Akıllı Yönetim Bilişim Sistemlerinde Yapay Zeka ve Kuantum Bilişimin Değerlendirilmesi

Literatür Makalesi/Literature Article

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Özet— Literatürdeki çalışmalar, kuantum bilgisayarların hafıza probleminin çözülmesinin, yaygın olarak kullanılacak yapay zeka (YZ) algoritmalarında çığır açıcı gelişmelere yol açarak süreçleri, stratejileri, ekonomiyi ve politikaları etkileyeceğini göstermektedir. YZ ve kuantum bilişim teknolojisinden yararlanarak mevcut yöntemleri iyileştiren kuantum uyarlamalı algoritmalar yaygın olarak uygulanmaktadır. Kuantum bilgisayarların alt iş parçacıklarını oluşturmayı hedefleyen hibrit kuantum sistemleri ile yeni gelişmeler elde edilse de bu gelişmelerin gelecekte nereye varacağı ve ne tür fayda ve riskler içerdiği tam olarak tahmin edilememektedir. Bu çalışmada, çağdaş ve disiplinler arası literatür bilgisine dayalı olarak, laboratuvar ortamında uygulamaları yeni başlayan kuantum bilgisayarların, süper YZ uygulamalarının ve kuantum hesaplama yöntemlerinin makine öğrenmesi üzerindeki ve potansiyel kullanımları yönetim bilişim sistemleri (YBS) disiplini perspektifinden incelenmekte ve değerlendirilmektedir. Kuantum bilgisayarların donanımsal ve maliyetle ilgili dezavantajlarının yakın zamanda ortadan kalkacağı ve gelecekte yeni kuantum uygulamalarının fazlaca geliştirileceği iddia edilmektedir. Bu, aslında Endüstri 4.0 ve Toplum 5.0 uygulamalarında nesnelerin interneti (IoT) ve robotik otomosyonun yaygın kullanımına uyum sağlamanın bir gereği olarak düşünülebilir. Bu nedenle, gelecekte keşfedilebilecek yeniliklerin rehberliğini gerçekleştirmek için YZ ve kuantum bilişimin teorik ve kavramsal yönleri çoklu disipliner olarak değerlendirilmektedir.

Anahtar Kelimeler— kuantum teknolojisi, akıllı MIS, ışınlanma, yapay zeka

Assessment of the Artificial Intelligence and Quantum Computing in the Smart Management Information Systems

Abstract— Studies in the literature argue that solving the memory problem of quantum computers (QC) will lead to groundbreaking developments in artificial intelligence algorithms affecting every process, strategy, business, and policies. Quantum adaptive algorithms have been widely applied, which improve existing methods by taking advantage of artificial intelligence and quantum computing. Although new developments are achieved with hybrid quantum systems, which aim to have sub-threads made by quantum computers, it cannot be predicted precisely where these studies will reach in the future and what kind of benefits and risks, they involve. In this study, based on the knowledge of contemporary and interdisciplinary literature, the current and potential uses of quantum computers, super artificial intelligence applications, and quantum computing methods on machine learning, whose applications have just begun in the laboratory environment, are examined, and assessed from the perspective of Management Information Systems (MIS) discipline. It is claimed that the hardware disadvantages of quantum computers will disappear, and new quantum applications will be developed in the future. This is a requirement of adaptation to the prevalent usage of IoT in Industry 4.0 and Society 5.0 applications. Therefore, theoretically, and conceptual aspects of AI and quantum computing are evaluated to realize guidance of the innovations that can be discovered in the future.

Keywords— quantum technology, smart MIS, teleportation, artificial intelligence

1. INTRODUCTION

Quantum theory is the basis of quantum cryptology. Quantum theory explains the nature and behavior of matter and energy in modern physics at the atomic and subatomic levels (electron, proton, and neutron) [1]. The operational structure of today's quantum computers (QC) is based on quantum mechanics. Max Planck, Albert Einstein, Louis de Broglie, Neils Bohr, Werner Heisenberg, Erwin Schrodinger, Max Born, and Paul Dirac contributed to developing quantum mechanics [2]. Quantum information technology is the leading guardian of the second quantum revolution and is based on 'second order' effects once little known and predicted by quantum theory. These effects were introduced at the earliest in 1935 in an article written by Einstein, Podolsky, and Rosen (EPR), drawing attention to the fact that some carefully prepared quantum systems have non-local, entangled, non-classical correlations between them [3]. Einstein, Podolsky, and Rosen correlations are not only a manifestation of the usual wave-particle duality but a new kind of high-level quantum effect that manifests itself only in precisely designed human-made quantum architectures. In 1981, Richard Feynman introduced a quantum computer at the Massachusetts Institute of Technology [4]. According to Feynman, quantum physics laws could be used in a computer, but those quantum mechanical systems could not be correctly applied in a classical computer. Still, a new type of machine (QC) produced could fully simulate a molecule in the future [5]. In 1989, scientists at IBM were able to spell the company's name using 35 xenon atoms on a nickel [6]. In 1994, Peter Shor developed a quantum computing-powered algorithm to break encryption systems [7]. Shor's algorithm can crack cryptographic keys based on the factorization of large numbers [8]. This invention is considered a turning point in terms of quantum cryptology [9].

