Management Of Islamic Educational Institutions In Facing The Era Of Industrial Revolution 4.0

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The goal to be achieved in this article is to explain the existence of Islamic educational institutions to be able to implement modern, innovative and responsive education management strategies that are expected to be able to compete competitively with other educational institutions in the era of the industrial revolution 4.0. Until now, Indonesia still needs IT infrastructure transformation, enforcement of data sovereignty and finally a personal data protection law. The problems that occur today cannot be solved in the same way as in the past concepts. The 4.0 industrial revolution cannot only be faced with technological development without involving social dynamics in it. In addition to preparing superior competitiveness, it is necessary to build public awareness and maturity in responding to current world developments, where information flows without clarity of truth. It is necessary to formulate a national policy strategy through awareness and maturity of thought. Besides that, public education needs to be adapted to meet the needs for skills in the era of the industrial revolution 4.0. Educators, educational staff, managers of Islamic educational institutions also need new management and have a stake in facing the 4.0 industrial revolution, especially in terms of the values that are built, because it does not mean the 4.0 industrial revolution is without negative access. That's where religion can play a role. Key words: Management, Islamic educational institutions, industrial revolution 4.0

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Introduction

Industrial Revolution 4.0 is an event that combines communication and information system technology. In this era there are many shifts in manufacturing and people's behavioral patterns (Widyasari and Mukhibat 2020) This is a trend of automation and data exchange in manufacturing technology, including cyber-physical systems, internet of things or Internet of Things (IoT), computing cloud and cognitive computing (Haris 2019) Industry 4.0 produces "smart factories". In a modular smart factory, cyber-physical systems monitor physical processes, create virtual copies of the physical world, and make decentralized decisions. Through the internet of things (IoT), cyber-physical systems communicate and collaborate with each other and humans simultaneously. Through cloud computing, internal and cross-organizational services are provided and utilized by various parties in the value chain.

The industrial revolution 1.0 developed so quickly and had a significant impact on human civilization that it has now become industry 4.0. As stated by Richard Mengko; First, the industrial revolution 1.0 (1750-1850), known since the end of the 18th century, which was marked by the invention of the first mechanical loom in 1784. The big change was the replacement of human power with machines; Second, industrial revolution 2.0 (1870-1914), occurred at the beginning of the 20th century. The existence of electricity at that time encouraged scientists to discover various technologies such as lights, telegraph machines, and conveyor belt technology. Electricity also reduces industrial efficiency by up to 300%; Third, industrial revolution 3.0, its emergence occurred in the early 1970s starting with the use of electronics and information technology to automate production, camera technology that was integrated with mobile phones began to become popular, and the music industry at that time was increasingly advanced with the discovery of digital music; Fourth, industrial revolution 4.0, from the beginning of 2018 until now. Automation technology in phase 3.0 is now combined with cyber technology. Industry has blended with virtual reality, in the form of connectivity between humans, machines and data spread everywhere (internet of things) (Fannah, Asy'ari, and Ratnaningsih 2022).

Indonesia is currently entering the era of Industrial Revolution 4.0. The middle of this century (the digital revolution) is marked by the fusion of technology and the blurring of the lines of physical, digital and biological space. In the Era of Industrial Revolution volume 4.0, there are fewer and fewer activities physically tied to geographical locations because all human activities are converting from manual to digital (Ake Wihadanto), "Entrepreneurial Leadership in the Era of Industrial Revolution 4.0," Text of Scientific Oration, Open University Graduation Ceremony Period I Year Academic 2017/2018) (Hardhienata, Suchyadi, and Wulandari 2021).

Saat ini, revolusi industri keempat (4.0) mengubah ekonomi, pekerjaan, dan bahkan masyarakat itu sendiri. Salah satu karakteristik revolusi industri 4.0 adalah pengaplikasian kecerdasan buatan atau artificial intelligence (Qurtuby 2021). Hakikatnya merupakan penggabungan teknologi fisik dan digital melalui analitik, kecerdasan buatan, teknologi kognitif, dan Internet of Things (IoT) untuk menciptakan perusahaan digital yang saling terkait dan mampu menghasilkan keputusan yang lebih tepat.

