Journal of Economic, Administrative and Legal Sciences (JEALS) • Vol 9, Issue 7 (2025) • P: 139 - 132
https://journals.ajsrp.com/index.php/jeals
ISSN: 2522-3372 (Online) • ISSN: 2522-3372 (Print)

University governance challenges and opportunities in light of the Fourth Industrial Revolution

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Received: 11/03/2025
Revised: 15/03/2025
Accepted: 27/03/2025
Published: 30/07/2025

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Citation: Algazo, F. A., Aldahabi, Z. M., Alanazi, A. M., & Hajjaj, R. Y. (2025). University governance challenges and opportunities in light of the Fourth Industrial Revolution. *Journal of Economic, Administrative and Legal Sciences, 9*(7), 132 – 139. https://doi.org/10.26389/AJSRP.L130325

Abstract: This study examines the benefits and problems of the Fourth Industrial Revolution (4IR) for university governance. The statement underscores the need for academic institutions to reconsider and revamp their governing frameworks to accommodate swift progress in technology and digital transformation. The study demonstrates how governance principles such as transparency, engagement, justice, accountability, adaptability, efficiency, sustainability, and inclusivity can assist academic institutions in overcoming 4IR's obstacles and grabbing hold of benefits such as better information availability, streamlined administrative processes, optimized resource allocation, enhanced learning experiences, and increased performance. From a methodological standpoint, this study analyzes how universities might implement transformative policies to guarantee effective governance in the digital era using a conceptual framework. Significant findings indicate that universities must successfully integrate new technologies, improve decision-making, build collaborations, foster an innovative-driven culture, enhance responsiveness to emerging challenges, and promote interdisciplinary research initiatives to attain competitive advantages in a world that is changing quickly.

The study recommends implementing digital governance initiatives, strengthening cybersecurity measures, increasing digital literacy, and establishing regulations to ensure ethical AI use in decision-making.

Keywords: Fourth Industrial Revolution; University governance; Challenges; Opportunities; digital transformation.

تحديات وفرص حوكمة الجامعات في ظل الثورة الصناعية الرابعة

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المستخلص: تبحث هذه الدراسة فوائد الثورة الصناعية الرابعة وتحدياتها على حوكمة الجامعات. وتؤكد على ضرورة إعادة النظر في أطر حوكمة المؤسسات الأكاديمية وتطويرها لمواكبة التقدم السريع في التكنولوجيا والتحول الرقمي. وتوضح الدراسة كيف يمكن لمبادئ الحوكمة، كالشفافية والمشاركة والعدالة والمساءلة والقدرة على التكيف والكفاءة والاستدامة والشمول، أن تساعد المؤسسات الأكاديمية على تجاوز عقبات الثورة الصناعية الرابعة والاستفادة من مزاياها، المتمثلة في تحسين توافر المعلومات، وتبسيط العمليات الإدارية، وتخصيص الموارد على النحو الأمثل، وتحسين تجارب التعلم، وتحسين الأداء.

ومن منظور منهجي، تم توظيف اطار مفاهيمي لفهم كيفية تطبيق الجامعات لسياسات تحويلية لضمان حوكمة فعّالة في العصر الرقمي . وتشير النتائج المهمة إلى أن الجامعات يجب أن تدمج بنجاح التقنيات الجديدة، وتُحسّن عملية صنع القرار، وتبني التعاون، وتعزز ثقافة الابتكار، وتعزز الاستجابة للتحديات الناشئة، وتشجع مبادرات البحث متعددة التخصصات لتحقيق مزايا تنافسية في عالم سريع التغير. وتوصي الدراسة بتنفيذ مبادرات الحوكمة الرقمية، وتعزيز تدابير الأمن السيبراني، وزيادة الثقافة الرقمية، ووضع لوائح لضمان الاستخدام الأخلاقي للذكاء الاصطناعي في صنع القرار..

الكلمات المفتاحية: الثورة الصناعية الرابعة؛ حوكمة الجامعات؛ التحديات؛ الفرص؛ التحول الرقمي.

