

Complementary Themes for South Africa's Information and Knowledge Management Practitioners in the 4IR

Kagiso Mabe¹ and Kelvin Joseph Bwalya^{1,2}

¹The Department of Information and Knowledge Management, College of Business and Economics, University of Johannesburg, South Africa

²Research and Development, The Faculty of Computing and Information Technology, Sohar University, Oman

kmabe@uj.ac.za

Abstract: The purpose of this study was to identify the supplemental or complementary areas of study that information and knowledge management (IKM) practitioners need to pursue to succeed in the 4IR. Against the backdrop of limited empirical guidance on 4IR preparedness within the South African context, the research addresses the urgent need for structured upskilling to ensure that IKM business units remain relevant, competitive, and strategically positioned in increasingly digital environments. This was a pilot study for a PhD, from which three journal articles have been published. The study employed a Delphi methodology involving eight experts, equally drawn from academia and industry. Two rounds of data collection were conducted using anonymised questionnaires to ensure unbiased evaluation and consensus building. The first round aimed to collect as many thematic responses as possible, whereas the second round was used to determine consensus on the identified critical areas of study for IKM practitioners' success in the 4IR. In the second round, participants evaluated these items using a five-point importance scale. Consensus was defined as a collective agreement or strong agreement across participants. ChatGPT was utilised to write the abstract only, while Grammarly was used for grammar enhancement. The findings revealed 16 overarching themes as foundational for IKM advancement in the 4IR. Notably, consensus was reached on two dominant themes: information security and theoretical knowledge of 4IR pillars. Information security emerged as the highest-ranked priority, underscoring the need to safeguard digital assets against unauthorised access, alteration, and destruction. Theoretical knowledge of 4IR pillars, including artificial intelligence, big data, cloud computing, cybersecurity, Internet of Things, systems integration, simulations, augmented reality, autonomous robotics, and additive manufacturing, was identified as essential for enabling innovation and informed strategic participation. The study serves as a blueprint for curriculum and professional development. By emphasising interdisciplinary competencies beyond traditional IKM boundaries, the results aim to position practitioners to compete effectively alongside intelligent systems and improve their employability scores. While context-specific adaptations are necessary, the results offer a scalable foundation for future research and continuous refinement, contributing to workforce development, digital transformation, and broader socio-economic advancement aligned with the Sustainable Development Goals.

Keywords: Fourth industrial revolution, Information science, Information and knowledge management, Information security, Data management

1. Introduction

Due to the limited empirical evidence on 4IR activity in South Africa (McGrath, 2022), it is challenging to predict the social and business changes the 4IR will introduce (Lee and Lee, 2022), underscoring the need for early preparation. This study thus offers supplementary themes information and knowledge management (IKM) practitioners need to study as knowledge areas to facilitate success in this era of rapid technological advancement. Chiu and Ho (2023) provided that people's information behaviour has changed due to the introduction of new technologies. Mhlanga (2022) argued that the 4IR focuses on more than technological development, as it creates opportunities for societies as a whole and can use technologies that facilitate integration to develop a more inclusive, people-centred future. Introducing new technologies requires organisations and their employees to adapt (Mulyadi, Huda and Gusmian, 2022).

The South African government realised the importance of creating an environment that takes advantage of all the 4IR offers as demonstrated by the creation of the Commission for the Fourth Industrial Revolution, Chaired by the Republic's President of the Republic himself. The Commission was tasked with developing policy and legislation to improve the employment rate by leveraging 4IR technologies (Moloi and Salawu, 2022). Using information can facilitate forecasting desired changes, underscoring the importance of IKM in the 4IR environment.

Utilising IKM in the 4IR has driven positive change and enhanced value across industries, including finance, manufacturing, supply chain, utilities, healthcare, retail, and logistics. The enhancement is a result of improved organisational decision-making and application (Tang, Hsiao and Hwang, 2022). IKM facilitates the following processes: successful information and knowledge transfer to human resources and the identification of tools for effectively utilising information and knowledge (Petras, 2024; Guisseppi and Forgionne, 1992). IKM departments

and their staff can use the provided themes to adapt to the 4IR by quickly identifying key areas that require upskilling for success. These themes also inform curriculum development, as IKM offerings must incorporate them into their module offerings or through module electives.

