**South African Journal of Information Management**
ISSN: (Online) 1560-683X, (Print) 2078-1865



# Nominal ranking technique in information and knowledge management: A methodology to SoTL

**Authors:**
Lucian T. de Koker[1]
Tanya du Plessis[1]

**Affiliations:**
[1]Department of Information and Knowledge Management, College of Business and Economics, University of Johannesburg, Johannesburg, South Africa

**Corresponding author:**
Lucian de Koker,
luciand@uj.ac.za

**Dates:**
Received: 24 Nov. 2023
Accepted: 28 May 2024
Published: 25 July 2024

**How to cite this article:**
De Koker, L.T. & Du Plessis, T., 2024, 'Nominal ranking technique in information and knowledge management: A methodology to SoTL', *South African Journal of Information Management* 26(1), a1806. https://doi.org/10.4102/sajim.v26i1.1806





**Background:** The scholarship of teaching and learning (SoTL) makes provision for methodology contributions across disciplines. The information and knowledge management (IKM) discipline prepares students to function optimally in the Fourth Industrial Revolution (4IR). To keep abreast with continuous and agile change in the 4IR, a new contribution is made to the SoTL in the form of a nominal ranking technique (NRT) methodology in the IKM discipline.

**Objectives:** To develop the NRT methodology for constructing IKM heat maps of the 4IR elements and criteria relating to strategic information management (SIM) business case studies (BCSs). By sharing the NRT methodology, this paper aims to make a SoTL contribution in IKM.

**Method:** Using the qualitative research approach, content analysis was used to analyse 101 BCSs of SIM students. By employing critical case sampling and the NRT methodology, the top BCSs were identified for inclusion in constructing the IKM heat maps.

**Results:** Four BCS categories, unique, novice, duplicate, and duplicate-novice, were determined by applying the NRT methodology, with 5 elements and 25 criteria in constructing the IKM heat maps.

**Conclusion:** The NRT methodology serves as a guideline for constructing IKM heat maps, a unique contribution to the SoTL in the IKM discipline. Each application of the NRT methodology will be unique and beneficial.

**Contribution:** In this study, the value relates how the IKM discipline prepares SIM students to function optimally in the 4IR, evidenced by the four categories of BCSs.

**Keywords:** scholarship of teaching and learning; SoTL; nominal ranking technique; heat maps; information and knowledge management; business case studies.

## Introduction

The scholarship of teaching and learning (SoTL) draws expertise from multiple disciplines and shares common elements. Typical SoTL elements include a research question that relates to teachers or teaching and/or learners or learning in any discipline, literature review, systematic inquiry, evidence, reflective discussion, and conclusion. The research question addressed by this paper reflects on the nominal ranking technique (NRT) as a methodology for constructing information and knowledge management (IKM) heat maps. In this paper, the heat maps relate students' business case studies (BCSs) in preparation for the Fourth Industrial Revolution (4IR).

The structure of this paper begins with an introduction to establish the research question in the context of SoTL. The literature review focusses on the IKM framework relevant to the 4IR, followed by the research methodology for systematic inquiry. The focus of the systematic inquiry is to demonstrate the steps in the development and application of the NRT methodology, which is the new contribution. Evidence of the new contribution is found in the reflective discussion of the NRT results. The paper concludes with the NRT methodology as a unique contribution to the SoTL.

### Scholarship of teaching and learning in the information and knowledge management discipline

Scholarship of teaching and learning is defined by Potter and Kustra (2011) as:

> [*T*]he systematic study of teaching and learning, using established or validated criteria of scholarship, to understand how teaching (beliefs, behaviours, attitudes, and values) can maximize learning, and/or develop a more accurate understanding of learning, resulting in products that are publicly shared for critique and use by an appropriate community. (p. 2)

Kanuka (2011:2) explains further that the 'greatest value of SoTL is the contributions researchers make to teaching and learning that is deeply embedded in the disciplines'. In the case of this research, the discipline is IKM, and the application is NRT.

By sharing the NRT methodology, this paper aims to make a SoTL contribution in IKM. The objective is to develop the NRT methodology for constructing IKM heat maps of the 4IR elements and criteria relating to strategic information management (SIM) BCSs. Similar studies have not yet been conducted in the IKM discipline, with some studies marginally reflecting on IKM frameworks such as knowledge sharing and literacies for the 21st century (Cambridge 2007), knowledge dissemination process (Dobbins 2008), case study critical analysis (Sams & Sams 2011), and the Nominal Focus Group (Varga-Atkins, McIsaac and Willis 2015).

Varga-Atkins et al. (2015:287) demonstrated that 'the two-staged Nominal Focus Group brought the benefits of both Focus Group and the Nominal Group Techniques (NGT)'. In the same vein of nominal techniques as demonstrated by Varga-Atkins et al. (2015), this paper represents the voices of students documented in their own BCSs. The BCSs relate students' learning and application of SIM toolkits in preparation for the 4IR.

The literature review in the next section focusses on the IKM framework relevant to the 4IR.

### The fourth industrial revolution and the information and knowledge management framework

Current 4IR technologies such as Generative Artificial Intelligence (AI) and robotics are forcing businesses to develop new and innovative frameworks (Anshari & Hamdan 2022; Sabzalieva & Valentini 2023). As such, revised methodologies are required to fast-track the development of business frameworks. Specifically in terms of IKM frameworks, the 4IR offers many opportunities and challenges for businesses. Recently, Van der Poll (2022) developed a 4IR formal method framework, Xu, He and Jiang (2022) developed a novel framework of knowledge transfer, and Khumalo (2023) developed a SIM signification framework. Also, De Koker (2019:107) developed an IKM framework for KM consulting firms in the 4IR.

To stay competitive in the 4IR, businesses need to adapt to an agile manner of conducting business. The emergence of the 4IR has shown that businesses must invest in educating themselves on how to transform and remain competitive in the 4IR by acquiring IKM skills such as business intelligence and competitive intelligence (Hussin, Hashim & Yu 2018; Quain 2018; Saratoga 2018; Mubuyaeta & Ngulube 2023). Information and knowledge management is defined as the simultaneous management of numerous processes associated with both information (information management) and knowledge (knowledge management), to generate and contribute to the overall competitiveness of an organisation (De Koker 2019:xiii). Also, De Koker and Du Plessis (2020:1) recognised that an IKM framework for business is required to improve the viability of success in the 4IR. The IKM framework developed by De Koker and Du Plessis (2020) lists five pillars required for a successful business:

- Commercialisation life cycle.
- Business model canvas.
- Digital business transformation.
- Fourth industrial revolution.
- Strategic information management.

This brief literature review presents a broad overview of the IKM framework in the 4IR, illustrating that IKM is crucial to successfully conduct business in the 4IR. The next section describes the research methodology. It must be noted that this paper presents a section of a much larger study. This paper's redacted research methodology aims to describe the NRT methodology applied to categorise SIM students' BCSs and develop IKM heat maps.

## Research methodology

The research philosophy for the study was interpretivism and designed based on qualitative inquiry guidelines by Saunders, Lewis and Thornhill (2009), and Creswell (2013). The methodological choices for case sampling, data collection and analysis followed the NRT as described by McMillan, King and Tully (2016). Nominal ranking technique is also referred to as NGT, which was originally developed in the late 1960s by Delbecq and Van de Ven (1971). Using the qualitative research approach, content analysis allowed for the analysis of 101 BCSs. By employing critical case sampling and the NRT methodology, the top BCSs were selected, which provided the basis for constructing IKM heat maps. As mentioned previously, this paper aims to make a SoTL contribution to the IKM discipline; therefore, this section of the paper centres around IKM heat maps, whereas the original study also had the Data Analysis Spiral (De Koker 2019).

For this paper, the NRT methodology is central in the construction of IKM heat maps. Heat maps will indicate the 4IR elements featured in students' BCSs as a representation of their voices in a type of documented learning. In this manner, this paper shows how the NRT methodology that was developed and applied makes a new SoTL contribution to the IKM discipline. As such, the purposive sampling technique was applied together with critical case sampling. The selection of BCSs was based on 5 IKM elements and 25 criteria used under the NRT, which was used to rank the BCSs based on the relevance of the BCSs. The 25 criteria were linked to the IKM framework from the literature review, and specifically the 5 pillars identified by De Koker and Du Plessis (2020).

