SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2023
ORGANIZATION AND MANAGEMENT SERIES NO. 189

# HUMANOID ROBOTS IN MANAGERIAL POSITIONS – DECISION-MAKING PROCESS AND HUMAN OVERSIGHT

Ida SKUBIS[1]*, Krzysztof WODARSKI[2]

[1] Silesian University of Technology; i.k.skubis@gmail.com, ORCID: 0000-0002-2447-9832
[2] Silesian University of Technology; krzysztof.wodarski@polsl.pl, ORCID: 0000-0002-4725-1064
* Correspondence author

**Purpose:** This article explores the roles of humanoid robots as CEOs in modern corporations, with a focus on Mika and Tang Yu as case studies. It compares their decision-making processes and emphasizes the importance of human oversight for ethical decisions. The article also discusses the European Union's guidelines on decision-making of AI and human oversight. Additionally, it examines the potential for robots to replace CEOs and the importance of human-robot collaboration in the future of corporate management and decision-making.
**Design/methodology/approach**: This article begins by providing statistics on the humanoid robot market and then profiles two well-known humanoid robots, Mika and Tang Yu, who function as CEOs. The research compiles data from various sources to create a comprehensive dataset on their roles and functions. It analyzes their responsibilities, decision-making processes, and interactions with humans to identify differences and similarities between them. The paper also examines EU guidelines on AI decision-making and explores the future of corporate management and decision-making.
**Findings:** Two humanoid robots, Mika and Tang Yu, have assumed CEO roles with distinct approaches. Mika, a real humanoid robot, focuses on community engagement and efficient data-driven decisions. Tang Yu, a virtual humanoid robot, concentrates on workflow optimization through data-driven decision-making and significantly improving the company's stock market value. While Mika's decision-making encompasses emotional and strategic elements, Tang Yu's approach emphasizes data-driven analysis. Both CEO robots require human oversight to align with company values and ensure ethical decision-making. The future holds potential for robots to reshape corporate leadership, but ethical concerns and human-robot collaboration remain crucial.
**Practical implications:** The research shows that the corporate management is undergoing change and evolution by integrating humanoid robots into future roles as managers, leaders, and CEOs. CEO robots are expected to reshape corporate leadership through their evolving decision-making capabilities, adaptability, and a focus on data-driven, analytical, and strategic decision-making.
**Social implications:** The introduction of humanoid robots as CEOs represents a significant shift in corporate leadership. While the potential benefits in terms of efficiency and decision-making are substantial, the associated social implications, including job displacement and ethical considerations, must be managed carefully to ensure a smooth transition and positive outcomes for society as a whole.

http://dx.doi.org/10.29119/1641-3466.2023.189.36 http://managementpapers.polsl.pl/

**Originality/value:** The article presents and compares two humanoid robots who act as CEOs. It analyses the EU guidelines in terms of decision-making and human oversight and makes a valuable contribution to the discussion of the future of corporate leadership and management.

**Keywords:** humanoid robot, humanoid robot CEO, humanoid robot leader, decision-making, human oversight.

**Category of the paper:** Research paper.

## 1. Introduction

The industrialization process has been greatly shaped by technological advancements, particularly the Industrial Revolutions. The third revolution, which focused on automation, emerged in the late 20th century and is still widely used by many companies (Sanghavi et al., 2019).

Industry 4.0, the fourth industrial revolution, represents a new level of organization and control over the entire product lifecycle, with a primary focus on meeting individual customer requirements. This revolution impacts various aspects of the industry, including research and development, design, inventory management, service, and customer care (Vaidya et al., 2018; Neugebauer, 2016).

Industry 4.0 is expected to drive significant development in the coming decades and is associated with terms like "smart factory", "smart manufacturing", "big data analytics", "cyber-physical systems", and "smart machines". It embodies the digitization of manufacturing through the integration of advanced technology into successive generations of tools and techniques.

In the past, technology development primarily aimed at automation, but today's focus is on smart industry technologies that facilitate cooperation between humans and machines. This means that teams in smart industries consist not only of humans but also include AI-powered robots, as noted by various researchers (Molitor, Renkema 2022).

## 2. Literature review

### 2.1. Collaboration of AI with humans

Collaboration between humans and AI leads to significant performance improvements in businesses. This collaborative intelligence capitalizes on the complementary strengths of both parties, with humans contributing leadership, teamwork, creativity, and social skills, while AI offers speed, scalability, and quantitative capabilities (Gościniak, Wodarski, 2019).

To fully use the potential of this collaboration, companies should understand how humans can enhance machines and vice versa, and redesign their processes accordingly.

Five principles for optimizing this collaboration include reimagining business processes, encouraging experimentation and employee involvement, actively guiding AI strategy, responsible data collection, and redesigning work to incorporate AI and develop relevant employee skills. A survey of 1,075 companies across 12 industries found that adopting more of these principles correlated with better AI initiative performance in terms of speed, cost savings, revenues, and other operational measures (Wilson, Daugherty, 2018).

The advent of humanoid robots creates a new working environment, transforming the way enterprises operate and manage resources. Traditional managerial roles are now being redefined as companies increasingly explore the incorporation of humanoid robots into these positions.

This article demonstrates the potential of humanoid robots as managerial assets, addressing their implications for future of corporate management and decision-making within the context of enterprise management.

## 2.2. Service robots, cobots (collaborative robots) and humanoid robots

For the purpose of this article, it is necessary to provide the definition of a *humanoid robot*, however, it is worth mentioning some broader notions first. Defining robots is challenging due to the absence of a global scientific consensus. In broad terms, a robot is seen as a physical machine capable of awareness, decision-making, and may also possess autonomy and learning, communication and interaction skills. This definition refers mostly to autonomous robots, which are characterised by their ability to acquire autonomy through sensors or data exchange with their environment, optional self-learning capability, a physical form, and adaptability to their surroundings (Nevejans, 2016).

The International Organization for Standardization (ISO) issued a document called ISO/TS 15066:2016 in which the definitions related to collaborative robots are explained. According to this document, the term *collaborative operation* is a "state in which a purposely designed robot system and an operator work within a collaborative workspace", while *collaborative workspace* is a "space within the operating space where the robot system (including the workpiece) and a human can perform tasks concurrently during production operation". A *collaborative robot* is a "robot designed for direct interaction with a human within a defined collaborative workspace".

Another type of a robot that is defined, is an *industrial robot,* which definition appears in ISO 8373:2021. In accordance with this document, an *industrial robot* is a programmable, multipurpose manipulator that can be automatically controlled in three or more axes. It can either be fixed in place or attached to a mobile platform and is used for automation applications in an industrial environment. This term encompasses the manipulator, the robot controller, and the means for teaching or programming the robot, including communication interfaces. Industrial robots may also include auxiliary axes integrated into their kinematic solution, and they cover the manipulating portion of mobile robots, where a mobile robot consists of a mobile platform with an integrated manipulator or robot (ISO 8373:2021).