As great as the 4IR can be, it also creates many fears that society needs to prepare for (Saniuk, Grabowska, and Grebski, 2022). Identifying themes to enable IKM practitioners to upskill is one way to help the IKM society understand the current environment and thrive within it. The one change society is aware of regarding technological innovations is that they replace low-skill jobs with high-skill jobs due to automation (Pedota and Piscitello, 2022). As such, through helping to create a skilled and intelligible IKM society, this study can contribute to supporting SDG goal 1: end poverty in all its forms everywhere. Achieving SDG goal 1 is possible as practitioner employability improves, leading to increased employment and entrepreneurship opportunities in the IKM society. To fully realise the potential of the 4IR, skills and competencies must be enhanced to align with the environment and enable effective individual participation ([removed for anonymity], 2022).

This study aimed to determine the themes IKM practitioners need to study as supplementary knowledge areas to thrive in the 4IR in South Africa and make recommendations for IKM practitioner preparation to succeed in the 4IR. To satisfy the aims, three objectives were developed.

1. The first was to determine the study areas IKM practitioners need to look into for 4IR relevance.
2. The second was to determine a consensus on the identified themes.
3. To provide a way forward for South African IKM practitioners in preparing for the 4IR.

The study is premised on the South African context but has global relevance. Today, technologies can display human qualities, such as caregiving and complex communication (Pedota and Piscitello, 2022). This development highlights that people currently compete for jobs against other people and machines. With the continued growth of artificial intelligence (AI) and its increasing capabilities, more information systems have been endowed with human-like abilities, thereby requiring humans to significantly enhance their own skills. This study sought to assist practitioners in this plight by providing a way to upskill and thus attain or maintain a competitive advantage.

2. Literature Review

2.1 The Role of Information and Knowledge Management in the 4IR

Information and knowledge management (IKM) studies are known to improve information literacy and foster an information culture by teaching knowledge economics and instructing students on how to utilise computer technology to meet their information needs (Shehata, 2021). IKM research enables individuals to make informed decisions in their personal lives and businesses. IKM focuses on improving information engagement, processing, and utilisation from psychological, social and behavioural perspectives (Wong, Walton and Bailey, 2020). An example of the effectiveness of IKM is that it can save a person's life by equipping the individual with the skills to seek and understand quality health information and then use that information to make crucial health decisions (Shehata, 2021). These facts indicate that while the study aimed to equip IKM professionals in South Africa with key skills, IKM skills can benefit everyday people, particularly in the 4IR.

IKM focuses on data curation and management, supporting open data initiatives (Jackson, 2021). Additionally, IKM assists people in understanding best practices for information collection, curation, storage, retrieval, data mining, classification, visualisation, archiving, bibliometrics, and overall management. For South African practitioners, this means they can deliver intelligence in a manner that is easy to understand, thereby positively influencing decision-making promptly. The lack of information literacy skills (the ability to locate, select, understand and use information) and suffering from information poverty (the denial or lack of access to equitable and critical information) leads to organisations making costly business decisions, due to exposure to misinformation (Yamaguchi et al., 2025) or disinformation. These decisions could result in South African businesses ceasing to exist, highlighting the importance of investing in IKM business units.

IKM encourages interdisciplinary work (Park, 2022) because of its focus on information; thus, its importance is recognised across various industries. IKM professionals become experts in evaluating information sources by assessing their accuracy, authority, scope, reliability, usefulness, verifiability, timeliness, and veracity (Adomi and Oyovwe-Tinuoye, 2022). Information and knowledge are crucial for all types of businesses. IKM research helps satisfy organisations' information needs, as the field has developed systems to identify, capture, distribute, and store information and knowledge (Lam et al., 2024). These systems also help develop solutions to complex

societal challenges (Guisseppe and Forgionne, 1992). These skills are essential in the 4IR as the competitiveness of the business environment has intensified.

