Journal of Intelligence Studies in Business Vol. 13 No. 2 (2023) pp. 6-24
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SECI Knowledge Model and Opportunities of Engaging Business Intelligence by Maturity Level: Case Study at Selected Businesses in the Czech Republic

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Received 10 May 2023 Accepted 22 June 2023

ABSTRACT This study aims to examine the possibilities of engaging business intelligence (BI) with regard to the level of maturity within systemic knowledge management (KM). The individual modes of knowledge sharing and conversion are illustrated in Nonaka's SECI model that defines four conversion modes of knowledge exchange: socialisation, externalisation, combination and internalisation. The submitted case study presents the current and potential engagement of BI when applying knowledge conversion tools in three Czech organisations of various sizes. Most businesses use both tools (BI and KM) but they are often not able to coordinate their joint implementation in a suitable way. Currently, the results of the case study indicate a more optimal adaptation in the environment of larger businesses. However, the addressed businesses, regardless of their size, most often see the potential and great opportunities of the tools in the combination mode in the future.

KEYWORDS: business intelligence, case study, knowledge management, maturity model, SECI

1. INTRODUCTION

Knowledge is considered one of the most valuable assets of organisations in the current economy. The growth of modern society has moved from natural resources and physical assets to intellectual capital of organisations where it has become the source of innovation and competitive advantage (Arora 2002). Research interest in knowledge management is considerable as knowledge has become the key to success in today's global, highly competitive economy. Companies that control their organisational knowledge with a clear and well-defined vision, objectives and approaches, tend to be more successful while other companies who approach knowledge management only with focus on IT may fail as they do not concentrate on the human aspect and long-term strategy (Abubakar et al. 2019).

The main objective of the presented study is to propose potentials of engaging business intelligence tools in the process of knowledge management. The modes of knowledge sharing and conversion are illustrated on Nonaka's SECI model that defines four conversion modes of knowledge (socialisation, externalisation, combination and internalisation) (Nonaka, Toyama, and Konno 2000b). Three businesses of different sizes were selected for the case study where

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the current level of BI engagement in the processes and tools of knowledge management were ascertained. Also, the potential of future application was examined in order to determine the probable boundaries of combining business intelligence with knowledge management.

The main task of business intelligence lies in converting available data into information. The information is then used as the basis of managerial decision-making (Gaardboe and Svarre 2018). Knowledge management can be understood as a conscious implementation of strategy, based on delivering the right knowledge to the right people at the right time using the available information to improve an organisation's performance (O'Dell and Grayson 1998). The comprehensive approach to knowledge management also includes acquiring knowledge and experience so that it is available for further use. It provides an easy access to specialised knowledge and know-how, whether formally recorded or only in the minds of specific individuals (du Plessis 2007). An easier approach to knowledge and its accessibility may be supported by engaging business intelligence in selected processes within the organisation (Sabherwal and Becerra-Fernandez 2013). The integration of knowledge through knowledge management platforms, tools, methods and processes must thus facilitate accessibility and sharing of such knowledge so that it is possible to implement personal and organisational learning and the creation of innovation while using the newly acquired knowledge (Baddi & Sharif, 2003).

To meet the main intention of the submitted study, the research was divided into several stages: the first part of the literary research presents the basic characteristics of Nonaka's SECI model. This is followed with a detailed list of tools and methods used in the defined stages of knowledge conversion. The second part presents the current approaches to combining knowledge management and business intelligence, followed with a list of models of maturity of both tools, individually and together. The advantages and suitable application of case studies are briefly characterised within the methodology and the procedure of the presented study is introduced. The following part contains the outcomes that are further discussed. The conclusion contains a short summary, the limitations of the study and outlines the potential directions of future studies.

2. LITERATURE REVIEW

The first part of the detailed literary research is based on researching documents dedicated to knowledge management and Nonaka's model of knowledge management – SECI. A detailed list of tools used in the individual methods of conversion was made: socialisation, externalisation, combination and internalisation. The overview was used as a basis for creating the final list of common tools for the assessment of the engagement of BI in KM within the case study.

