

# Key performance areas and indicators perceived to be critical for Information Science roles in the Fourth Industrial Revolution

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*The Fourth Industrial Revolution (4IR) has transformed the rules of competition, resulting in organisations needing new and improved business strategies. The execution of these strategies is critical to organisational success. One way of ensuring that employees execute strategies optimally is by developing key performance areas (KPA) and key performance indicators (KPI). This study focused on the field of Information and Knowledge Management (IKM) and its related departments or teams. Thus, the study aimed to determine KPAs and KPIs needed by IKM teams for success in the 4IR. To fulfil the aim of the study, the researchers used a Delphi study where experts participated in two rounds of data collection, using questionnaires on Google forms. The questionnaires collected both qualitative and quantitative data. The first round involved the identification of the KPAs and KPIs necessary for IKM teams, and the second was to get the experts to share their thoughts on each other's views regarding KPAs and KPIs necessary for success in the 4IR dispensation. The experts identified 54 KPAs and 33 KPIs in total. Individual organisations should undertake further research to determine whether they are useful in achieving optimum success. Furthermore, there is a need to decide whether they need to update the existing KPAs and KPIs or not.*

**Keywords:** Fourth industrial revolution, key performance areas, key performance indicators, information and knowledge management, Delphi study.

## 1 Introduction

A significant paradigm shift has been realised due to the introduction of cyber-physical systems (CPS) generated by the 4IR. These systems function through multipurpose technologies, operating in various industries, such as blockchain, artificial intelligence (AI), genomics, the Internet of Things (IoT) (Chalmers, MacKenzie & Carter 2021), big data, additive manufacturing, robotics, among others, to integrate the physical and the virtual (Anshari, Almunawar & Razzaq 2021). CPS systems integrate networking, control, sensing and computation into tangible entities and infrastructure, connecting them to the Internet and each other (National Science Foundation n.d.). The South African government responded to the 4IR by establishing a presidential commission to leverage 4IR technologies and improve development, industrialisation, and employment, among others, through policy and legislation development (Moloi & Salawu 2022). The project embarked on by the South African government, like any other, requires the development of KPAs and KPIs for successful implementation and goal attainment measurement.

The nature of technology infamously replacing low-skill work with high-skill demanding work has changed to being more task-oriented (Pedota & Piscitello 2022). The speedy spread of AI leads to change taking place faster in the 4IR era (Chalmers et al. 2021), as automation is facilitated. With automation replacing manual labour (Pedota & Piscitello 2022), it remains prudent to measure how well tasks and new processes are being completed. This measurement highlights the importance of KPAs and KPIs. The 4IR has led to business upgrades from a technology standpoint. For example, the world now has education 4.0, agriculture 4.0 and health 4.0 (Anshari et al. 2021), and newly developed 5.0s. These industries are now considered 4.0's because they adopted 4IR technologies such as sensors that allow real-time data analysis from remote areas (Anshari et al. 2021). Education 5.0 builds on education 3.0, which focuses on teaching, research, and community service. Education 5.0 adds two more focuses: innovation and industrialisation (Togo & Gandidzanwa 2021). Healthcare 5.0 was established when AI met 5G communication services and the IoT in the healthcare space (Mohanta, Das & Patnaik 2019). The technologies found in healthcare 5.0 are also prevalent in agriculture 5.0. The difference here is that from an agriculture standpoint, these technologies work in congruence with green energy sources, such as renewable energy sources (Ragazou et al. 2022).

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Forecasting the changes, the 4IR will introduce, both from a social and lifestyle perspective is challenging (Lee & Lee 2022). Regardless, change is coming, and to an extent, it already is here, even though there may be a shortage of empirical evidence (McGrath 2022). Therefore, organisations need to be in position to deal with the changes. New metrics for success need to be developed, thus the need to alter organisational KPAs and KPIs. Organisations must take advantage of these technologies. However, that can only happen if organisations are willing to recreate their business models and value generation strategies (Bettiol et al. 2020). Thus, it is necessary for key performance areas (KPAs) and key performance indicators (KPIs) in organisations to be reworked. 4IR technologies have advanced organisational performance by enabling businesses to innovate, exploit markets and improve policymaking through using big data analytics (Gwala & Mashau 2022) and increase productivity (Nyagadza et al. 2022).

The wealth created in the 4IR environment will lead to new jobs (Anshari et al. 2021). New jobs mean new KPAs and KPIs need to be created, and this reflects the gap filled by this study – the identification of KPAs and highlighting the KPIs necessary for IKM practitioners in the 4IR age. To achieve the aim of the study, the researchers employed a Delphi study.

## 2 Key performance areas and indicators

Efficaciously measuring and managing KPAs and their related KPIs will provide Southern Africa with the capability to compete successfully and ensure survival in the future, in the market (Dougall & Mmola 2015). KPAs can be defined as general areas of results or outputs that need to be satisfied by fulfilling a particular role or collaboration of roles (Talentalign 2022). KPAs are valuable instruments for observing and managing performance (Dougall & Mmola 2015). Individuals or teams are logically responsible for achieving the desired results for each existing KPA in an organisation. Examples include innovation and customer focus, given that the organisational objectives involve delivering new products and services and improving customer service (Talentalign 2022). KPAs and KPIs are integral to performance management (Marais n.d.). KPAs are those areas of performance unambiguously or implicitly detailed in an organisation's vision and strategy and represent the organisation's critical success factors (CSFs) (Dougall & Mmola 2015). A KPA describes all the activities, not necessarily outcome-based, a person has to perform at work (HRDictionary 2012). KPAs are made up of KPIs that will help determine the overall success of a KPA (Dougall & Mmola 2015). As a subset of KPAs, the measurement of KPIs helps manage KPAs (Dougall & Mmola 2015).

