.0 services; point out the main concerns of entrepreneurs; and emphasize the need to clarify the purpose of blockchain adoption, as well as the potential inefficiencies of smart contracts. The chapter concludes with a research agenda on blockchain service design. Blockchain technology adoption has surged this past decade. A virtual economy created a secure, decentralized, and public financial infrastructure. However, and despite the enthusiasm of virtual economy participants and a series of blockchain applications in various verticals, there are challenges such as transaction fees, network congestion, and price volatility.

The Ethereum platform broadened the use of blockchain technology by pioneering the concept of smart contracts and allowing developers to create applications on its more general purpose ledger [21-23]. Such applications run different business models, including token creation and decentralized applications and exchanges. The large number of tokens created on top of the Ethereum blockchain will help implement Distributed Autonomous Organizations. These new business models compound the investment challenges posed by virtual currencies. Such characteristics, along with the increase of decentralization of the Ethereum platform, have provoked institutional players in the financial services industry to seriously consider blockchain technology as an alternative to their traditional, centralized, business models.

3.2. Risk Management Strategies

In the past few decades, the complexity of finance organizations has risen considerably [9,24,25]. This growth is attributed to the financial innovation of numerous products that investors use. However, the efficiency and usefulness of certain strategies have been the cause of the global crisis that started in 2008. To avoid such situations and reduce the excessive risk taken by certain participants in the finance market, regulators have established several mandatory risk measures, known as risk management strategies. Although in the past, these regulations had success in stabilizing the financial world, in the last few decades, these rules have been circumvented with the creation of financial products that have not passed any regulatory filter. In order to reduce the systemic risk, there is an urge for regulators to create some sort of universal rule system that will not only allow risk analysts to assess how much risk their company is taking but will also ensure the stability of the market in periods of crisis. In this section, we discuss how Digital Banking in a state of low interest rates has lost its function as intermediary and is becoming a risk seeker in their search for short-term profitability. Commercial banks have reduced their capital requirements to bring them closer to the market consensus of a few months ahead, in spite of a high debt level that has increased the risk faced by investors. In addition, it is argued that not only have volatility measures lost their usefulness as a guide to volatility, having shown remarkably small values in comparison to the realizations during the last economic crisis, but due to the selected method, the relation is also asymmetrical, with highly negative returns resulting in bank volatility being considerably low.

3.3. Digital Banking Transformation

Open banking dynamics, AI predictive analytics, the GDPR data privacy policy, the global banking crisis, and the Fintech revolution are some of the key drivers accelerating digital transformation in retail banking [26-28]. 86% of banking customers want more innovative digital services. They want to feel appreciated and valued, requesting personalized experiences and instant, omnichannel communication. Retail banks face growing competition from digital-first financial players. By 2024, nonbank digital players will generate 50% more revenue per customer than traditional banks. While COVID-related digital adoption accelerated the shift to all things digital, banks are still struggling to transform high-friction, complex processes into streamlined customer experiences. 76% of financial services executives drive digital transformation through new technologies.

Digital Banking Transformation is a collaborative effort of Applied Technology, Business Process Redesign, and Change Management. Digital banking transformation initiatives should include a cloud-based open banking infrastructure for banks and fintechs to accelerate their digital transformation; unique services, next-gen applications to enhance real-time, direct communication and interactions with customers across all channels; a focus on streamlining customer back-end experiences in using banking services as these become more embedded into their activities; and bank participation in connected ecosystems across a wider range of financial services. Banks will need to focus on thoughtful customer understanding, core operations agility, digital innovation fuel, technology architecture modernization, and platforms ecosystem connectivity. The question is whether they can bridge the digital adoption gap and evolve from experience-enhancing backlinks to more integrated, ecosystem-driven platforms for the services their customers really care about.

3.4. Regulatory Challenges and Solutions

Blockchain's great promises in finance systems generate interest to regulators, but these new systems challenge regulatory barriers in place stimulating discussions worldwide. Regulatory paradox emerges from fears of regulatory arbitrage, but also the temptation to take advantage of innovation excluding competitors [6,29-31]. Most discussions contact over distributed ledger technologies beginning to affirm promises in terms of trade clearing, audit of external parties of trade verifications, and fraud reduces. Until now cross border transactions involving securities have reduced settlement securities of financial institutions, banks particularly. Blockchain handles problems like sybil attack, double spend, modified transaction, and smart contract. Current exploratory results of blockchain cross borders available transactions using linking strategy are still in development.

However blockchain is in infancy addressing regulatory challenge at cross border transactions for unique identifiers assigned at initiation. Existing rules, which would serve as basis to regulate roles of these regulators at cross borders transactions involving unique individual entities, may have to be reinforced. Regulatory systems are set on principles on which they are built. Using principles as a foundation for cross border unique individual identifiers can trigger principles attached to risk management and create a legal framework for liens at jurisdictions managing their principles [32,33]. However, those tools can be a detractor for implementation to cross borders. Blockchains reassure financial institutions reducing risks of arbitrary expropriation induced by political turbulence of economic attractiveness based on comparative advantages.