1. INTRODUCTION:

The Fourth Industrial Revolution involves systemic change across many sectors. Values act as human life that drives transformation to become commotion in the way that economic, political, and social value is generated, exchanged, and delivered (Philbeck & Davis, 2019). This transformation will be positive, depending on how challenges are understood and converted into opportunities (Gray, 2016). These changes have become faster, radical, and in a new style. Societies and organizational institutions need to seriously rethink the design, organization, adaptation, and implementation of governance practices and principles as required by 4IR (Sivathanu & Pillai 2018).

While universities have great importance in societies because of their role in shaping the human mind and supplying the labor market with qualified human resources, which forces these institutions to adopt effective systems to harmonize their duties with responsibilities, the Industrial Revolution casts a shadow over their systems to govern it and activate governance principles to harness the opportunities that came with this revolution (Benešová & Tupa, 2017).

1.1 RESEARCH QUESTIONS:

The study tries to answer the questions below:

What are the challenges and implications of 4.0 IR on university governance? How does university governance address and cope with these challenges?

What are the 4.0IR opportunities that can promote university governance? What are the requirements needed to ensure the success of university governance in light of 4.0 IR?

1.2 AIM OF STUDY

This article aims to explore the challenges and implications of the Fourth Industrial Revolution (4IR) that faces the governance of the university, how universities deal with these challenges to get more 4.0 IR opportunities, and the university governance requirements to adopt the 4.0 IR reflections.

1.3 IMPORTANCE OF THE STUDY

The importance of this study comes from the importance of activating university governance principles that enhance university management to bear its role in facing the 4th IR challenges and from the importance of new university governance that is more responsive to the 4th IR ramifications.

2. THEORETICAL FRAMEWORK

According to Schwab (2016), the Industrial Revolution (4.0) is considered a mix of the physical, the digital, and the biological world that fused without limitations through technologies, technologies such as the Internet of Things, artificial intelligence, robotics, smart cities, three-dimensional printing, super-intelligent computers, smart factories, nanomaterials, and virtual worlds; it represents a digital transformation moving the world toward new development, discovery, and revolution stages in all aspects of life by using smart technologies that facilitate doing business and providing services.

(Erboz, 2017) sees Industry 4.0 as a collective technology of value chain organizations creating smart systems by adopting more digitized systems and network combinations that will replace existing duties with human labor using machines.

2.1 CHALLENGES of 4.0 IR from a GOVERNANCE PERSPECTIVE

Any revolution has new challenges that need to be dealt with correctly to avoid its negative reflections and challenges as the following (Schwab, 2018):

1. Electronic challenges are represented by the risks of Internet and cyberspace protection.
2. Artificial Intelligence Challenges: The software system that will enable machines to run thinking and reporting behavior without human intervention.
3. Economic challenges are represented in the equity of the distribution of wealth and the level of income between groups and between rich and poor countries.

4. Societal transformation on a global scale: by affecting the incentives, rules, and norms of economic life, it transforms ways to communicate, learn, and relate to one another.

2.2 OPPORTUNITY of 4.0 IR from a GOVERNANCE PERSPECTIVE

Using technologies that are the most prominent feature of 4.0 IR provides many opportunities to support governance principles through the enhancement of public services, increasing the demand of customers on digital services with their knowledge and experiences to deal with new technologies, enhancing better access to information that will save time, and avoiding bureaucracy. On the other hand, service providers should ensure progress in the delivery of public information and services through organizational procedures and technologies (Meijer and Bolívar 2016).

Saving better information accessibility and reducing the administrative burden and time of organizational agencies, all these enhancing improvement and quality of service provided, availability, and accessibility of information facilitate communication, participation, openness, involvement, and decision making for all beneficiary parties, leading to more transparency and promoting accountability (Hung et al., 2013; Pereira et al., 2018) in other words, it enhances performance through deepening governance and its principles (Iqbal et al., 2019; Goldkuh, 2016).