KPIs are quantifiable elements, agreed to in advance, that are CSFs for any business (Dougall & Mmola 2015). KPIs are indicators that use metrics to manage a business' internal affairs and the risk assessment process (Zarzycka & Krasodomska 2021; Zarzycka & Krasodomska 2022). KPIs are utilised to measure key aspects of business; hence, they must be measurable and verifiable and easily comprehensible by employees (Faria et al. 2021). KPIs mainly focus on elements key to organisational success in the present and the future (Zarzycka & Krasodomska 2021). Defining and monitoring KPIs is key for organisational success as organisations will be able to remain competitive in their industries (Hennyeyová et al. 2021). The aim of KPI development should be to provide transparency regarding CSFs. KPIs should be presented in an easy-to-understand format to facilitate their recognition, comprehension and feasibility and improve their utilisation, fulfilment, and relevance (Zarzycka & Krasodomska 2021; 2022). KPIs are tools that need to be objective-oriented, laden with meaning, easy to understand and be utilised to compare different organisations (Rodrigues, Godina & da Cruz 2021).

KPIs are tools used to meticulously reflect a project's goals as they assist in detailing the nature, scope, projected quality, and unique traits of the project (Ho et al. 2021). KPIs are essential for planning, control, establishing transparency, and supporting decision-making in management (Hennyeyová et al. 2021). KPIs are ideally useful for performance analysis (Ho et al. 2021). Rodrigues et al. (2021) argue that KPIs are, without a doubt, the critical measurement and control instruments within every organisational process. KPIs can be used to measure both processes and outcomes (Ho et al. 2021). With technology increasing the competitiveness in various industries, organisations have had to develop strategies to help them stay ahead of competitors or even survive. These strategies include observing performance through the adoption of KPIs (Rodrigues et al. 2021). KPIs can measure, for example, the impact of a particular strategy (Zarzycka & Krasodomska 2021). As such, KPIs must resonate with a business's strategy and assist in successfully executing the organisational strategy (Rodrigues et al. 2021). KPIs are utilised to determine whether key processes are performed optimally, for example, efficiently without resource wastage (Rodrigues et al. 2021).

KPI development should be done in collaboration with stakeholders (Zarzycka & Krasodomska 2021). As done with this study, senior team members should develop a list of KPIs and secure input from other team members to finalise and choose the adequate KPIs, which will assist with obtaining buy-in and improving KPI quality (Dougall & Mmola 2015). KPIs are also the tools used to measure a project's progress in goal achievement and allow further learning and project enhancement (Ho et al. 2021). It is essential for KPIs to be of high quality – hence the study involved experts only for their identification – however, even with expert involvement, KPIs need piloting to ensure they perform optimally when published officially (Zarzycka & Krasodomska 2021).

### 3 Problem statement, research aim, research question and research objectives

With the 4IR leading to change taking place faster (Chalmers et al. 2021) and businesses evolving (Anshari et al. 2021), it becomes necessary for organisations to identify new KPAs and KPIs that will help them achieve success in this current environment. Organisations in South Africa are slowly introducing the 4IR to their environment and thus should be implementing appropriate KPAs and KPIs for organisational success at the departmental levels. Without appropriate KPAs and KPIs, organisations risk failure as KPAs and KPIs are critical for performance management (Marais n.d.). KPAs and KPIs are those areas of performance unambiguously or implicitly outlined in an organisation's vision and strategy and pinpoint the organisation's CSFs (Dougall & Mmola 2015). This study thus aimed to determine the KPAs and KPIs organisations need to put in place to perform IKM roles in the 4IR environment successfully.

#### 3.1 Research question

What KPAs and KPIs do organisations need for IKM roles to be performed optimally?

#### 3.2 Research objectives

- To determine the KPAs IKM departments need to succeed in the 4IR age.
- To determine the KPIs needed to measure the identified KPAs' performance for IKM departments' success in the 4IR age.

### 4 Research methodology

Firstly, it is critical to point out that this paper is part of a bigger study, as this had implications for some aspects of the methodology (indicated below). To fulfil the requirements of the study, the researchers used the Delphi study methodology as there was a need for the respondents to reach a consensus (Puig & Adams 2018) and resolve a pressing issue by collecting expert opinions (Salkind 2011). The researchers used pragmatism to determine scientific evidence (Baker & Schaltegger 2015) regarding the KPAs and KPIs relevant to IKM practitioners in the 4IR age. The study collected two data sets, both qualitative and quantitative, meaning that a multimethod research paradigm was employed.