4. Smart Cities Case Studies

Urbanization is one of the most fast-growing phenomena nowadays. Its rise creates a new set of challenges in managing urban areas, and many cities around the world are experimenting with different types and combinations of solutions. The ubiquity of technology solutions in our daily lives builds a solid foundation to try to address these challenges with technology [34-36]. Cities are becoming the world's biggest laboratory of technological solutions. These solutions are not exclusively developed in smart cities, but rather they represent a small portion of the case studies provided in this section. Many problems we face in urban settings have been already addressed in other fields. So cities should also look at what has been done in other contexts and adapt available solutions to their problems.

To explore their own available alternatives, cities are collaborating with private companies and universities to experiment with new technological solutions that can help them in solving their challenges [16,37-40]. Thus, urban laboratories have proliferated in the past years in collaboration with the installation of sensors in urban areas. This has stimulated the creativity of startups and big companies specialized in software development, cloud computing services, and physical infrastructure. Today, we see several initiatives to design new solutions to optimize urban mobility, promote renewable and sustainable energy sources, create smart infrastructures, and engage citizens.

4.1. Urban Mobility Solutions

The advancement of technology is reflected in the first case study presented. The futurist elaborates on flying taxis, vehicles capable of vertical take-off and landing, that will arrive more quickly than expected [41-43]. Urban air mobility seems to be not only a fantastic concept but is raying on the horizon since big player companies in the transportation and technology markets have been investing exorbitant sums of money to materialize this dream. Will it be possible to experience a rush hour in the sky? How would such a blueprint impact the way big cities are structured and how will the masses commute? The questions are many, the doubts too, but the investment is serious. Other cities have been rapidly investing in either reducing the amount of time citizens spend commuting or monetizing this amount of time. These are the cases of two major cities.

In congested cities, rather than trying to validate an electric car's range, we can turn our attention to diverting non-essential urban traffic to aerial systems. Thanks to the clear technological advance that has been taking place lately, urban air mobility should not only exist on paper. The most practical and accelerated application of this type of mobility is the use by companies. But that would already be a major funeste for large spenders in cities, dumping the brazen incivility of being in traffic for six hours a day [44,45]. In addition to necessary applications for aerodynamic taxis, attracting more private flying vehicles can also have applications in tourism, and unforeseen emergencies like the transfer of patients and the rush to receive vaccines. Other cities have been rapidly investing in either reducing the amount of time citizens spend commuting or monetizing this amount of time. These are the cases of two major cities.

In the former, congestion pricing is seen as a clear and demonstrable action that can have a real effect on reducing traffic jams and their dire effects. In the latter, the City allows companies to invest in public transport solutions that fuel their operations in exchange for lucrative work.

4.2. Sustainable Energy Initiatives

Sustainable energy has developed as a critical research topic in the IT domain. Most sustainable energy initiatives are the result of public-private partnerships. There are partnerships that focus exclusively on the sustainable energy domain; there are also projects initiated within the framework of other domains, such as smart cities and smart homes [22,30,46-49]. In a way, the sustainable energy initiatives represent the digitalization and smart extension of the traditional energy market with modern collaborative service provisioning solutions. From an energy resources perspective, we notice that, in addition to the efficient energy consumption aspect, there is also interest in the utilization of renewable energy resources such as solar, wind, geothermal, and ocean energy on a larger scale. From an energy usage perspective, we notice initiatives related to both smart buildings and residential energy management systems and smart grids that optimize the performance and usage of the traditional energy management infrastructure.

In this subsection, we briefly present several projects with various aims and architectures; some projects are more related to traditional energy management systems; others focus on residential energy management. Even so, the distinction between the two is sometimes blurred; after all, residential energy usage is a part of the total urban usage. The objectives of these projects are the reduction of the total energy usage, the reduction of the CO2 footprint, and the acceleration of the development and adoption of innovative business models. Even if other stakeholders are also involved in most sustainable energy initiatives, in our opinion, they represent the IT contribution to the smart cities compressed message.

4.3. Smart Infrastructure Development

Smart infrastructure and urban asset management is a paramount challenge not only for smart cities, but also for other large-scale facilities and processes that are relatively less complex. For example, energy operations such as pipelines, large oil facilities and refineries, lumber processing plants, artificial lakes for cooling operations, shipyards, are becoming inherently intelligent due to the amount of sensors and automated systems involved. Since large city infrastructure has many tangible components, such as asphalt roadways and building roofs, these infrastructure components are subject to physical processes, whose natural non-compliance can be detected through careful monitoring, and if applicable, much less costly than periodic inspections.

Emerging techno-genetic capabilities, such as artificial intelligence, multi-modal sensing and communication technologies, and digital twins, are impacting traditional asset management concepts and needs. By bridging the realms of IT and OT into a cybersecurity-aware convergence, cities should invest in platforms that enable long-term asset management throughout their lifecycle [3,15-17]. Such a vision implies that investments in digital twins, monitoring, and predictive analytics capabilities for short and mid-term asset performance optimization yield dividends down the road during physical pavement or building component renovation or replacement. Each use case provides insights into tech-genic cultural transformations in U.S. Cities required to embrace a Smart Cities Ecosystem framework focused on trustworthy partnerships and customer engagement.