Some key topics covered in IKM are information overload, avoidance, misinformation and disinformation. These issues can be seen as reasons society remains stagnant, even though the information tools to move forward exist (Haider, Johansson and Hammarfelt, 2022). Thus, a key IKM research area is to determine how technological developments, and their consequent information generation, can be managed (Haider et al., 2022). In the 4IR, machine learning (ML) and artificial intelligence (AI) are utilised to discern misinformation. Although technologies can assist human judgment, they cannot replace it when determining the quality of information (Wong et al., 2020). In an era when people increasingly rely on social media (SM) for information, IKM studies are more prudent, as they help people understand how propaganda and fake news operate (Wong et al., 2020). South Africa's IKM practitioners should thus be at the forefront, governing the information being spread and consumed.

IKM research will thus benefit society as a whole. Building a skilled workforce with the competencies to guide information behaviour in the 4IR is critical. Through sharpening and focusing IKM skills, South Africans will benefit, as the information they receive will be vetted. X already has a fact-checking AI feature. Similar tools are needed on other platforms and must be fed the correct facts by IKM practitioners. The global fear is that many people will be out of work due to the introduction of intelligent machines (Corfe, 2018). However, it is essential to note that those who decide to upskill for the 4IR will gain jobs, including higher-paying ones (Anshari, Almunawar and Razzaq, 2021). Not only will people improve their employment opportunities, but they will also open up opportunities for entrepreneurial success (Byas and Velasquez, 2026). As a result, it becomes imperative that educational institutions prepare students through facilitating the acquisition of relevant and necessary skills (Patacsil and Tablatin, 2017). The premises presented by Byas and Velasquez (2026) and Patacsil and Tablatin add to the study's significance, as the results can also inform university curricula.

3. Methodology

Pragmatism was utilised to accurately identify the key topics relevant to IKM practitioners in the 4IR (Baker and Schaltegger, 2015). Using a pragmatic approach, the researchers adopted a mixed-methods research design that combined qualitative and quantitative data. Importantly, this was a pilot study for a PhD, from which three journal articles have been published. A Delphi study was conducted to collect both types of data, as it required expert participants to confirm or disagree with one another's thoughts (Puig and Adams, 2018; Salkind, 2011). A Delphi study requires expert participation. As such, the researchers identified eight experts to participate in the study. The participants involved were four senior managers from corporate organisations and four university professors in South Africa. The senior managers headed their organisation's IKM divisions and were involved in IKM and organisational strategy development, while the academics had at least 10 years of experience in IKM. The sample thus comprised highly experienced individuals.

The logic behind these selections was the need to source high-level data from the best individuals with proven track records and from disparate backgrounds. The diversity of backgrounds was also important to ensure that the data did not contain any academic or industry bias, but instead bridged the theory-practice gap. Additionally, the participants' identities were kept confidential from other participants to prevent bias in the answers of specific parties from affecting the results.

The authors captured the experts' views using Google Forms. Two rounds of data collection ensued, with the first round collecting qualitative data requiring participants to identify all themes they considered crucial for IKM success in the 4IR. The second round was used to have the experts cross-examine each other's responses unthinkingly. In other words, all participants were allowed to review what others had provided, but they were unaware of who had made each statement. Similar to a double review, the participants were unaware of who else participated in the study, nor did they know which participant had nominated which theme. Thus, ensuring their honest views were shared without any bias.

A five-point scale was used, with 1 being "extremely unimportant" and 5 being "extremely important". The details provided in this section and the section below help the study obtain confirmability (Baskerville, 2014), thereby illustrating the validity and reliability of the study's findings. The authors also continuously liaised with participants to ensure they understood the responses well before finalising the results section of this study, enhancing the credibility of the findings (Mills, Durepos & Wiebe, 2012). Participant bias was also limited by keeping the responses anonymous.