This approach was chosen so that the study would satisfy the requirements of systematic inquiry (Saunders et al. 2009:240).

The following section presents the NRT methodology developed for this study, applied to the IKM discipline, specifically the SIM BCSs database of a South African higher education institution (HEI).

# Nominal ranking technique methodology

As mentioned previously, the NRT is also referred to as the NGT. Nominal group technique was originally developed by Delbecq and Van de Ven (1971), 'as a procedure to facilitate effective group decision-making'. It is useful for identifying strategic problems and develop appropriate and innovative programmes to solve strategic problems (Hugé & Mukherjee 2018:33–34). Nominal group technique is primarily a structured face-to-face group interaction (McMillan et al. 2014, 2016:656). For this study, the principles of NGT were adapted to develop the NRT methodology for the analysis of BCSs. Content analysis, as the appropriate data collection technique, was applied to analyse documents, which were 101 BCSs, with appropriate ethical consideration.

## Nominal ranking technique methodology steps

These three steps and tables are from the study conducted by De Koker (2019).

### Step 1: Clean-up of strategic information management business case studies database

The first step entailed scrutinising the content in the 101 BCSs to determine the uniqueness of the document. The following filters and colour codes were applied:

- A BCS was considered *Unique* if it was the only complete BCS in the database. Unique BCSs were colour coded *Green*.
- A BCS was considered *Novice* if the BCS was incomplete. Novice BCSs were colour coded *Orange*.
- A BCS was determined to be a *Duplicate* if one or more BCSs existed in the database with the same content. Duplicate BCSs were colour coded *Red*.
- A BCS was determined to be a *Duplicate-Novice*, if one or more BCSs existed in the database with the same content and if the BCS was not complete. Duplicate-Novice BCSs were colour coded *Yellow* (De Koker 2019).

Table 1 shows how the database was scrutinised using the filter and colour codes to determine the category in which the 101 BCSs in the database belonged (De Koker 2019). The 101 BCSs belong to the SIM BCSs database of a South African HEI, with specific file names. File names were kept unchanged in the SIM BCSs database. Table 1 indicates the file names as found in the SIM BCSs database.

Table 2 illustrates the discovery made in the BCSs database and how the BCSs were categorised through **Step 1** during the filter and colour coding process (De Koker 2019). It was found that:

- Sixty-two BCSs exist in the database as *Unique*, as only 62 complete BCSs existed in the database.
- Eleven BCSs exist in the database as *Novice*, as 11 of the 101 BCSs were not complete.
- Twenty-seven BCSs exist in the database as *Duplicate*, as 27 BCSs were found to share the same content with one or more BCSs.
- One BCS exists in the database as *Duplicate-Novice*, as that one BCS shared the same content as another BCS and it was not complete (De Koker 2019).

As seen in Table 2, the first step followed a rigorous approach to determine the category in which a BCS belonged. Once the categorisation was complete, Step 2 in the process commenced (De Koker 2019).

### Step 2: Categorisation of business case studies in different folders

During this step, separate folders were created for the different categories in the database (De Koker 2019). This was done to separate the BCSs according to their categories. The Unique, Novice, Duplicate and Duplicate-Novice BCSs were moved to separate folders under the categories where each BCS belonged. Determining the categories in Step 1 and separation in Step 2, were crucial to make sure only unique BCSs were focussed on, to be used in the next step of the process. The 62 unique BCSs were assigned new numbers; for example, from Table 1, the BCS_2016_1 was number 100, whereas in the unique BCS folder, it was number 62, denoting the quantity of BCSs. In other words, the NRT methodology facilitates filtering and ranking of content as demonstrated in Table 4, Table 5, Figure 1, Figure 2 and Figure 3. With these first two steps complete, the process moved on to Step 3 (De Koker 2019).

### Step 3: Nominal ranking technique

The final step, Step 3, is the process of ranking or determining the importance of a BCS. Nominal ranking technique was used to filter through the 62 unique BCSs (De Koker 2019). This was used to determine if any of the 62 unique BCSs contained or illustrated that they contained specific IKM framework elements and criteria as outlined in Table 3 and described further hereinafter.

Table 3 illustrates the 5 IKM elements and 25 criteria. The NRT process allows for the researcher to determine through these elements and criteria, which BCS contains all or part of the elements and criteria. Business case studies are ranked, according to how many of the IKM framework elements and criteria each BCS contains (De Koker 2019).

## Information and knowledge management framework elements and criteria

The IKM framework, as structured by De Koker (2019) on 5 IKM elements and 25 criteria, is briefly discussed here:

- *Element 1: Components of the commercialisation lifecycle (CLC)* include any of the stages in the generic CLC, namely, (1) Idea Generation, (2) Concept Development/Testing, (3) Analysis,

**TABLE 1:** Business case studies database and categories.

| Number | File name | Category |
|---|---|---|
| 1 | BCS_1 | Unique |
| 2 | BCS_2 | Unique |
| 3 | BCS_3 | Unique |
| 4 | BCS_4 | Novice |
| 5 | BCS_5 | Novice |
| 6 | BCS_6 | Unique |
| 7 | BCS_7 | Unique |
| 8 | BCS_8 | Unique |
| 9 | BCS_9 | Unique |
| 10 | BCS_10 | Unique |
| 11 | BCS_11 | Duplicate |
| 12 | BCS_12 | Unique |
| 13 | BCS_13 | Novice |
| 14 | BCS_14 | Unique |
| 15 | BCS_15 | Unique |
| 16 | BCS_16 | Unique |
| 17 | BCS_17 | Duplicate |
| 18 | BCS_18 | Unique |
| 19 | BCS_19 | Unique |
| 20 | BCS_20 | Unique |
| 21 | BCS_21 | Unique |
| 22 | BCS_22 | Unique |
| 23 | BCS_23 | Duplicate |
| 24 | BCS_24 | Unique |
| 25 | BCS_25 | Unique |
| 26 | BCS_26 | Duplicate |
| 27 | BCS_27 | Novice |
| 28 | BCS_28 | Unique |
| 29 | BCS_29 | Unique |
| 30 | BCS_30 | Unique |
| 31 | BCS_31 | Unique |
| 32 | BCS_32 | Duplicate |
| 33 | BCS_33 | Unique |
| 34 | BCS_34 | Unique |
| 35 | BCS_35 | Duplicate |
| 36 | BCS_36 | Unique |
| 37 | BCS_37 | Unique |
| 38 | BCS_38 | Unique |
| 39 | BCS_39 | Duplicate-novice |
| 40 | BCS_40_1 | Unique |
| 41 | BCS_40_2 | Novice |
| 42 | BCS_41 | Unique |
| 43 | BCS_42 | Unique |
| 44 | BCS_43 | Unique |
| 45 | BCS_44 | Unique |
| 46 | BCS_45 | Unique |
| 47 | BCS_46 | Unique |
| 48 | BCS_47 | Unique |
| 49 | BCS_48 | Unique |
| 50 | BCS_49 | Unique |
| 51 | BCS_50 | Duplicate |
| 52 | BCS_55 | Unique |
| 53 | BCS_66 | Unique |
| 54 | BCS_67 | Unique |
| 55 | BCS_68 | Unique |
| 56 | BCS_69 | Unique |
| 57 | BCS_70 | Unique |
| 58 | BCS_72 | Duplicate |
| 59 | BCS_73 | Duplicate |
| 60 | BCS_74 | Duplicate |