In 2016 IBM launched Q Experience, arguably the most comprehensive platform [10]. In July 2017, Chinese scientists sent an information packet from Tibet to an orbiting satellite up to 870 miles (1,400 kilometers) above the earth's surface. Scientists irradiated the quantum state (information about its polarization) into orbit [11]. In 2018, Rigetti's Forest developed Aliyun of Alibaba, which launched a quantum cloud computing service collaborating with Google's Cirq and the Chinese Academy of Sciences [10]. In October 2018, D-Wave Systems launched Leap, its real-time cloud access to quantum annealer hardware [10]. IBM was able to run its most giant quantum computer, a 53-qubit model, and Amazon Web Services has added a research-oriented quantum computing service called Bracket to its infrastructure. Rigetti Computing, in which 2019 QC join IonQ and D-Wave in Amazon's Bracket service, introduced a 32-qubit quantum computer. 2019 Microsoft said it is almost ready to power quantum computing based on "topological" qubits. They launched the 2019 Azure Quantum cloud computing service. 2019 Intel announced the production of a quantum computing controller chip called Horse Ridge, designed to shrink and simplify the hardware needed to communicate with quantum processors that house qubits. 2019 Google announced that the fastest supercomputer achieved quantum supremacy by performing a task that took 10,000 years on a 53-qubit quantum computing chip in 200 seconds [12]. In August 2017, Chinese scientists announced establishing the first private quantum communication network [13]. IBM has set a goal of building a computer containing 1000 qubits by 2023. In February 2020, Chinese scientists entangled two quantum memories 50 kilometers apart with fiber optic cables, 40 times the previous record [14].

1.1. Problem Statement

The article aims to assess the potential impact of quantum computing and artificial intelligence in smart management information systems (MIS) and their potential use in industry 4.0 and society 5.0 applications. The authors argue that hybrid quantum systems and quantum adaptive algorithms can improve existing AI methods, but the hardware limitations of quantum computers remain a challenge. The study aims to evaluate the theoretical and conceptual aspects of AI and quantum computing and provide guidance on their potential benefits and risks.

1.2. Assumptions

This study lean on the following basic assumptions:

1. Quantum computing can revolutionize the way we approach problems in various fields, including smart MIS and AI.
2. Quantum computing can overcome some of the limitations of classical computing, especially in processing large amounts of data and solving complex optimization problems.
3. The integration of quantum computing and AI can lead to more powerful and efficient algorithms, with the potential to transform various industries.
4. Quantum computing is still in its early stages of development, and there are hardware limitations that need to be addressed before realizing its full potential.

1.3. Research Hypothesis

The study has the following hypothesis: The integration of quantum computing and AI can lead to breakthroughs in smart MIS and industry 4.0 applications, with the potential to transform various industries. However, hardware limitations and risks associated with quantum computing need to be addressed before realizing its full potential.

Therefore, with a multidisciplinary approach, it is argued that the effects of this on the economy and business processes can occur at unpredictable levels. Accordingly, first of all, the conditions that trigger quantum computing are examined; what kind of approaches can be put forward to solve urbanization problems are evaluated; E-government and MIS applications are analyzed; The arrival

of quantum computing products and the strategies of interested big companies are mentioned.

2. CONDITIONS THAT TRIGGERS QUANTUM COMPUTING

Quantum computing does not improve the existing technology but creates a new field in technology. QC cannot perform the simple operations that classical computers do. However, they can solve problems that cannot be solved with classical mechanics, with the available memory and operating power. This new system will support the development of artificial intelligence technologies and provide new cryptographic information to information and communication systems. By opening the doors of new technology for the design of new materials, tools, and equipment that can be produced, it will perform fast and effective searches in big data quickly.

With today's state-of-the-art computers, a job that would take hours, maybe even days, can be done in a short time that can be measured in milliseconds. Secure communication and encrypted communication opportunities in the field of information and communication technology will be achieved thanks to QC. Quantum computing systems will achieve the desired efficiency from new generation technologies. QC decrypt passwords and cryptocurrencies, providing some advantages and disadvantages to governments in terms of defense and security. Quantum computing can threaten the defense and cybersecurity of traditional businesses. Quantum technology, which can break crypto algorithms developed for today's computers efficiently, will cause a severe security weakness when implemented. Now, it is essential to see the critical triggers behind this technology.

2.1. Advances in Artificial Intelligence

It is necessary to consider intelligence as the "ability to process data" to better refer to artificial intelligence. The concept of artificial intelligence, which started to be used in the 1950s, has started to be used in many stages of life today, together with more and more critical developments, and can be defined as a set of techniques that enable computers to imitate human behavior [15].

Artificial Neural Networks (ANNs), which imitate the working principle of the human brain, appear as one of the artificial intelligence technologies [16,17]. We have reached today, modern computers can process much better data than people, even without interpreting yet. Artificial Intelligence has become an area where action can be taken on more extensive data, especially with the development of Big Data and Deep Learning fields [18].

As questions like "Can, people investigate this more accurately, or is it a social network knitted with artificial intelligence?" were multiplied, it was not enough to analyze them. It is necessary to add comments that artificial intelligence emerged with this need. 'Artificial Intelligence' pushing the boundaries of intelligence is a branch of science that deals with the ability of machines to produce solutions to complex problems like humans. This is usually done by taking the characteristics of human intelligence and applying them to the computer as algorithms. According to the requested or desired needs, The most effective or less flexible or practical approach to what effect is to be displayed, even though it appears to be an improvement in artificial intelligence ICT, includes mathematics, biology, psychology, philosophy, etc. other sciences. The combination of information in all these areas depends on developments in artificial intelligence.