4.4. Citizen Engagement through Technology

Citizen engagement is at the core of smart city initiatives, letting them become "living labs" where experimental governance can be tested. We studied two cases of technology-assisted engagement of citizens, called "natural probes": an experimental platform for crowd-sourcing answers to public policy questions from a pool of citizens that opted-in to a program, and a city-wide initiative that employed new types of technology tools to achieve higher levels of citizen participation. Both initiatives are place-based and embrace the "technologies of the local," relying on technologies that improve local, real-world citizen interactions through individual engagement as well as peer-to-peer and government-to-citizen relationships. These examples showcase how proposed designs can be successfully implemented and allow cities to learn from experience the same way businesses do – through trial-and-error implementation. The digital technologies that enable them to do so are available; what is needed are creative, technology-savvy leaders who can motivate their localities to embrace these learning-oriented initiatives.

The technology-assisted engagement designs presented are examples of partial "surrogates" for citizen behavior and preferences, in the same way that advisor systems are surrogates for expert behavior and preferences. By serving as "citizen density monitors," the technologies enable local governments to experience the same dynamics that shape markets: their realization provides public agencies valuable feedback on pricing, fees, and service levels, allowing them to adjust and recalibrate. The agencies can therefore create the kind of conditions that activate useful surrogates and reward desirable behaviors, such as participating in government processes and engaging with other residents, tech-savvy or not. As such surrogates have become possible in the consumer marketplace, finance, and national security, so too have they become possible in local government. In short, these approaches and methods can increase citizen engagement, helping governments become smarter, more efficient, and citizens happier.

5. Defense Case Studies

The complex network of interconnected tactical data in the Department of Defense (DoD) creates an attractive surface for malicious actors. The fictitious scenario presented is just one of the hundreds of complex data-related dilemmas that the DoD and other defense organizations faced in 2022, and will continue to face as the threat of cyberwarfare looms. The consequences not only affect military objectives, but also have a waning effect on the safety of citizens in the affected regions. Although there is no universal solution to avert the growing risk of cyber threats to DoD operations, we discuss a few ways in which the DoD has used or can leverage lessons learned from other verticals to develop effective solutions to large security problems.

5.1. Cybersecurity Measures

From the very first years of the introduction and expansion of the Internet, a significant number of revolts occurred repeatedly to author government agencies to reverse the founding objective of shared knowledge and open access promoted by the precursory initiative of the Internet to either blocking and/or inhibiting the process that made Internet assumed the form of a sort of worldwide informational basement, calling for control over its flow of traffic and the political power exercised by the states and private companies on top of the technological structure that supports it. In this view, it is consolidated in the contemporary political world a universal norm that established the State as responsible for the security of cyberspace and for developing cybersecurity measures. So recently adopted directive established that the United States "establish policies and procedures to manage risk to information and information technology system resources, including national security systems and controlled unclassified information residing on or transiting information networks. The objective is to ensure that appropriate cybersecurity measures are applied to limit the risks posed to networks and systems and to mitigate incidents that affect them." Two aspects emerge from this scenario. The first is the perception of cyberspace as dangerous and "cybersecurity as a national security issue, cybercrime as terrorism." The second aspect is the state becoming aware of its leading role in regulating activities and relations to diminish or eliminate security issues in cyberspace.

5.2. Advanced Robotics in Defense

As military operations evolve, they rely more and more on robotic and autonomous systems for successful completion. These innovations can operate in previously too dangerous or complex environments. This is especially true in the defense domain, where technologies such as field robotics, mobile robotics, and wearable robotics are developed and implemented. This subsection presents three case studies that highlight the versatility of robotics applications in the defense area. They cover Aerial and Space robotics, Commercial-off-the-shelf solutions, and how new technologies are being applied in military settings.

Robotics and autonomous systems technologies, as any other scientific or engineering domain, advance at highly variable rates due to a variety of social and economic connections. As a result, the military domain is sometimes criticized for pursuing solutions for issues that have vanished. There is, however, a strong trend for the military to take advantage of commercial-off-the-shelf technologies, utilizing them to solve emerging needs and problems. We highlight that the fast deployment solutions can furnish outputs for a much larger variety of use cases by utilizing and or adapting existing approaches for military applications, where deployment and cost are hypothetically less strict.

Particularly for overseas bases, cannot be considered anymore like a home base, logistic support at all levels supplies delays and additional costs that affect not only system efficacy but also the timely and accurate delivery of goods and supplies. At the same time, with the increasing confinement of the effects of climatic changes, the military has to often operate not only in hostile environments but also in dramatic climatic conditions for long periods. As a result, the need to deploy solutions for special missions, exploring and disrupting enemy supply lines for example, is more and more frequent.

5.3. Data-Driven Decision Making

Over the last several years there has been a concerted effort to convert military systems into data-driven machine learning capabilities. Such capabilities exist already in many military operations—driving a vehicle, targeting a weapon, setting an investment strategy, determining how to defend and how to attack, and planning an opportune engagement time. However, most capabilities require more research and enterprise-level data infrastructure investments to achieve the vision of Joint All Domain Command and Control—unifying the collection of all sensor data to make operational decision-making instantaneous, accurate, and low-risk.