The second part of the research presents the fundamentals of the relation between business intelligence and knowledge management. This is followed with an overview of five approaches to the assessment of the level of implementation in an organisation – known as maturity models. Two are dedicated to BI, two to KM and the last one offers maturity levels combining both tools. This part was then used to define the levels of maturity and the levels of implementation applied in the next section of the case study.

2.1. Knowledge Management and SECI Model

Nonaka (1994) designed the SECI model to understand the dynamics of the creation of knowledge. This model is a process model and according to Nonaka et al. (2008, p. 19): "*It starts with socialisation of individuals, transfers into externalisation in groups, combination in organisations and then returns to internalisation of individuals. It is important that the individuals, groups and organisations transform in the process of creating knowledge as they are a set of processes."* According to this model, there are two types of human knowledge: tacit and explicit. Explicit or codified knowledge relates to knowledge that can be transferred in a formal, systemic way. On the other hand, tacit knowledge has a personal quality that

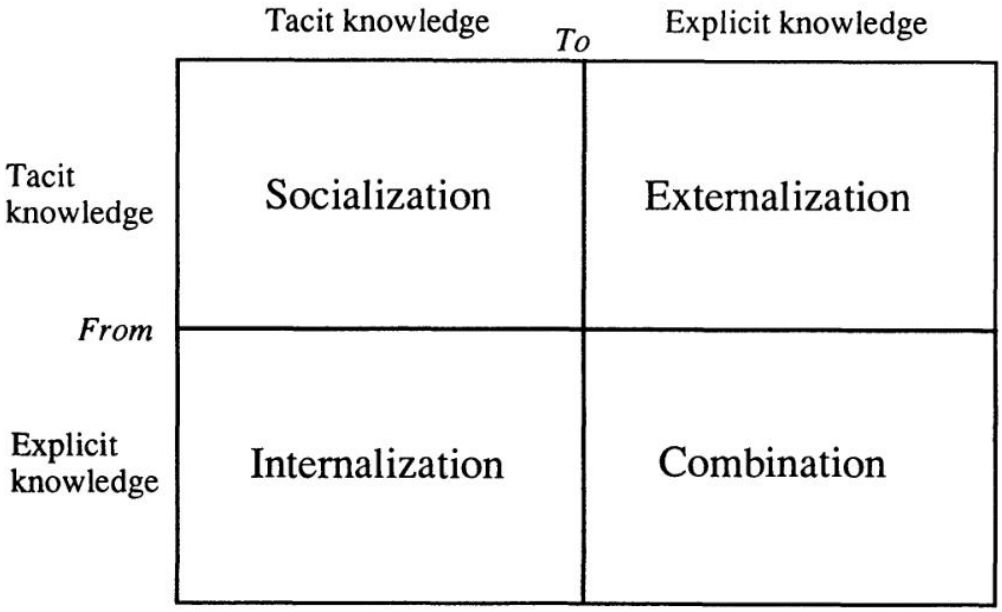
makes it difficult to formalise and transfer such knowledge; it is deeply rooted in the activity, engagement and involvement into the specific context of the performed activity. Tacit knowledge contains both cognitive and technical elements. Those working models contain diagrams, paradigms, beliefs and points of view that provide 'perspectives' that help individuals perceive and define their world. On the other hand, the technical element of tacit knowledge contains specific know-how, crafts and skills applied in specific relations. It is important to note that the cognitive element of tacit knowledge relates to the individual's ideas about the reality and visions of the future, i.e., to what is and what should be (Nonaka, 1995).

Knowledge management is understood as the management of the processes of creating, storing, making available and spreading intellectual resources of the organisation (Antunes and Pinheiro 2020). The fundamental challenge in knowledge management is the question of how to share knowledge in the most effective and efficient way (Barbeira, Franco, and Haase 2012). Knowledge can be shared at an individual, group and organisational level, within an organisation or among organisations (Ipe 2003). Sharing knowledge is a process of transferring knowledge (especially tacit) from one person to another, at the level of individuals – knowledge exchange, or collectively – through education (Xuan 2020). To share tacit or explicit knowledge, the knowledge must be maintained within the organisation so that it is available and traceable for employees. Tacit and explicit knowledge is then created at an organisational level using conversion.