The research had limitations due to its use of purposive sampling. However, a sampling technique was required to select the best participants. Delphi studies also create limitations, as they can require extensive time to complete and therefore prove tedious for participants (Salkind, 2011), as seen in this study, where one participant completed only the first round. To limit attrition, the researchers allowed participants sufficient time (two weeks) to complete each round of data collection. This extended time also allowed them to reflect deeply on the study's objectives. These results will not be compared to any other future results. As such, a cross-sectional time horizon was utilised (Cummings, 2018). However, given the need to continuously improve the resulting framework, a longitudinal approach could also be applied.

4. Data Analysis

The researchers utilised the resultant Google Forms graphs, Microsoft (MS) Excel and qualitative content analysis to analyse data. The researchers needed to assess the qualitative data using content analysis to identify and consolidate the themes presented by experts. Content analysis was used as no explanations were required. As such, the data was in list form. MS Excel and Google Forms graphs were used to analyse the quantitative data, with the graphs displaying the consolidated responses from participants, and MS Excel was used to associate the responses. Through this consolidation, the researchers could draw deductive conclusions from the data. A consensus was reached when all participants agreed (4) or completely agreed (5) on a theme. The researchers created a ranking system where scores were added to determine the most and least important themes based on participant voting. For example, if all seven participants completely disagreed with an identified theme, that theme would score 7, as the score for completely disagreeing is 1, as eluded to above. The score would be 7, not 8, because the eighth participant did not complete round 2 of data collection.

Notably, no codes were created for the themes, as these were standalone areas of study. Figure 1 provides the colour coding indicating the result of the votes where a consensus was not reached. For example, where participants strongly agreed, agreed, or were neutral on whether a theme was important, the theme was coded in red. It is essential to note that the colour coding shown in Figure 1 was applied consistently across all results where consensus was not reached.

Result	Colour code
Strongly agree, agree, and neutral.	Red
Strongly agree, agree, neutral, and disagree.	Blue
Strongly agree, agree, neutral, and strongly disagree.	Yellow
Strongly agree, agree, and disagree.	Blue
Strongly agree, agree, and strongly disagree.	Light Blue
Strongly agree and neutral.	Orange
Strongly agree, neutral, and disagree.	Yellow
Strongly agree, neutral, disagree and strongly disagree.	Green
Agree and neutral.	Red
Agree, neutral, and disagree.	Green
Agree, neutral, disagree and strongly disagree.	Cyan
Agree, neutral, and strongly disagree.	Grey
Agree and disagree.	Orange
Agree, disagree and strongly disagree.	Grey

Figure 1: Colour coding for the results where a consensus was not reached.

5. Presentation of Findings and Discussion

This study aimed to determine the themes IKM practitioners need to study as supplementary knowledge areas to thrive in the 4IR in South Africa. The participants identified 16 topics as critical to IKM practitioners' success in the 4IR, with two achieving consensus, making them the most important themes. Information security was deemed the most important topic. Six (85.7%) participants strongly agreed that information security was very important, and one (14.3%) agreed that it was important. In second place was theoretical knowledge of the 4IR pillars, with five (71.4%) participants indicating it was very important and two (28.6%) indicating it was important. In third, scoring 32 points was practical knowledge and experience in curation activities. Five (71.4%) participants regarded practical knowledge and experience in curation activities as very important; one participant (14.3%) regarded it as important, and another (14.3%) regarded it as neutral.

Five (71.4%) participants stated that practical knowledge and experience in auditing data for quality, reliability and continued accessibility was very important; one (14.3%) stated that it was important, and another (14.3%) said it was not an important topic. While AI had the same score of 31 as practical knowledge and experience in auditing data for quality, reliability, and continued accessibility, the topic had a lower ceiling but a higher floor. This happened because, compared with the former topic, fewer participants viewed AI as very important, but none thought it was not important. Four (57.1%) participants saw AI as very important, two (28.6%) as important, and one (14.3%) was neutral. Furthermore, three participants and another three saw strategic KM as either very important (42.9%) or important (42.9%). However, one (14.3%) was neutral. The topics mentioned in this paragraph make up the last of the topics receiving 30 or more points. All topics with a score of 30 or higher can be considered highly relevant to IKM practitioners' success in the 4IR.