Equally critical, if not more so, is the mission of the Digital Modernization Strategy, which involves creating a data asset, a true knowledge base of human knowledge that the algorithm experts can utilize for data-driven recommendation generation and decision support throughout the breadth of the missions on behalf of citizens. We explain the foundational elements of a successful data-driven machine-learning infrastructure, provide a set of research questions, and then present examples that focus largely on decision-making and specific data assets. We then view the mission of a National Digital Transformation, which could create a data asset for operations by the US and its allies for combined military mission planning.

5.4. International Collaboration in Defense

International cooperation in defense creates interoperability, access to advanced skills and equipment, information sharing and improves trust reducing the chances of misunderstanding that lead to war. Defense consumer standards for performance play a role in forging a common approach to achieving such interest. The NATO alliance under the leadership of the USA is a very important player and has played a key role for many decades. PhD programs and general data, software and cyber infrastructures are usually hard to hide and create options for other groups and geopolitical issues favor both secrecy, harsh competition, mistrust and parochial software and hardware solutions that minimize access where real needs exist. Access to better solutions would greatly speed up and improve defense related problems being solved and also be a clear way to target risky and often bribery corrupt solutions by leaving those without access behind.

NATO has a deep history in providing PhDs to its members since decades and it should strengthen the partnership program and the related student exchange programs and continue on allowing student interns at the NATO headquarters in Brussels as well as at its Science Office. Over the years these interns have become ambassadors in their respective countries. Any technical solution relies on a cadre of well trained and experienced humans and to maintain a leading edge in solving defense related problems NATO defense capability would greatly benefit solutions that are focused on the specific defense needs of the alliance and its partners. There is room in AI and data driven decision making to create sympathetic solutions that are well organized and articulated but at the core are humans with a very deep knowledge in their sector of work that are working to assist the user in solving its task.

6. Comparative Analysis of Industries

The innovative technology application projects described in the seven case studies are drawn from four different business sectors: healthcare, finance, smart cities, and defense. This chapter presents a comparative analysis of the four sectors using the various technologies and case studies as a framework for discussion. The comparative analysis is organized around three discussions. First, we identify and describe the challenges faced by all four business sectors, focusing on those common to all sectors and those unique to specific sectors. Then we summarize the primary technologies and capabilities used to design, develop, and deliver solutions by sector. Over twenty innovative technologies and technological capabilities are cited, with specific cases identified for each. And finally, we describe the lessons learned and recommend future trends based on our experiences and feedback from our work with project teams in these four sectors.

Innovation comes from collaboration between industry sectors, by leveraging similarities and adapting solutions to fit the special requirements and conditions of the domain of application. Moreover, people problems and technological challenges overlap, suggesting a pattern for finding new ideas or variations on older technologies. There are differences among the domains. Some are more mature and settled than others, where the users have researched and specified technology-resistant requirements. Others are still stormy seas of change, moving into unknown waters, thirsty for knowledge and blue-sky thinking; even so, fruitful collaborations are possible with both kinds of domain. Citizens and companies interact with several of the aforementioned sectors, and these interactions are representatives of our society and economic activity.

6.1. Common Challenges Across Sectors

Diverse sectors across the economy tend to create similar challenges as a result of three underlying megatrends: Data proliferation, Funding and resources constraints, Need for resilience. Data Proliferation: Sectors that are seen as resistant to change often show similar characteristics, with a gradual evolution followed by rapid transformation triggered by a sudden change. The rising digitalization and availability of data enabled by the digital transformation are disrupting existing practices, models and business priorities across all sectors of the economy. The forces are magnified in sectors that use big data and advanced analytics at the center of their transformation such as smart cities with pervasive sensory webs and defense that explore novel ways to use artificial intelligence and unmanned aerial systems for crowd and events control.

Funding and Resource Constraints: In the wake of navigated pandemic and the current geopolitical risks driven by rising inflation, interest rates, and fiscal pressures caused by underfunded social security systems, all Western democracies are being driven to make choices around the fiscal space of military, healthcare and public infrastructure investments. This is exacerbated by a growing need to rationalize pandemic-related expenses in the next few years, creating an opportunity – yet also significant challenges – to harness technology-led everywhere transformation enablers driven by the demand from citizens in defense, smart cities and healthcare sectors, such as telemedicine, digital twins, intelligent automation, public safety and business continuity. Need for Resilience: Two challenges that have been underscored with force in the last few years by the pandemic and changing geopolitical environment driving inflation have come to dominate the priority agendas of industries and sectors across the global economy: The first is the need to improve internal resilience, enabling continuity of operations in adverse and challenging scenarios through greater reliance on novel forms of on-demand, flexible, cost-effective and eco-sustainability forms of operations at times of peak requirement.

6.2. Innovative Solutions and Best Practices

While frontline workers have been heavily burdened in multiple industries, there are a host of innovative solutions and best practices that are either being utilized or will soon be adopted. The key note is flexibility and timely, informed sharing of knowledge. In healthcare and finance, especially in the initial intersection of supply gap and spike in demand, condition-specific and population-specific data models are quickly built in response to the pandemic, helping local resource allocation. In smart cities, hospitals and planning commissions partner to share layouts, work flows and peak times to plan where extra service crews would be most helpful, how to quickly deploy them and how to share resources seamlessly. In Defense, an innovative change from predictive, demand-driven traits of supply chain for fighting wars to reactive, availability-driven supply chain for supporting peacekeeping and national disaster response fills an important mismatch gap.