The next definition, essential in the context of this article, is the one of a *service robot*, which appears in ISO 8373:2021, and is as follows: “robot (3.1) in personal use or professional use that performs useful tasks for humans or equipment”. There are two additional notes to this definition, the first one relates to their personal use, where service robots can be involved in various tasks such as handling or serving items, transportation, providing physical support, offering guidance or information, grooming, cooking and food handling, and cleaning. These tasks are typically related to assisting individuals in their daily lives. The second note refers to their professional use, in which service robots are employed for tasks including inspection, surveillance, handling of items, transporting individuals, providing guidance or information, cooking and food handling, and cleaning. These tasks often pertain to supporting or automating processes in a professional or industrial setting.

A term *social robot* does not have a separate entry in the above mentioned documents, however, they are a sub-type of service robots. Social robots are an emerging frontier in the field of personal robotics. They are created to independently engage with people in diverse application areas using natural and intuitive interactions, employing the same social signals as humans (Vollmer et al. 2018). Shortly, a social robot is a physical robot that has the capability to engage in social interactions with people (Sharkey, A., Skarkey, N., 2020).

The technical report “Automation and Robots in Services” by Sostero in 2020 defines *social robots* as capable of interacting and communicating with each other, with humans, and their surroundings. The report clarifies that service robots have the potential to function as social robots, such as customer-service bots, but it is not a requirement. On the other hand, some social robots designed for personal use, not professional tasks, do not fit the definition of service robots according to the same report.

Finally, we can move to the definition of a humanoid robot, which is the basis for the empirical part of this article and the analysis is going to be based on the definition provided by ISO 8373:2021, in which a *humanoid robot* is defined as follows: “robot (3.1) with body, head and limbs, looking and moving like a human”. This definition is essential for the empirical study of this paper.

### 2.3. Robot-supervisor and decision-making process

The robots as supervisors evoke many emotions. On the one hand, they inspire admiration and hope; on the other, doubt and fear of potential consequences, including, for example, the loss of jobs.

Yam et al. (2022) indicate that a robot supervisor offers numerous advantages, primarily due to its exceptional data processing capabilities, enabling it to efficiently incorporate extensive information into its decision-making processes. Gombolay et al. (2015) examined the integration of highly autonomous mobile robots into human teams in manufacturing.

The research explores shared decision-making authority in human-robot and human-only teams. The results proved that autonomous robots can outperform humans in task allocation and that people are willing to cede control authority to robots.

While humans value human teammates more, giving robots authority over team coordination enhances the perceived value of these agents more than giving the same authority to another human teammate. The study also identifies a tendency for people to take on more work when collaborating with a robot than with human teammates. The findings offer design guidance for integrating robotic assistants into the workplace (Gombolay et al., 2015).

The results obtained by Haesevoets et al. (2021) in their research suggest that most managers are willing to accept a cooperative partnership with machines, provided that humans retain a substantial role in decision-making. The scientists emphasize the importance of finding optimal levels of human-machine collaboration for efficient decision-making.

Despite early promise, AI in management is currently used mainly for routine decisions. To unlock its potential, it is important to focus on delegating decisions to AI. For example, in sensitive areas like mergers and acquisitions, AI can provide input while managers retain control. AI complements human decision-making by handling specific tasks, not replacing entire roles. Humans and AI have unique strengths, and companies should delegate decisions that augment managerial abilities to fully benefit from AI.

Raisch and Krakowski (2020) analysed three books presenting the relationships between automation and augmentation. The companies can choose one of those two options in terms of AI usage. Automation minimizes human involvement for efficient processing, while augmentation promotes ongoing collaboration between humans and machines to profit from their respective strengths, like intuition. The choice between these approaches depends on the task: automation is suitable for routine and structured tasks, while augmentation is better for complex and ambiguous ones (Davenport and Kirby in Raisch and Krakowski).

Apart from advantages, machines have also some limitations in management tasks, including:

1. Goals and purposes

   They lack a sense of self or purpose, so humans must define their objectives and take responsibility for the associated tasks and outcomes. This responsibility relies on human intentionality. In tasks like product innovation and talent acquisition, humans set objectives, remain involved, and take responsibility (Braga, Logan, 2017; Raisch, Krakowski 2020).

2. Intuition and imagination

   For complex managerial tasks, machines can only provide options that relax the real-life constraints. Managers need to use their intuition and common-sense judgment to make final decisions based on machine output. In talent acquisition and product development, machines can automate certain aspects but cannot fully handle the complexity, especially in assessing ambiguous predictors like cultural fit or interpersonal relations (Raisch, Krakowski, 2020).

Humans use logical reasoning for planning and problem-solving but also heavily rely on intuition in activities that require quick decisions. Wicked problems are solved by making intuitive, new assumptions, not through logic. AI devices, working within a closed logical system, cannot handle wicked problems due to their inability to intuit new paradigms or assumptions. Diverse beliefs among humans are influenced by intuition and varying emotional needs (Braga, Logan, 2017).

Braga and Logan (2017) underline that computers lack imagination as they do not perceive things as humans do; they are confined by logic. Imagination means thinking outside the box, while logic is about demonstrating equivalence between statements, not generating new knowledge. Creativity and imagination are intuitive, posing a barrier for computers to achieve general intelligence.

3. Experience and task assignment

Machines are limited to the tasks they have been trained for and lack the general intelligence to transfer their knowledge to other domains. As a result, managers must ensure contextualization beyond automated tasks. For instance, HR managers must coordinate meetings to align hiring decisions with business strategy, and product developers need to collaborate with marketing departments to match their products with business models (Raisch, Krakowski, 2020).

4. Emotions, curiosity, humour – human senses and social skills

Machines lack human senses, perceptions, emotions, and social skills, while humans cannot function without emotions. For example in the HR department, HR managers use emotional and social intelligence to establish relationships and attract talent, which machines cannot replicate (Raisch, Krakowski 2020).

Computers lack chemical neurotransmitters, which explains their inability to experience emotions and the associated drives. Emotions are crucial for intelligence, driving purpose, objectives, and goals. They also play a vital role in fostering curiosity, creativity, and aesthetics, all of which are essential components of human intelligence. Curiosity is both an emotion and a behaviour, and without the emotional aspect, the behavior of curiosity is impossible. Since computers lack the capacity for emotions, they cannot be curious, which is a fundamental element of intelligence (Braga, Logan, 2017).