Two (28.6%) participants saw big data as very important, four (57.1%) considered it important, and one (14.3%) was neutral. Additionally, two (28.6%) participants regarded strategic information management (SIM) as very important, three (42.9%) considered it important, and two (28.6%) were neutral. SM and basic coding had the same score of 28 as strategic knowledge management (SKM). The responses were identical for SM, but three (42.9%) participants rated basic coding as very important, two (28.6%) as important, one (14.3%) as neutral, and one (14.3%) as not important. Furthermore, two (28.6%) participants regarded strategy [development] as very important, three (42.9%) said it was important, while one (14.3%) participant and another (14.3%) were neutral and considered strategy not important at all, respectively.

One (14.3%) participant considered content very important, two (28.6%) considered it important; however, the majority of participants, four (57.1%), were neutral. While the scores for content and business processes were the same, the responses were different. Four (57.1%) participants stated that studying business processes was important, while three (42.9%) were neutral. The same was true for performance measurement and workplace communities. Two (28.6%) participants saw performance measure as important, four (57.1%) were neutral, and one (14.3%) shared it was not important. On the other hand, four (57.1%) participants indicated that workplace communities was important, two (28.6%) were neutral, and another two (28.6%) regarded it as not important. The topics mentioned in this paragraph make up the last of the topics receiving 20 or more points. All topics with a score of 20-29 can be considered relevant based on organisational context and should thus be strongly considered by IKM practitioners per their context.

Conspiracy theory scored the fewest points (19) and had the most varied responses. One (14.3%) participant thought it important, four (57.1%) were neutral, one (14.3%) viewed it as not important and another one (14.3%) as not important at all. Given that the only participant who found it important was the same one who recommended it, the topic can be disregarded. Figure 2 presents participants' results, highlighting all identified themes. The figure is structured to display the highest-ranking themes in descending order, along with their assigned scores. The two green scores reflect the two themes where a consensus was reached and are thus discussed further below.

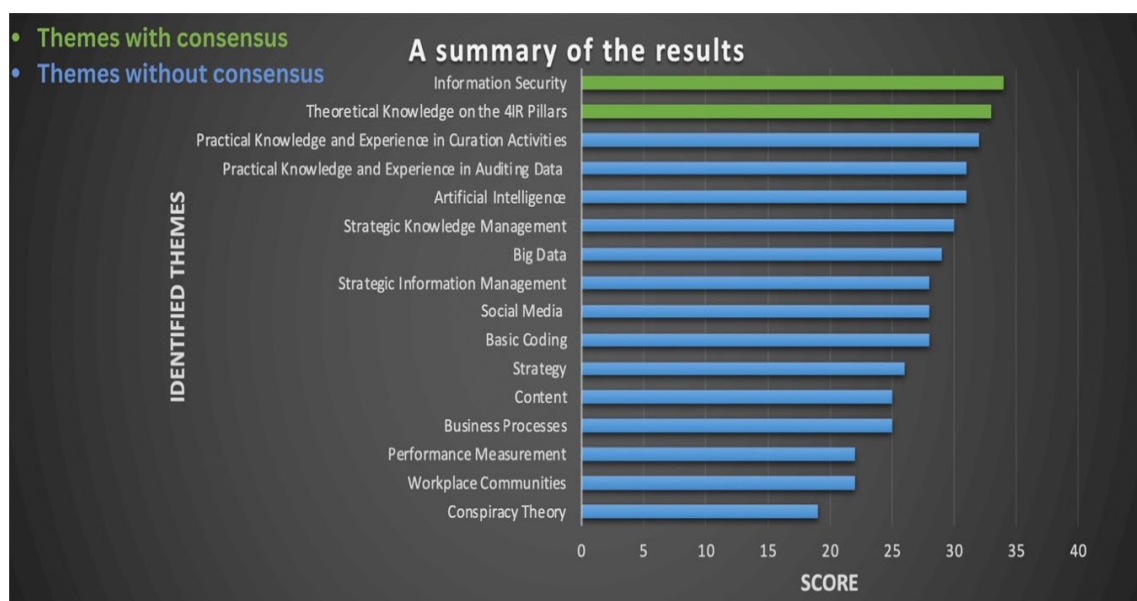


Figure 2: IKM themes identified as essential for success in the 4IR by participants