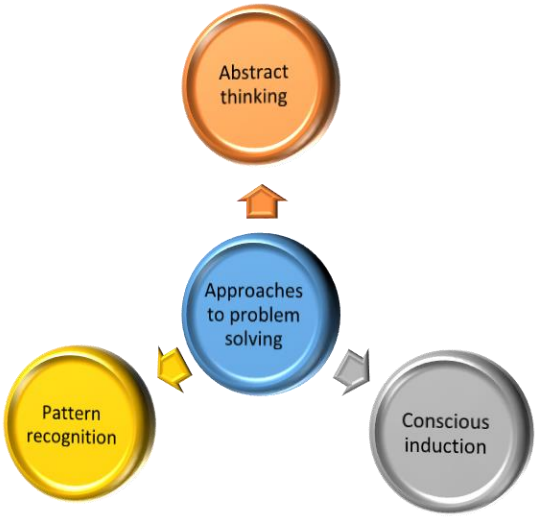

Figure 1. Three ways to approach problems

The potential uses and impact of the application of expert systems technology to entomology and agriculture are explored. The most common type of expert system, the rule-based approach, is described.

The representation of information in the form of rules and the interpretation of rules by the system is explained. Based on this general description of expert systems, three types of application are discussed: diagnostic systems, simulation delivery systems, and large-scale systems that act as integrators of different kinds of knowledge (e.g., expert opinion, objective information, and simulation models) [19]. Unlike humans, computers cannot realize special situations and adapt to new requirements.

Artificial intelligence aims to improve the behavior of machines in such complex tasks. Many synthetic intelligence types of research have enabled us to understand our mental behavior better. People have interesting approaches to problem-solving based on abstract thinking, conscious induction, and pattern recognition. Artificial intelligence will help us understand

this process by refreshing and exceeding our existing capacity.

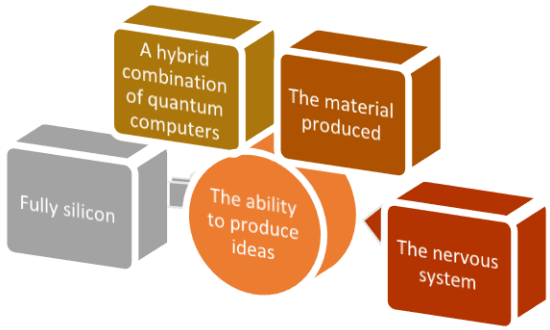

Figure 2. Ideas production abilities

One of the critical aspects of creativity is producing original ideas. Originality is defined as the novelty and rarity of an idea and is measured by the infrequency of a concept and structure compared to existing others [20]. Many different approaches have not been proven correct or wrong on artificial intelligence. While some appear to be much more helpful, new alternatives are constantly produced. Over the past 50 years, artificial intelligence researchers have often turned to solve specific problems. Numerous solutions have been made and implemented effectively and reliably in this context. It is certain that artificial intelligence, which has been the subject of many science fiction films until now, will carry our daily life in many different directions with the acceleration and development of research in this direction in the following years. Although the application areas mentioned above are only a tiny amount of this, especially for military purposes, many people have been embellishing their fantasies for the past years. Artificial intelligence crumbs are still used in the game world, the most crucial entertainment tool often used by the young population. The robots will fight soon instead of people.

The machines can now comment and combine the collected data to create a standard synthesis. By learning their pattern, predictions can be found much faster than human beings as part of the functionalities of new generation MIS and ERP systems. Now that artificial intelligence is in the field of management information systems. To exemplify a little more on what does the mayor do? The mayor reviews the inputs, plans, and investments, listening to the mass of people he addresses while optimizing these plans. How can he hear? "What does this city need?" The question is the question a mayor sought the most. Can a person do this more efficiently, or is it a system that can correctly interpret the correct data statistics organized by surveys or even receive feedback through social media? Undoubtedly, existing technology is ready for the existence of such artificial intelligence. So, current technology can now manage a city, and likewise, the same goes for a company or even a country. What is the chairman of the board of companies or political parties doing? First, he listens to stakeholders, but he appeals to hundreds of staff, and it is impossible to listen to all staff. Therefore, it does not access the correct data by filtering it to reach knowledge and wisdom.

Much data is being prepared about marketing research. Decisions are generally made with human-made reports. It says; we should enter this area or move to that area. Artificial intelligence can make a much more comfortable decision than a person in a marketing field by analyzing the data. When we look at the world, most companies and countries have already started to accept the AI situation to all MIS and ERP applications. Unfortunately, most companies are still not ready for modern understanding in some countries because they prefer traditional methods. After a certain period, all companies will have to surrender to artificial intelligence in their MIS and ERP systems. A product will be controlled and manufactured by a trusted

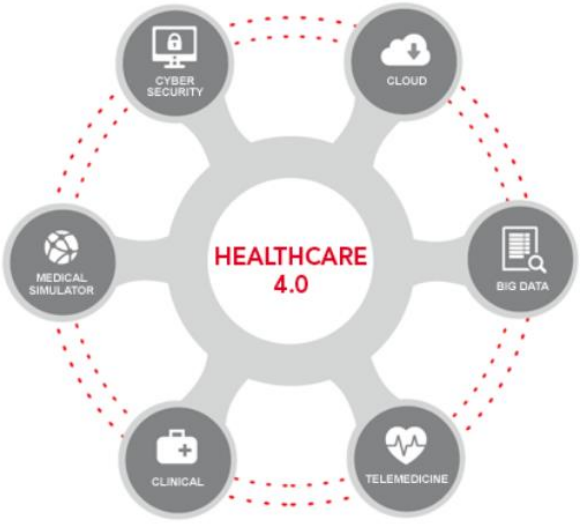

Figure 3. Elements of Healthcare

company or roofing company. Developing, trusted companies follow high technology closely and adapt quickly to the situation.