5. Accountability

Delegating decisions to AI instead of humans presents a challenge in terms of accountability. Managers are held responsible for AI errors, raising significant governance concerns for the company, especially when these errors have profound and long-lasting impacts on legal, ethical, financial, and strategic aspects (Feuerriegel et al., 2022).

Moreover, the emergence of humanoid robots in managerial positions can be analysed in terms of Responsible Leadership (RL) which, as outlined by Maak and Pless, prioritizes the creation of forward-looking systems that benefit a variety of stakeholders. Ethical leadership fosters positive relationships between employees and society (Skubis et al., 2023a).

Responsible leadership, as described by Trevino et al. (2000), centers on leaders serving as positive role models, displaying virtuous behavior, upholding ethical standards, promoting ethical and pro-social conduct in the workplace, and employing moral reasoning in decision-making. It goes beyond motivating employees; it influences organizational citizenship behaviour, fostering innovation, commitment, and job satisfaction, ultimately benefiting the well-being of the business, employees, and society as a whole (Skubis et al., 2023b)

Humanoid robot CEOs, free from human biases and emotions, have the capacity to consistently uphold ethical standards, promoting ethical and socially responsible behavior in the workplace. This parallels the idea of leaders serving as role models, as suggested by Trevino et al.

## 3. Examples of humanoid robots on the market

The concept of humanoid robots has long captivated the human imagination, permeating our science fiction and cultural narratives with visions of machines that emulate our form and abilities. For decades, the idea of creating robots that can walk, talk, and interact with us on a human level has been a driving force in the field of robotics. While we have not yet achieved the seamless integration of human and machine that fiction often portrays, remarkable strides have been made in the development of humanoid robots.

When evaluating humanoid robots in conversation two primary factors can be taken into account, as in the case of dialogue systems: their human likeness and the adequacy of their responses. The concept of adequacy encompasses various aspects, including the correctness, relevance, and coherence of their interactions (Wołk et al., 2022; Wołk et al., 2021).

Humanoid robots are inspired by human capabilities and aim to replicate not only the physical appearance but also the cognitive and emotional aspects of human beings. There exists a diverse array of humanoid robots, each uniquely designed to mimic various aspects of human anatomy and behaviour (Kemp et al., 2014). They are designed to perform tasks that require human-like dexterity, mobility, and adaptability, making them relevant in a wide range of applications, from healthcare and education to entertainment and research. Below some famous humanoid robots along with their short description:

1. Sophia by Hanson Robotics

**Figure 1.** Sophia, https://www.hansonrobotics.com/sophia

Sophia is a highly advanced humanoid robot known for her human-like appearance and ability to hold conversations. The robot, created by David Hanson, uses artificial intelligence to process information and respond to questions. In October 2017, Sophia was granted citizenship in Saudi Arabia during the Future Investment Initiative in Riyadh. That same year, she was also recognized as the first non-human "Innovation Champion" at an Asian United Nations Development Programme symposium.

In terms of natural language processing, Sophia employs three distinct control systems. The first is a timeline editor for entirely pre-written speeches, enabling users to input speeches in advance. Sophia converts the written text into speech while servomotors generate human-like expressions during performances. A more advanced speech production system, the intelligent chatbot, is used for interactive conversations, using Google's algorithms to comprehend human queries, search for answers in a database, and generate concise responses. The third speech control system, opencog, is under development by Ben Goertzel and is envisioned to evolve into a second-generation artificial intelligence (AGI). This aligns with the Loving AI development project, affiliated with the SingularityNet network founded by Goertzel, aimed at promoting open-source AI development. This initiative facilitates access to extensive data for independent researchers, reducing dependency on technology giants (Parviainen and Coeckelbergh 2020).

2. Atlas by Boston Dynamics

**Figure 2.** Atlas by Boston Dynamics, https://bostondynamics.com/atlas

The information about Atlas on Boston Dynamics website presents Atlas as an advanced humanoid research robot with state-of-the-art hardware and a sophisticated control system, allowing remarkable mobility and bimanual manipulation. Atlas is used to explore the potential of humanoid robots, emphasizing agility and speed. It is part of the endeavor to create the next generation of robots that possess the required mobility, perception, and intelligence to seamlessly integrate into our daily lives.

3. ASIMO by Honda


**Figure 3.** ASIMO, https://asimo.honda.com/default.aspx

ASIMO was designed for tasks like walking, climbing stairs, and assisting in human environments. It also had the capability to recognize faces and voices (Sakagami et al., 2002). The robot has advanced communication abilities and is capable of recognising various aspects of human interaction and communication, making it highly adept at engaging with people. ASIMO uses cutting-edge recognition technology, including (https://asimo.honda.com/default.aspx):

- recognition of moving objects: it can detect and track the movements of multiple objects using a camera installed in its head;
- posture/gesture recognition: it interprets hand movements, postures, and gestures, allowing it to respond to natural human movements;
- environment recognition: the robot can assess its surroundings and navigate around obstacles to prevent collisions;
- sound recognition: ASIMO can distinguish between different sounds, including voices and other environmental noises;
- face recognition: ASIMO can recognise faces, even in motion.

4. Nao by SoftBank Robotics

**Figure 4.** NAO, https://us.softbankrobotics.com/nao

The description of NAO on SoftBank Robotics' website depicts NAO as a highly versatile and interactive robot that serves as a valuable educational tool, particularly for teachers and students. As a programmable personal teaching assistant, NAO can enhance the learning experience by making lessons more engaging and enjoyable. This robot forms genuine connections with students, establishing trust and fostering a positive learning environment.

Designed to captivate students' attention and maintain their focus, NAO combines knowledge with a warm and patient personality. Its interactive nature inspires students to remain committed and persistent in their learning endeavors, thus promoting active engagement in the educational process.

As can be read on the website, NAO bridges the gap between theoretical concepts and practical application through hands-on projects that encourage participation, teamwork, and creative problem-solving. Regardless of age, NAO is equipped to assist a broad range of students, from preschoolers to those pursuing advanced degrees. It can introduce STEM students to the world of programming and provide additional support and attention to children with special needs, making it a valuable asset in diverse educational settings.

As Podpecan (2023) indicates, the NAO robot is widely analysed in Child-Robot Interaction (CRI) research, particularly with children but also involving other age groups. In 2021, Amirova et al. (2021) underlined that a huge number, over 13,000 of NAO robots were deployed across over 70 countries globally.

5. Pepper by SoftBank Robotics

**Figure 5.** Pepper, https://us.softbankrobotics.com/pepper

Pepper, as the previous example – NAO, is created by SoftBank Robotics. Pepper is a people-centric robot, designed to connect, assist, and share knowledge while benefiting businesses. On the SoftBank Robotics' website the following industries are mentioned where Pepper can be used, that is: healthcare, hospitality, senior living, commercial cleaning, higher education, workplace and multifamily. The company advertises the characteristics of the robot in selected sectors.