Data was collected using Google forms, where two questionnaires were developed. The questionnaire for the first round of data collection gathered qualitative responses to allow respondents to provide as many IKM related KPAs and KPIs as possible. The second round then aimed to collect quantitative data. Experts provided their thoughts on whether they agreed or disagreed that each identified KPA or KPI was required for IKM practitioners in the 4IR age. The second round aimed for the experts to reach a consensus. The researchers used a five-point scale for the second round, where one (1) represented not useful at all and five (5), very useful. For the experts to reach a consensus, they all had to select options four or five, with four representing useful. Content analysis was utilised to identify the various KPAs and KPIs itemised in round one. The participants were tasked to determine, qualitatively, the KPAs and KPIs they deemed critical for IKM practitioners in the 4IR age. The authors then had to analyse the content provided by the participants to identify the KPAs and KPIs. Following analysis, some of the KPAs and KPIs were subsequently subsumed by others. Additionally, Google forms graphs and Microsoft Excel were used to analyse the quantitative section by summarising the data and developing the tables in the results section.

The researchers then drew logical conclusions based on the data analysis, thereby applying deductive reasoning. This was an expert review study through the need to employ experts for data collection solely. The researchers purposively identified eight IKM experts, with four from corporate backgrounds (senior managers) and four from academia (professors). The reason for selecting senior managers and professors and excluding lower-level managers and academics was the requirement to obtain high-quality responses from people who have a proven track record in the field. By discussing the methodology meticulously, the researchers aim to achieve confirmability (Baskerville 2014), making the study's findings valid and reliable. In an attempt to ensure the credibility of the results, the authors continuously followed up with respondents guaranteeing that the data and analysis thereof accurately represented the views of the experts (Mills, Durepos & Wiebe 2012). Before data was collected, the researchers provided the experts with a letter of informed consent, giving them insight into their rights and roles for the study. The main study was granted ethical clearance (the ethical clearance code is 2020SCiS51) by the University of Johannesburg's CBE Research Ethics Committee.

The study's limitations included using purposive sampling, making it challenging to generalise findings; however, it was imperative to generate expert opinions to realise a chance to address the research question. Additionally, a limitation of Delphi studies is that they can get tedious as they are time-consuming (Salkind 2011). This led to the researchers only having seven respondents complete this section of the bigger study. In an attempt to resolve the issue of attrition, the researchers allowed the experts two weeks to a month for each round of data collection, hoping that this would ease the

pressure of participation and enable experts to give more thought to their responses. The time horizon identified as appropriate for this study was cross-sectional, as data was collected at a specific point in time (Cummings 2018), and data will not be collected again, by the current researchers, for this study once this paper has been completed.

## 5 Results and discussion

### 5.1 Key performance areas with no consensus

The numbers seen as headings in figures 1-4 below represent the options selected by respondents. There was a consensus on eighteen KPAs identified, meaning that a consensus was not reached on 36 of the KPAs identified. Concerning organisation operation KPAs, a consensus was not reached on the following: Business process mapping, workflow, and improvement; compliance checklist; strategy academies; certification for the resources being managed; using knowledge contributors as opposed to KPAs; enterprise resource planning; risk profile management; quality assurance checklists and procedures developed; and life cycle management.

**Table 1 Results of organisation operation KPAs where consensus was not reached**

5,4,3	5,4,3,1	4,3	4,2	4,2,1
<p><b>Business process mapping, workflow, and improvement</b> = Four (57.1%) respondents stated that it is useful, two (28.6%) provided that it is very useful, and one (14.3%) was neutral</p> <p><b>Enterprise Resource Planning</b> = Three (42.9%) respondents regarded it as very useful, three (42.9%) useful, and one (14.3%) was neutral</p> <p><b>Risk profile management</b> = Four (57.1%) respondents viewed it as useful, two (28.6%) thought it very useful, and one (14.3%) was neutral</p> <p><b>Quality assurance checklists and procedures developed</b> = Five (71.4%) respondents indicated that it is useful, one (14.3%) stated that it is very useful, and one (14.3%) was neutral</p> <p><b>Life cycle management</b> = Three (42.9%) respondents regarded it useful, two (28.6%) very useful, and two (28.6%) were neutral.</p>	<p><b>Compliance checklist</b> = Three (42.9%) respondents thought it useful, two (28.6%) were neutral, and one (14.3%) viewed it as very useful, and one thought it not useful at all.</p>	<p><b>Strategy academies</b> = Four (57.1%) respondents were neutral, and three (42.9%) considered it useful.</p>	<p><b>Certification for the resources being managed</b> = Six (85.7%) respondents considered it useful, and one (14.3%) respondent regarded it as not useful.</p>	<p><b>Using knowledge contributors as opposed to KPAs</b> = Five (71.4%) respondents believed it would be useful, one (14.3%) thought it would not be useful, and another one thought it not useful at all.</p>

**Source: Authors' compilation**

Concerning innovation, data related, and techno-centric KPAs, a consensus was not reached on the following: Data translation (visualisation); e-commerce; programming skills/languages; search engine optimisation; future of work, workers, and workplaces; customer-centric transformation; innovation ecosystem management; and a single view of client communication.