The assumption that knowledge is created by conversion between tacit and explicit knowledge makes it possible to postulate four different 'methods' of knowledge conversion from:

1. Tacit knowledge to tacit knowledge – socialisation mode
2. Explicit knowledge to explicit knowledge – externalisation mode
3. Tacit knowledge to explicit knowledge – combination mode
4. Explicit knowledge to tacit knowledge – internalisation mode

The individual modes of conversion are shown in Figure 1 below.



The **socialisation mode** is the first method of knowledge conversion, i.e., conversion of tacit knowledge through interaction between individuals when the individual can acquire such knowledge without using speech during the transfer. The key to obtaining tacit knowledge is a shared experience; it is very difficult for people to share the line of thought with others without this form. Considering the fact that tacit knowledge is difficult to formalise and it is often specific in time and space, it is only possible to obtain tacit knowledge through a shared experience, such as spending time together or living in the same environment (Nonaka, Toyama, and Konno 2000b). When transferring tacit knowledge, emotions and nuances of contexts related to the shared experience must be applied. The socialisation process is based on the creation of tacit knowledge through a shared experience. This mode usually starts with building a 'team' or a 'field' of interaction. This field facilitates sharing experience and points of view of the members. Socialisation also takes place outside the boundary of the organisation; it can occur at informal social meetings where tacit knowledge, such as opinions about the world, mental models and mutual trust, can be created and shared (Nonaka, Toyama, and Konno 2000b).

The **second method of conversion** is the transformation of tacit knowledge to explicit knowledge, which is called externalisation and 'metaphor' plays an important role in this process. This method of knowledge transfer is very important since as soon as the tacit knowledge 'crystallises' as explicit knowledge, its transfer is easier and cheaper in terms of space and time than in case of tacit knowledge (López-Sáez et al. 2010b). In this dialogue, using 'metaphors' in a sophisticated way, team members can express their own points of view and thus uncover the hidden tacit knowledge that is difficult to formulate. A successful transformation of tacit knowledge to explicit knowledge depends on the gradual use of metaphor, analogy and model (Nonaka, Toyama, and Konno 2000b).

The third and fourth method of knowledge conversion concerns conversion containing both tacit and explicit knowledge and it expresses the idea that tacit and explicit knowledge complement one another and may expand in time through the process of mutual interaction.

The **third method of conversion** of knowledge (combination) includes the use of social processes to combine various pieces of the individuals' explicit knowledge. Explicit knowledge is collected inside or outside the organisation and then combined, modified or processed to create new knowledge. The new explicit knowledge is then spread among the members of the organisation (Nonaka, Toyama, and Konno 2000b). This process of knowledge conversion is usually facilitated

Figure 1. SECI Model. (Source: own processing according to Nonaka 1994.

with triggers such as 'coordination' between the team members and other divisions of the organisation and 'documentation' of the current knowledge. The concepts created by teams can be combined with existing data and external knowledge with such knowledge being created when explicit knowledge is combined and new ideas, or innovations, are created (Faith and Seeam 2018a). These processes of sharing information create a higher level of knowledge such as models, best practices, handbooks and information that may also spread without interpersonal relations (Farnese et al. 2019b; van den Hooff and de Ridder 2004).

The **fourth method of conversion** of knowledge (internalisation) is the transfer of explicit knowledge to tacit knowledge; this mode is known as internalisation, closely linked to 'action'. The closest manifestation of internalisation is learning through practice (López-Sáez et al. 2010b). The concepts created in the process of combination by teams are further formulated and developed through the iterative process of trials and errors until they appear in a specific form. Such 'experimenting' may create internalisation through the process of 'learning by doing'. When the knowledge is internalised and becomes a part of the tacit knowledge base of individuals in the form of shared mental models or technical know-how, it becomes a valuable asset. Such tacit knowledge collected at the level of an individual can launch a new spiral of creation of knowledge when shared with others through socialisation and expanded across organisations both horizontally and vertically. This is a dynamic process that starts at the level of an individual and expands as it moves through social interactions (Nonaka, Toyama, and Konno 2000b)

Table 1 summarises the tools and methods stated in available publications dedicated to the active use of knowledge in organisations.