2.2. Digital Health and Need for Privacy

Implementing an open innovation framework in the healthcare industry, namely general health, enhances health-related organizations' innovation and creative capability by building a next-generation collaborative framework with partner organizations and the research community [22]. Digital Transformation in Health Industry 4.0, which enables the development of patient-specific devices, provides significant advantages in medical manufacturing. This decentralized production model can make production decisions without operator intervention. This production model provides robustness, autonomy, self-regulation, personal care, repair, and predictability.

Thus, the automatic production of fully personalized products for patient needs is practical, highly efficient, and economical. Due to the high quality of each product, patient-specific device production offers unmatched.

Although the costs of these devices are now a problem, they will be used extensively in a few years with Industry 4.0 solutions. Let us look briefly at digital transformation success with giant steps in developing the health sector in Turkey.

Medical devices are becoming intelligent, intelligent health devices, communicating with health monitoring systems and remote physicians. Bosch produces piston filling machines for liquid pharmaceutical agents such as cough syrup. It gives an immediate warning if specific components are used near the device. In addition, quality controls and service maintenance are performed. Reciprocating filling machines, such as printed circuit boards, is also networked production, enabling smaller batches according to customer requirements [23].

eHealth services facilitate the secure and straightforward exchange of essential health data between healthcare providers within and between countries. E-healthcare 4.0 poses some challenges, particularly:

- Epidemiological- and clinical-data mining systems: Big Data and Smart Data
- Cybersecurity solutions and services
- ICT-based mobility solutions
- Medical-image management and processing solutions
- Remote healthcare systems (telemedicine) working on both a patient-physician and physician-physician basis: telepediactrics and teleophthalmology platforms
- Intraoperative surgery and radiotherapy planning and simulation systems
- Monitoring and follow-up systems for chronic, multi-pathology patients
- Telerehabilitation systems
- Mobility systems, humanitarian aid, and emergency-management infrastructure
- Technology consultancy and optimization of processes

2.3. The solution finding Approaches to Urban Problems

A broad spectrum of blockchain applications promises solutions for problems ranging from risk management and financial services to cryptocurrency and the Internet of Things (IoT) to public and social services. Furthermore, the convergence of Artificial Intelligence (AI) and blockchain technology is revolutionizing the intelligent city network architecture to build sustainable ecosystems [24]. Smart City solutions are implemented in such a way as to enable decision-making based on real-time information integrated into the information technology infrastructure systems of cities such as the Urban Information System (UIS) and Geography Information System (GIS). Smart city solutions can be examined under energy, water, transportation, urban, and health services. Smart City creates a digital ecosystem of the following functionalities [25] :

- Electricity networks take account of interconnected user behavior for sustainable, economic, and safe electricity supply.
- To utilize renewable natural resources such as the sun, water, and wind. Water quantity and quality management with hydrological cycle stages are predominantly agricultural and industrial.
- Street lights used in the lighting of public spaces also fulfill other functions such as air pollution control or wireless internet connection. (Central management systems communicating with street lamps can reduce operating costs and provide instant information about weather conditions).
- To improve the logistics flow in the city by effectively integrating traffic situation, geographical and environmental factors, and working life requirements.
- To establish wireless networks to monitor the conditions of crops and manage crop cultivation processes.
- To provide information before travel and, more importantly, during the journey by using dynamic and multimodal information systems to improve the transport and traffic quality and efficiency.

2.4. E-Government and Cyber MIS Applications

As the government and the political process become more transparent, participatory, online, and multimedia-rich, there is an excellent opportunity to adopt advanced AI and intelligent systems research in e-government and politics 2.0 applications [26]. E-Government Digital transformation transforms the government because it digitizes public services. This change in Turkey is significant because we complain of the "bureaucratic state" tradition. For businesses in the public sector, each enterprise had to create a certain number of jobs, which would end. The goal of the e-Government apps is to provide public required services through a single address, such as password, electronic signature, mobile signature, and authentication systems.

A new application is emerging every day, with the banks constantly changing their service types and integrating them with developing technologies. Internet banking is one of the recent applications. Each bank has an internet banking system using Fintech AI. This service can be used with many tools such as computers, phones, and tablets. In this way, the most straightforward process to keep banks' path has been date and a few clicks from anywhere. Several other digital enterprises, customers, and devices touched digital ecosystems. Over the past few years, social, mobile, analytics, and cloud (SMAC) companies have come together to create a storm of digital transformation, reshaping markets, and changing the way we work and live [27].

Turkey has gained significant momentum in digital development and transformation point; perhaps it has also become a country that will shape the future of this transformation. The company sees the pulse of the

customer there; it can receive immediate return there. At this stage, proper communication with the brand's target audience contributes to the brand's reputation management in the long term. Therefore, brands that catch this potential one step ahead will lead their sector.

The amount of information produced and stored globally is unimaginable and grows every day. This shows the potential for providing critical insights from business information, yet very few have been analyzed. What does this mean for companies? How can companies benefit from this information that has not been studied? When the big data is combined with powerful analyzes, the following can be accomplished:

- To identify the root causes of real-time errors and problems.
- To make sales coupons based on customers' buying habits.
- To recalculate the risks of new portfolios.
- To detect wrong behavior before affecting functioning. Big data directly affects each industry branch.

2.5. Society 5.0

Digital transformation is essentially a social transformation. Its definition is "through the high degree of merging between cyberspace and physical space, will be able to balance economic advancement with the resolution of social problems by providing goods and services that granularly address latent manifold needs regardless of age, location, sex, or language" [28].