**Table 2 Results of innovation, data related, and techno centric KPAs where consensus was not reached**

5,4,3	5,4,2	5,4,1
<p><b>Data translation (visualisation)</b> = Four (57.1%) respondents viewed it as very useful, two (28.6%) thought it useful, and one (14.3%) was neutral</p> <p><b>E-commerce</b> = Four (57.1%) respondents looked at it as useful, two (28.6%) thought it useful, and one (14.3%) was neutral</p> <p><b>Search engine optimisation</b> = Four (57.1%) respondents considered it very useful, two (28.6%) thought it useful, and one (14.3%) was neutral.</p> <p><b>Future of work, workers and workplace</b> = Four (57.1%) respondents considered it very useful, two (28.6%) regarded it useful, and one (14.3%) was neutral.</p> <p><b>Customer centric transformation</b> = Four (57.1%) respondents considered it useful, two (28.6%) regarded it very useful, and one (14.3%) was neutral.</p> <p><b>Innovation ecosystem management</b> = Three (42.9%) respondents viewed it as very useful, two (28.6%) as useful, and another two were neutral.</p>	<p><b>Programming skills/language</b> = Five (71.4%) respondents indicated that it would be useful, one (14.3%) provided it would be very useful, and one stated that it would not be useful.</p>	<p><b>Single view of client communication</b> – Five (71.4%) respondents viewed it as very useful, one (14.3%) thought it useful, and one thought it is not useful at all.</p>

**Source: Authors' compilation**

In terms of knowledge management (KM) and security KPAs, a consensus was not reached on the following: knowledge mapping and assessment; knowledge coding/tagging; knowledge processing; knowledge value chain management; knowledge ecosystem management; health and safety; and security.

**Table 3 results of KM and security KPAs where consensus was not reached**

5,4,3	5,4,3,2	5,3
<p><b>Knowledge mapping and assessment</b> = Four (57.1%) respondents viewed it as useful, two (28.6%) thought it very useful, and one (14.3%) was neutral</p> <p><b>Knowledge coding/tagging</b> = Four (57.1%) respondents provided that it is very useful, two (28.6%) thought it useful, and one (14.3%) was neutral.</p> <p><b>Knowledge value chain management</b> = Three (42.9%) respondents considered it very useful, another three viewed it as useful, and one (14.3%) was neutral.</p> <p><b>Knowledge processing</b> = Four (57.1%) respondents provided that it is useful, two (28.6%) thought it very useful, and one (14.3%) was neutral.</p> <p><b>Knowledge ecosystem management</b> = Four (57.1%) respondents viewed it as very useful, two (28.6%) regarded it useful, and one (14.3%) was neutral.</p>	<p><b>Health and safety</b> = Three (42.9%) respondents considered it very useful, two (28.6%) as useful, one (14.3%) was neutral, and another one thought it is not useful.</p>	<p><b>Security</b> = Six (85.7%) respondents thought it very useful, and one (14.3%) was neutral.</p>

**Source: Authors' compilation**

Concerning research and digital requirements KPAs, a consensus was not reached on the following: Competitive intelligence; strategic digital leadership; digital leadership and culture; digital knowledge networks; digital monitoring and evaluation; digital business platform management; cloud-enabled transformation; digital transformation strategy; digital disruption response; digital performance management; digital twin training; and digital product management.

**Table 4 Results of research and digital requirements KPAs where consensus was not reached**

5,4,3		
<p><b>Competitive intelligence</b> = Five (71.4%) respondents considered it very useful, one (14.3%) thought it useful, and another one was neutral.</p> <p><b>Digital leadership and culture</b> = Three (42.9%) respondents thought it very useful, another three were neutral, and one (14.3%) saw it as useful.</p> <p><b>Strategic digital leadership</b> = Three (42.9%) respondents viewed it as very useful, two (28.6%) as useful, and another two were neutral.</p> <p><b>Digital knowledge networks</b> = Three (42.9%) respondents considered it useful, and two (28.6%) as very useful, and two were neutral.</p>	<p><b>Digital monitoring and evaluation</b> = Four (57.1%) respondents regarded it useful, two (28.6%) as very useful, and one (14.3%) was neutral.</p> <p><b>Cloud-enabled transformation</b> = Three respondents viewed it as very useful (42.9%), three thought it useful, and one (14.3%) was neutral.</p> <p><b>Digital business platform management</b> = Three (42.9%) respondents viewed it as useful, two (28.6%) as very useful, and two were neutral</p> <p><b>Digital transformation strategy</b> = Three (42.9%) respondents considered it very useful, another three thought it useful, and one (14.3%) was neutral.</p>	<p><b>Digital disruption response</b> = Three (42.9%) respondents viewed it as very useful, two (28.6%) as useful, and two were neutral.</p> <p><b>Digital twin training</b> = Three (42.9%) respondents considered it very useful, two (28.6%) thought it useful, and two were neutral.</p> <p><b>Digital performance management</b> = Three (42.9%) respondents viewed it as useful, two (28.6%) thought it very useful, and two were neutral.</p> <p><b>Digital product management</b> = Three (42.9%) respondents viewed it as useful, another three thought it very useful, and one (14.3%) was neutral.</p>

Source: Authors' compilation

## 5.2 Key performance indicator with no consensus

There was a consensus on nine of the KPIs identified, meaning that a consensus was not reached on 24 of the KPIs identified. Concerning knowledge and data related KPIs, a consensus was not reached on the following: What knowledge has been identified; which knowledge has been captured and successfully used in another project; of the knowledge in the "system", what is the percentage of the ones discarded, improved or refreshed; advanced knowledge about data management; evidence of quality audits; advanced knowledge about data preservation; derivatives of data sets created; active support in collecting quality-assured data; an established network of data providers; and active support in visualising/implementing/applying the data resource.