2.3 OPPORTUNITIES and CHALLENGES of 4.0 IR from a UNIVERSITY GOVERNANCE PERSPECTIVE

The 4IR offers an opportunity for university governance to generate a creative and innovative environment that requires the restructuring of institutions and the redesigning of the education system, not locally but internationally. In addition to providing new specialties and programs, Penprase (2018) provides an opportunity for partnerships with other stakeholders, such as the government and private sectors in technological areas (Chetty and Pather, 2015).

The road to governance university in the light of 4IR is not surrounded with positivity; the realization of existing challenges is another face of success: One of the main challenges is the lack of funding needed to prepare technological infrastructure, training, and rehabilitation (Brown-Martin , 2017).

Another challenge related to inequality is the fear of a lack of possession, access, and protection of 4IR technologies for poor individuals, organizations, or society (Brown, 2017). This leads to denial of participation, distrust, and discrimination, which are obstacles to attaining university governance (Goldkuh, 2016).

On the other hand, the 4IR will need a new set of specialized skills needed in digital transformation. The new wave of technology with smart manufacturing will assist technology in evolving and improving productivity (Tram and Trung,2021). To be able to employ "smart manufacturing" in practice, it is necessary to have high-quality human resources, which demands governance of the university to adopt adequate training programs (PwC, 2017:12).

2.4 Requirements of University Success in the Light of 4.0 IR

Considering 4IR, university governance requires certain standards to be adopted and activated, some of which are crucial, as follows:

- Legal legislation: Until the Fourth Industrial Revolution, rules could be adopted that protect people's privacy when using computers, such as the Internet of Things. Because the Industrial Revolution avoided legal hazards, it was like upgrading life goals.
- Creating an ethical charter: Users of 4.0 IR techniques must abide by the establishment of an ethical code that imposes minimal ethical requirements (Gamito & Ebers, 2021).
- Rethinking programs to adjust and get beneficiaries ready for changes to rules and to incorporate decisions that align with the advancements of the Fourth Industrial Revolution, as each change necessitates initializing behavior (Juiz and Toomey, 2015; Brown, 2017).
- Establishing the technological device infrastructure as the suggested conceptualization of the prerequisites for e-governance and IoT networks in educational establishments (Frost & Lal, 2018).

- Enhancing education initiatives regarding the nature of 4IRA and fostering a mindset of worry for future technology and its applications, as well as how to help people in charge of education by giving them access to all new information and training (Brown-Martin 2017).
- Emphasizing leaders and those in charge of technology-related administrative procedures, such as preserving human, financial, and material resources, as well as offering leadership and management support to transform (De Haes et al., 2020).
- Creating and reimagining university institutions to move away from rigid ones unsuitable for 4IR (Campbell et al. 2015).

2.5 University Governance Models:

To harmonize academic goals with administrative administration, university governance has historically placed a strong emphasis on values, including accountability, transparency, and participation (De Haes et al., 2020). However, these conventional models, which are frequently distinguished by hierarchical, centralized decision-making structures, are becoming less and less equipped to handle the swift changes that the Fourth Industrial Revolution (4IR) is bringing about (Mazzucato, 2021). The need for more adaptable and dynamic governance frameworks is highlighted by the inability of governance models formerly successful in maintaining institutional stability to deal with technological shocks (Penprase, 2018).

As digital technologies proliferate, university governance needs to change from inflexible frameworks to more flexible networked systems. Universities can handle difficulties such as decentralized information flows and enhanced stakeholder participation with the help of these systems, which are necessary to handle the rapid transformation and increasing complexity delivered by 4IR.

2.6 4IR Technologies and Their Educational Impact:

Higher education is changing because of the Fourth Industrial Revolution, which is being propelled by advancements like artificial intelligence (AI), big data, and the Internet of Things (IoT) (Zawacki-Richter, 2020).

Universities must deal with the societal and ethical issues that accompany new technologies in addition to integrating them into their academic and administrative operations.