In addition to the internet of objects, big data, and artificial intelligence in production, societies started to develop by introducing information technology and advanced technology in this integrated framework in their new disciplines. Today, while the world's cultures are ranked, a new ranking is made: Hunter-Society, Agricultural-Society, Industrial-Society, Information-Society, and Intelligent-Society 5.0.

While advanced and developing countries discuss the advantages and disadvantages of industry-pioneered by Germany, Japan, which uses high-tech systems such as robotics and digital technology, is not associated with industry 4.0. Japan, Germany's pioneering approach to the development process in the world and its own country, sees Industry 5.0 as a philosophy. The age of humanity, which started with the hunter society, is now transitioning from the information society to super-intelligent communities [29].

The concept of "Society 5.0" defines this "super-smart society." It is a concept that was first recorded in Japan. Japan's approach to Industry 4.0 from a social perspective is mainly due to 3 reasons; The country's aging population, natural disasters in terms of having geography, and risk of environmental pollution and energy costs. Society 5.0 is regarded as a revolution that can eliminate these problems,

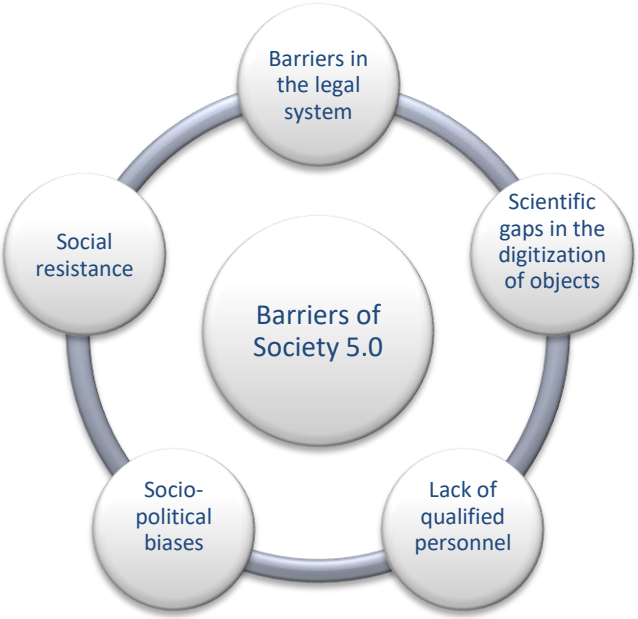

Figure 4. Five key barriers to Society 5.0

which are severe enough to destroy the country's future by integrating the technological innovations brought by Industry 4.0 most efficiently.

The five essential barriers need to be demolished to develop Community 5.0. Communities must cooperate to break down these barriers and continue Community 5.0. These are briefly the developments regarding Community 5.0 in the world.

3. THE ADVENT OF QUANTUM COMPUTING PRODUCTS

Today, the computers we use are out of life, instead of QC. Traditional computers define numbers as 0s and 1s; QC; use quantum fragments or 'cubits' on an atomic scale. On the other hand, QC are an alternative to existing computers composed of small electron stoppers called transistors. Here are the questions that stir our minds:

- What is the 'Quantum Computer' expected to cause revolutionary changes?
- Will computers be running at quantum speed, breaking conventional encryption?
- Can Quantum technology provide opportunities for teleportation?
- Will the post-quantum society be able to use the power of Gins and other spirituals?

'Qbits" instead of one simultaneously, all 'logic works. The qubit can have both 0 and 1 at the same time. They do not work by stopping electrons like standard computers and producing bits. Instead, they use photons called cubits and generate data. The essence of the job; can also be 0 and 1.

Figure 7 Branches of Quantum Technology

Moreover, this system is revolutionary in terms of efficiency and performance. QC, studied since 2012, were first a room size. The work continues rapidly. It is said that 10-20 years of the process is needed for models used in real life [30]. For 'normal' computers, 'material science' is sufficient, but for QC, the professors of MIT Physics continue to work! They are now huge, but in what areas will they make our lives easier when they are up in the future?

QC, which are an unusual alternative to 'normal' computers of 0 and 1 's, reveal the technological revolution because they promise to solve the problems that will take years to solve in a short time, even if they are still taking their first steps. Unstructured data will lead to more intensive use of large data infrastructures. One of the reasons IBM opened this project to the public is finding who will seek answers to what questions? It is already a big mistake to compare with 'normal' computers regarding speed! It is essential to ask the correct question. Questions answers; will also open the door to the everyday use of QC.

Despite all expectations, the ideas and projections about QC' role in our lives may be entirely out of place. The presence of transistors had evolved to the present day when smartphones were produced and virtually connected. With quantum technology, we will make a much more significant jump.