Information security received a score of 34, making it the most central theme identified. Information security is paramount in IKM, as it involves installing protective measures to safeguard against unauthorised usage, alteration, or destruction of information (Surwade and Patil, 2019). Practitioners must ensure they safeguard an organisation's information assets to protect it against litigation and to prevent competitors from gaining insights into its organisational strategy. The second most important topic, with a score of 33, was theoretical knowledge of the 4IR pillars.

The 4IR pillars that IKM practitioners need knowledge of are augmented reality, autonomous robots, systems integration, cloud computing, simulations, additive manufacturing, the Internet of Things (IoT), cybersecurity, and big data (BD) (Palka and Ciukaj, 2019). These technologies are utilised across many industries; consequently, IKM practitioners can improve their employability scores in any industry, even in the era of rapid technological development. Additionally, knowledge of these two themes could help organisations in South Africa take advantage of 4IR technologies, such as BD and cybersecurity, to facilitate innovation and safeguard data and intelligence from unauthorised access, leveraging cybersecurity protocols in an increasingly digital society. Figure 3 below provides clarity on how votes were cast for themes where consensus was not reached. The colour coding is consistent with the standard described for Figure 1.

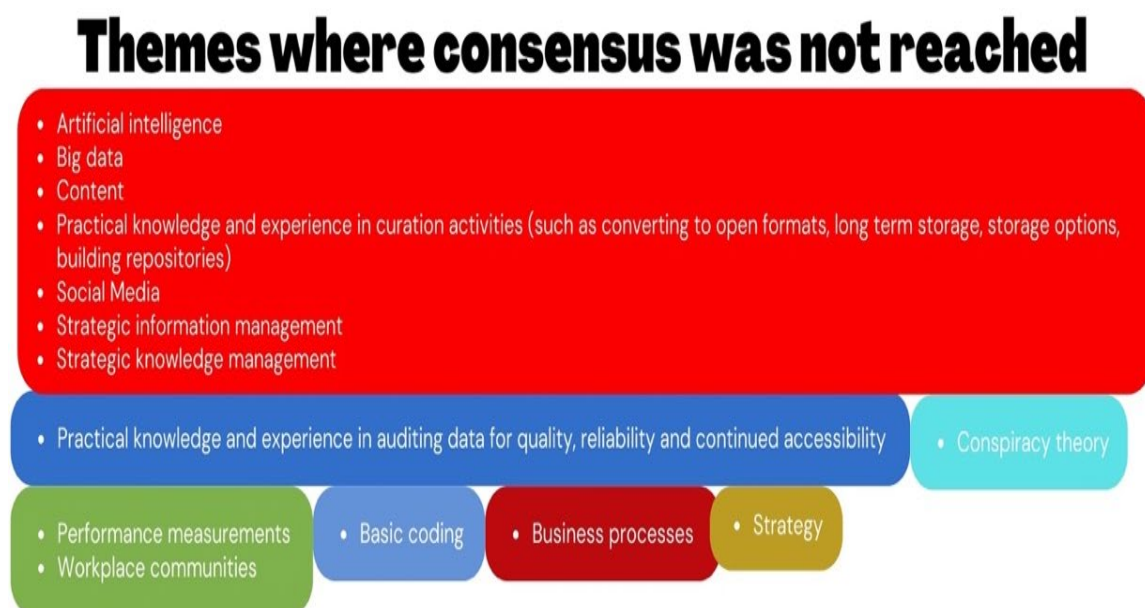


Figure 3: Themes where consensus was not reached

6. Conclusions and Implications

The key finding of this study was that IKM experts agreed on only 2 themes as universally necessary for upskilling in the 4IR. These themes are identified as critical for realising the potential of IKM as a beacon of the 4IR. It is necessary to note that this does not mean that, if a consensus was not reached on a particular theme, it is not required for success. IKM practitioners thus need to assess all recommendations to determine relevance to their context. However, the two themes where consensus was reached should be considered essential irrespective of context. It is therefore essential to note that the 'no one-size-fits-all' principle remains relevant in this new age, as IKM is still practised across many industries with varying requirements. This idea highlights the importance of reporting results when a consensus was not reached, as some of the identified themes may be better suited to specific environments. All themes scoring 30 or higher are highly recommended as their scores also suggest importance, even though a consensus was not reached on all of them. The score indicates that the majority of experts deem them necessary. The themes scored 20-29 must be considered in light of the organisational context of IKM practitioners.

This study proposes foundational findings for researchers to build upon, given the varying circumstances and contexts. The reality is that technology is constantly changing, requiring disciplines to be agile. The findings imply that the study's results may be true today but may not be accurate tomorrow. Therefore, the secondary and third implications of this study are that researchers continually update the list of themes. Future research calls should include more participants and use in-depth interviews to capture the justifications for theme selection. The fourth implication of this study is the requirement to review tertiary education curricula to ensure they

equip IKM students with the skills that can be acquired from the themes identified in this study. The results serve as a guide for IKM departments and professionals to identify, from a broad perspective, key IKM themes relevant to acquiring the skills needed for success in the 4IR.

Ethics Declaration: From an ethical standpoint, the authors provided participants with a letter of informed consent that detailed the study's purpose, confidentiality clause, and benefits of participation, among other relevant details. Additionally, before any data was collected, the study received ethical clearance from the University of Johannesburg's College of Business and Economics Research Ethics Committee. The ethical clearance code is 2020SCI551.

AI Declaration: AI was used in the development of this article. Grammarly was also utilised only to improve grammar and correct spelling errors, while ChatGPT was used to write the abstract.