For example, AI has the potential to automate university governance decision-making procedures and increase accountability and efficiency (Akinwalere & Ivanov, 2022). However, there are also issues with algorithmic bias, transparency, and data privacy in its application. Similarly, IoT technologies are turning campuses into smart settings where real-time data collection and analysis may improve everything from student services to resource management (Penprase, 2018). However, universities face significant challenges regarding the financial investment and technical expertise required to maintain these systems (Ahmed et al., 2023).

Governance and Technological Adaptation:

- Universities that want to fully use 4IR must re-evaluate their governance frameworks to ensure they can effectively manage and utilize these technologies. According to recent research, governance models should include more participatory and collaborative methods in which stakeholders actively participate in decision-making (Lemoine & Richardson, 2019). To navigate the complexities of digital technology, such models enable faster and more informed decision-making (Bocken et al., 2020).

The trend toward "smart governance," also known as digital governance, stresses the use of digital tools to improve communication, transparency, and the effectiveness of decision-making. Higher education institutions that effectively incorporate digital governance are more equipped to fulfill the requirements of 4IR; nonetheless, obstacles, including technology infrastructure, funding, and training, remain significant barriers (Hartati et al., 2023).

3. METHODOLOGY

This study paper used theoretical and conceptual evaluation, which is suitable for providing a conceptual framework of university governance considering the 4IR.

The references were chosen using certain criteria to verify their credibility and relevance. The criteria include:

- Recency: Studies published within the last decade were preferred to ensure current insights into 4IR and governance.
- Relevance: Only materials directly addressing university governance, digital transformation, and 4IR concerns and opportunities were considered.

- Academic rigor: Peer-reviewed journal papers, books, and authoritative reports from reputable organizations were prioritized.
- Comparative Value: Studies that provide cross-country or multi-institutional assessments were preferred to increase the breadth of the discussion.

Using these selection criteria, this study ensures a strong and well-supported theoretical foundation for understanding governance modifications in higher education institutions.

4. FINDINGS and DISCUSSION

The findings of this study are consistent with the literature in that there is an interrelationship between the principles of governance and the Fourth Industrial Revolution.

Governance principles are, in essence, a means by which universities can meet the challenges they face in the era of the Fourth Industrial Revolution if the principles of efficient governance are followed; otherwise, 4IR serves adequate opportunities for enhancing governance principles such as participation, transparency, and fairness. Successful universities must implement transformational policies that ensure the best use of technologies to achieve efficient performance (Hilb, 2020).

To clarify, the results are summarized in Table 1 below:

Table 1. Findings of the study

Key Finding	Description
Governance Adaptation	**Integration of AI, blockchain, and IoT to improve university governance.**
Strategic Decision-Making	**The use of data-driven models enhances efficiency and accountability.**
Collaboration & Innovation	**Strengthening partnerships with external stakeholders promotes technical advancement.**
Technological Challenges	**Financial and digital inequities impede implementation.**
Institutional Performance	**Digital governance improves administrative procedures and research quality.**

Based on the result of the study, I believe that good university governance in the fourth industrial revolution requires a proactive rather than a reactive strategy. Institutions that predict technological developments and invest in digital infrastructure early will have a competitive advantage over those who wait and see.

From my viewpoint, digital transformation should be understood as an organizational and cultural revolution rather than just a technological one. Universities must build a governance culture that welcomes change, stimulates innovation, and promotes multidisciplinary collaboration.

Furthermore, whereas digital governance improves efficiency, it presents ethical and societal challenges. AI-powered decision-making, for example, can boost administrative efficiency but simultaneously risk bias and a lack of transparency. Therefore, governance systems must include ethical safeguards to ensure fairness and accountability in decision-making processes.

Another crucial factor to consider is leadership's involvement in driving governance transformation. Governance improvements in universities rely heavily on institutional leaders' commitment and vision. Even the most advanced governance models may fall short of their intended impact if they lack good leadership.

To summarize, while the 4IR brings both difficulties and opportunities, institutions that embrace a forward-thinking, ethical, and leadership-driven governance strategy will be better positioned to prosper in the digital age. As a result, I argue that the key to successful governance in the 4IR era is balancing technology efficiency with human-driven ethical considerations, ensuring that universities remain responsive, inclusive, and accountable.