In retail, Pepper engages customers, answers queries, recommends products, and guides them to desired items, resulting in improved customer satisfaction, cost reduction, decreased turnover, and increased sales with better margins.

In the banking sector, Pepper offers a unique and enjoyable customer experience by addressing common questions, assisting with paperwork, and educating clients about services. This reduces wait times and allows staff to focus on more critical tasks.

In education, Pepper caters to students of all ages, providing interactive learning experiences that make subjects like STEM more engaging. It sparks curiosity and prepares students for future technologies, particularly in fields like computer science and robotics.

In the hospitality industry, Pepper becomes a friendly, futuristic presence at events and venues, offering greetings, guiding visitors, connecting them with information or individuals, and making wait times more pleasant.

In healthcare, Pepper supports both hospitals and patients by aiding with scheduling, guiding visitors through facilities, collecting health data, and providing companionship and assistance to individuals with health issues that affect independent living.

In terms of robot's autonomy, Pepper possesses modules and applications that enable it to exhibit behavioral autonomy in specific applications. This reduces the reliance on human intervention, making it more self-sufficient in certain tasks (Pandey, Gelin, 2018).

6. iCub by the iCub Consortium

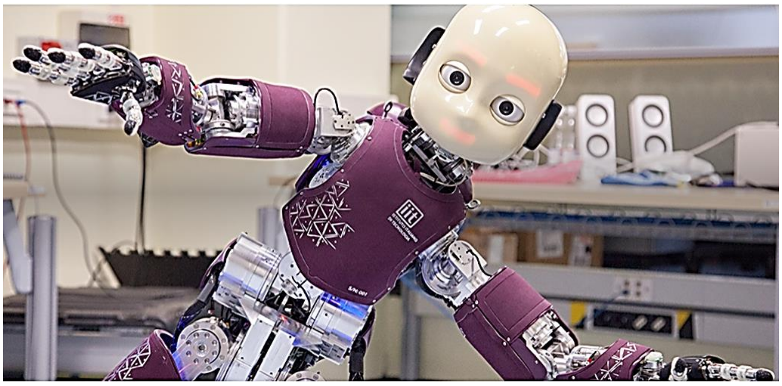

**Figure 6.** iCub, https://icub.iit.it/products/icub-robot

iCub is a research-oriented humanoid robot created to facilitate the development and testing of embodied AI algorithms. It is well-suited for robotics laboratories and is part of the iCub Project. iCub is 104 cm tall, roughly the size of a five-year-old child. It possesses versatile mobility, including crawling, walking, and sitting to manipulate objects. Notably, its hands are designed for sophisticated manipulation skills, as stated on its website.

The iCub is distributed as Open Source under GPL licenses designed for cognitive development studies in robotics. Over 40 such robots are now in use worldwide, including Europe, the US, Korea, Singapore, China, and Japan. It distinguishes itself with a sensitive full-body skin for physical interaction with the environment, including people. The project aims to make personal humanoid robots a reality for everyday use.

These are only a few examples of humanoid robots, their intended use may vary. In the following sections, the topic of humanoid robots in managerial positions is going to be discussed.

## 4. Analysis

### 4.1. Methodology

This article starts with providing statistics on the humanoid robot market. Afterwards, two profiles of worldwide known humanoid robots functioning as CEOs: Mika and Tang Yu are presented. The research aims to gather data from various sources, including official company websites, news articles, video interviews, and credible reports, to create a comprehensive dataset on Mika and Tang Yu's roles and functions as CEOs.

The information on their responsibilities, decision-making processes, and how they interact with humans within their respective organizations were collected and analyzed to identify key differences and similarities between Mika and Tang Yu in terms of their tasks, decision-making approaches, and their relationships with humans in their roles as CEOs.

Moreover, the aim of this paper is to examine relevant EU guidelines and policies concerning decision-making of AI and human oversight. Finally, an attempt is made to predict the future of a corporate management and decision-making.

### 4.2. Humanoid Robot Market

Market statistics from both Marketsandmarkets (https://www.marketsandmarkets.com/…) and Precedence Research (https://www.precedenceresearch.com/humanoid-robot-market) show significant growth in the humanoid robot market. In 2023, the humanoid robot market is valued at USD 1.8 billion, as reported by Marketsandmarkets. In contrast, Precedence Research notes that in 2022, the global humanoid robot market had a slightly lower value of USD 1.62 billion. However, Marketsandmarkets predicts that by 2028, the market is anticipated to reach USD 13.8 billion, Precedence Research projects a higher figure of approximately USD 28.66 billion by 2032, whereas GlobeNewsWire Report Linker (https://www.globenewswire.com) predicts the market to reach to reach $39.6 billion by 2030.

The growth rates also vary significantly between those three sources, with Marketsandmarkets forecasting a Compound Annual Growth Rate (CAGR) of 50.2% from 2023 to 2028, Precedence Research expects a CAGR of 33.28% from 2023 to 2032, while GlobeNewsWire predicts the highest CAGR of 52.8% from 2023 to 2030.

As can be observed, there are various data and these are only predictions, no one can provide the exact number as the technological progress changes extremely fast. There exist other statistics that provide even much higher numbers when it comes to forecasting of the future humanoid robot market.

### 4.3. Humanoid Robot as CEO

**Figure 8.** Mika – humanoid robot CEO, https://dictador.com/the-first-robot-ceo-in-a-global-company

In September 2023, the news worldwide have made a groundbreaking announcement about a humanoid robot called Mika, "who" became CEO of a company based in Poland. Mika is a humanoid robot with advanced AI capabilities and will represent Dictador, a leading luxury rum producer.

As presented on Dictador's website, Mika, an advanced female AI robot developed by Hanson Robotics, is a superior version of her sister prototype, Sophia, who was activated in 2015. Mika's role as a CEO involves serving as a board member, overseeing the Arthouse Spirits DAO project, and facilitating communication with the DAO community on behalf of Dictador. The contract with Mika, the world's first AI CEO robot, was signed on 30th August 2022, and she officially began her career at Dictador on 1st September 2022.

As demonstrated in the Reuters video interview (https://www.youtube.com/…), Mika is known for her tireless work ethic, operating 24/7 and seven days a week. She plays an important role in various tasks, such as identifying potential clients and choosing artists for bottle designs. Mika's decision-making process relies on data analysis and aligning with the company's goals, ensuring unbiased choices. However, major decisions at Dictador remain in the hands of human executives. Mika also leads the Arthouse Spirits decentralised autonomous organization project and interacts with its community.