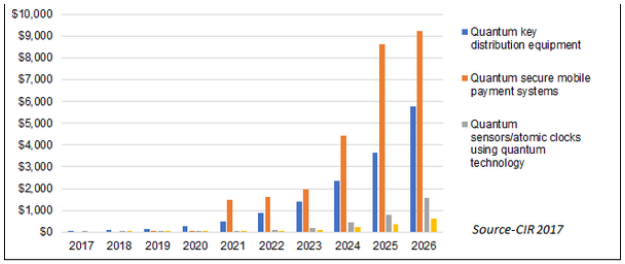

Figure 5. Ten-year Forecasts of Quantum Spending by End-User Segments ($ Millions)

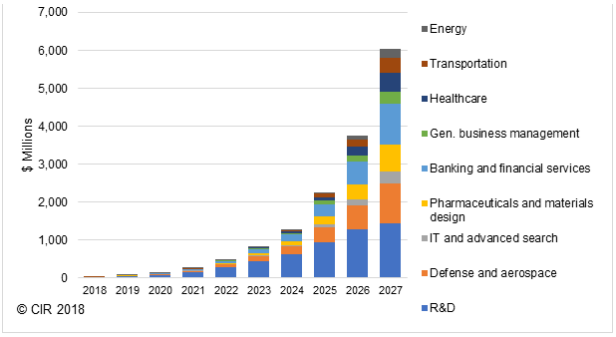

Figure 6. Quantum Network Revenues ($ Millions)

Source: CIR 2017

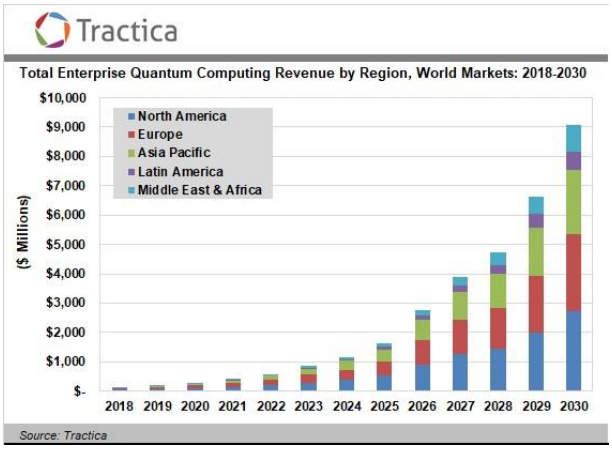

Figure 8. Total Enterprise Quantum revenue b Region, Markets

While many companies have been talking about them for years, the difference between the current one is that the table we see now has real quantum processors under their hands. We should try to answer the question, "Who produces these devices and how, on which physical technology, to whom does it sell?"

3.1. D-Wave: 'The' Quantum Computer Firm

To talk about the commercialization of QC, we first need to look at the history of the D-Wave company, Founded in Canada in 1999. D-Wave became the most current researcher and entrepreneur in the field, aiming to make a quantum computer. In contrast to a universal quantum computer, these devices were only systems designed to solve specific problems, using partial benefits of quantum mechanics (working with numbers such as solving the optimization problem using physical systems' low energy orientation) [31].

D-Wave from computers really after many years of discussion of whether they show quantum effects 2015 Google already purchased the D-Wave 2X system for his work as a result of classical on sometimes they have tested that 100 million positions faster announced. D-Wave had already sold to big names like Lockheed Martin and

NASA. They established a subsidiary company that specifically deals with the US. In addition, D-Wave continues to create potential customers for the future by providing cloud service via D-Wave Leap, which enables newly established techno-enterprises to access devices in exchange for membership and data sharing agreements.

3.2. IBM and the Universal Quantum Computer

After D-Wave, perhaps the longest-running commercial activity in this field, IBM, quantum IT initiatives are based much earlier than D-Wave. The commercial breakthrough IBM started with IBM Q System at the beginning of 2018. However, what is the difference between IBM devices and D-Wave? Understanding Quantum Computer, the probability distributions of zeros, and the matrix system in our article on QC are essentially the universal quantum computer model tools. In D-Wave's 2000 qubic system, it is sufficient to monitor the behavior of the overall system rather than the individual control of each qubit [32].

In contrast, IBM's 50 cubic processors require monitoring of the connection of each cubit to other cubits, clearing unwanted interactions, regular error checking. This makes D-Wave 2000 to 4000 relatively easy to upgrade, making IBM even harder to go from 50 to 60. However, this does not prevent IBM from gaining commercial revenue from its devices, developing software languages, and offering device access to potential customers.

3.3. Google and New Big Actors

In 2014, Google itself entered the race for making QC. The new quantum processor Bristlecone announced the 72 qubit superiority of the new chip with quantum limit beyond which plans to enter the top researchers in the Chinese market Google Alibaba. Sad news came from Bristlecone due to error rates in chips. It was noted to be inadequate to achieve this goal. Of course, this does not change that Google will be a powerful player in this market in hardware, software, and infrastructure.

Intel announced its 49-cubit processor Tangle Lake in 2018. Thanks to its partnership with the QuTech headquarters in the Netherlands, Intel has gained experience in custom chip production and has first-hand access to the research resources needed for the infrastructure of the quantum internet (QuTech aims to establish the first 'quantum internet in 4 cities by 2020'). This gives Intel a 'first-turn advantage' in identifying the possible quantum hardware infrastructure of the future internet.

Honeywell is a brand that most of us do not know in Turkey, continuing its actions financed activities for about 130 years, an annual turnover of over US $ 40 billion. If Honeywell were included in this list, they would produce ion-trapped cubits that operated with 99.997% accuracy (fidelity) announced at the beginning of 2019. However, introducing processors capable of physically making universal QC based on ion traps can start a severe technological transformation. The cubits of IBM and D-Wave's superconducting systems are much lower inaccuracy, making it difficult and costly to troubleshoot error correction and percentage minor quantum effects [33].

Honeywell is not the only company working in this field, but many start-ups and resident companies are experimenting with ion traps. Of course, the high accuracy of the individual cubits does not guarantee that they can be easily entangled or linear scaling up. Nevertheless, serious investment in a different physical system provides a possible alternative to the story that IBM wants to convince everyone of, the future's quantum computer will consist of superconductors.