After immediate needs are met, common collaboration dashboards across industries are set up for ongoing allocation of supplies among local providers, often across healthcare settings. In smart cities, situation rooms help assess needs based on existing and historical data; they partner with hospitals and clinics to have their staffing increased proactively if uneven patterns emerge. In finance, collaboration occurs over how to fix stock outs in some areas because they look good at first but are critically backordered for certain business practices and not others.

6.3. Future Trends and Predictions

Learning algorithms will increase in sophistication, allowing the development of impressive models for prediction, classification, and anomaly detection. Despite the media hype, many models will still rely on the completely unexciting traditional techniques which will be carefully tuned to match the nature of the problem. Resource constraints and ease of model interpretation will also remain integral factors curating the selection of appropriate techniques.

Explanations associated with the decisions made by deep knowledge systems will remain at the level of technobabble despite enormous efforts to make them more interpretable, and this peculiarity will impair the propagation of deep learning solutions into many areas requiring clear accountability. The application of natural language processing and machine learning to parse complex clinical documents highlights the need for innovation in this arena. There's no consensus way to record, track, and analyze data on any aspect of clinical research.

Foresight will become an essential business function for many sectors as the turbulent digital transformations they are undergoing introduce unforeseen complications. Anomalies will become more frequent, disruptions lengthier, and supply and demand prediction errors at the core of the just-in-the-moment logistics systems sustaining globalization larger. Many businesses will choose to employ their own foresight abilities to deal with this increasing adversity. These changes will require new ways of collaboration, instill a greater spirit of accountability at every employee level, and provoke fierce resistance from bureaucracies in sectors such as healthcare and education.

7. Implications for Policy and Practice

Recent advancements in technology enable rapid capabilities for tactical and strategic missions. There are many technologies being developed either intentionally or unintentionally to aid in asymmetric engagements. Policies, practices, and regulations are lagging behind the technological advancement, creating a situation where governmental actors have limited consideration into the range of implications from particular uses of these technologies. Further, best practices and useful recommendations are lacking for tech developers who want to promote goodness in our systems or constrain harm that can emerge from indiscriminate applications of the technologies.

7.1. Regulatory Considerations National and international bodies need to work more closely to validate successful regulations to guide tech developers to consider the ultimate applications of their products. Certainly, not every tech pipeline and product evaluation requires government involvement; however, there are aspects of some products that without the use of regulatory oversight and consultation would result in the absence of considerations for secondary and tertiary applications of those products that would lead to harms of the populace. For example, a widely released technology is currently responsible for a flourishing new genre of tricking targets into possible internet scams. Scam artists impersonate bank representatives to potential users and trick them into wiring money to a fraudulent account.

7.2. Ethical Implications of Technology A collaborative effort is required to train future leaders to ensure that ethical context is applied both to decision making and product evaluations. Leaders in technology should understand that there ultimately are humans behind the applications, as well as an impact on human lives. Additionally, engineers should be trained to appreciate the weight of their decisions. Failing to educate engineers and product developers to the ethical implications of their technologies could lead to inadvertent developments of technology that creates widespread harm to vulnerable victims; regulation is a tool of last resort if the company will not regulate itself for the good of humanity.

7.1. Regulatory Considerations

While the cross-industry Insights and Recommendations are suggestive of a degree of regulatory uniformity across different sectors concerning AI use, the situation is far more nuanced. Of primary importance is the degree, type, and motive of intervention. Motives for regulatory intervention would center chiefly on realism (cautiousness concerning high-impact deployment particularly in life-critical sectors), risk-adjusted economic consequences (dismitting uniquely severe regulatory overreach), and promotion of maximal generalizable welfare (addressing divergence in potential positive and negative welfare impacts across sectors). AI regulation is in its infancy, and how it is constructed, and its impact on the pacing and impact of transformative technologies is under debate.

With specific reference to the four sectors, there is a well-spelled out and understood historical precedent of different regulatory intensity concerning various economic activities in the two commercial sectors versus the two non-commercial sectors. The former two are subjects of high-intensity regulatory scrutiny, review, approval, development, and use, given historical instances of fraud, malpractice, privacy, and data security concerns, resulting in economic loss and harm to consumers and society. These two sectors, as private entities, do not truly bear the fiscal costs of the decision-making externalities and consequential welfare impacts from negative events that may occur due to lax rules governing fast or rapid AI development and use.

On the other hand, behind-the-scenes but politically charged considerations dominate the defensive oversight and policy mechanisms surrounding the Defense and Healthcare sectors. Proponents would argue that consumers and private firms in the commercial sectors must be on levels two or three strike forces, or prepare for inevitable strike waves, who re-align resources, assets, and efficiencies through creative destruction enabled by maximal firm experimentation, innovation, and development whereby regulations provide only support for maintaining symmetry between technology and policy. It would be imprudent if not paradoxical to regulate the net transfer function such that in economic quiescence, organizations and firms are said to be operating in their homeostatic equilibrium, but in times of extreme duress, regulations form an asymmetric safety net that can only be filled by slow-moving bureaucracies.