**Table 5 Results of knowledge and data related KPIs where consensus was not reached**

5,4,3	5,4,3,1
<p><b>What knowledge has been identified</b> = Four (57.1%) respondents viewed it as very useful, two (28.6%) thought it useful, and one (14.3%) was neutral.</p> <p><b>Which knowledge has been captured and successfully used in another project</b> = Four (57.1%) respondents considered it as very useful, two (28.6%) as useful, and one (14.3%) was neutral</p> <p><b>Of the knowledge in the "system", what is the percentage of the ones discarded, improved or refreshed</b> = Four (57.1%) respondents viewed it as useful, two (28.6%) thought it very useful, and one (14.3%) was neutral.</p> <p><b>Advanced knowledge about data management</b> = Three (42.9%) respondents viewed it as very useful, three as useful, and one (14.3%) was neutral.</p>	<p><b>Advanced knowledge about data preservation</b> = Five (71.4%) respondents provided that it is very useful, one (14.3%) stated it is useful, and another one was neutral.</p> <p><b>Active support in collecting quality assurance data</b> = Four (57.1%) respondents considered it very useful, two (28.6%) thought it useful, and one (14.3%) was neutral.</p> <p><b>An established network of data providers</b> = Three (42.9%) respondents viewed it as very useful, two (28.6%) as useful, and another two were neutral.</p> <p><b>Active support in visualising/implementing/applying the data resource</b> = Three (42.9%) respondents regarded it as very useful, another three thought it</p>

**Evidence of quality audits =** useful, and one (14.3%) was neutral.  
 Three (42.9%) respondents viewed it as very useful, another three as useful, and one (14.3%) was neutral.

**Source: Authors' compilation**

In terms of organisational, personal and easily measurable KPIs, a consensus was not reached on the following: Requires recognition of knowledge contributors as opposed to KPIs; to be determined by incumbent/stakeholders; value-based contextual, cultural and competitive intelligence; impression; the number of articles published; the number of operational or governance documents written; SLA recovery or SLA response error rate; and effective mentoring measured by getting feedback from mentees.

**Table 6 Results of organisational, personal and easily measurable KPIs where consensus was not reached**

5,4,3	5,4,2	4,3
<p><b>Recognition of knowledge contributors as opposed to KPIs =</b> Four (57.1%) respondents thought it useful, two (28.6%) thought it very useful, and one (14.3%) was neutral.</p> <p><b>Value-based contextual, cultural and competitive intelligence =</b> Three (42.9%) respondents thought it useful, two (28.6%) as very useful, and another two were neutral.</p> <p><b>Impression =</b> Three (42.9%) respondents thought it useful, another three were neutral, and one (14.3%) saw it as very useful.</p> <p><b>The number of operational or governance documents written =</b> Three (42.9%) respondents thought it useful, two (28.6%) held the position it is very useful, and another two were neutral.</p>	<p><b>The number of articles published =</b> Four (57.1%) respondents viewed it as useful, two (28.6%) thought it very useful, and one (14.3%) held the position that it would not be useful.</p> <p><b>Effective mentoring measured by getting feedback from mentees =</b> Three (42.9%) respondents considered it very useful, another three thought it useful, and one (14.3%) viewed it as not useful.</p>	<p><b>KPIs being determined by incumbent/stakeholders =</b> Four (57.1%) respondents were neutral, and three (42.9%) thought it useful.</p> <p><b>SLA recovery or SLA response error rate =</b> Five (71.4%) respondents regarded it useful, and two (28.6%) were neutral.</p>