Table 1 continues on the next column →

**TABLE 1 (Continues...):** Business case studies database and categories.

| Number | File name | Category |
|---|---|---|
| 61 | BCS_77 | Duplicate |
| 62 | BCS_78 | Duplicate |
| 63 | BCS_79 | Duplicate |
| 64 | BCS_80 | Unique |
| 65 | BCS_81 | Unique |
| 66 | BCS_82 | Unique |
| 67 | BCS_83 | Unique |
| 68 | BCS_84 | Unique |
| 69 | BCS_85 | Duplicate |
| 70 | BCS_86 | Duplicate |
| 71 | BCS_87 | Duplicate |
| 72 | BCS_88 | Duplicate |
| 73 | BCS_89 | Novice |
| 74 | BCS_90 | Novice |
| 75 | BCS_91 | Novice |
| 76 | BCS_92 | Novice |
| 77 | BCS_93 | Duplicate |
| 78 | BCS_94 | Duplicate |
| 79 | BCS_95 | Novice |
| 80 | BCS_96 | Duplicate |
| 81 | BCS_98 | Duplicate |
| 82 | BCS_111 | Unique |
| 83 | BCS_112 | Unique |
| 84 | BCS_113 | Unique |
| 85 | BCS_114 | Duplicate |
| 86 | BCS_115 | Duplicate |
| 87 | BCS_118 | Duplicate |
| 88 | BCS_119 | Duplicate |
| 89 | BCS_120 | Duplicate |
| 90 | BCS_121 | Unique |
| 91 | BCS_122 | Unique |
| 92 | BCS_123 | Duplicate |
| 93 | BCS_124 | Unique |
| 94 | BCS_125 | Unique |
| 95 | BCS_126 | Unique |
| 96 | BCS_127 | Unique |
| 97 | BCS_128 | Unique |
| 98 | BCS_129 | Unique |
| 99 | BCS_2014 | Unique |
| 100 | BCS_2016_1 | Unique |
| 101 | BCS_2016_2 | Novice |

*Source*: De Koker, L.T., 2019, 'The commercialisation lifecycle of a knowledge management consulting firm in the fourth industrial revolution', Master's dissertation, University of Johannesburg

BCS, business case studies.

**TABLE 2:** Total business case studies after filter and colour code completion.

| Category | Total |
|---|---|
| Unique | 62 |
| Novice | 11 |
| Duplicate | 27 |
| Duplicate-Novice | 1 |
| **Total BCS** | **101** |

*Source*: De Koker, L.T., 2019, 'The commercialisation lifecycle of a knowledge management consulting firm in the fourth industrial revolution', Master's dissertation, University of Johannesburg

BCS, business case studies.

(4) Product Development and Market Testing, and (5) Commercialisation (De Koker 2019).

*Commercialisation lifecycle:* According to McCoy (2007:8), commercialisation is 'the process of developing a product from

**TABLE 3:** Five information and knowledge management elements and 25 criteria.

| IKM elements | #Criterion |
|---|---|
| **Element 1: Components of the CLC** | |
| Criteria | |
| 1. Idea generation | 1 |
| 2. Concept development testing | 2 |
| 3. Analysis | 3 |
| 4. Product development and market testing | 4 |
| 5. Commercialisation | 5 |
| **Element 2: Components of the BMC** | |
| Criteria | |
| 1. Customer segments | 6 |
| 2. Value propositions | 7 |
| 3. Channels | 8 |
| 4. Customer relationships | 9 |
| 5. Revenue streams | 10 |
| 6. Key resources | 11 |
| 7. Key activities | 12 |
| 8. Key partners | 13 |
| 9. Cost structure | 14 |
| **Element 3: Features of DBT** | |
| Criteria | |
| 1. Innovation is key to the organisation | 15 |
| 2. Big data are embedded in the organisation | 16 |
| 3. Business process automation in the organisation | 17 |
| 4. Information security is key in the organisation | 18 |
| **Element 4: Features of the 4IR** | |
| Criteria | |
| 1. Artificial intelligence is a key consideration for the organisation in the 4IR | 19 |
| 2. The Internet of Things is a key consideration for the organisation in the 4IR | 20 |
| 3. Robotics are considered as present or future business importance | 21 |
| **Element 5: SIM principles** | |
| Criteria | |
| 1. Information is a key asset to the organisation | 22 |
| 2. Information is integrated in the overall strategy of the organisation | 23 |
| 3. Information is managed strategically in the organisation | 24 |
| 4. Information is crucial to the success of the organisation | 25 |

*Source*: De Koker, L.T., 2019, 'The commercialisation lifecycle of a knowledge management consulting firm in the fourth industrial revolution', Master's dissertation, University of Johannesburg

SIM, strategic information management; 4IR, fourth industrial revolution; DBT, digital business transformation; BMC, business model canvas; CLC, commercialisation lifecycle; IKM, information and knowledge management.

concept, through feasibility and implementation, to its successful introduction into a given market' while Heffernan (2010) explains that:

> [*I*]n business life, the innovation has to be turned into a product. The process of turning an idea or an innovation into a product is productization (De Koker 2019). The product or service can then be commercialised. (p. 20)

Researchers view commercialisation as a process, with new innovation being introduced into the market. New innovation can be a product or a service (Bers et al. 2008; Razak, Murray & Roberts 2014; Cannatelli et al. 2017; Khumalo & du Plessis 2017:198, 2024:2).

- *Element 2: Components of the BMC* include the nine building blocks, namely, (1) Customer Segments, (2) Value Propositions, (3) Channels, (4) Customer Relationships, (5) Revenue Streams, (6) Key Resources, (7) Key Activities, (8) Key Partners, and (9) Cost Structure (De Koker 2019).

  *Business Model Canvas:* BMC is 'a shared language for describing, visualizing, assessing, and changing business models' (Osterwalder & Pigneur 2010:13). The BMC gives context on how a business 'creates, delivers, and captures value' (Osterwalder & Pigneur 2010:13; Ojasalo & Ojasalo 2018:72).

- *Element 3: Features of Digital Business Transformation (DBT)* include any features of digital business transformation, namely, (1) Innovation is key to the organisation, (2) Big Data are embedded in the organisation, (3) Business process automation in the organisation, and (4) Information security is key in the organisation (De Koker 2019).

  *Digital Business Transformation:* The use of new technologies for the development of new business models, new business processes, new workflows, new technologies, new software, new systems and new services, leading to the improvement of business operations and efficiency, further resulting in greater profit generation for the business, can be defined as digital business transformation (Schwertner 2017:388).

- *Element 4: Features of the 4IR* include any features of the 4IR, namely, (1) Artificial intelligence is a key consideration for the organisation in the 4IR, (2) The Internet of Things (IoT) is a key consideration for the organisation in the 4IR, and (3) Robotics are considered as present or future business importance (De Koker 2019).

  *Fourth Industrial Revolution* is continuing to change everything (Schwab 2018). The 4IR is characterised by a wide variety of new technologies, with impacts on all disciplines (Mhlanga & Ndhlovu 2023:2).

- *Element 5: SIM principles* include any of the following SIM principles, namely, (1) Information is a key asset to the organisation, (2) Information is integrated in the overall strategy of the organisation, (3) Information is managed strategically in the organisation, and (4) Information is crucial to the success of the organisation (De Koker 2019).

  *Strategic information management* is defined as a situation in which:

  > [*I*]nformation and related resources […] are used or utilized by an organization (profit or non-profit) to support, implement or achieve strategic position in order to gain competitive advantage/strategic advantage. (Hussin et al. 2018:292)

Constructing the IKM heat maps meant that a certain process had to be followed. This study applied the NRT methodology as follows: each BCS was opened from the folder in the database named Unique (De Koker 2019). Each BCS was studied and analysed individually against the 5 IKM elements and 25 criteria. If a BCS illustrated that it contained only some elements of the NRT criteria in the 5 IKM elements as stated above, the BCS would then be ranked out of 5. The calculation process to determine the rank of the 62 unique BCSs was as follows:

→ If a BCS illustrates at least one criterion from each of the five IKM elements, the BCS will rank 5.
→ If a BCS illustrates at least one criterion from four of the five IKM elements, the BCS will rank 4.
→ If a BCS illustrates at least one criterion from three of the five IKM elements, the BCS will rank 3.
→ If a BCS illustrates at least one criterion from two of the five IKM elements, the BCS will rank 2.
(De Koker 2019)

Business case studies could rank the highest 5, or the lowest 2. All 62 unique BCSs were found to contain at least 1 criterion from 2 of the 5 IKM elements; therefore, the lowest rank is 2; however, this does not mean that all 62 unique BCSs ranked 2 (De Koker 2019). The evidence of systematic inquiry is discussed in the results and discussion section.