References

- Adomi, E.E. and Oyovwe-Tinuoye, G.O., 2022. COVID-19 information seeking and utilisation among library and information science professionals in Nigeria. *International Federation of Library Associations and Institutions*, 48(1), pp 216-227.
- Anshari, M., Almunawar, M.N. and Razzaq, A., 2021. Developing talents vis-à-vis fourth industrial revolution. *International Journal of Asian Business and Information Management*, 12(4), pp 20-32.
- Baker, M. and Schaltegger, S., 2015. Pragmatism and new directions in social and environmental accountability research. *Accounting, Auditing and Accountability Journal*, 28(2), pp 263-294.
- Baskerville, R., 2014. "Rigour". In: *The SAGE encyclopedia of action research*: pp 691-692. Edited by Coghlan, D. and Brydon-Miller, M., London: SAGE Publications Ltd.
- Byas, K. and Velasquez, V., 2026. *5 entrepreneurial skills you didn't know you needed until now*. Available at: <https://www.investopedia.com/articles/personal-finance/080615/5-skills-every-entrepreneur-needs.asp#:~:text=To%20mitigate%20the%20risk%20of,a%20very%20valuable%20life%20skill> [accessed 8 March 2026].
- Chiu, D.K.W. and Ho, K.K.W., 2023. Editorial: advances in information and knowledge management. *Library Hi Tech*, 41(4), pp 993-1005.
- Corfe, S., 2018. *4IR in the Workplace: ensuring employers and employees benefit*. London: The Social Market Foundation.
- Cummings, C.L., 2018. "Cross-sectional design". In: *The SAGE encyclopedia of communication research methods*: pp 315-317. Edited by Allen, M., Thousand Oaks: SAGE Publications, Inc.
- Guisseppe, A. and Forgonne, G.A., 1992. Streamlining information science research and education. *Information and Management*, 23(3), pp 141-147.
- Haider, J., Johansson, V. and Hammarfelt, B., 2022. Time and temporality in library and information science. *Journal of Documentation*, 78(1), pp 1-17.
- Jackson, B., 2021. Open data policies among library and information science journals. *Publications*, 9(2), pp 1-12.
- Lam, K., Kong, E.W.S., Chiu, D.K.W. and Ho, K.K.W., 2024. Knowledge-sharing attitude and behavior of civil servants: motivations behind rewards. *Aslib Journal of Information Management*, 76(6), pp 1010-1028.
- Lee, D. and Lee, S., 2022. A study of the competitiveness and development strategy of Korean venture companies in the fourth industrial revolution using SWOT/AHP. *Sustainability*, 14(9), pp 1-22. [removed for anonymity].
- McGrath, S., 2022. Vocational education in the fourth industrial revolution. *Journal of Vocational Education and Training*, 74(2), pp 352-354.
- Mhlanga, D., 2022. Stakeholder capitalism, the fourth industrial revolution (4IR), and sustainable development: issues to be resolved. *Sustainability*, 14(7), pp 1-20.
- Moloi, T. and Salawu, M.K., 2022. Institutionalising technologies in South African universities towards the fourth industrial revolution. *International Journal of Engineering and Technology*, 17(3), pp 204-227.