Menteri Nasir juga menekankan bahwa keberhasilan Indonesia untuk menggiring SDM muda menghadapi Revolusi Industri 4.0, juga ditentukan oleh kualitas dari Dosen, Guru, maupun Tenaga Pendidik lainnya. Mereka harus menguasai (i) Skills (dalam kepemimpinan dan tim kerjasama, (ii) Kemampuan beradaptasi dengan teknologi baru dan tantangan global (Cultural Agility), serta (iii) mempunyai kemampuan untuk berwirausaha (Entrepreneurship), termasuk penguasaan social entrepreneurship (Sakban and Resmini 2018)

Methods

This research uses a type of library research. Literature review is research where data collection techniques are carried out in the field (in the library) based on reading literature that provides information about a research topic. The information is then reduced, presented and presented using research procedures (Sari and Asmendri 2020). This approach uses various literature studies. After that, the information is reduced, displayed and presented in accordance with research procedures. The approach uses various literature studies. The literature used is journals and books that support the development of ideas about the management of Islamic educational institutions in facing the digital era.

Researchers develop a conceptual framework for the management of Islamic educational institutions in facing the digital era. Next, the researcher developed a concept to develop how Islamic educational institutions can face the digital era and teachers can adapt in the digital era.

Result

1.1. Industrial Revolution 4.0

Industrial revolution consists of two (2) words, namely revolution and industry. Revolution, in the Big Indonesian Dictionary (KBBI), means very rapid change, while the definition of industry is an effort to implement the production process (Galuh, Putri, and Cahyani 2022). So if these two (2) words are combined they mean a change in the process fast production. This rapid change is not only aimed at increasing the number of goods produced (quantity), but also improving the quality of production results (quality).

The term "Industrial Revolution" was introduced by Friedrich Engels and Louis-Auguste Blanqui in the mid-19th century. This industrial revolution is also ongoing from time to time. This last decade can be said to have entered the fourth phase 4.0. Changing phase to phase provides an articulate difference in terms of usefulness. The first phase (1.0) involves the discovery of machines which emphasizes (stressing) production mechanization. The second phase (2.0) has moved on to the mass production stage which is integrated with quality control and standardization. The third phase (3.0) enters the stage of mass uniformity which relies on computerized integration. The fourth phase (4.0) has brought digitalization and automation, combining the internet with manufacturing (Mavianti 2019).

Industry 4.0, which is a continuation of Industry 3.0, which adds connectivity instruments to obtain and process data, automated network devices, internet of things (IoT), big data analytics, cloud computing and cyber security are the main elements in Industry 4.0. These connectivity devices are connected to physical industrial devices. The goal is to receive and send data according to specified commands, either manually or automatically based on artificial intelligence. IoT devices in Industry 4.0 are known as IoT (Industrial Internet of Things), which was previously very useful for internal monitoring.

In the industry 4.0 concept, Internet of Things (IoT) devices have the ability to connect to a Wide Area Network (WAN) network via a cloud environment, a technology that enables data management in a more efficient and integrated manner. When data from IoT devices makes it to the cloud environment, it is not only stored, but also deeply processed to produce valuable information. This information can then be disseminated to various parties who need it, either for analysis, decision making, or developing better services. This process not only relies on basic cloud technologies, but also requires sophisticated automation and mature orchestration in a hybrid cloud environment. Automation is needed to ensure that the data processing process runs without obstacles and with minimal human intervention, while orchestration functions to manage integration between various different systems. The main aim of this approach is to make it easy for developers to continue to innovate in the products or services they produce, as well as to assist operational parties in maintaining and improving system performance so that it remains reliable and able to meet the ever-growing needs of this digital era.

Apart from that, the phenomenon of disruptive innovation has also caused several professions to disappear because they have been replaced by machines. For example, now all the work of check-in counter officers at various international airports has been taken over by machines that can directly respond to passengers' needs, including scanning machines for checking passports and visas, as well as printers for printing boarding passes and luggage tags. Another impact is the emergence of new professions that did not previously exist, such as YouTubers, Website Developers, Bloggers, Game Developers and so on (Hermawan, Sitika, and Syarief 2021).

Islamic education is currently in the midst of a rapidly developing digital era, where high mobility and access to information are the primary needs of every individual. In this context, society increasingly demands immediacy and real-time services. Everything needed must be available quickly and efficiently. If access to these needs takes too long, people tend to lose interest and switch to other service providers who are more responsive. This condition creates great pressure on the speed of responding or responding.