### Ethical considerations

Ethical approval was obtained from the Faculty of Management Faculty Ethics Committee, University of Johannesburg in 2016. Reference number: FOM2016-IKMNov2016_4. The BCSs were anonymised and stored on an external hard drive. The researcher assigned a generic database name in accordance with the conditions outlined by the higher education institution (HEI) database administrator. The content analysis conducted on the 101 BCSs followed a specific process. The process consisted of three steps, with NRT discussed in Step 3.

## Results and discussion

From Step 1, outlined above, four BCS categories were determined, namely, Unique, Novice, Duplicate, and Duplicate-Novice (De Koker 2019). The 5 IKM elements and 25 criteria were crucial for the NRT process to determine the relevance of the 62 unique BCSs in terms of how each BCS ranked. From the 62 unique BCSs, it was found that 8 BCSs ranked 5, 10 BCSs ranked 4, 31 BCSs ranked 3, and 13 BCSs ranked 2 (De Koker 2019).

Table 4 illustrates the NRT as it was applied by this study. The outcome of the calculation process, explained above, appears in the last column of Table 4.

From the 62 unique BCSs, it was found that 8 BCSs ranked 5, 10 ranked 4, 31 ranked 3, and 13 ranked 2.

### Top eight business case studies

A separate folder in the SIM BCS database was created (De Koker 2019). The top eight BCSs were moved from the Unique folder to the new folder named *Top 8_Based on NRT*. There were eight BCSs that ranked the highest with a score of 5, as can be seen in Table 5.

### Heat map of top eight business case studies

The top eight BCSs were scrutinised by means of a heat map as part of the NRT methodology (De Koker 2019). This resulted in the determination of 4 BCSs, as the final top BCSs from the 101 BCSs. To determine the top four BCSs, a heat map was designed making use of Microsoft Excel. The heat map makes use of different colours. The red colour in the heat map shows the highest value and the green colour shows the lowest value. The heat map values are located across a row for each of the eight BCSs.

The heat map consists of various sections, namely, the number for each BCS and the name of the top eight BCSs. Under the IKM elements section, the 5 IKM elements and 25 criteria are found. A final column named TOTAL is found on the far-right end of the Table, indicating the total value a BCS received. The high ranking BCSs of the TOTAL determined the top four BCSs. These top four BCSs are highlighted in red (De Koker 2019).

Each BCS received points based on what was found in the BCS, which was determined by the 5 IKM elements and 25 criteria (De Koker 2019):

> IKM element 1 contains a set of five criteria.
>
> IKM element 2 contains a set of nine criteria.
>
> IKM element 3 contains a set of four criteria.
>
> IKM element 4 contains a set of three criteria.
>
> IKM element 5 contains a set of four criteria.
>
> In sum, this made up the total of 25 criteria.

In each of the eight BCSs, it was checked to determine if each criterion in each of the five IKM elements was present in the BCS (De Koker 2019). Each BCS contained the four criteria of IKM element 5. Each BCS, therefore receiving four points for IKM element 5. The heat map is presented in Figure 1.

To determine the TOTAL value of each of the top four BCSs, each of the eight BCSs were opened from the SIM BCS database, from the folder in the database named *Top 8_Based on NRT*. Once opened, each BCS was studied and analysed individually against the 5 IKM elements and the 25 criteria. For each BCS, different results were found (De Koker 2019).

BCS_7

> *Element 1: Components of the CLC* contained three of the criteria: (1) Idea Generation, (2) Product Development & Market Testing, and (3) Commercialisation.
>
> *Element 2: Components of the BMC* contained three of the criteria: (1) Value propositions, (2) Key Activities, and (3) Key Partners.
>
> *Element 3: Features of DBT* contained two of the criteria: (1) Innovation is key to the organisation, and (2) Business process automation in the organisation.
>
> *Element 4: Features of the 4IR* contained one of the criteria: Robotics are considered as present or future business importance.
>
> *Element 5: SIM principles* contained all four of the criteria. The four criteria were: (1) Information is a key asset to the organisation, (2) Information is integrated in the overall strategy of the organisation, (3) Information is managed strategically in the organisation, and (4) Information is crucial to the success of the organisation.

When calculating the various criteria BCS 7 had, the total received was 13 (De Koker 2019).

**TABLE 4:** Nominal ranking technique on unique business case studies.

| Nominal ranking technique | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Number** | **Unique business case studies** | **IKM elements** | | | | | **Rank** |
| | | **Element 1** | **Element 2** | **Element 3** | **Element 4** | **Element 5** | |
| | | **Components of the CLC** | **Components of the BMC** | **Features of digital DBT** | **Features of the 4IR** | **SIM principles** | |
| 1 | BCS_1 | - | - | □ | - | □ | 2 |
| 2 | BCS_2 | - | - | □ | - | □ | 2 |
| 3 | BCS_3 | □ | - | □ | □ | □ | 4 |
| 4 | BCS_6 | - | □ | □ | - | □ | 3 |
| 5 | BCS_7 | □ | □ | □ | □ | □ | 5 |
| 6 | BCS_8 | - | □ | □ | - | □ | 3 |
| 7 | BCS_9 | - | - | □ | - | □ | 2 |
| 8 | BCS_10 | □ | □ | □ | □ | □ | 5 |
| 9 | BCS_12 | - | - | □ | - | □ | 2 |
| 10 | BCS_14 | - | - | □ | □ | □ | 3 |
| 11 | BCS_15 | - | - | □ | □ | □ | 3 |
| 12 | BCS_16 | - | - | □ | □ | □ | 3 |
| 13 | BCS_18 | - | □ | □ | - | □ | 3 |
| 14 | BCS_19 | - | □ | □ | □ | □ | 4 |
| 15 | BCS_20 | - | □ | □ | - | □ | 3 |
| 16 | BCS_21 | - | □ | □ | - | □ | 3 |
| 17 | BCS_22 | - | □ | □ | - | □ | 3 |
| 18 | BCS_24 | - | - | □ | - | □ | 2 |
| 19 | BCS_25 | - | - | □ | - | □ | 2 |
| 20 | BCS_28 | - | - | □ | - | □ | 2 |
| 21 | BCS_29 | - | □ | □ | - | □ | 3 |
| 22 | BCS_30 | - | - | □ | - | □ | 2 |
| 23 | BCS_31 | - | □ | □ | - | □ | 3 |
| 24 | BCS_33 | - | □ | □ | - | □ | 3 |
| 25 | BCS_34 | - | □ | □ | - | □ | 3 |
| 26 | BCS_36 | - | □ | □ | - | □ | 3 |
| 27 | BCS_37 | - | □ | □ | - | □ | 3 |
| 28 | BCS_38 | - | □ | □ | - | □ | 3 |
| 29 | BCS_40_1 | - | □ | □ | - | □ | 3 |
| 30 | BCS_41 | - | □ | □ | - | □ | 3 |
| 31 | BCS_42 | - | □ | □ | - | □ | 3 |
| 32 | BCS_43 | - | □ | □ | - | □ | 3 |
| 33 | BCS_44 | - | □ | □ | - | □ | 3 |
| 34 | BCS_45 | □ | □ | □ | □ | □ | 5 |
| 35 | BCS_46 | - | □ | □ | - | □ | 3 |
| 36 | BCS_47 | - | □ | □ | - | □ | 3 |
| 37 | BCS_48 | - | - | □ | - | □ | 2 |
| 38 | BCS_49 | - | □ | □ | - | □ | 3 |
| 39 | BCS_55 | □ | □ | □ | □ | □ | 5 |
| 40 | BCS_66 | □ | □ | □ | □ | □ | 5 |
| 41 | BCS_67 | □ | □ | □ | - | □ | 4 |
| 42 | BCS_68 | □ | □ | □ | - | □ | 4 |
| 43 | BCS_69 | - | □ | □ | - | □ | 3 |
| 44 | BCS_70 | □ | □ | □ | - | □ | 4 |
| 45 | BCS_80 | - | □ | □ | - | □ | 3 |
| 46 | BCS_81 | - | - | □ | - | □ | 2 |
| 47 | BCS_82 | - | - | □ | - | □ | 2 |
| 48 | BCS_83 | - | □ | □ | - | □ | 3 |
| 49 | BCS_84 | - | - | □ | - | □ | 2 |
| 50 | BCS_111 | - | □ | □ | - | □ | 3 |
| 51 | BCS_112 | - | - | □ | - | □ | 2 |
| 52 | BCS_113 | □ | □ | □ | - | □ | 4 |
| 53 | BCS_121 | - | □ | □ | - | □ | 3 |
| 54 | BCS_122 | □ | □ | □ | - | □ | 4 |
| 55 | BCS_124 | □ | □ | □ | - | □ | 4 |
| 56 | BCS_125 | □ | □ | □ | - | □ | 4 |
| 57 | BCS_126 | - | □ | □ | - | □ | 3 |
| 58 | BCS_127 | □ | □ | □ | □ | □ | 5 |