It was inevitable that Microsoft, like Google, would be involved. However, Microsoft is trying to develop topological cubits ' as an alternative to their methods rather than outperforming their competitors IBM and Google and trying to outperform them technically (we will discuss this issue in another article specifically).

4.4. Business expectations on what should be done

Investing in quantum informatics is not a new topic, and even an excellent article was written at the Economist last year. To distinguish between two classes of venture capital investments, the investments made to get a share from the market that will develop in quantum technologies and the investments made to obtain a percentage from the development of quantum technologies market.

It is like the first-class technology investments we know. To rely on the product or infrastructure to be developed by a firm and invest money believing that its value will increase investment faster than alternative investment tools. At the end of this way, the company can pay the agreed price and buy shares from or sell the company to a more significant wholesale buyer because the firm's product and infrastructure (including people) have value.

The second class is about intellectual property-based value generation in emerging technology fields. In an emerging and burgeoning area, it is finding an area that has not been extensively patented before and supporting companies that will operate there, then selling intellectual property portfolio.

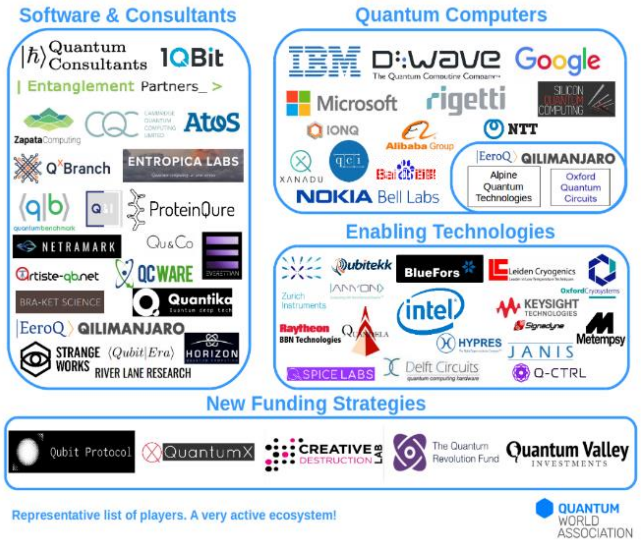

Figure 9. Company list for Quantum Computing

There are dozens of companies, venture capital ventures, suppliers, and end-users that we cannot handle here in the commercial ecosystem of QC, and these numbers are increasing every day. Even though there is still a minimal and niche area within the general business informatics atmosphere, quantum computer-based commercial activities are expected to reach $ 10 billion annually in the next 5–10 years. This means almost nothing compared to the overall IT market volume, but a tremendous acceleration for a technology that foresees the earliest 2050s for commercialization ten years ago. Even if it is unclear what the future will bring, it is clear that an approach beyond quantum "every word and wish is a prayer" is essential.

5. AN ASSASSMENT FROM MIS PERSPECTIVE

AI techniques, such as machine learning, deep learning, and natural language processing, have enhanced the decision-making process, data analysis, and operational efficiency of MIS [34]. On the other hand, quantum computing has the potential to address complex computational problems, which were once deemed intractable by classical computers, thereby further improving the capabilities of smart MIS [35].

AI technologies have been successfully applied in smart MIS to optimize resource allocation, predict trends, and automate various business processes [36]. For instance, AI-powered recommendation systems have revolutionized e-commerce by offering personalized product suggestions to customers, leading to increased sales and improved customer satisfaction [37]. Furthermore, AI-driven chatbots have enabled organizations to provide instant customer support, thereby enhancing user experience and reducing operational costs [38].

Quantum computing, although still in its infancy, has demonstrated promising potential to revolutionize smart MIS by offering significant computational advantages [39]. Quantum algorithms, such as Shor's algorithm for factoring large numbers and Grover's algorithm for searching unsorted databases, are expected to drastically impact data security and database management in MIS[40], [41]. Additionally, quantum machine learning algorithms hold the potential to outperform classical algorithms in terms of efficiency and accuracy, leading to improved decision-making in smart MIS [38].

Despite the numerous benefits, integrating AI and quantum computing in smart MIS also presents certain challenges. Issues related to data privacy, algorithmic bias, and the lack of standardized regulations must be addressed to ensure ethical and responsible use of these technologies [42]. Furthermore, organizations must invest in employee training and upskilling to adapt to the rapidly changing technological landscape and harness the full potential of AI and quantum computing in smart MIS [43].

Therefore, the integration of artificial intelligence and quantum computing in smart management information systems has the potential to drastically enhance decision-making, data analysis, and operational efficiency. However, it is crucial to address the challenges associated with data privacy, algorithmic bias, and regulatory frameworks to ensure the responsible and ethical use of these technologies.

6. CONCLUSIONS

Digital transformation is for all layers of society, but it imposes different tasks on different social groups. For example, preparing a 5G broadband strategy and laying the country with broadband fiber-optic networks is one of the duties of the public sector as it is a business to be carried out directly with public investments. However, communities are sensitive to the environmental and health effects of 5G, particularly after the COVID19 pandemics in 2021. On the other hand, it is among the duties of related institutions and companies to use information technologies effectively in production, take necessary security measures, and make employees willing to learn and use new technologies. We have to go from digital transformation to technological transformation and place the idea of digital transformation on the central axis for social transformation.

One of the distinguishing features of the fourth industrial revolution is the emergence of global digital platforms closely associated with the physical world and the ecosystem created by these platforms. A digital code should not be understood as a part of the ecosystem. The Digital Ecosystem is more; service providers should consider infrastructural practices enabling the exchange of services, encouraging the transfer of information with its environment, and supporting stakeholders.