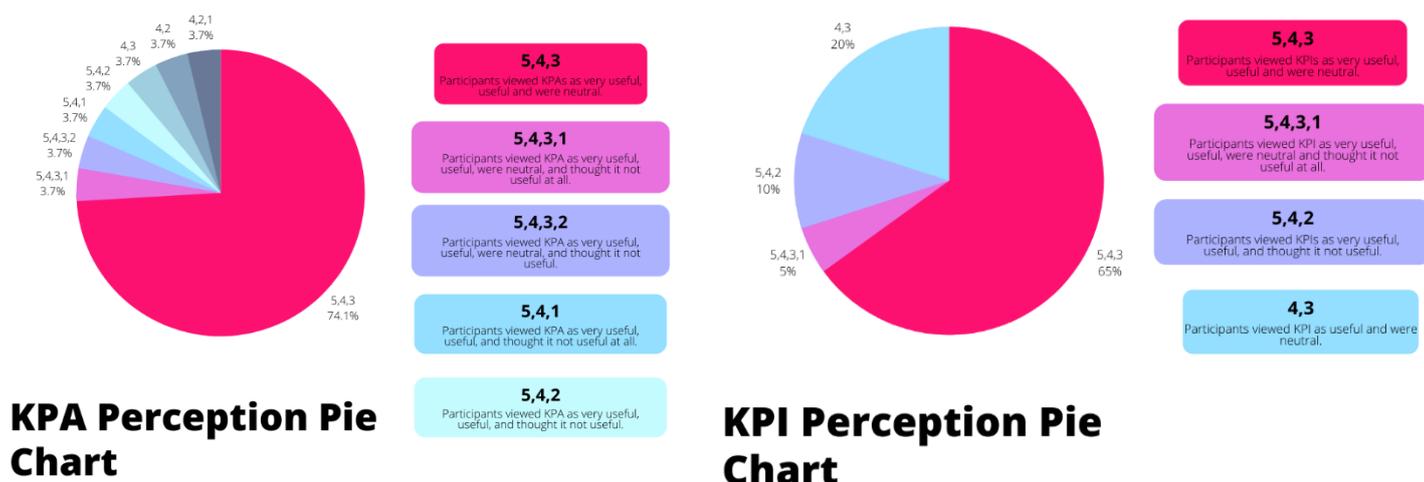
**Source: Authors' compilation**

Concerning innovation KPIs, a consensus was not reached on the following: Innovation; strategic learning; transformation as a result of design thinking; simulation; visualisation; and transformation.

**Table 7 Results of innovation KPIs where consensus was not reached**

5,4,3	4,3
<p><b>Innovation =</b> Five (71.4%) respondents provided that it is very useful, one (14.3%) viewed it as useful, and another one was neutral.</p> <p><b>Strategic learning =</b> Three (42.9%) respondents thought it useful, two (28.6%) held the position it would be very useful, and another two were neutral.</p> <p><b>Transformation as a result of design thinking =</b> Three (42.9%) respondents thought it useful, two (28.6%) believed it would be very useful, and another two were neutral.</p> <p><b>Transformation =</b> Five (71.4%) respondents provided that it is useful, one (14.3%) thought it very useful, and another one was neutral.</p>	<p><b>Simulation =</b> Five (71.4%) respondents provided that it would be useful, and two (28.6%) were neutral.</p> <p><b>Visualisation =</b> Six (85.7%) respondents viewed it as useful, and one (14.3%) was neutral.</p>

**Source: Authors' compilation**



Figures 1 and 2: Summary of results of KPAs and KPIs without consensus (Authors' compilation)

The results presented in figures one and two show that all KPAs and KPIs identified are to a level accepted by respondents, as every KPA and KPI identified had respondents agreeing that it would be useful in the 4IR. In fact, most KPAs and KPIs had respondents strongly agree that they would be useful. This suggests that organisations should consider all KPAs and KPIs identified and present them to stakeholders. The organisation can then utilise only those agreed upon as establishing an organisation's KPAs and KPIs should be done collaboratively.

### 5.3 Key performance areas with consensus

Six (85.7%) respondents regarded a good governance strategy as a very useful KPA, and one (14.3%) thought it useful. This strategy is essential from an IKM perspective as it will influence information governance, which focuses on who manages information as a resource throughout the entire organisation. Therefore, information governance can be defined as a collection of skills or practices that allow information to be created, appraised, saved, utilised, archived, and disposed of effectively (Mikalef et al. 2020).

Five (71.4%) respondents considered an Insight-driven organisation a very useful KPA, and two (28.6%) viewed it as useful. This result can be attributed to the fact being insight-driven means an organisation entrenches analysis, data, and intellectual thinking into the decision-making process daily, all of which are the responsibilities of an IKM role. An insight-driven organisation allows organisational projects to provide significantly positive results (Deloitte 2022). Data visualisation is a tool that assists with knowledge sharing in that visualised data refers to graphical depictions or illustrations used to communicate accurate information (Johansson & Stenlund 2022). Data visualisation is used to provide meaning to data. Hence it makes sense that four respondents considered the toolset to collect and visualise data very useful (57.1%) and three (42.9%) as useful.

Five respondents regarded access to quality-assured data (FAIR data) as very useful (71.4%) and two (28.6%) as useful. On the one hand, FAIR refers to findability, accessibility, interoperability, and reuse. These principles allow data from various sources to be integrated easily, thereby increasing the value of data in the knowledge creation process (De la Hidalgo et al. 2022). On the other hand, one of the most detrimental errors an organisation can make is assuming that data is error-free. Poor data quality can impact the quality of critical decisions made, thereby increasing the importance of quality assurance (Fong 2001). Data quality must be assured for organisational success and survival. Thereby justifying the respondents' views as IKM roles rely on data to provide information, knowledge, and intelligence. Data management is increasingly important as 4IR technologies enable the analysis of vast volumes of data (Tavakoli et al. 2006). Hence the results of the following KPAs:

- "A quality assured source of data for the product or service" was regarded as very useful by four (57.1%) respondents and useful by three (42.9%).
- "Advice on tap (capacity to advise on data management topics)", six (85.7%) respondents considered it useful, and one (14.3%) felt it very useful.
- The numbers for training on tap (capacity to develop data management skills) are the same as the numbers for advice on tap (capacity to advise on data management topics), with the majority of respondents, six (85.7%), considering it useful, and one (14.3%) viewing it as very useful.

To fulfil these KPAs, an organisation needs to employ individuals holding specialised skills and experience to avoid the trial-and-error approach (Tavakoli et al. 2006).