Table 4 continues on the next page →

**TABLE 4 (Continues...):** Nominal ranking technique on unique business case studies.

| Nominal ranking technique | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Number** | **Unique business case studies** | **IKM elements** | | | | | **Rank** |
| | | **Element 1** | **Element 2** | **Element 3** | **Element 4** | **Element 5** | |
| | | **Components of the CLC** | **Components of the BMC** | **Features of digital DBT** | **Features of the 4IR** | **SIM principles** | |
| 59 | BCS_128 | □ | □ | □ | □ | □ | 5 |
| 60 | BCS_129 | - | □ | □ | □ | □ | 4 |
| 61 | BCS_2014 | - | □ | □ | - | □ | 3 |
| 62 | BCS_2016_1 | □ | □ | □ | □ | □ | 5 |

*Source*: De Koker, L.T., 2019, 'The commercialisation lifecycle of a knowledge management consulting firm in the fourth industrial revolution', Master's dissertation, University of Johannesburg

IKM, information and knowledge management; BCSs, business case studies; CLC, commercialisation life cycle; BMC, business model canvas; DBT, digital business transformation; 4IR, fourth industrial revolution; SIM, Strategic information management.

**TABLE 5:** Top eight business case studies.

| Top eight BCSs | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Number** | **Unique business case studies** | **IKM elements** | | | | | **Rank** |
| | | **Element 1** | **Element 2** | **Element 3** | **Element 4** | **Element 5** | |
| | | **Components of the CLC** | **Components of the BMC** | **Features of DBT** | **Features of the 4IR** | **SIM principles** | |
| 1 | BCS_7 | □ | □ | □ | □ | □ | 5 |
| 2 | BCS_10 | □ | □ | □ | □ | □ | 5 |
| 3 | BCS_45 | □ | □ | □ | □ | □ | 5 |
| 4 | BCS_55 | □ | □ | □ | □ | □ | 5 |
| 5 | BCS_66 | □ | □ | □ | □ | □ | 5 |
| 6 | BCS_127 | □ | □ | □ | □ | □ | 5 |
| 7 | BCS_128 | □ | □ | □ | □ | □ | 5 |
| 8 | BCS_2016_1 | □ | □ | □ | □ | □ | 5 |

*Source*: De Koker, L.T., 2019, 'The commercialisation lifecycle of a knowledge management consulting firm in the fourth industrial revolution', Master's dissertation, University of Johannesburg

IKM, information and knowledge management; BCSs, business case studies; CLC, commercialisation life cycle; BMC, business model canvas; DBT, digital business transformation; 4IR, fourth industrial revolution; SIM, Strategic information management.

| Top 8 BCSs heat map | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Number** | **Top eight BCSs** | **IKM elements** | | | | | | | | | | | | | | | | | | | | | | | | | | **Total** |
| | | **Element 1: Components of the CLC** | | | | | **Element 2: Components of the BMC** | | | | | | | | | | **Element 3: Features of DBT** | | | | **Element 4: Features of the 4IR** | | | **Element 5: SIM principles** | | | | |
| | | **a. Idea generation** | **b. Concept development/testing** | **c. Analysis** | **d. Product development and market testing** | **e. Commercialisation** | **f. Customer segments** | **g. Value propositions** | **h. Channels** | **i. Customer relationships** | **j. Revenue streams** | **k. Key resources** | **l. Key activities** | **m. Key partners** | **n. Cost structure** | | **o. Innovation is key to the organisation** | **p. Big data are embedded in the organisation** | **q. Business process automation in the organisation** | **r. Information security is key in the organisation** | **s. Artificial intelligence is a key consideration for the organisation in the 4IR** | **t. The internet of things is a key consideration for the organisation in the 4IR** | **u. Robotics are considered as present or future business importance** | **v. Information is a key asset to the organisation** | **w. Information is integrated in the overall strategy of the organisation** | **x. Information is managed strategically in the organisation** | **y. Information is crucial to the success of the organisation** | |
| 1 | BCS_7 | 3 | | | | | 3 | | | | | | | | | | 2 | | | | 1 | | | 4 | | | | 13 |
| 2 | BCS_10 | 3 | | | | | 7 | | | | | | | | | | 3 | | | | 3 | | | 4 | | | | 20 |
| 3 | BCS_45 | 2 | | | | | 9 | | | | | | | | | | 1 | | | | 1 | | | 4 | | | | 17 |
| 4 | BCS_55 | 1 | | | | | 9 | | | | | | | | | | 2 | | | | 3 | | | 4 | | | | 19 |
| 5 | BCS_66 | 1 | | | | | 2 | | | | | | | | | | 2 | | | | 1 | | | 4 | | | | 10 |
| 6 | BCS_127 | 4 | | | | | 4 | | | | | | | | | | 3 | | | | 3 | | | 4 | | | | 18 |
| 7 | BCS_128 | 1 | | | | | 9 | | | | | | | | | | 2 | | | | 1 | | | 4 | | | | 17 |
| 8 | BCS_2016 1 | 3 | | | | | 4 | | | | | | | | | | 4 | | | | 3 | | | 4 | | | | 18 |

*Source*: De Koker, L.T., 2019, 'The commercialisation lifecycle of a knowledge management consulting firm in the fourth industrial revolution', Master's dissertation, University of Johannesburg

SIM, strategic information management; 4IR, fourth industrial revolution; DBT, digital business transformation; BMC, business model canvas; CLC, commercialisation lifecycle; BCSs, business case studies.

**FIGURE 1:** Top eight business case studies – heat map.

BCS_10

*Element 1: Components of the CLC* contained three of the criteria: (1) Idea Generation, (2) Concept Development/Testing, and (3) Analysis.

*Element 2: Components of the BMC* contained seven of the criteria: (1) Customer Segments, (2) Value Propositions, (3) Customer Relationships, (4) Revenue Streams, (5) Key Resources, (6) Key Activities, and (7) Key Partners.

*Element 3: Features of DBT* contained three of the criteria: (1) Innovation is key to the organisation, (2) Big Data are embedded in the organisation, and (3) Business process automation in the organisation.

*Element 4: Features of the 4IR* contained all three of the criteria: (1) Artificial intelligence is a key consideration for the organisation in the 4IR, (2) The Internet of Things is a key consideration for the organisation in the 4IR, and (3) Robotics are considered as present or future business importance.

*Element 5: SIM principles* contained all four of the criteria: (1) Information is a key asset to the organisation, (2) Information is integrated in the overall strategy of the organisation, (3) Information is managed strategically in the organisation, and (4) Information is crucial to the success of the organisation.

When calculating the various criteria BCS 10 had, the total received was 20 (De Koker 2019).

BCS_45

*Element 1: Components of the CLC* contained two of the criteria: (1) Idea Generation, and (2) Product Development & Market Testing.