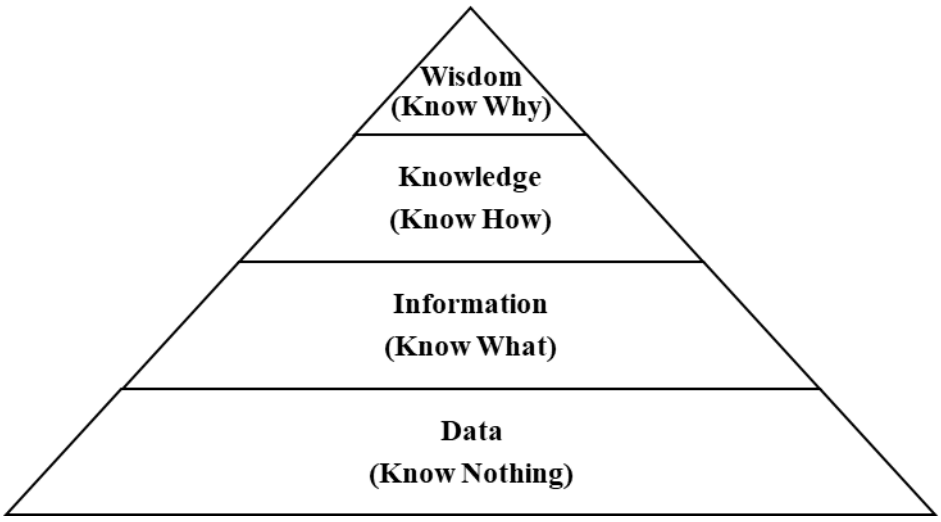
Table 1. Overview of Knowledge Conversion Tools and Methods (Source: own processing)

SECI Model Modes				
Knowledge Conversion Tools and Methods	**Socialisation Mode**	**Externalisation Mode**	**Combination Mode**	**Internalisation Mode**
	Walking around the workplace	Concepts	Database of best practices	Simulation
	Direct interaction	Images	Intranet	Learning by doing
	Observation	Written documents	Prototypes	Encouraging workers to use explicit knowledge in organisational measures
	Listening	Seminars, informing individuals of informational and documentation methods	Computer communication networks	Designing an available bank of explicit knowledge for measures and decision-making of workers in the organisation
	Guidance (mentor x apprentice)	Handbooks	Statistical banks	Lectures
	Practice	Codified documents	Scientific works	Training programmes
	Imitation	Dialogues	Meetings	Reading documents or handbooks
	Brainstorming	Discussion platforms	Organising conferences	Trials and errors
	Brainwriting	Interviews with experts	Systematisation of terms in the knowledge system	Mentoring
	Personal contact	E-mail	Integration of concepts in the knowledge system	The organisation organises meetings where they explain the content of related messages or documents
	Group work	White pages	Overview report, trend analysis, brief summary or new database for organising content	The organisation organises meetings where they explain reports issued by customers, suppliers, competitors, partners or government

	Providing employees with opportunities to study	Minutes from meetings	Web fora	The organisation supports its employees in post-graduate studies
	Participation in formal and informal communities	Documentation of seminars, workshops, conferences and training programmes	Groupware	The organisation provides access to the results or recommends educational programmes, workshops and seminars
	Follow-up evaluation after participation in an event	Documentation of useful experience of qualified employees of the company	E-learning	
	Sharing best practices	Newsletters	Classification of information in databases, networks and reports	
	Knowledge communities	Websites	Database updates	
	Employee rotations	Patents	The organisation collects, sorts and informs its employees of reports and decisions issued by external authorities	
	Joint projects	Metaphors	Virtual communities	
	Workshops	Team confrontations	Information storage	
	Seminars		Electronic cooperation systems	
	Informal meetings outside the workplace		Net-meeting	
	Training in human resources		Podcast	
			Video-conference	
			Wiki	