This digital era not only brings changes in technology, but also encourages new perspectives and mindsets towards services, especially in responding to user needs. Response speed is a key element that greatly influences user satisfaction and loyalty. If Islamic education is unable to adapt to these demands, there is a big risk of decreasing relevance in a society that increasingly prioritizes efficiency and timeliness.

Rhenald Kasali describes this phenomenon as a "corporate mindset," where the mindset of an organization or institution needs to be oriented towards speed, responsiveness, and adaptation to the dynamics of user needs. In the context of Islamic education, adopting this mindset is not only important to remain relevant in the digital era, but also to ensure that religious values can continue to be conveyed effectively amidst the challenges of ever-changing times (Inayatusufi 2018)

Industry 4.0 which relies on the internet also has several benefits, in general they include (Haris 2019):

1.1.1. Optimization

Optimizing production is a key advantage for industry 4.0. smart factories that can optimize their own production will lead to almost zero production time. This is especially important for industries that use expensive manufacturing equipment such as the semi-conductor industry. Being able to utilize production constantly and consistently will benefit the company. For educational institutions, machine optimization can help the community distribute positive content. For example, the author developed an Information Technology website with the domain www.tahutech.me, which can be used by the public to learn technological information, or for prospective teaching staff, prospective educational staff can get additional information.

1.1.2. Adjustment

Creating a flexible, customer-oriented market will help people's needs quickly and smoothly. It will also dissolve the boundaries between manufacturers and customers, between teachers and students. Communication will take place between the two directly. This speeds up the production and delivery process, precisely and efficiently and accelerates the positive learning process.

1.13. Encourage Education and Research

The application of Industry 4.0 technology will encourage various fields such as information technology and will improve education in particular. New industries will require new sets of skills. Consequently, education and training will take new forms that provide such industries with the required workforce.

The starting point for the education revolution 4.0 according to Hambali & Muhaimin (Muallimin, 2020) is the start of using cyber technology in the learning process which is expected to provide convenience and effectiveness for students and education managers. This educational technology is often called edutech (educational technology), not only for students, the online learning system is also designed for teachers and parents which is very easy to reach via computers, tablets and smartphones, such as the official application of the Ministry of Education and Culture of the Republic of Indonesia Rumah Belajar, Ruangguru, Smart Class and Zenius, which provide free and paid content for all subjects for elementary, middle and high school levels based on Curriculum 13 and Solve Education which packages English lessons in a fun way through the game "Dawn of Civilization" on smartphones for free (Fannah, Asy'ari, and Ratnaningsih 2022)

1.2. *Subsection Challenges and Management of Islamic Education Institutions Facing the Era of Industrial Revolution 4.0*

Revolutions have occurred throughout history when new technology and new ways of understanding the world trigger major changes in economic systems and social structures. Industrial Revolution 4.0 is not just machines and intelligent systems, its scope is much wider because it occurs simultaneously, namely in the form of a wave of breakthroughs in various fields, sequencing genes to nanotechnology, from renewable energy to quantum computing (Schwab 2017).

Wherever people read nowadays, it is difficult to avoid information or writing about information technology (IT) and the internet. This not only happens in their country of origin, namely America, but also in Indonesia. Newspapers and magazines are filled with stories of successes and failures of individuals or companies embracing IT and the internet. The internet has filled everyday public spaces, from the time someone wakes up until they go back to sleep, colored by activities connected to the internet, such as checking comments or posts on social media. The internet is no longer just a matter of defense as this technology was first born in America, but has penetrated various sectors of life.

The importance of information technology and the internet is so important in various areas of life, including the world of education, Marquardt specifically discusses the importance of this technology in learning organizations (read: educational institutions), Marquardt said there are 3 (three) technological subsystems, namely: information technology, technology-based learning , and electronic performance support system (EPSS) (Djayusman 2021). Information Technology is defined as computer-based technology used for collecting, coding, processing, storing, transferring and using data between machines, people and organizations. Meanwhile, technology-based learning refers to video, audio and computer-based multimedia training for the delivery and exchange of information, knowledge and skills. Meanwhile, electronic performance support systems are defined as the use of databases (text, visual, or audio) and knowledge bases to obtain, store and distribute information throughout the organization.