*Element 2: Components of the BMC* contained all nine of the criteria: (1) Customer Segments, (2) Value Propositions, (3) Channels, (4) Customer Relationships, (5) Revenue Streams, (6) Key Resources, (7) Key Activities, (8) Key Partners, and (9) Cost Structure.

*Element 3: Features of DBT* contained one of the criteria: Innovation is key to the organisation.

*Element 4: Features of the 4IR* contained one of the criteria: The Internet of Things is a key consideration for the organisation in the 4IR.

*Element 5: SIM principles* contained all four of the criteria: (1) Information is a key asset to the organisation, (2) Information is integrated in the overall strategy of the organisation, (3) Information is managed strategically in the organisation, and (4) Information is crucial to the success of the organisation.

When calculating the various criteria BCS_45 had, the total received was 17 (De Koker 2019).

BCS_55

*Element 1: Components of the CLC* contained one of the criteria: Idea Generation.

*Element 2: Components of the BMC* contained all nine of the criteria: (1) Customer Segments, (2) Value Propositions, (3) Channels, (4) Customer Relationships, (5) Revenue Streams, (6) Key Resources, (7) Key Activities, (8) Key Partners, and (9) Cost Structure.

*Element 3: Features of DBT* contained two of the criteria: (1) Innovation is key to the organisation, and (2) Big Data are embedded in the organisation.

*Element 4: Features of the 4IR* contained all three of the criteria: (1) Artificial intelligence is a key consideration for the organisation in the 4IR, (2) The Internet of Things is a key consideration for the organisation in the 4IR, and (3) Robotics are considered as present or future business importance.

*Element 5: SIM principles* contained all four of the criteria: (1) Information is a key asset to the organisation, (2) Information is integrated in the overall strategy of the organisation, (3) Information is managed strategically in the organisation, and (4) Information is crucial to the success of the organisation.

When calculating the various criteria BCS_55 had, the total received was 19 (De Koker 2019).

BCS_66

*Element 1: Components of the CLC* contained one of the criteria: Idea Generation.

*Element 2: Components of the BMC* contained two of the criteria: (1) Value propositions, and (2) Customer Relationships.

*Element 3: Features of DBT* contained two of the criteria: (1) Innovation is key to the organisation, and (2) Business process automation in the organisation.

*Element 4: Features of the 4IR* contained one of the criteria: Robotics are considered as present or future business importance.

*Element 5: SIM principles* contained all four of the criteria: (1) Information is a key asset to the organisation, (2) Information is integrated in the overall strategy of the organisation, (3) Information is managed strategically in the organisation, and (4) Information is crucial to the success of the organisation.

When calculating the various criteria BCS_66 had, the total received was 10 (De Koker 2019).

BCS_127

*Element 1: Components of the CLC* contained four of the criteria: (1) Idea Generation, (2) Concept Development/Testing, (3) Analysis, and (4) Product Development & Market Testing.

*Element 2: Components of the BMC* contained four of the criteria: (1) Value Propositions, (2) Customer Relationships, (3) Key Activities, and (4) Key Partners.

*Element 3: Features of DBT* contained three of the criteria: (1) Innovation is key to the organisation, (2) Big Data are embedded in the organisation, and (3) Business process automation in the organisation.

*Element 4: Features of the 4IR* contained all three of the criteria: (1) Artificial intelligence is a key consideration for the organisation in the 4IR, (2) The Internet of Things is a key consideration for the organisation in the 4IR, and (3) Robotics are considered as present or future business importance.

*Element 5: SIM principles* contained all four of the criteria: (1) Information is a key asset to the organisation, (2) Information is integrated in the overall strategy of the organisation, (3) Information is managed strategically in the organisation, and (4) Information is crucial to the success of the organisation.

When calculating the various criteria BCS_127 had, the total received was 18 (De Koker 2019).

BCS_128

*Element 1: Components of the CLC* contained one of the criteria: Idea Generation.

*Element 2: Components of the BMC* contained all nine of the criteria: (1) Customer Segments, (2) Value Propositions, (3) Channels, (4) Customer Relationships, (5) Revenue Streams, (6) Key Resources, (7) Key Activities, (8) Key Partners, and (9) Cost Structure.

*Element 3: Features of DBT* contained two of the criteria: (1) Innovation is key to the organisation, and (2) Business process automation in the organisation.

*Element 4: Features of the 4IR* contained one of the criteria: The Internet of Things is a key consideration for the organisation in the 4IR.

*Element 5: SIM principles* contained all four of the criteria: (1) Information is a key asset to the organisation, (2) Information is integrated in the overall strategy of the organisation, (3) Information is managed strategically in the organisation, and (4) Information is crucial to the success of the organisation.

When calculating the various criteria BCS_128 had, the total received was 17 (De Koker 2019).

BCS_2016_1

*Element 1: Components of the CLC* contained three of the criteria: (1) Idea Generation, (2) Concept Development/Testing, and (3) Analysis.

*Element 2: Components of the BMC* contained four of the criteria: (1) Value Propositions, (2) Key Resources, (3) Key Activities, and (4) Key Partners.

*Element 3: Features of DBT* contained all four of the criteria: (1) Innovation is key to the organisation, (2) Big Data are embedded in the organisation, (3) Business process automation in the organisation, and (4) Information security is key in the organisation.

*Element 4: Features of the 4IR* contained all three of the criteria: (1) Artificial intelligence is a key consideration for the organisation in the 4IR, (2) The Internet of Things is a key consideration for the organisation in the 4IR, and (3) Robotics are considered as present or future business importance.

*Element 5: SIM principles* contained all four of the criteria: (1) Information is a key asset to the organisation, (2) Information is integrated in the overall strategy of the organisation, (3) Information is managed strategically in the organisation, and (4) Information is crucial to the success of the organisation.

When calculating the various criteria that BCS_2016_1 had, the total received was 18 (De Koker 2019).

## Heat map of top four business case studies

The top four BCSs determined from the top eight BCSs heat map can be seen in Figure 2.

## Recurring criteria for top four business case studies

There were recurring criteria found, that was present in each of the four BCSs. This can be seen in Figure 3.

The criteria that recurred in the four BCSs were: (1) Idea Generation, (2) Key Partners, (3) Key Activities, (4) Value propositions, (5) Innovation is key to the organisation, (6) Big Data are embedded in the organisation, (7) Artificial intelligence is a key consideration for the organisation in the 4IR (De Koker 2019), (8) The Internet of Things is a key consideration for the organisation in the 4IR, (9) Robotics are considered as present or future business importance, (10). Information is a key asset to the organisation, (11) Information is integrated in the overall strategy of the