4.1 Policy Implications (Theoretical Focus)

Although this study paper is theoretical, the proposed framework has significant policy implications for university governance in the context of the Fourth Industrial Revolution (4IR). University leaders and policymakers can use the insights from this study to shape strategic decision-making processes that foster governance models more suited to digital transformation (PwC, 2017). Several key policy recommendations have emerged from this theoretical exploration.

1. Adoption of Digital Tools for Governance: To expedite decision-making, increase transparency, and reduce administrative costs, policymakers should support the integration of digital tools, such as blockchain, artificial intelligence, and data analytics. In an

increasingly digital society, these solutions not only improve governance efficiency but also provide real-time monitoring and response procedures (Goode, 2018).

2. Emphasize Ethical and Legal Considerations: University governance rules ought to clearly define ethical standards for the application of 4IR technologies, such as IoT and AI. This covers the reduction of bias in automated decision-making, algorithmic transparency, and data privacy protection. Building trust among stakeholders will be facilitated by ensuring that these ethical issues are addressed at the governance level.
3. Equitable Access to Technology: To ensure that all students and staff have access to essential digital infrastructure and resources, policymakers must concentrate on closing the digital divide within universities. This could be achieved through government funds, commercial partnerships, or initiatives aimed at advancing digital literacy and technology.
4. Collaboration with External Stakeholders: Universities should establish partnerships with the public and private sectors as well as other academic institutions to utilize outside resources and knowledge. These collaborations can help develop and implement technology-driven governance models that align with the development of the 4IR. Constant Flexibility and Adaptation in Governance Models: Governance models must be sufficiently flexible to accommodate upcoming technological advancements. Policies should support governance structure flexibility so that universities can adapt to new technologies and stay competitive in a world that is changing rapidly and quickly.

4.2 Future Research Directions

The theoretical framework described in this paper can be further explored and validated through several research pathways that are laid forth in this publication. This study concentrates on the theoretical components of university governance within the framework of the Fourth Industrial Revolution; nevertheless, empirical research is required to validate and improve these concepts in practical contexts. Potential future research directions include the following.

1. Empirical Validation of the Theoretical Framework: Future studies could employ quantitative and qualitative research methods to investigate how universities are currently adapting to 4IR challenges and whether the proposed governance model holds up in practice. Surveys, case studies, and interviews with university leaders and governance experts could provide valuable insights.
2. Comparative Analysis of Governance Models: Scholars could study and compare universities with and without successfully integration of 4IR technologies into their governance systems. These studies could look at what makes governance reform successful and draw generalizable conclusions.
3. The Effect of 4IR on University Performance: Future studies should examine how university performance indicators and the adoption of 4IR technologies relate to one another. Analyses of the effects of digital governance tools on faculty productivity, student happiness, and overall institutional efficiency may fall under this category.
4. Ethical Implications of Technology in Governance: Future studies should examine the moral issues raised by automated decision-making in higher education, given the growing influence of AI and other technologies in governance. How can governance frameworks guarantee accountability, transparency, and justice when using algorithmic technologies?
5. Equity and Digital Divide in Higher Education Governance: It is critical to investigate how the growing integration of digital tools by universities affects the fair distribution of educational opportunities and resources. Subsequent investigations may concentrate on approaches to mitigate the digital divide and guarantee that technological progress benefits all parties involved, especially marginalized and underprivileged communities.
6. Global and Cultural Variations in Governance Models: Given that 4IR has an impact on academic institutions across the globe, future studies should examine how various regulatory and cultural contexts affect the uptake and effectiveness of digital governance frameworks. International comparative research can identify optimal practices and draw attention to issues unique to various geographical areas and political structures.

Statements and Declarations

1. Ethical Approval and Consent to Participate

   This study did not involve human or animal subjects. Therefore, this statement declaration was not applicable.

2. Consent for Publication

The manuscript does not contain any individual personal data, images, or videos. Therefore, this statement declaration was not applicable.

3. No funding was received to assist with the preparation of this manuscript.

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