Seeing the fact that IT and the internet are not just complementary (secondary) tools for humans but have become part of human (primary) life, as well as the urgency for Islamic education, this article needs to explain the challenges and management of educational institutions, especially for managers of Islamic educational institutions , how can school/madrasah principals or Islamic boarding school leaders navigate this change, by integrating digital and physical technology in all areas of business, production, mobility and communication, the fourth industrial revolution represents a broad and comprehensive shift that must be addressed comprehensively if schools/ madrasah/Islamic boarding school want develop

There are at least three things that must be considered in facing industry 4.0, namely (Haris 2019):

1.2.1. Public

Society is an important element in change. People, especially in big cities, are among those who enjoy this change the most. City residents are the biggest users of application-based online transportation services, city people are also the biggest accessers of information spread across various internet-based media and social media. Urban communities are the largest users of internet services compared to rural communities. Without society, technology is meaningless. This is both a challenge and an opportunity for Islamic educational institutions. Society can become a new "market" as learning citizens who are not limited by age, space and time

It is time for Islamic education managers to prepare their educational models to no longer rely on classical models that utilize space and time. In responding to these challenges and opportunities, managers can develop learning tutorials and Android-based e-books (electronic books).

1.2.2. Strategy

It is time for the management of Islamic educational institutions to open themselves to this technology. There are several steps that managers can take, including:

1.1.2.1. Preparing talent sources from various universities to support the development of information technology or the internet in the learning process, both as providers of learning content and as institutional governance.

1.2.2.2. Enlarge the "market" or market that is underserved and affordable through the development of e-learning and social media management that is friendly, inspiring and intelligent.

1.1.2.3. Offering predictive tools to help improve processes and reduce risks, especially in decision support, as stated by Marquardt regarding the electronic performance support system technology subsystem.

1.2.2.4. Building networks with the government, internet service providers and other private sectors.

1.2.2.3 Technology

The industrial revolution 4.0 guarantees integrated digital and physical technology. This approach can improve organizational operations, productivity, growth, and innovation. So far, it seems as if the managers of educational institutions have used this technology, but unfortunately they are actually using this digital technology to do the same things they have always done before, only to do things faster and better. In fact, many researchers have found that Industry 4.0 organizations are actually using it to create new business models. It is fitting that slam education institutions expand the use of Industry 4.0 technology to include suppliers, customers, workers, partners and other parties in the ecosystem, so that they can find more transformative benefits.

Discussion

Irianto in the work of Industry 4.0; The Challenges of Tomorrow (2017), states that the challenges of Industry 4.0 include several things. First, industrial readiness. Second, trusted workforce. Third, ease of socio-cultural arrangements. Fourth, diversification and creation of jobs and opportunities for industry 4.0, namely ecosystem innovation, competitive industrial base, investment in technology and integration of Small and Medium Enterprises (SMEs) and entrepreneurship (Ridwan 2021).

Is it just the world of work and digital at large? Certainly not. The challenges of the Industrial Revolution 4.0 era are very complex. Not to mention in the world of education, everything has converted to the digital world. If in the past a manual, ancient, primitive system was enough, now everything has to be completely cyber. For example, e-library (digital library), e-learning (digital learning), e-books (online books), and others.

The following are several things that are other challenges of the industrial revolution 4.0, including (Haris 2019):

1.2.2.1. Security

The most challenging aspect of Industry 4.0 is the IT security risk to industrial systems, including educational institutions. This online integration will give room for security breaches, data leaks and even cyber theft including negative websites must also be considered. Therefore, research in security is very important.

1.2.2.2. Negative Content Provider

An aspect that is no less challenging than industry 4.0 is the availability of negative content services such as pornography and information containing hoaxes, radicalism, anti-diversity and so on. Of course, intelligence, creativity and wisdom are needed to deal with it.

1.2.2.3. Capital

One of the important principles in such a transformation is that it requires large investments in new technologies. The risks must also be calculated and taken seriously

1.2.2.4. Educators and Education Personnel

While it is still too early to speculate on the condition of the teaching and education workforce with the global adoption of Industry 4.0, it is safe to say that teachers and employees will need to acquire different or entirely new skills.

1.2.2.5. Privacy

This is not only a concern for the community as learning citizens, but also for teachers and institutional managers. In interconnected industries, managers need to collect and analyze data. To the public, this may seem like a threat to their privacy. Small and large educational institutions that have not shared their data in the past must work their way towards a more transparent environment. Bridging the gap between "consumers" and "producers" will be a major challenge for both parties.