Many websites provide the information that Mika is the first-ever AI robot CEO of a global company, however, her debut in Dictador in September 2022 coincides with the introduction of another robot by a Chinese gaming company named Fujian NetDragon Websoft. The company appointed an "AI-powered virtual humanoid robot" named Tang Yu as the CEO of one of its subsidiaries. Tang Yu is a virtual humanoid robot, while Mika is a real humanoid robot that exists in real world and is present in the company's headquarter.

### 4.4. Humanoid Virtual Robot as CEO

**Figure 9.** Tang Yu – virtual humanoid robot CEO, https://www.showmetech.com.br/en/tang-yu-the-first-aiceo-in-a-company

In August 2022, the Chinese gaming company NetDragon Websoft appointed an "AI-powered virtual humanoid robot" named Tang Yu as the chief executive of its subsidiary, Fujian NetDragon Websoft. Since this appointment, NetDragon's stock has performed well, outperforming the Hang Seng Index, which tracks major companies in Hong Kong. Tang Yu, the AI-supported female bot, is expected to streamline processes, enhance work quality, improve execution speed, and serve as a real-time data hub for analytical decision-making and risk management. The virtual CEO will also focus on talent development and fostering a fair workplace. This move reflects NetDragon's "AI + management" strategy and its aim to become a "Metaverse organization".

The media worldwide wrote about Tang Yu, her potential and the new upcoming era of humanoid robots as managers. The idea of robots working 24h/7 days a week was very promising, however, at that time, no one knew what effects on the company the robot would have. The satisfying results appeared quite quickly, after six months of introducing the virtual robot, Tang Yu has increased the company's value up to 10% on the Hong Kong stock market (https://www.showmetech.com.br/en/tang-yu-the-first-aiceo-in-a-company).

As said in the video and as can be observed in the picture below taken from a video "Un robot est devenu PDG d'une entreprise chinoise" (TF1 INFO https://www.youtube.com/watch?v=ohB9uPmsnuk&t=63s), anyone can play the role of a robot by trying on the equipment.

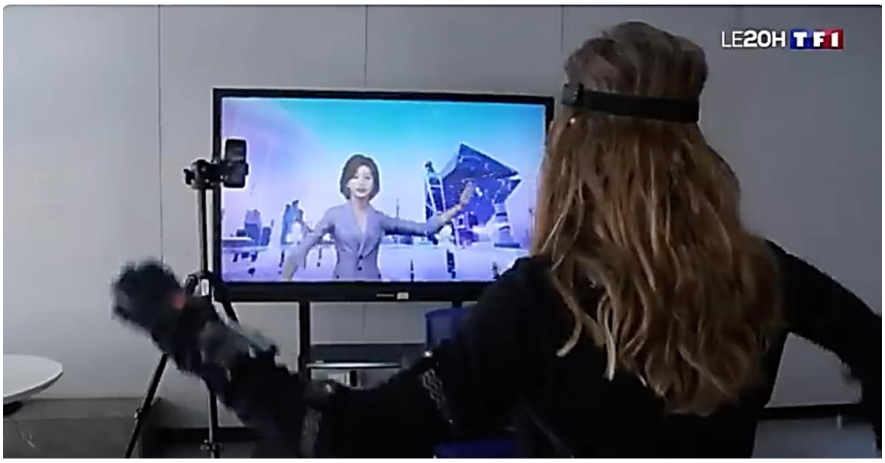


**Figure 10.** Fragment of a video "Un robot est devenu PDG d'une entreprise chinoise", TF1 INFO https://www.youtube.com/watch?v=ohB9uPmsnuk&t=63s

### 4.5. Mika and Tang Yu – comparison, decision-making and human oversight

Below, we gathered the data about both CEOs – Mika and Tang Yu and an attempt was made to make their comparison in terms of general information and their tasks, decision-making possibilities and their co-functioning with humans and human oversight.

Mika and Tang Yu are both CEOs, but they differ in several aspects. Mika is a humanoid robot serving as the CEO of Dictador, a luxury rum producer in Poland, while Tang Yu is a virtual humanoid robot CEO at Fujian NetDragon Websoft, a video game company in China.

Mika's role at Dictador is to be the official face of the company, a board member responsible for the Arthouse Spirits DAO project, and to handle communication with the DAO community. Mika also oversees the treasury, facilitates interactions between the Arthouse Spirits DAO community, and embodies Dictador's vision, inspiring luxury clients.

Tang Yu, on the other hand, is primarily focused on optimizing workflow efficiency, enhancing work quality, accelerating execution speed, and promoting logical decision-making. Tang Yu also contributes to risk management, talent development, and maintaining a fair work environment.

**Table 1.**
*Mika and Tang Yu - comparison*

| | **Mika** | **Tang Yu** |
|---|---|---|
| |  |  |
| Type | Humanoid Robot | Virtual Humanoid Robot |
| Position | CEO | CEO |
| Company | Dictador | Fujian NetDragon Websoft |
| Branch | luxury rum producer | video game company |
| Country of "residence" | Poland | China |
| Introduction | August/September 2022 | August 2022 |

Cont. table 1.

| | | |
|---|---|---|
| Tasks | - serving as the official face of Dictador,<br>- being a board member responsible for the Arthouse Spirits DAO project,<br>- handling communication with the DAO community on Dictador's behalf,<br>- overseeing the treasury, which consists of an exclusive collection of rare rums worth over US$50 million,<br>- facilitating interactions between the Arthouse Spirits DAO community and herself,<br>- providing an exclusive opportunity for members to meet and hang out with her,<br>- embodying Dictador's vision of impacting the future, pushing the brand into new frontiers and inspiring digitally native, young, and trendsetting luxury clients,<br>- contributing to Dictador's mission of being a next-generation collectible and global thought leader with a strong orientation toward the future. | - optimizing workflow efficiency,<br>- enhancing the quality of work tasks,<br>- accelerating execution speed,<br>- functioning as "a real-time data hub" and analytical tool for promoting logical decision-making,<br>- facilitating a more efficient risk management system,<br>- playing a pivotal role in the development of talents<br>- maintaining a fair and productive work environment for all staff members |

In terms of decision-making, Mika's role seems more focused on brand representation and community engagement, which might involve a mix of emotional and strategic decisions. In contrast, Tang Yu appears to be more oriented toward data-driven and analytical decision-making, enhancing productivity and efficiency.

Both CEO robots do not have emotions, intuition, or curiosity as they are not living organisms. They can perform tasks efficiently based on their programming. However, human oversight is essential in both cases, as it ensures that robots are aligned with the company's goals, values, and the overall strategy. It also allows humans to intervene in case of unexpected situations or challenges that the robots may not be programmed to handle.