2.2. Knowledge Management and Business Intelligence

The connection of key components of both strategic tools (BI and KM) in modern management can be easily organised into a value chain model of knowledge in the order of data → information → knowledge (Almarabeh et al. 2009). In this model, data are understood as descriptions of objects or events. Information represents processed data with assigned meaning and value in a specific context. When we add prior experience to information, appropriately put into context, we can transfer the information into knowledge (Martz and Shepherd 2003). The DIKW pyramid is considered an extension of this model; it expands the original diagram with the wisdom level. It is most frequently shown as follows:

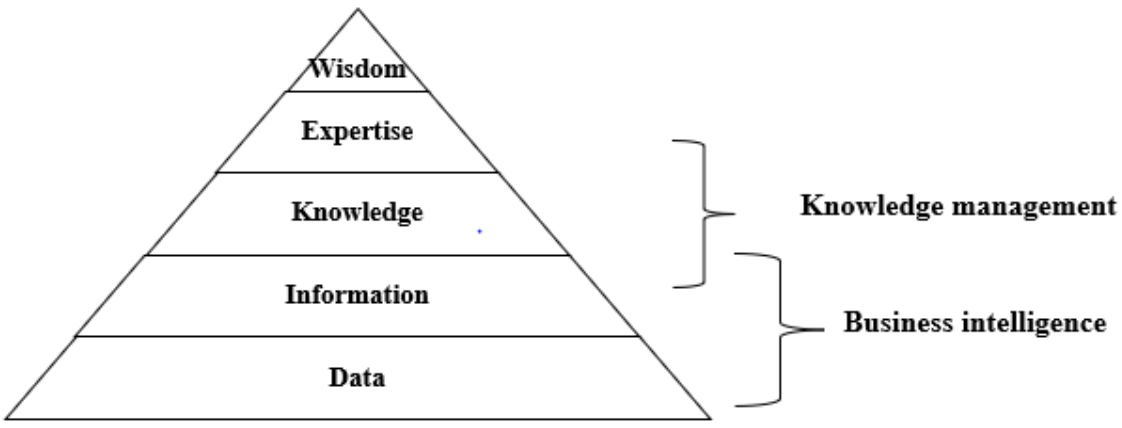


The individual levels may include idioms expressing their essence for better understanding. At the lowest level, data present symbols that only represent the properties of the environment and objects that require further observation (Know Nothing). When data are processed into information, it is possible to classify the properties of the environment and objects (Know What). The following boundary between information and knowledge can be overcome thanks to an appropriately set mutual transformation containing distribution, identification, obtaining and sharing knowledge using BI tools (Know How) (Shehabat and Berrish 2021). The last level (Know Why) can be achieved by adding value to the obtained knowledge through a strategic judgement (Mohamad, Jayakrishnan, and Mohd Yusof 2022).

Liebowitz (2019) adds an expertise level to the DIKW pyramid, placed between the levels of knowledge and wisdom. It represents corporate environment where achieving the expertise level among the maximum number of employees is a priority in a better way. Liebowitz's pyramid describes the system of organisational intelligence structure (Liebowitz 2019). The hierarchy is illustrated in Figure 3 on the left.

Figure 3. Organisational Intelligence Structure. (Source: own processing according to Liebowitz, 2019)

Figure 2. DIKW Pyramid. (Source: own processing according to Martz and Shepherd 2003)



The diagrams and models stated above clearly imply that an optimal combination of knowledge management and business intelligence represents a key instrument of a business in the effort to improve organisational intelligence and achieving the expertise level across the company. The field of activity of both tools indicates the extension of Liebowitz's pyramid in Figure 2. Their relation and overlapping in building organisational intelligence play an important role in the sequence of the individual levels.

In the past ten years, many publications discuss the successful application of knowledge management and business intelligence, separately. The studies confirm the importance of implementation of both

business intelligence (e.g.: (Ain et al. 2019; Arefin, Hoque, and Bao 2015; Gaardboe and Svarre 2018; Pranjić 2018; Rouhani et al. 2016) and knowledge management (Abusweilem and Abualous 2019; Jennex and Olfman 2003; Keyes n.d.; Shehabat and Berrish 2021; Shujahat et al. 2017) in corporate processes. However, only a limited number of studies examine a suitable connection of both tools. Below, the selection of the most relevant approaches from the past ten years is presented.