Five respondents viewed the KPA reliable infrastructure (zero downtime) as very useful (71.4%) and two (28.6%) as useful. Additionally, four (57.1%) respondents viewed the KPA continuous connectivity management as very useful and three (42.9%) as useful. The reality is that for devices connected through the IoT to deliver valuable insight, they need continuous connectivity, enabling the machines to communicate in real-time. For example, for security purposes, one missed second can make all the difference in identifying foul play or the perpetrator (Knox 2018). Hence connectivity was also recognised as a KPI, with four (57.1%) respondents viewing the KPI as very useful and three (42.9%) as useful. The IKM role relies heavily on technology to effectively satisfy job requirements, making it easy to understand the respondents' views.

Interestingly, respondents viewed cyber-security as both a KPA and a KPI. The majority of them, however, strongly agreed to it being a KPA as six (85.7%) respondents provided that the secure digital future (cyber-security) KPA is a very useful KPA, and one (14.3%) viewed it as useful. In comparison, only four (57.1%) respondents viewed the KPI cyber-security as useful and three (42.9%) as very useful. Working online has increased the need to protect the online environment, which is done through applying cybersecurity (Craig Diakun-Thibault & Purse 2014).

Five respondents viewed Business Intelligence (BI) as a very useful (71.4%) KPA, and two (28.6%) as useful. With this KPA, it can be argued that participants concurred because BI focuses on producing actionable intelligence by gathering and analysing information on internal business processes. This intelligence is used to enhance decision making (Maungwa & Fourie 2018). The results make sense in that BI is part of the IKM role as the primary objective of any IKM position in business is to provide knowledge or intelligence.

Four (57.1%) respondents viewed innovation as a very useful KPA, and three (42.9%) as useful simply because innovation is essential to business as it will facilitate growth and assist organisations to keep ahead of competitors (MasterClass 2021). There is a need for the IKM role to be innovative in how it uses data and information; thus, the KPA could facilitate this process.

Information storage is a key characteristic of information technology. With vast amounts of information being created, it must be stored appropriately to ensure usability when required (Gnanasundaram & Shrivastava 2012). This definition explains why five (71.4%) respondents provided that the secure storage of information KPA is very useful, and two (28.6%) viewed it as useful.

The researchers deemed the following KPAs as KPIs for the KM KPA:

- Six (85.7%) respondents viewed effective knowledge transfer as very useful and one (14.3%) as useful.
- Four (57.1%) respondents regarded knowledge identification as useful and three (42.9%) as very useful.
- Insight visualisation (knowledge translation) had five (71.4%) respondents view it as very useful and two (28.6%) as useful.
- Knowledge reuse had identical results as insight visualisation (knowledge translation), with five (71.4%) respondents viewing it as very useful and two (28.6%) as useful.
- Knowledge capturing was regarded as very useful by four (57.1%) respondents and useful by three (42.9%).
- The only KPI identified as a KPI was advanced topic knowledge, where four (57.1%) respondents viewed the KPI as useful and three (42.9%) as very useful.

It is hard to argue against these views as it is widely accepted that knowledge is key to organisational success (Do & van Hieu 2020). The accretion of knowledge resources by knowledge staff escalates the value of any organisation (Siemieniak & Rembiasz 2019). Participants concurred as the IKM roles include being the heads of KM in organisations.

#### 5.4 Key performance indicators with consensus

Four (57.1%) respondents viewed the KPI advanced knowledge to address interoperability issues as very useful, and three (42.9%) as useful. This result makes sense from the context of the 4IR as interoperability enables machines to communicate. This communication could be the exchange of data or information (Technopedia 2022). Machines can then automatically use this data or information to initiate and complete a process. IKM practitioners are expected to perform tasks requiring various communication systems; hence, this KPI is justified.

Five (71.4%) respondents viewed the KPI "evidence of risk assessments" as useful and two (28.6%) as very useful. Risk assessment can be defined as a tool to identify the nature and degree of risk through evaluating potential threats and analysing the prevailing conditions of vulnerability that, when coupled, could hurt exposed individuals, livelihoods, material goods, services and the environment they rely on (Rovins et al. 2015). The IKM role plays a significant part in analysing data to identify potential threats; hence this too should be a KPI for the role.

Five (71.4%) respondents viewed the KPI "availability" as useful and two (28.6%) as very useful. Being available from a human standpoint means one always has the willingness to assist. Organisations are made up of teams. Similarly, to sports teams, the individuals in the team need to work together to achieve what they otherwise would not, working in isolation