7.2. Ethical Implications of Technology

While being clear that ethics cannot be attributed to a technical solution alone, we nevertheless also want to emphasize the priority of the ethical issues, not only the consequences. At the same time, our goal is not to convert this cross-domain effort into a merely techno-political discussion. The aim here is not to fuel the tech-experts critique of politics from the position of superior rationality. Rather, what we want to focus on are the spaces for intervention into concrete forms of technological mediation even if selective and partial in terms of the wider socio-technical configurations [3,5]. The basic point of focusing on ethics first, techno-ethics second, and the possible use of the techno-political category later, is not to privilege ethical concerns per se, but rather to highlight that and why they are on the critical path. They take precedence for our analysis precisely because the urgency is not about technical solutionism even if to some researchers careful and selecting approaches in terms of technical interventions or partial transformations could appear as rational ways to organize the practical steps.

While ethical issues have always been and will always be part and parcel of our relationship with the techno-scientific world, they are called for in a more pressing way today. From the elementary question of who counts as really-the-one whose ethics is supposed to be preserved in terms of protection against beings whose life some see as less valuable or who can be sacrificed as collateral damage in the military world-who are excluded from the sphere of ethics ethics cannot answer to the simplest technical questions how do we know that it is impossible for others to cross the line?

7.3. Public-Private Partnerships

Public-Private Partnerships (PPPs) are contractual agreements between public and private entities which provide a mechanism to share resources, risk, and policy objectives across sectors. The concept of PPPs covers a continuum of relationships, ranging from temporary collaborative projects to more integrated long-term strategic alliances. There are divergent motivations for public and private partners to establish a collaborative relationship, and many forms of partnership. The former are typically motivated by the efficiency of service delivery, the desirability of avoiding the creation of a monopoly, and the competitiveness of the service offered to the public. Private entity motivations typically include profit-seeking, the desire for stability of output demand, and the minimization of the costs associated with the vagaries of private sector market forces and subsequent business cycle.

For example, in the Defence sector, the successful delivery of many defence capabilities or services requires the effective integration of different skills, disciplines, knowledge and resources, enabling a unitary effort to be made towards a common goal. Defence Public-Private Partnerships may be channeled through a variety of acquisition routes, ranging from traditional types of transactions to more integrated and collaborative policies. Defence-related PPPs, focusing on the delivery of critical infrastructure or services through a long-term collaborative relationship between the Contracting Authority and the private entity, may be leveraged to optimize the architecture and the provision of Defence capabilities and the associated lifecycle costs and risks involved, in the short as well as in the long term.

8. Conclusion

In this work, we explored cross-industry applications of artificial intelligence to enhance public and private services. Our aim was to uncover similarities across sectors and identify specific interesting challenges. To this end, we presented and discussed cross-sector applications in four domains: healthcare and well-being; finance; smart cities; and defense. For each sector, we provided a selection of cross-sector applications and presented cases where relevant. This is a thematic selection only, not statistical over-representative of the many existing applications.

The questions we aimed to answer in our exploration were: if the same AI functions are used across sectors; whether some specific functions are the exclusive domain of only one sector; if the cross-sector applications are facing similar challenges, and if the reasons for engaging in the application are the same across the sectors. In general, we found that there is a common need for predictive functions and intelligent agents in sector applications. Image understanding appears to be mainly used in healthcare. We also found an active cross-sector interest in optimization and reinforcement learning functionalities. Decision support systems, used only in finance and healthcare, are raising important concerns about transparency and interpretability.

Challenges encountered in cross-sector AI applications relate mainly to the difficulties of harmonizing and sharing multimodal, heterogeneous, and unequal data. Particularly strong issues are gender and racial biases and privacy concerns in finance and healthcare, while defense could be especially vulnerable to potential misdemeanors with damaging effects on the person and on the public. All applications face both technological and human-centered challenges. The urgency of the COVID crisis facilitated collaborative efforts in healthcare, and deeper collaboration across domains may increase risk resilience and enhance the agile capacity of modern services in other sectors as well.

References:

[1] Jia Y, Gu Z, Du L, Long Y, Wang Y, Li J, Zhang Y. Artificial intelligence enabled cyber security defense for smart cities: A novel attack detection framework based on the MDATA model. Knowledge-Based Systems. 2023 Sep 27;276:110781.

[2] Prawiyogi AG, Purnama S, Meria L. Smart cities using machine learning and intelligent applications. International Transactions on Artificial Intelligence. 2022 Nov 27;1(1):102-16.

[3] Javed AR, Ahmed W, Pandya S, Maddikunta PK, Alazab M, Gadekallu TR. A survey of explainable artificial intelligence for smart cities. Electronics. 2023 Feb 18;12(4):1020.