Based on literary research of other studies, Rostami (2014) mentions the human factor, closely related to the setting of the corporate culture and the form of leadership, as the decisive factor of success in the mutual integration BI and KM. When the factors are set in an appropriate way, it is possible to achieve optimal organisational effectiveness, to improve the principles of learning organisation and to improve the performance of the organisation (Rostami 2014). Abusweilema and Abualoushb (2019) examined the effect of the process of knowledge management and business intelligence on the performance of the organisation. Based on the performed survey, it is possible to support the company's effectiveness by implementing activities built on generating knowledge and creating platforms for sharing knowledge. That helps organisations effectively and purposefully strengthen the capacity of knowledge management and thus achieve a higher performance (Abusweilem and Abualous 2019).

Muhammad et al. (2014) describes the role of BI and KM integration using the financial sector as an example. The financial sector is characterised by fast-changing market environment and managing huge quantities of data. He sees the main contribution of business intelligence in uncovering hidden patterns and extracting valuable information from internal and external sources of data. The knowledge management system then provides sharing and management of tacit and explicit knowledge. Within the integration of business intelligence, the tools support knowledge management for the purpose of maintaining and increasing performance of (not only) organisations operating in the financial sector (Muhammad et al. 2014).

2.3. Maturity Models

For the purpose of this study, the levels of engagement of business intelligence, knowledge management or both tools together in corporate processes were examined. Grossmann and Rinderle-ma examine only BI combined with strategic management. There are four possible scenarios of using business intelligence tools in strategic planning. The list below states the individual stages and examples from practice (Grossmann and Rinderle-Ma 2015):

1. BI and strategic management are separated: BI outputs basically represent standardised reports designed for a specific part of the organisation. They only fulfil the short-term objectives of the specific department.
2. BI as an organisation's performance control support: Monitoring is performed when checking stipulated measurable objectives. BI application is formulated within the determination of strategic objectives.
3. BI as a means of feedback when formulating the strategy: The balanced scorecard is a typical outcome of this scenario. BI tools are applied during strategy optimisation.
4. BI as a key source of strategic planning: BI outputs are used directly when defining strategies and they thus provide substantial inputs when creating the strategic plan at the top managerial level.

Gartner's model is one of the most frequently used models in the assessment of business intelligence implementation maturity. The maturity model for business intelligence recognises five levels of maturity: unconscious, tactical, concentrated, strategic and omnipresent. It is used for assessing the initial effort and the achieved maturity. The assessment includes three key areas: people, processes and metrics and technologies (Rajteri 2010). The hierarchy of the individual stages with basic characteristics is illustrated in Figure 4.

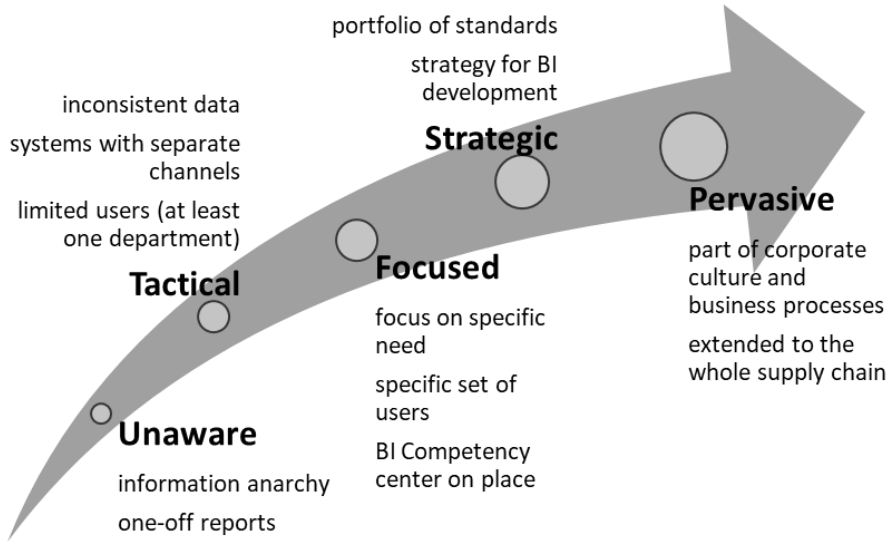


Figure 4. Business Intelligence Maturity Model. (Source: own processing according to Gartner 2006 and Rajteri 2010)