- Mills, A.J., Durepos, G. and Wiebe, E., 2012. "Credibility". In: *Encyclopedia of case study research*: pp 243-244. Edited by Mills, A.J., Durepos, G. and Wiebe, E., Thousand Oaks: SAGE Publications, Inc.
- Mulyadi, D., Huda, M. and Gusmian, I., 2022. Smart learning environment (SLE) in the fourth industrial revolution (IR 4.0): practical insights into online learning resources. *International Journal of Asian Business and Information Management*, 13(2), pp 1-23.
- Palka, D. and Ciukaj, J., 2019. Prospects for development movement in the industry concept 4.0.. *MAPE*, 2(1), pp 315-326.
- Park, J.M., 2022. Statistics training in library science: comparing approaches in library and information science to sociology graduate programs. *Journal of Education for Library and Information Science*, 63(2), pp 216-230.
- Patacsil, F.F. and Tablatin, C.L.S., 2017. Exploring the importance of soft and hard skills as perceived by IT internship students and industry: a gap analysis. *Journal of Technology and Science Education*, 7(3), pp 347-368.
- Pedota, M. and Piscitello, L., 2022. A new perspective on technology-driven creativity enhancement in the fourth industrial revolution. *Creativity and Innovation Management*, 31(1), pp 109-122.
- Petras, V., 2024. The identity of information science. *Journal of Documentation*, 80(3), pp 579-596.
- Puig, A. and Adams, C.M., 2018. "Delphi technique". In: *The SAGE encyclopedia of educational research, measurement, and evaluation*: pp 480-483. Edited by Frey, B.B., Thousand Oaks: SAGE Publications, Inc.

- Salkind, N.J., 2011. "Delphi technique". In: *Encyclopedia of measurement and statistics*: pp 241-246. Edited by Salkind, N.J., SAGE Publications, Inc., Thousand Oaks.
- Saniuk, S., Grabowska, S. and Grebski, W., 2022. Knowledge and skills development in the context of the fourth industrial revolution technologies: interviews of experts from Pennsylvania state of the USA. *Energies*, 15(7), pp 1-17.
- Shehata, A., 2021. Health information behaviour during COVID-19 outbreak among Egyptian library and information science undergraduate students. *Information Development*, 37(3), pp 417-430.
- Surwade, Y.P. and Patil, H.J., 2019. *Information security*. Available at: <https://www.researchgate.net/publication/330778559> Information Security (Accessed 10 March 2026).
- Tang, K., Hsiao, C. and Hwang, G., 2022. A scholarly network of AI research with an information science focus: Global North and Global South perspectives. *PLoS ONE*, 17(4), pp 1-22.
- Wong, K., Walton, G. and Bailey, G., 2020. Using information science to enhance educational preventing violent extremism programs. *Journal of the Association for Information Science and Technology*, 72(4), pp 362-376.
- Yamaguchi, S., Oshima, H., Watanabe, T., Osaka, Y., Tanihara, T., Inoue, E. and Tanabe, S., 2025. An analysis of literacy differences related to the identification and dissemination of misinformation in Japan. *Global Knowledge, Memory and Communication*, 74(11), pp 121-139.