Both Mika and Tang Yu, despite their non-human nature, exemplify the evolving nature of decision-making in the corporate world. Mika's decision-making process involves the emotional and strategic aspects, while Tang Yu's approach emphasises data-driven and analytical elements. These distinctive approaches highlight the diversity and adaptability of CEO robots in addressing the unique demands of their respective industries.

It has to be remembered that human oversight remains a cornerstone in the successful operation of CEO robots. While these robots exhibit efficiency and effectiveness in their roles, the dynamic nature of business demands continuous alignment with corporate values, strategies, and objectives. Moreover, human oversight is essential in identifying potential challenges, ensuring ethical and responsible decision-making, and addressing unforeseen scenarios beyond the robots' programming.

In summary, while Mika and Tang Yu are both CEOs, their roles and tasks differ significantly, and the nature of their decision-making also varies. Human oversight is necessary to ensure that they align with the company's goals and to address unforeseen issues.

### 4.6. EU guidelines: decision-making of AI and human-oversight

In April 2018, the European Commission unveiled its AI strategy, which included the development of a Coordinated Plan with EU Member States to align their AI strategies. Additionally, the Commission established a High-Level Expert Group, which in April 2019 published Guidelines on trustworthy AI.

In response, the Commission published a Communication with seven key requirements identified in these guidelines: human agency and oversight; technical robustness and safety; privacy and data governance; transparency, diversity, non-discrimination, and fairness; societal and environmental wellbeing; accountability (White Paper, 2020). The accompanying Report to the White Paper (2020) establishes that some AI systems can demonstrate autonomous behaviour throughout their existence, which could result in substantial changes to the product, impacting safety. This may require a new risk assessment. To guarantee safety, human supervision may be essential from product design to the entire life cycle of AI products and systems. The document indicates four forms of human oversight, including:

1. Requiring human review and validation before the AI system's output becomes effective, such as in the rejection of social security benefit applications;
2. Allowing AI systems to make immediate decisions but ensuring human intervention is possible afterward, like in the case of processing credit card applications;
3. Real-time monitoring of AI systems with the ability for humans to intervene or deactivate, as seen in driverless cars with a stop button controlled by a human;
4. Introducing operational constraints on AI systems during the design phase, such as requiring driverless cars to stop under specific conditions of low visibility or maintain a certain distance from the preceding vehicle under all circumstances.

One of the main fears connected to AI development is safety and responsibility (Skubis, 2021). Moreover, recognizing the profound societal implications of AI and the imperative to establish trust, it is crucial that European AI development is firmly rooted in core values and fundamental rights, including human dignity and the safeguarding of privacy (White Paper, 2020).

The document "European civil law rules in robotics" (Nevejans, 2016) discusses the notion of granting legal personality to autonomous robots. On the one hand, it questions the idea of assigning legal personality to machines, as they are essentially sophisticated mechanisms and do not guarantee such a status. On the other hand, the motion for a resolution seems to lean towards viewing robots as electronic persons when they make autonomous decisions or interact with third parties, implying that robots themselves would have legal liability.

Moreover, it raises questions about whether a machine, lacking consciousness, feelings, thoughts, or its own will, can become a fully autonomous legal actor. As indicated in the document, the feasibility of such a concept within the next 10 to 15 years is questioned from scientific, legal, and ethical perspectives, as it seems impossible for robots to participate in legal matters without human control.

In 2018, the European Group on Ethics in Science and New Technologies issued a "Statement on Artificial Intelligence, Robotics, and 'Autonomous' Systems" presenting roboethics guidelines aligned with EU Treaties and the EU Charter of Fundamental Rights. This document covered several key aspects, including human dignity, autonomy, responsibility, justice, equity, democracy, rule of law, accountability, security, safety, bodily and mental integrity, data protection, privacy, and sustainability.

Subsequently, in 2019, the European Parliament released a resolution entitled "A comprehensive European industrial policy on artificial intelligence and robotics", which discusses the following main aspects:

1. A society supported by artificial intelligence and robotics.
2. The technological path towards artificial intelligence and robotics.
3. Industrial policy.
4. Legal framework for artificial intelligence and robotics.
5. Ethical aspects.
6. Governance.

The point 123 in the fourth chapter "Legal framework for artificial intelligence and robotics" refers to decision-making process and human oversight. This principle highlights that existing regulations like the Services Directive, Professional Qualifications Directive, and e-Commerce Directive already address various policy aspects related to AI-enabled services. It emphasises the crucial role of humans in decision-making, particularly in professions like medicine, law, and accounting. It is underlined that humans should always be considered responsible for decision-making process.

The fifth chapter deals with a human-centric technology and point 143 emphasizes the necessity of establishing ethical guidelines to promote human-centric AI development, ensures accountability and transparency in algorithmic decision-making systems, enforces clear rules of liability, and upholds fairness.

The subchapter 5.3 refers to decision-making and limits to the autonomy of artificial intelligence and robotics. Five principles (151-155) highlight that the decision-making process of AI is complex and challenging to predict, especially in interactions between AI systems. There is a call for evaluating the need for specific AI-related regulations. AI is seen as a valuable tool for enhancing human actions and reducing errors. Individuals should have the right to be informed, appeal decisions, and seek redress when AI makes significant decisions affecting their rights or well-being. Prior assessments are required for deploying algorithms in decision-making systems unless their impact is negligible. AI systems, particularly those with autonomy, must adhere to strong principles, including not storing or sharing personal information without explicit consent from the source.

The decision-making process can be also problematic in terms of transparency and bias. AI offers significant advantages in automation and decision-making, but it poses risks when algorithms are rigid and non-transparent. There is an emphasis on the importance of increased algorithm transparency. The policy urges the Commission, Member States, and data protection authorities to work together to prevent and reduce algorithmic discrimination and bias. It also calls for the development of a robust ethical framework for transparent data processing and automated decision-making to guide data usage and uphold Union law.

AI's machine learning algorithms self-learn, benefiting automation and decision-making. The text calls for AI ethics guidelines to address algorithmic transparency, explainability, accountability, and fairness. It notes that disclosing the computer code alone won't solve transparency issues, as it won't reveal inherent biases or explain the machine-learning process. Transparency encompasses not only code but also data and automated decision-making.

The importance of AI systems not creating or reinforcing bias is emphasized. Considerations of bias and fairness must be integrated into all stages of algorithm development and use, from design to implementation. Regular assessment and testing of datasets and algorithms are crucial to ensure accurate decision-making.