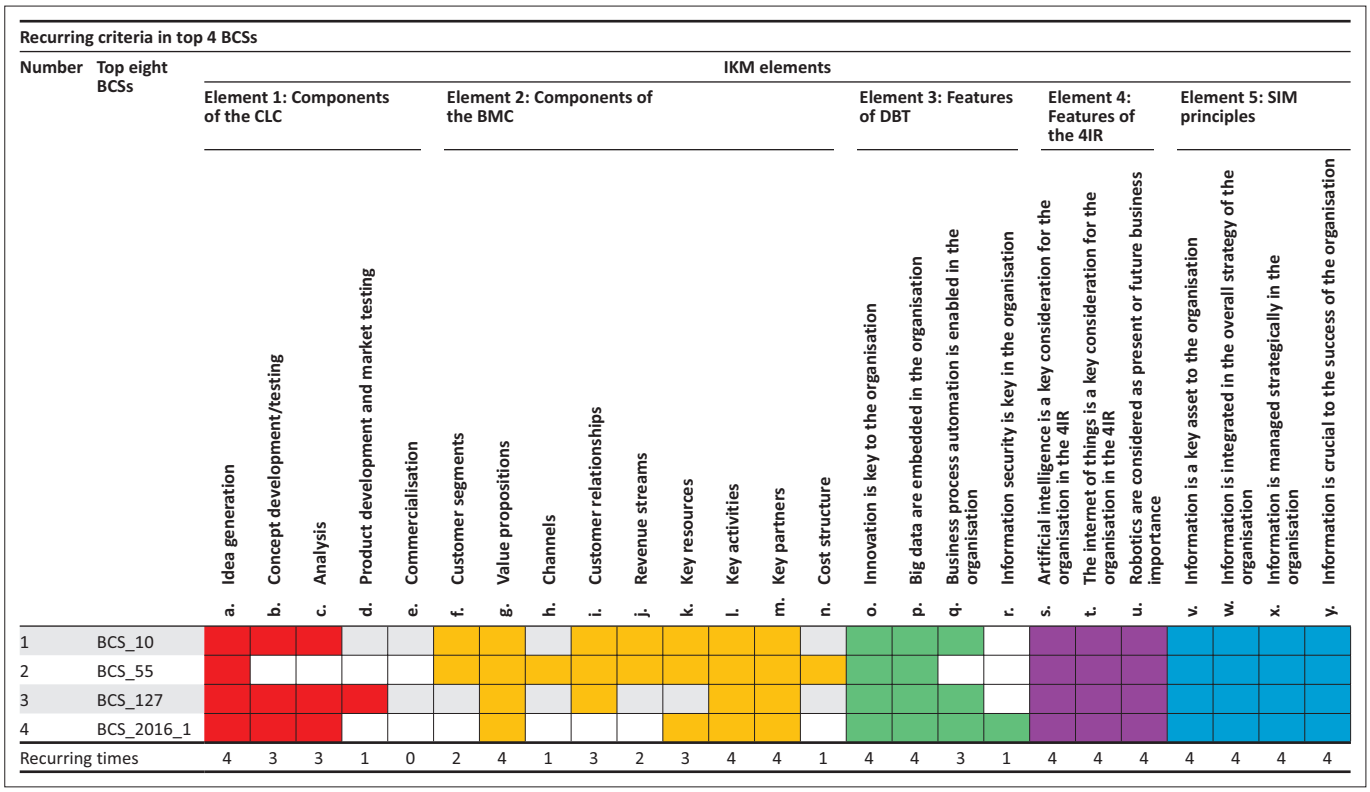
**Top 4 BCSs heat map**

| Number | Top four BCSs | IKM elements | | | | | | | | | | | | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Element 1: Components of the CLC | | | | | Element 2: Components of the BMC | | | | | | | | | | Element 3: Features of DBT | | | | Element 4: Features of the 4IR | | | Element 5: SIM principles | | | | |
| | | a. Idea generation | b. Concept development /testing | c. Analysis | d. Product development and market testing | e. Commercialisation | f. Customer segments | g. Value propositions | h. Channels | i. Customer relationships | j. Revenue streams | k. Key resources | l. Key activities | m. Key partners | n. Cost structure | | o. Innovation is key to the organisation | p. Big data are embedded in the organisation | q. Business process automation is enabled in the organisation | r. Information security is key in the organisation | s. Artificial intelligence is a key consideration for the organisation in the 4IR | t. The internet of things is a key consideration for the organisation in the 4IR | u. Robotics are considered as present or future business importance | v. Information is a key asset to the organisation | w. Information is integrated in the overall strategy of the organisation | x. Information is managed strategically in the organisation | y. Information is crucial to the success of the organisation | |
| 1 | BCS_10 | 3 | | | | | 7 | | | | | | | | | | 3 | | | | 3 | | | 4 | | | | 20 |
| 2 | BCS_55 | 1 | | | | | 9 | | | | | | | | | | 2 | | | | 3 | | | 4 | | | | 19 |
| 3 | BCS_127 | 4 | | | | | 4 | | | | | | | | | | 3 | | | | 3 | | | 4 | | | | 18 |
| 4 | BCS_2016 1 | 3 | | | | | 4 | | | | | | | | | | 4 | | | | 3 | | | 4 | | | | 18 |

*Source*: De Koker, L.T., 2019, 'The commercialisation lifecycle of a knowledge management consulting firm in the fourth industrial revolution', Master's dissertation, University of Johannesburg

SIM, strategic information management; 4IR, fourth industrial revolution; DBT, digital business transformation; BMC, business model canvas; CLC, commercialisation lifecycle; IKM, information and knowledge management; BCSs, business case studies.

**FIGURE 2:** Top four business case studies – heat map.




*Source*: De Koker, L.T., 2019, 'The commercialisation lifecycle of a knowledge management consulting firm in the fourth industrial revolution', Master's dissertation, University of Johannesburg

SIM, strategic information management; 4IR, fourth industrial revolution; DBT, digital business transformation; BMC, business model canvas; CLC, commercialisation lifecycle; IKM, information and knowledge management; BCSs, business case studies.

**FIGURE 3:** Top four business case studies – Recurring criteria.

organisation, (12) Information is managed strategically in the organisation, and (13) Information is crucial to the success of the organisation (De Koker 2019).

The criteria that recurred in three BCSs were: (1) Concept Development/Testing, (2) Analysis, (3) Customer Relationships, (4) Key Resources, and (5) Business process automation in the organisation.

The criteria that did not recur but were present once in a BCS were: (1) Product Development & Market Testing, (2) Channels, (3) Cost Structure, and (4) Information security is key in the organisation.

The only criterion that was not present in any of the top four BCSs was: Commercialisation.

From the rigorous NRT methodology followed, the top four BCSs were BCS_10, BCS_55, BCS_127, and BCS_2016_1 with their IKM heat maps (De Koker 2019). These results establish the contribution made to SoTL in the form of a NRT methodology in the IKM discipline. The results demonstrate the ranking of BCSs leading to IKM heat maps as a representation of the voices of students documented in their SIM BCSs. The BCSs relate students' learning and application of SIM toolkits in preparation for the 4IR. The results of this study align with the overall notion of Varga-Atkins et al. (2015:289), that nominal ranking 'is appealing in a Higher Education era focused on the student voice' in face-to-face focus groups. In addition, this paper illustrates an application of nominal ranking that interrogates teaching and learning without face-to-face student interaction. Subsequently, this paper concludes its reflective discussion.

## Conclusion

The IKM heat maps illustrate the beneficial NRT methodology and make a new contribution to the SoTL in the IKM discipline. The steps in the NRT methodology can be used as a research methodology for analysing students' BCSs. The NRT methodology has built-in flexibility; for example, the data collection and content analysis could be tailored in the analysis of BCSs to identify strategic areas beyond the 4IR. At the time when this study was conducted, the 4IR proceeded faster than anticipated with global impacts on businesses. Disruptive technologies such as Generative AI necessitate innovative business frameworks. As such, revised methodologies are required to fast-track the development of IKM frameworks.

Future research that might be undertaken can focus on more categories in the categorisation of BCSs in the NRT methodology. Scholarship of teaching and learning is often an iterative process, which means that SoTL research questions are typically not completely answered in one project. This study produced a methodological stepping stone in the SoTL in the IKM discipline.

## Acknowledgements

This article is partially based on the author's thesis of the degree of Magister Philosophiae in Information Management at the Department of Information and Knowledge Management, School of Consumer Intelligence and Information Systems, College of Business and Economics, University of Johannesburg, South Africa, with supervisor Prof. Tanya du Plessis, received on December 2018, available at: https://scholar.google.com/citations?view_op=view_citation&hl=en&user=dgglI28AAAAJ&citation_for_view=dgglI28AAAAJ:u5HHmVD_uO8C.

### Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

### Authors' contributions

L.T.d.K. and T.d.P. contributed equally to this research article. L.T.d.K. was a master's student, supervised by T.d.P.

### Funding information

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

### Data availability

The data that support the findings of this study are available from the corresponding author, L.T.d.K., upon reasonable request.

### Disclaimer

The views and opinions expressed in this article are those of the authors and are the product of professional research. It does not necessarily reflect the official policy or position of any affiliated institution, funder, agency, or that of the publisher. The authors are responsible for this article's results, findings, and content.