The main goal of industry 4.0 is the stability of the distribution of goods and needs. Industry 4.0 makes it possible to collect data on people's needs in real time, and send this data to producers. So, producers can produce the right quantities according to needs. Of course, economically, this can maintain price stability. From a business perspective, this can expand the market (Hertati and Safkaur 2020).

For educational institutions, collecting data on community learning needs makes it possible for managers to provide content that meets community needs without ignoring religious teaching values, and is managed efficiently or capital-intensive. Here are some examples of industry 4.0 opportunities for Islamic education (Susyanto 2022):

1.2.2.1. Providing real-time information about religious or preaching content that is friendly, anti-hoax, intelligent and inspiring to anticipate various other sites that are radical, anti-diversity, and so on. Real-time information and predictive analytics will improve institutional planning and resource allocation across management levels.

1.2.2.2. Providing learning content can act as a substitute for real-world experience.

1.2.2.3. Providing study programs, expertise majors for the community in this field.

In order to welcome Islamic Education 4.0, like it or not, all the latent problems above must be able to find a solution. If not, it will be difficult if not reluctant to say that it is impossible to realize Islamic education that is contextual to the times. Therefore, as stated above, there is a need for reform and renewal of all aspects of Islamic education. Borrowing Rhenald Kasali's term, there are three steps that Islamic education must take in this 4.0 era, namely disruptive mindset, self-driving, and reshape or create (Inayatusufi 2018)

Disruptive mindset. Mindset is how humans think which is determined by the settings we create before thinking and acting. Islamic education today is in a fast-paced digital era, high mobility, and access to information is everyone's primary need. In addition, today's society demands immediacy and real-time. Everything needed must be immediately available. If access to these needs takes too long, people will abandon it and switch to other services. In essence, the demands in this era of disruption are responses.

Self-Driving. Organizations that are agile and dynamic in adapting to navigate the ocean of disruption are organizations that have HR (Human Resources) with the mentality of good drivers, not passengers. Human resources with a good driver mentality will be willing to open up, read situations quickly and accurately, have integrity, be agile in acting, be alert to all bad possibilities, and be able to work effectively, innovatively and efficiently. These abilities are especially needed by leaders and managers of Islamic educational institutions. They are required to be reliable drivers for their institution. Therefore, managerial competence alone is not enough. But it must also be accompanied by the ability to lead. Meanwhile, human resources with a passenger mentality will tend to be bureaucratic, rigid, slow and lack discipline. this is still firmly held. The genealogy is "keeping the good old and taking the new, better". As mentioned above, the 4.0 era is an era where speed and convenience are human demands.

This of course requires massive adjustments. So there are two logical choices for Islamic education to face this era, namely reshape or create. Reshape in the genealogy above means maintaining the good old thing. However, in the 4.0 era, maintaining it alone is not enough, it must be sharpened. Old methods and systems that are still good and relevant need to be modified according to changes and developments over time. For example, at the level of management and professionalism of human resources, competence and capacity need to be strengthened and increased. This can be done through training, seminars, workshops, study scholarships, and so on. Another alternative is create, creating something completely new or in the genealogy above "taking something new and better". This means that the old methods and systems are obsolete. So it can't be used again. The only way out is to create completely new methods and systems. For example, developing a new digital-based service system. So that residents of Islamic educational institutions can freely access all needs related to education and administrative services. Another example is developing contemporary learning models by fully utilizing digital technology, such as E-learning, Blended Learning, and so on.

In implementing strategic steps to anticipate and respond to changes in the education system in this industrial era, it is necessary to change the implementation of the system in Islamic education institutions towards digital transformation. Apart from core competencies, teaching staff are also required to have qualifications and supporting competencies, which include (Haris 2019):

1.2.2.1. Agility.

In terms of agility, teaching staff are required to continuously transform and experiment so that they can produce new learning ideas.

1.2.2.2. Innovation,

In terms of innovation, teaching staff are required to have the capacity to translate their ideas or findings into valuable creativity. This innovation can be in the form of new products or services for student learning patterns, current learning processes, or innovations that produce new competitive advantages.

1.2.2.3 Creativity

Educators are required to have creativity, so they can change an idea or imagination into something new. In this case, educators are expected to be able to see things in a new way, find interesting and new patterns, or connect old things and new things to produce better products.