### 4.7. The future of corporate management and decision-making

Top tech executives, including Alibaba founder Jack Ma, acknowledge the potential for robots to replace CEOs in the near future. In 2017, Ma predicted that a robot could be featured as the best CEO on Time Magazine's cover within 30 years and warns of challenges for those unprepared for technological disruptions. He emphasizes the need for educational systems to nurture creativity and curiosity in children. Ma notes that robots are faster, more rational, and less emotionally biased than humans but remains optimistic that they will ultimately enhance human life by complementing and cooperating with humans rather than becoming adversaries (CNN.com, https://money.cnn.com/2017/04/24/technology/alibaba-jack-ma-30-years-pain-robot-ceo/index.html).

The future potential of CEO robots is vast and exciting. Their evolving decision-making capabilities and adaptability to industry-specific requirements position them as assets that can drive innovation and efficiency. Moreover, they offer the potential to redefine the roles of human leaders by focusing on data-driven, analytical, and strategic decision-making.

The emergence of CEO robots, epitomized by Mika and Tang Yu, represents a promising frontier in the corporate landscape. These robots exemplify diverse decision-making approaches that cater to the unique demands of their industries. However, human oversight remains imperative to ensure alignment with organizational goals and values, ethical decision-making, and responsiveness to unforeseen challenges. As CEO robots continue to evolve, their potential to reshape corporate leadership is a compelling area of exploration and innovation.

Moreover, the topic of humanoid robots as CEOs might become essential in terms of responsible leadership. These advanced machines have the potential to embody certain key qualities that are essential for ethical and effective leadership. They can operate with unwavering consistency, free from human biases and emotions, thereby ensuring fair and equitable decision-making. Moreover, their ability to process vast amounts of data in real-time can lead to data-driven, rational decisions that benefit both their organizations and society at large. However, the ethical implications of this shift in leadership must be carefully considered, as questions around accountability, ethics programming, and human-robot collaboration will play a pivotal role in determining how humanoid robot CEOs can responsibly lead in the future.

## 5. Conclusions

This research has explored the profiles of two humanoid robots serving as CEOs: Mika and Tang Yu. The study used a comprehensive methodology, collecting data from various sources to understand their roles, responsibilities, decision-making processes, and interactions with humans within their respective organizations. The findings have allowed for an insightful comparison of these two CEO robots, highlighting key differences and similarities in terms of their tasks, decision-making, and human interactions.

Mika, a real humanoid robot, was appointed as CEO of Dictador, a luxury rum producer based in Poland. Her role involves acting as a board member, overseeing the Arthouse Spirits DAO project, and facilitating communication with the DAO community on behalf of Dictador. Mika's work is characterized by tireless dedication, efficient decision-making through data analysis, and alignment with the company's objectives. However, major decisions at Dictador continue to be made by human executives.

Tang Yu, a virtual humanoid robot, serves as CEO of Fujian NetDragon Websoft, a Chinese video game company. Tang Yu focuses on streamlining processes, enhancing work quality, accelerating execution speed, and serving as a real-time data hub for analytical decision-making. Her appointment had a positive impact, increasing the company’s value on the stock market. Tang Yu’s approach is data-driven, and she plays a pivotal role in talent development and workplace fairness.

In the context of decision-making, Mika’s role incorporates elements of emotional and strategic decisions, while Tang Yu’s approach emphasises data-driven and analytical decision-making, enhancing productivity and efficiency. Although these CEO robots lack emotions and intuition, human oversight remains a vital aspect of ensuring they align with their companies’ goals, values, and strategies, and are equipped to handle unforeseen challenges.

The research analyses and demonstrates the EU guidelines and policies concerning AI decision-making and human oversight. The European Commission's strategy emphasises human agency and oversight, technical robustness and safety, privacy, transparency, and societal wellbeing. The document outlines various forms of human oversight, including human validation, intervention, real-time monitoring, and operational constraints, highlighting the importance of human accountability in AI decision-making.

Looking ahead, the research explores the future potential of CEO robots. Industry leaders, such as Jack Ma, foresee the possibility of robots replacing human CEOs in the coming decades. Ma stresses the importance of nurturing creativity and curiosity in education systems to adapt to technological disruptions, highlighting that robots can complement and cooperate with humans, rather than replace them. CEO robots hold immense promise, with evolving decision-making capabilities and adaptability to industry-specific needs, potentially redefining corporate leadership through data-driven, analytical, and strategic decision-making.

In conclusion, Mika and Tang Yu, as CEO robots, symbolize an exciting frontier in corporate management. They showcase diverse decision-making approaches while underlying the necessity of human oversight to ensure responsible decision-making. As CEO robots continue to advance, they offer the potential to reshape corporate leadership by enhancing efficiency, innovation, and adaptability. The future of corporate management is increasingly connected with AI, promising to be both transformative and collaborative with human leaders.

## References

1. Amirova, A., Rakhymbayeva, N., Yadollahi, E., Sandygulova, A., Johal, W. (2021). 10 Years of Human - NAO Interaction Research: A Scoping Review. *Front. Robot. AI, 8*, 744526. doi: 10.3389/frobt.2021.744526
2. Braga, A., Logan, R. (2017). The emperor of strong AI has no clothes: Limits to artificial intelligence. *Information, 8*, 156-177.
3. European Commission (2020). *White Paper on Artificial Intelligence: a European approach to excellence and trust,* https://commission.europa.eu/publications/white-paper-artificial-intelligence-european-approach-excellence-and-trust_en#details
4. European Commission (2018). *Directorate-General for Research and Innovation*. European Group on Ethics in Science and New Technologies, Statement on artificial intelligence, robotics and 'autonomous' systems – Brussels, 9 March 2018, Publications Office, 2018, https://data.europa.eu/doi/10.2777/531856
5. European Parliament (2018*). A comprehensive European industrial policy on artificial intelligence and robotics.* European Parliament resolution of 12 February 2019 on