Entrepreneurial companies offering innovative solutions shook the traditional corporate strategies of existing companies. For this reason, the market share, which is

already in operation with conventional methods, will start feasibility studies with a digital platform, large companies will seek ways to maintain their income without a headquarters or permanent staff. In summary, they will be forced to review their corporate strategies.

Digital transformation is a very radical revolution. It enables the development of transparent and sustainable asset/value sharing models in the economy. Such transformations create new problems with robust large-scale platforms that offer unlimited content access for the goods and service producers, which strategy should be interacted with, and how to define product ownership criteria.

It is a very short-term perspective to see improved in-house productivity as the main reason for the Digital Transformation. It does not take advantage of strategic benefits and makes it difficult for staff to engage in digital transformation. Companies need to carefully consider how they position the Internet of Things (IoT) and other advanced technologies, how they use these technologies to transform staff from "data-phobic" to "data fans," and explain their benefits. Successful technology changes are adapted from the bottom to the top, and people guide them. The personnel must be involved. The opportunities for progress and development for all must be clearly explained. Imagine a maintenance engineer who hears predictive maintenance from the system.

There are a few points to be bulleted:

- Consider how your organizational structure needs to be developed to strengthen digital transformation. For large companies, there is the option to create new departments that are structured for digital enterprises that protect analytical skills and feed them within the company.
- Carry out a digital competency inventory: There is a great need for staff to be trained in data management and analysis. Companies need to meet this need to be successful in digital enterprises. Start identifying motivated people to take their skills to the next level as part of this digital inventory.
- The proper development of skills is significant. HR teams need to decide which existing tasks need to be developed and where new capabilities are needed. Bring instructors from outside the company to gain new perspectives.
- Work with local universities to attract talents and direct schools to focus their education on the right areas. Recruitment programs offer real-life programming experience to university students and help improve the company and the student. Internship programs discover local talents, support them and provide space for development.
- Decide where to focus. Digital transformation has three basics to succeed: Technology, investment, and human capital.

The technology aspect of the business is often the most successful way of directing because it is guided by technologists who have clearly defined areas of responsibility. The main question is whether focusing on the right technology to perform the transformation at the right time. As for the investments, as we have seen in this survey, companies think they are investing enough in digital transformation, but do they focus on the right areas? The results indicate an intense focus on process efficiencies.

Finally, people are often the most forgotten factor in digital transformation. This is important from the point of view of both talent and communication. If more than 50 percent of the unwillingness to change is seen as the main obstacle, employee communication is crucial to ensure that staff knows the purpose of change and its effect. Therefore, it may be necessary to focus on more innovation-oriented investments. Research on which big enterprises are getting the most benefit from quantum technology delivered some interesting results across multiple industry sectors [44]:

- **Insurance**—The potential applications of quantum calculation begin with the valuation of financial instruments (e.g., bonds, derivatives), options and guarantees in insurance products, and operational risk measurement.
- **Finance**—The banking sector presents many challenges, including portfolio optimization, asset pricing, risk analysis, fraud detection, and market forecasts for QC.
- **Chemicals and pharmaceuticals**: Drug discovery is costly and requires calculations to simulate molecules.
- **Energy**— The two main interconnected problems that quantum computing can solve in the energy sector are to optimize the current network structure and to predict the appropriate energy usage.
- **Transportation**— The best example of quantum computing is traffic optimization by Volkswagen and D-Wave. Traffic flow optimization minimizes the time for a given set of cars to travel between their individual starting points and destinations. Hardware implementations of quantum annealing, such as the quantum processing units (QPUs) produced by D-Wave Systems, have been subject to multiple analyses in research to characterize the technology's usefulness for optimization and sampling tasks.
- **Logistics**: Operations-related supply chain issues are often nearly impossible to optimize with traditional computers. This area can reap numerous benefits from quantum computing entering the market. Alibaba has begun to experiment with its hardware. It is currently building a superconducting quantum computer in its Hangzhou headquarters, and Alibaba wants to reach a point where quantum computing is scalable.

- **Automotive and aerospace**: Management of a large fleet of autonomous driving or flying vehicles creates optimization problems that are rapidly scaled by the number of cars.
- **Materials**: Industries based on better batteries, microchips, or network architectures can explore quantum computing to stimulate new possibilities or optimize existing structures.
- **Blockchain and cybersecurity:** Blockchain is all about secure transactions and contracts. It is based mainly on cryptographic methods and is vulnerable to cyberattacks involving the latest technologies.
- **Internet:** Making QC in various parts of the world and creating an internet network based on quantum mechanics has accelerated. Quantum teleportation will lead to new developments in transportation and communication and medical and military.
- **Teleportation**: Scientists at the University of Bristol and the Technical University of Denmark announced in April 2020 that they had developed a new quantum teleportation technology thanks to quantum entanglement mechanisms. Thus, for the first time, data was teleported between the two chips.

It is predicted that quantum computing, which opens the doors of an innovation era, will be among the future technology trends with its plus and minus aspects. Universities carry out studies on quantum, which have extraordinary technological potential. The number of courses on quantum computing in universities should be increased, and specialization in this field should be ensured. The future of quantum computing, which will create a new career opportunity for young people, is already curious. Teleportation took place thanks to a phenomenon called quantum entanglement. Quantum entanglement is where the two parts are intertwined enough to communicate long distances. Thus, the change on one particle immediately affects the other particle. There is no theoretical distance barrier for quantum entanglement.

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