## References


Anshari, M. & Hamdan, M., 2022, 'Understanding knowledge management and upskilling in fourth industrial revolution: Transformational shift and SECI model', *VINE Journal of Information and Knowledge Management Systems* 52(3), 373–393. https://doi.org/10.1108/VJIKMS-09-2021-0203

Bers, J.A., Dismukes, J.P., Miller, L.K. & Dubrovensky, A., 2008, 'Accelerated radical innovation: Theory and application', *Technological Forecasting & Social Change* 76(1), 165–177. https://doi.org/10.1016/j.techfore.2008.08.013

Cambridge, B., 2007, 'Learning, knowing, and reflecting: Literacies for the 21st century', *International Journal for the Scholarship of Teaching and Learning* 1(2), 1–7. https://doi.org/10.20429/ijsotl.2007.010202

Cannatelli, B., Smith, B., Giudici, A., Jones, J. & Conger, M., 2017, 'An expanded model of distributed leadership in organizational knowledge creation', *Long Range Planning* 50(5), 582–602. https://doi.org/10.1016/j.lrp.2016.10.002

Creswell, J.W., 2013, *Qualitative inquiry and research design: Choosing among five approaches*, 3rd edn., Sage, Thousand Oaks, CA.

De Koker, L.T., 2019, 'The commercialisation lifecycle of a knowledge management consulting firm in the fourth industrial revolution', Master's dissertation, University of Johannesburg.

De Koker, L.T. & Du Plessis, T., 2020, 'Research as a service offering of knowledge management firms in the fourth industrial revolution', *South African Journal of Information Management* 22(1), a1178. https://doi.org/10.4102/sajim.v22i1.1178

Delbecq, A.L. & Van de Ven, A.H., 1971, 'A group process model for problem identification and program planning', *The Journal of Applied Behavioral Science* 7(4), 466–492. https://doi.org/10.1177/002188637100700404

Dobbins, K., 2008, 'Enhancing the scholarship of teaching and learning: A study of the factors identified as promoting and Hindering the Scholarly activities of academics in one faculty', *International Journal for the Scholarship of Teaching and Learning* 2(2), 1–8. https://doi.org/10.20429/ijsotl.2008.020217

Heffernan, J., 2010, 'Productisation and commercialisation plan for Pharmatory Ltd.'s new service', Masters dissertation, Kemi-Tornio University of Applied Sciences.

Hugé, J. & Mukherjee, N., 2018, 'The nominal group technique in ecology & conservation: Application and challenges', *Methods in Ecology and Evolution* 9(1), 33–41. https://doi.org/10.1111/2041-210X.12831

Hussin, N., Hashim H. & Yu, H., 2018, 'Strategic information management (SIM) in Malaysian organizations: An investigation of its antecedent', *International Journal of Academic Research in Progressive Education and Development* 7(3), 291–304. https://doi.org/10.6007/IJARPED/v7-i3/4367

Kanuka, H., 2011, 'Keeping the scholarship in the scholarship of teaching and learning', *International Journal for the Scholarship of Teaching and Learning* 5(1), 3. https://doi.org/10.20429/ijsotl.2011.050103

Khumalo, S., 2023, 'Strategic information management system for commercialisation dynamics of entrepreneurial universities', PhD thesis, Department of Information and Knowledge Management, University of Johannesburg.

Khumalo, S. & Du Plessis, T., 2017, 'Responsiveness of a South African university to the country's agenda for entrepreneurial universities', in Proceedings of the Africa research group 5th international conference: Managing organisations in Africa, University of Mauritius in collaboration with University of Nottingham, August 29–31, 2017.

Khumalo, S. & Du Plessis, T., 2024, 'Commercialisation dynamics system principles and support units of entrepreneurial universities', *South African Journal of Information Management* 26(1), a1619. https://doi.org/10.4102/sajim.v26i1.1619

McCoy, A.P., 2007, 'Establishing a commercialization model for innovative products in the residential construction industry', Master's thesis, Virginia Polytechnic Institute and State University.

McMillan, S.S., Kelly, F., Sav, A., Kendall, E., King, M.A., Whitty, J.A. et al., 2014, 'Using the nominal group technique: How to analyse across multiple groups', *Health Services and Outcomes Research Methodology* 14(3), 92–108. https://doi.org/10.1007/s10742-014-0121-1

McMillan, S.S., King, M. & Tully, M.P., 2016, 'How to use the nominal group and Delphi techniques', *International Journal of Clinical Pharmacy* 38(3), 655–662. https://doi.org/10.1007/s11096-016-0257-x

Mhlanga, D. & Ndhlovu, E., 2023, 'The Fourth Industrial Revolution in Africa: An introduction', in D. Mhlanga & E. Ndhlovu (eds), *The Fourth Industrial Revolution in Africa. Advances in African economic, social and political development*, pp. 1–12, Springer, Cham.

Mubuyaeta, M. & Ngulube, P., 2023, 'Knowledge management implementation strategy for knowledge management systems in two mobile telecommunication companies Namibia', *Regional Journal of Information and Knowledge Management* 8(1), 123–151. https://doi.org/10.4018/IJKM.339555

Ojasalo, J. & Ojasalo, K., 2018, 'Service logic business model canvas', *Journal of Research in Marketing and Entrepreneurship* 20(1), 70–98. https://doi.org/10.1108/JRME-06-2016-0015

Osterwalder, A. & Pigneur, Y., 2010, *Business model generation*, John Wiley & Sons, Hoboken, NJ.

Potter, M.K. & Kustra, E.D.H., 2011, 'The relationship between scholarly teaching and SoTL: Models, distinctions, and clarifications', *International Journal for the Scholarship of Teaching and Learning* 5(1), 1–18. https://doi.org/10.20429/ijsotl.2011.050123

Quain, S., 2018, *6 Phases in new product development*, viewed 13 November 2023, from http://smallbusiness.chron.com/6-phases-new-product-development-18440.html.

Razak, A.A., Murray, P.A. & Roberts, D., 2014, 'Open innovation in universities: The relationship between innovation and commercialisation', *Knowledge and Process Management* 21(4), 260–269. https://doi.org/10.1002/kpm.1444

Sabzalieva, E. & Valentini, A., 2023, *ChatGPT and artificial intelligence in higher education: A quick start guide*, UNESCO, Paris.

Sams, C.E. & Sams, D., 2011, 'Best practice in developing critical analyses: An empirical study of self-efficacy from an interdisciplinary perspective', *International Journal for the Scholarship of Teaching and Learning* 5(2), 1–15. https://doi.org/10.20429/ijsotl.2011.050217

Saratoga, 2018, *Artificial intelligence and the future of the business consultant*, viewed 13 November 2023, from http://saratoga.co.za/artificial-intelligence-and-the-future-of-the-business-consultant/.

Saunders, M., Lewis, P. & Thornhill, A., 2009, *Research methods for business graduates*, 5th edn., Pearson Education, Essex.

Schwab, K., 2018, *The urgency of shaping the fourth industrial revolution*, viewed 13 November 2023. from https://www.weforum.org/agenda/2018/01/the-urgency-of-shaping-the-fourth-industrial-revolution.

Schwertner, K., 2017, 'Digital transformation of business', *Trakia Journal of Sciences* 15(1), 388–393. https://doi.org/10.15547/tjs.2017.s.01.065

Van der Poll, J.A., 2022, 'Towards a problematization framework of 4IR case of QUALITY 4.0', in H. Sharma, V.K. Vyas, R.K. Pandey & M. Prasad (eds.), *Proceedings of the International Conference on Intelligent Vision and Computing (ICIVC 2021). ICIVC 2021. Proceedings in adaptation, learning and optimization*, vol. 15, October 03–04, 2021, pp. 212–226, Springer, Cham.

Varga-Atkins, T., McIsaac, J. & Willis, I., 2015, 'Focus group meets nominal group technique: An effective combination for student evaluation?', *Innovations in Education and Teaching International* 54(4), 289–300. https://doi.org/10.1080/14703297.2015.1058721

Xu, J., He, M. & Jiang, Y., 2022, 'A novel framework of knowledge transfer system for construction projects based on knowledge graph and transfer learning', *Expert Systems With Applications* 199, 1–18. https://doi.org/10.1016/j.eswa.2022.116964