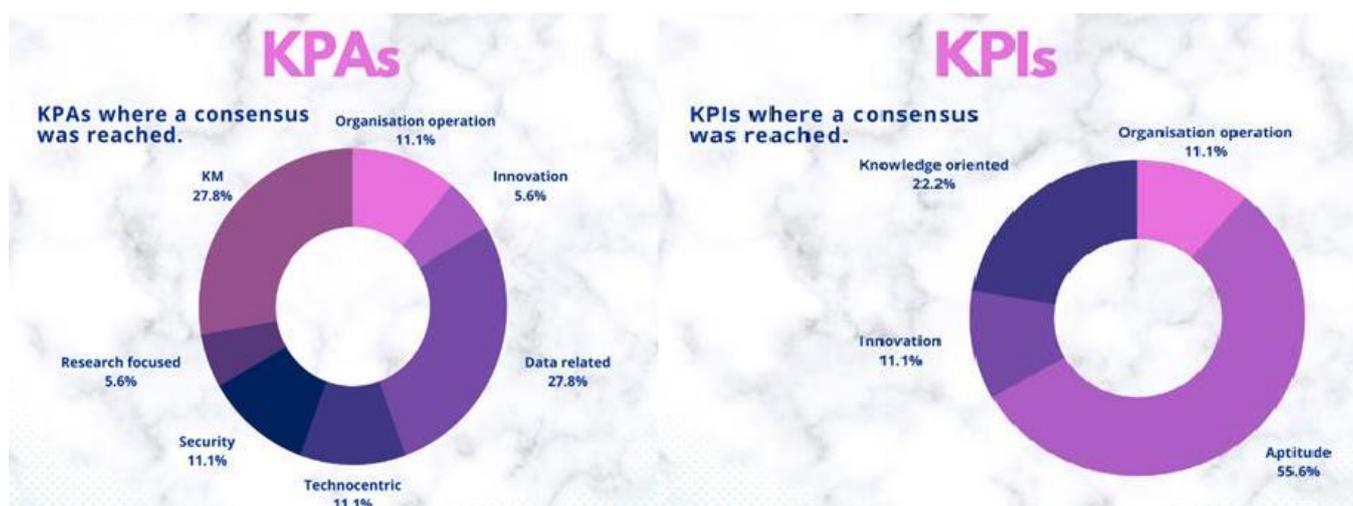
(Haddaway 2018). With the respondents working in teams daily, it is clear why there was an agreement for this KPI.

Workers need to develop trust for work teams to succeed (Morel 2014). Adding to that, no organisation can be successful working alone. Therefore, partnerships need to be created. However, partnerships will not work when there is no trust between partners. This could be trusting each other to be transparent and commit to shared goals (Pomponi, Fracocchi & Tafuri 2015). This description illustrates the need for organisations and individuals to be trustworthy, which can be fostered through having trust as a KPI. This definition clarifies why five (71.4%) respondents viewed the KPI "trust" as very useful and two (28.6%) as useful.

Four (57.1%) respondents viewed the KPI "leadership" as useful, and three (42.9%) as very useful. This result can be credited to the fact that leadership plays a critical role in the well-being of any organisation. Should there be a lack of effective leadership, an organisation's growth will be stunted (Nagan & Manausa 2020). Furthermore, without good leadership, organisations could suffer irreparable damages (Papadimos et al. 2020).

Five (71.4%) respondents viewed the KPI "communication" as very useful and two (28.6%) as useful. This result is due to oral and written communication being essential for business excellence (Lin, Krishnan & Grace 2014). Without effective communication, knowledge cannot be shared adequately within and across the organisation. IKM practitioners, like all other practitioners in the organisation, need to possess soft skills.

The results provided should be received as a prescription for organisational success. The identified KPAs and KPIs will assist organisations in ensuring they attain success in the 4IR. It is one thing to plan, execution, however, requires precision, and that is the real value of establishing KPAs and KPIs, as they are measurements of how well a plan is executed. The KPAs and KPIs provided can be received as a foundation to be built on. Remember, KPI development should be done in collaboration with stakeholders (Zarzycka & Krasodomska 2021). Senior team members should develop a list of KPIs and get input from other team members to finalise and choose the adequate KPIs, which will assist with securing buy-in and improving KPI quality (Dougall & Mmola 2015). Therefore, organisations should present the identified KPIs to their IKM teams before finalising their KPI list. It is possible that an organisation's KPAs and KPIs need updating. This study can act as a guide for that process. It is critical to build on this research to determine the KPAs and KPIs already in place within organisations to establish whether they align with what the experts identify as essential for success in the 4IR. Additionally, to determine whether they help the organisation achieve optimum success. Furthermore, to determine if they need updating.



**Figures 3 and 4: Summary of results of KPAs and KPIs where a consensus was reached (Authors' compilation).**

The results presented in figures 3 and 4 show that respondents mostly agreed with each other's perceptions of KM and data related KPAs, and KPIs focusing on aptitude. It was interesting that although some respondents strongly agreed and agreed with KPAs from the digital requirements category, a consensus was not reached on any of them. The same was true for data-related and easily measurable KPIs. The implication is that although individuals increasingly realise the key competence and skill attributes in the 4IR, there is still much work needed to gain global consensus. This implies that research work still in its nascent stage needs to include more contextual setups to delve toward a universal recognition of the 4IR KPAs and KPIs.

## 6 Conclusion

The main finding was that 54 KPAs and 33 KPIs were identified as critical success factors for the 4IR era. However, a consensus was reached on 18 KPAs and 9 KPIs, given that the experts included in this study are drawn from different backgrounds and therefore, did not view all KPAs and KPIs as completely necessary. A Delphi study was used to ascertain

which KPAs and KPIs are essential for IKM practitioners in the 4IR. It was essential to determine the KPAs and KPIs as they provide critical metrics required to measure organisational performance, guiding successful business operations. The key limitation in this study is that these results cannot be deemed globally representative of a mutually exhaustive list of KPAs and KPIs because they were only captured from the South African context. A recommendation for future studies is to conduct the same research on a larger scale. An additional recommendation is more studies in contextually different environments to develop global models of KPAs/KPIs depicting complete lists of skills and competencies required in the 4IR age. Furthermore, due to KPAs and KPIs requiring collaboration, another recommendation is for organisations to build on what has been identified in this study by involving stakeholders.

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