[4] Wolniak R, Stecuła K. Artificial intelligence in smart cities—applications, barriers, and future directions: a review. Smart cities. 2024 Jun 10;7(3):1346-89.
[5] Meir Y, Sardi S, Hodassman S, Kisos K, Ben-Noam I, Goldental A, Kanter I. Power-law scaling to assist with key challenges in artificial intelligence. Scientific reports. 2020 Nov 12;10(1):19628.
[6] Shivadekar S, Kataria DB, Hundekar S, Wanjale K, Balpande VP, Suryawanshi R. Deep learning based image classification of lungs radiography for detecting covid-19 using a deep cnn and resnet 50. International Journal of Intelligent Systems and Applications in Engineering. 2023;11:241-50.
[7] Panda SP. Relational, NoSQL, and Artificial Intelligence-Integrated Database Architectures: Foundations, Cloud Platforms, and Regulatory-Compliant Systems. Deep Science Publishing; 2025 Jun 22.
[8] Shlezinger N, Ma M, Lavi O, Nguyen NT, Eldar YC, Juntti M. Artificial intelligence-empowered hybrid multiple-input/multiple-output beamforming: Learning to optimize for high-throughput scalable MIMO. IEEE Vehicular Technology Magazine. 2024 May 20;19(3):58-67.
[9] Samuel O, Javaid N, Alghamdi TA, Kumar N. Towards sustainable smart cities: A secure and scalable trading system for residential homes using blockchain and artificial intelligence. Sustainable Cities and Society. 2022 Jan 1;76:103371.
[10] Villegas-Ch W, Govea J, Gurierrez R, Mera-Navarrete A. Optimizing security in IoT ecosystems using hybrid artificial intelligence and blockchain models: a scalable and efficient approach for threat detection. IEEE Access. 2025 Jan 22.
[11] Mungoli N. Scalable, distributed AI frameworks: leveraging cloud computing for enhanced deep learning performance and efficiency. arXiv preprint arXiv:2304.13738. 2023 Apr 26.
[12] Panda SP. Artificial Intelligence Across Borders: Transforming Industries Through Intelligent Innovation. Deep Science Publishing; 2025 Jun 6.
[13] Cheetham AK, Seshadri R. Artificial intelligence driving materials discovery? perspective on the article: Scaling deep learning for materials discovery. Chemistry of Materials. 2024 Apr 8;36(8):3490-5.
[14] Panda SP, Muppala M, Koneti SB. The Contribution of AI in Climate Modeling and Sustainable Decision-Making. Available at SSRN 5283619. 2025 Jun 1.
[15] Shivadekar S. Artificial Intelligence for Cognitive Systems: Deep Learning, Neuro-symbolic Integration, and Human-Centric Intelligence. Deep Science Publishing; 2025 Jun 30.
[16] DeCost BL, Hattrick-Simpers JR, Trautt Z, Kusne AG, Campo E, Green ML. Scientific AI in materials science: a path to a sustainable and scalable paradigm. Machine learning: science and technology. 2020 Jul 14;1(3):033001.
[17] Klamma R, de Lange P, Neumann AT, Hensen B, Kravcik M, Wang X, Kuzilek J. Scaling mentoring support with distributed artificial intelligence. InInternational Conference on Intelligent Tutoring Systems 2020 Jun 3 (pp. 38-44). Cham: Springer International Publishing.
[18] Otaigbe I. Scaling up artificial intelligence to curb infectious diseases in Africa. Frontiers in Digital Health. 2022 Oct 21;4:1030427.

[19] Dasawat SS, Sharma S. Cyber security integration with smart new age sustainable startup business, risk management, automation and scaling system for entrepreneurs: An artificial intelligence approach. In2023 7th international conference on intelligent computing and control systems (ICICCS) 2023 May 17 (pp. 1357-1363). IEEE.
[20] Peteiro-Barral D, Guijarro-Berdiñas B. A study on the scalability of artificial neural networks training algorithms using multiple-criteria decision-making methods. InInternational Conference on Artificial Intelligence and Soft Computing 2013 Jun 9 (pp. 162-173). Berlin, Heidelberg: Springer Berlin Heidelberg.
[21] Kuguoglu BK, van der Voort H, Janssen M. The giant leap for smart cities: Scaling up smart city artificial intelligence of things (AIoT) initiatives. Sustainability. 2021 Nov 7;13(21):12295.
[22] Gowda D, Chaithra SM, Gujar SS, Shaikh SF, Ingole BS, Reddy NS. Scalable ai solutions for iot-based healthcare systems using cloud platforms. In2024 8th International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud)(I-SMAC) 2024 Oct 3 (pp. 156-162). IEEE.
[23] Awan MZ, Jadoon KK, Masood A. Scalable and effective artificial intelligence for multivariate radar environment. Engineering Applications of Artificial Intelligence. 2023 Oct 1;125:106680.
[24] Landin M. Artificial intelligence tools for scaling up of high shear wet granulation process. Journal of Pharmaceutical Sciences. 2017 Jan 1;106(1):273-7.
[25] Panda SP. Securing 5G Critical Interfaces: A Zero Trust Approach for Next-Generation Network Resilience. In2025 12th International Conference on Information Technology (ICIT) 2025 May 27 (pp. 141-146). IEEE.
[26] Mocanu DC, Mocanu E, Stone P, Nguyen PH, Gibescu M, Liotta A. Scalable training of artificial neural networks with adaptive sparse connectivity inspired by network science. Nature communications. 2018 Jun 19;9(1):2383.
[27] Blanco L, Kukliński S, Zeydan E, Rezazadeh F, Chawla A, Zanzi L, Devoti F, Kolakowski R, Vlahodimitropoulou V, Chochliouros I, Bosneag AM. Ai-driven framework for scalable management of network slices. IEEE Communications Magazine. 2023 Nov 23;61(11):216-22.
[28] Sadek AH, Mostafa MK. Preparation of nano zero-valent aluminum for one-step removal of methylene blue from aqueous solutions: cost analysis for scaling-up and artificial intelligence. Applied Water Science. 2023 Feb;13(2):34.
[29] Cohen RY, Kovacheva VP. A methodology for a scalable, collaborative, and resource-efficient platform, MERLIN, to facilitate healthcare AI research. IEEE journal of biomedical and health informatics. 2023 Mar 20;27(6):3014-25.
[30] Adelodun AB, Ogundokun RO, Yekini AO, Awotunde JB, Timothy CC. Explainable artificial intelligence with scaling techniques to classify breast cancer images. InExplainable Machine Learning for Multimedia Based Healthcare Applications 2023 Sep 9 (pp. 99-137). Cham: Springer International Publishing.
[31] Sanz JL, Zhu Y. Toward scalable artificial intelligence in finance. In2021 IEEE International Conference on Services Computing (SCC) 2021 Sep 5 (pp. 460-469). IEEE.