a comprehensive European industrial policy on artificial intelligence and robotics (2018/2088(INI)).
6. Feuerriegel, S., Shrestha, Y.R., von Krogh, G., Zhang, C. (2022). Bringing artificial intelligence to business management. *Nat. Mach. Intell., 4,* 611-613. https://doi.org/10.1038/s42256-022-00512-5
7. Gombolay, M.C., Gutierrez, R.A., Clarke, S.G., Sturla, G.F., Shah, J.A. (2015). Decision-making authority, team efficiency and human worker satisfaction in mixed human–robot teams. *Autonomous Robots, 39(3),* 293-312. https://doi.org/10.1007/ s10514-015-9457-9
8. Gościniak, T., Wodarski, K. (2019). Effectiveness of using the method of artificial intelligence in maintenance of ICT systems. *Management Systems in Production Engineering 27, 1,* 40-45. http://dx.doi.org/10.1515/mspe-2019-0007
9. Haesevoets, T., De Cremer, D., Dierckx, K., Van Hiel, A. (2021). Human-machine collaboration in managerial decision making. *Computers in Human Behavior, 119.* https://doi.org/10.1016/j.chb.2021.106730
10. https://luxonomy.net/en/the-astonishing-impact-of-tang-yu-the-ai-ceo-who-skyrocketed-her-companys-value-by-10-on-the-stock-market/
11. https://www.analyticsinsight.net/top-10-companies-in-the-vanguard-of-the-rise-of-humanoid-robots/
12. https://www.globenewswire.com/news-release/2023/07/31/2715060/0/en/The-Global-Humanoid-Robot-Market-size-is-expected-to-reach-39-6-billion-by-2030-rising-at-a-market-growth-of-52-8-CAGR-during-the-forecast-period.html
13. https://www.marketsandmarkets.com/industry-news/Humanoid-Robots-in-2023-and-Beyond-From-UN-AI-for-Good-to-Boston-Dynamics
14. https://www.marketsandmarkets.com/ResearchInsight/humanoid-robot-market.asp
15. https://www.precedenceresearch.com/humanoid-robot-market
16. https://www.showmetech.com.br/en/tang-yu-the-first-aiceo-in-a-company/
17. https://www.youtube.com/watch?v=d5mpwNgyoms
18. https://www.youtube.com/watch?v=ohB9uPmsnuk&t=63s
19. ISO 8373:2021(en), *Robotics — Vocabulary*, https://www.iso.org/obp/ui/en/# iso:std:iso:8373:ed-3:v1:en
20. ISO/TS 15066:2016(en) *Robots and robotic devices — Collaborative robots*, https://www.iso.org/obp/ui/en/#iso:std:iso:ts:15066:ed-1:v1:en
21. Kemp, C.C., Fitzpatrick, P., Hirukawa, H., Yokoi, K., Harada, K., Matsumoto, Y. (2014). Humanoids. In: B. Siciliano, O. Khatib (Eds.), *Springer Handbook of Robotics* (pp. 1307-1333). Springer, doi: 10.1007/978-3-540-30301-5_57
22. Molitor, M., Renkema, M. (20220. Human-robot collaboration in a smart industry context: does HRM matter? *Advanced Series in Management*, *Vol. 28,* 105-123, doi:10.1108/S1877-636120220000028008

23. Neugebauer, R., Hippmann, S., Leis, M., Landherr, M. (2016). *Industrie 4.0. From the perspective of applied research.* 49th CIRP conference on Manufacturing systems (CIRP-CMS 2016), 2-7.
24. Nevejans, N. (2016). *European Civil Law Rules in Robotics*. https://www.europarl.europa.eu/RegData/etudes/STUD/2016/571379/IPOL_STU(2016)571379_EN.pdf
25. Pandey, A.K., Gelin, R.A. (2018). Mass-Produced Sociable Humanoid Robot: Pepper: The First Machine of Its Kind. *IEEE Robot. Autom. Mag., 25,* 40-48 [CrossRef].
26. Parviainen, J., Coeckelbergh, M. (2020). The political choreography of the Sophia robot: beyond robot rightsand citizenship to political performances for the social robotics market. *AI & Society 36(3),* 715-724, https://doi.org/10.1007/s00146-020-01104-w
27. Podpecˇan, V. (2023). Can You Dance? A Study of Child–Robot Interaction and Emotional Response Using the NAO Robot. *Multimodal Technol. Interact., 7, 85*. https://doi.org/10.3390/mti7090085
28. Raisch, S., Krakowski, S. (2020). Artificial Intelligence and Management: The Automation-Augmentation Paradox. *Academy of Management Review*, DOI: 10.5465/2018.0072
29. Sakagami, Y., Watanabe, R., Aoyama, C., Matsunaga, S., Higaki, N., Fujimura, K. (2002). *The intelligent ASIMO: System overview and integration*. Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IEEE), Lausanne, Switzerland, Volume 3, 2478-2483.
30. Sanghavi, D., Parikh, S., Raj, S.A. (2019). Industry 4.0: Tools And Implementation. *Management and Production Engineering Review, vol. 10, no 3,* 3-13, DOI: 10.24425/mper.2019.129593
31. Sharkey, A., Sharkey, N. (2021). We need to talk about deception in social robotics! *Ethics and Information Technology, 23,* 309-316, https://doi.org/10.1007/s10676-020-09573-9
32. Skubis, I. (2021). Językoznawstwo jako bezpieczna dyscyplina dla badań nad sztuczną inteligencją. In: B. Fischer, A. Pązik, M. Świerczyński, *Prawo sztucznej inteligencji i nowych technologii* (pp. 169-181). Warszawa: Wolters Kluwer.
33. Skubis, I., Akahome, J., Bijańska, J. (2023). Green innovations in healthcare sector in Nigeria. *Scientific Papers of Silesian University of Technology – Organization and Management Series, no. 176*, http://dx.doi.org/10.29119/1641-3466.2023.176.33
34. Skubis, I., Akahome, J., Bijańska, J. (2023). The brain drain syndrome and the role of responsible leadership in health care service organisation in Nigeria. *Scientific Papers of Silesian University of Technology – Organization and Management Series, no. 176,* http://dx.doi.org/10.29119/1641-3466.2023.176.34
35. Trevino, L.K., Hartman, L.P., Brown, M. (2000). Moral Person and Moral Manager: Her Executives develop a reputation for ethic leadership. *California Management Review, 42*, 128-142.

36. Vaidhya, S., Ambad, P., Bhosle, S. (2018). Industry 4.0 – A Glimpse. *Procedia Manufacturing, 20*, 233-238.
37. Vollmer, A.-L., Read, R., Trippas, D., Belpaeme, T. (2018). Children conform, adults resist: A robot group induced peer pressure on normative social conformity. *Science Robotics, 3,* eaat7111
38. Wilson, H.J., Daugherty, P.R., 2018, Collaborative intelligence: Humans and AI are joining forces. *Harvard Business Review, 96(4),* 114-123.
39. Wołk, A., Skowrońska, H., Skubis, I. (2021). Multilingual Chatbot for E-Commerce: Data Generation and Machine Translation. *PACIS 2021, Proceedings, 232*, 1-1.
40. Wołk, K., Wołk, A., Wnuk, D., Grześ, T., Skubis, I. (2022). Survey on Dialogue Systems including Slavic Languages. In: *Neurocomputing*, 62-84.
41. Yam, K.C., Goh, E.-Y., Fehr, R., Lee, R., Soh, H., Gray, K. (20220. When your boss is a robot: Workers are more spiteful to robot supervisors that seem more human. *Journal of Experimental Social Psychology, 102,* 1-12. https://doi.org/10.1016/j.jesp.2022.104360