1.2.2.4. Anticipation

Educators should be able to anticipate turbulent changes in this digital industrial era. So teaching staff are expected to have the capacity to anticipate and act quickly in any conditions. With this anticipatory ability, teaching staff can quickly respond, adapt, and create opportunities to win the turbulent changes in the digital industrial world.

1.2.2.5. Experiment

In this industrial era 4.0, teaching staff are required to be able to experiment or have the willingness to search for and try something new related to advances in digital technology and always prioritize enthusiasm in responding to developments in digital technology.

1.2.2.6. Open-mindedness

Educators should have an open mind so that they have the capacity to open themselves and accept all the possibilities offered by advances in digital technology, because the first step to a digital transformation is awareness and an attitude of opening oneself to the various potentials, threats and opportunities that arise as a result of advances in digital technology. .

1.2.2.7. Networking (Network)

Educators in this industrial era should have a wide network to support their performance and competence. So an educator should have relationships and be able to work together with all stakeholders.

From these requirements it can be understood that to overcome the industrial era 4.0, teaching staff must become future teachers, namely teachers who are oriented towards educating children who are prepared for future challenges. Future teachers must have several qualifications and abilities such as: adaptive, open and global minded, technology savvy, innovative and creative, and have the desire to continue learning (long life learners) (Teachers 2021) . What is mandatory is digital knowledge, in this case teaching staff know about digital applications; and digital experience, in this case teaching staff are required to have experience in using digital-based applications in all their work.

If you look back at the past, the learning system in universities only used the lecture method, with the medium of writing on a blackboard, and there were also some teaching staff delivering lecture material using transparent plastic media and then shining it on the screen using an OHP (overhead projector), the Students record the material in their notebooks using ballpoint pens. But in the current industrial era, now educators distribute lesson material using e-mail or slideshare, then in class they deliver the material using a projector connected to their computer and each student brings a laptop to type notes from the material delivered by the educator and even uses templates. e-learning learning. A phenomenon like this is an example that the changes and development of our world of education have reached the peak of the industrial era 4.0 due to digital transformation.

Therefore, to maintain the existence of Islamic education in the 4.0 era, like it or not, we must be able to find a way out. If not, it will be difficult to realize Islamic education that is contextual to the times. Therefore, there is a need for reform and renewal of all aspects of Islamic education. Using Rhenald Kasali's term, there are three steps that Islamic education must take in this 4.0 era, namely disruptive mindset, self-driving, and reshape or create (Widyasari and Mukhibat 2020).

The explanation above can be interpreted as meaning that teaching staff in Islamic educational institutions are required to be able to adapt to the Industrial Revolution 4.0. One of the adaptive attitudes is following technological developments in the application of learning patterns, conventional learning patterns can no longer be maintained, so that they are able to produce highly competitive graduates. In this way, Islamic educational institutions can always increase the capacity and capability of their teaching staff. In facing the industrial revolution, teaching staff must also follow core competency programs that are in line with the needs of the industrial revolution 4.0.

Conclusion

Industry 4.0 is not just an issue. In reality, until now, Indonesia still needs a transformation of information technology infrastructure, enforcement of data sovereignty and finally a personal data protection law. The problems that occur today cannot be solved in the same way as in the past. Industrial Revolution 4.0 cannot be faced only with technological development without involving social dynamics in it. Apart from preparing superior competitiveness, it is necessary to build awareness and maturity in society in responding to current world developments. Especially in this day and age when information flows rapidly without clarity of truth.

Declarations

First author: Underlines the main context regarding Industry 4.0 in Indonesia, including the need for transformation of information technology infrastructure, enforcement of data sovereignty, and the importance of personal data protection laws. The focus is on macro and policy issues.

Second author: Highlights today's challenges that cannot be solved using old methods, emphasizing the need for new approaches that are relevant to the Industrial Revolution 4.0. They put forward the idea that technology should be applied taking into account the broader social context.

Third author: Contribute to social aspects, especially the need to build community awareness and maturity. They emphasized the importance of society understanding and responding to the rapid flow of information whose truth is often unclear.

Fourth author: Integrates and summarizes the contributions of other authors, underscoring the need for a holistic approach that includes technological development, social awareness and competitiveness to face the challenges of Industry 4.0 as a whole.

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