[32] Haefner N, Parida V, Gassmann O, Wincent J. Implementing and scaling artificial intelligence: A review, framework, and research agenda. Technological Forecasting and Social Change. 2023 Dec 1;197:122878.

[33] Sai S, Chamola V, Choo KK, Sikdar B, Rodrigues JJ. Confluence of blockchain and artificial intelligence technologies for secure and scalable healthcare solutions: A review. IEEE Internet of Things Journal. 2022 Dec 29;10(7):5873-97.

[34] Moro-Visconti R. Artificial Intelligence-Driven Digital Scalability and Growth Options. InArtificial Intelligence Valuation: The Impact on Automation, BioTech, ChatBots, FinTech, B2B2C, and Other Industries 2024 Jun 2 (pp. 131-204). Cham: Springer Nature Switzerland.

[35] Oikonomou EK, Khera R. Designing medical artificial intelligence systems for global use: focus on interoperability, scalability, and accessibility. Hellenic Journal of Cardiology. 2025 Jan 1;81:9-17.

[36] Sayed-Mouchaweh M, Sayed-Mouchaweh, James. Artificial Intelligence Techniques for a Scalable Energy Transition. Springer International Publishing; 2020.

[37] Govea J, Ocampo Edye E, Revelo-Tapia S, Villegas-Ch W. Optimization and scalability of educational platforms: Integration of artificial intelligence and cloud computing. Computers. 2023 Nov 1;12(11):223.

[38] Hammad A, Abu-Zaid R. Applications of AI in decentralized computing systems: harnessing artificial intelligence for enhanced scalability, efficiency, and autonomous decision-making in distributed architectures. Applied Research in Artificial Intelligence and Cloud Computing. 2024;7(6):161-87.

[39] Pazho AD, Neff C, Noghre GA, Ardabili BR, Yao S, Baharani M, Tabkhi H. Ancilia: Scalable intelligent video surveillance for the artificial intelligence of things. IEEE Internet of Things Journal. 2023 Mar 31;10(17):14940-51.

[40] Sakly H, Guetari R, Kraiem N, editors. Scalable Artificial Intelligence for Healthcare: Advancing AI Solutions for Global Health Challenges. CRC Press; 2025 May 6.

[41] Shivadekar S, Halem M, Yeah Y, Vibhute S. Edge AI cosmos blockchain distributed network for precise ablh detection. Multimedia tools and applications. 2024 Aug;83(27):69083-109.

[42] Bano S, Tonellotto N, Cassarà P, Gotta A. Artificial intelligence of things at the edge: Scalable and efficient distributed learning for massive scenarios. Computer Communications. 2023 May 1;205:45-57.

[43] Mishra A. Scalable AI and Design Patterns: Design, Develop, and Deploy Scalable AI Solutions. Springer Nature; 2024 Mar 11.

[44] Panda SP. Augmented and Virtual Reality in Intelligent Systems. Available at SSRN. 2021 Apr 16.

[45] Abisoye A, Akerele JI. A scalable and impactful model for harnessing artificial intelligence and cybersecurity to revolutionize workforce development and empower marginalized youth. International Journal of Multidisciplinary Research and Growth Evaluation. 2022 Jan;3(1):714-9.

[46] Raman R, Buddhi D, Lakhera G, Gupta Z, Joshi A, Saini D. An investigation on the role of artificial intelligence in scalable visual data analytics. In2023 International Conference on Artificial Intelligence and Smart Communication (AISC) 2023 Jan 27 (pp. 666-670). IEEE.

[47] Panda SP. The Evolution and Defense Against Social Engineering and Phishing Attacks. International Journal of Science and Research (IJSR). 2025 Jan 1.
[48] Newton C, Singleton J, Copland C, Kitchen S, Hudack J. Scalability in modeling and simulation systems for multi-agent, AI, and machine learning applications. InArtificial Intelligence and Machine Learning for Multi-Domain Operations Applications III 2021 Apr 12 (Vol. 11746, pp. 534-552). SPIE.
[49] Bestelmeyer BT, Marcillo G, McCord SE, Mirsky S, Moglen G, Neven LG, Peters D, Sohoulande C, Wakie T. Scaling up agricultural research with artificial intelligence. IT Professional. 2020 May 21;22(3):33-8.