The Technology and Service Industry Association (TSIA) studies knowledge management on its own and they presented their own maturity model in 2017 (Ragsdale and Platz 2017). TSIA divides the progress of adopting knowledge management in an organisation into four stages:

- Recognition of the importance of KM
- Instantiation of the KM application strategy
- Value realization
- Strategy implementation

All four stages are then monitored from four points of view:

- Corporate culture
- People
- Processes
- Technology

The authors of a study focused on the research of fifteen models of KM maturity came up with a similar classification (Kuriakose et al. 2011). The main output of the study was a development of a new model complementing the strengths of the current approaches with flexibility, adaptability and practical application. The authors determined a total of six maturity levels after processing the existing models (Kuriakose et al. 2011):

- **Level 0, default status**: absence of any formal activity in the field of knowledge management. The organisation only acknowledges and rewards individual expert knowledge and abilities of individual workers.
- **Level 1, initial stage**: the company management shows initial interest and intention to adopt KM but there is still low awareness of the importance and advantages of knowledge management across the company.
- **Level 2, qualitative development**: the qualitative meaning of activities related to KM and their effect on the performance of individuals, divisions and the entire organisations are assessed in this stage.
- **Level 3, quantitative development**: the methods and tools of knowledge management have been implemented and objectives are achieved in a structured and coordinated way. KM activities can be connected to the organisation's effectiveness and assessed using various types of performance indicators. The organisation achieves the level of 'conscious competence'.
- **Level 4, maturity**: knowledge management becomes an integral part of work routines and is reflected not only in

everyday activities, but also in the corporate culture.

- **Level 5, extended – organisational maturity**: the last level is characterised with achieving maturity in terms of partner organisations, such as suppliers, customers, government institutions and others, as well as trouble-free integration and cooperation with such organisations.

All the levels are monitored in several segments of the organisation. The authors determined five parameters in total: once again, the parameters include people, processes and technologies, supplemented with knowledge and ROI (Return On Investments). The assessment of the adoption maturity by the individual parameters is measured using a radar chart. An example of such assessment is illustrated in Figure 5.

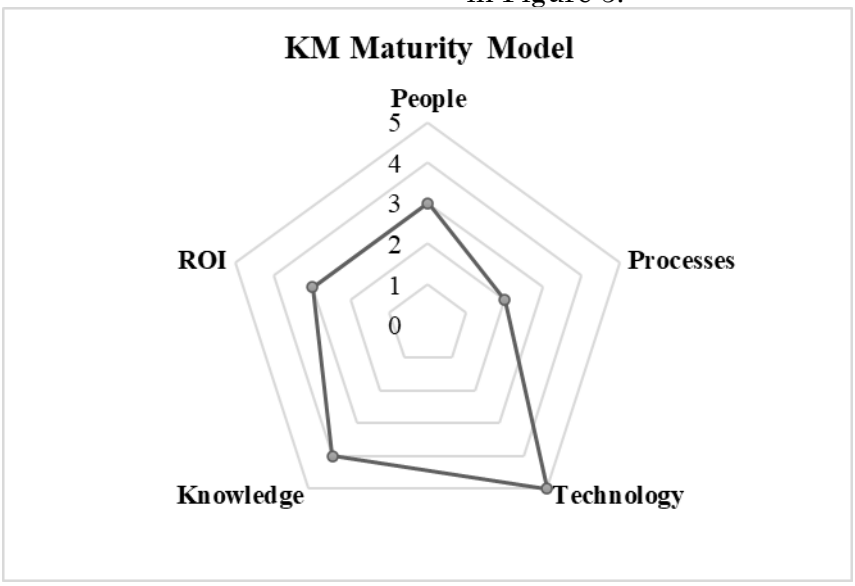


Figure 5. KM maturity model by Kuriakose et al. with completion example. (Source: own processing)

Sabherwal and Becerra-Fernandez (2013) present integration of business intelligence and knowledge management within engagement into corporate processes. They divide the process into four stages:

Both systems are separate in the first stage; therefore, it is called the **isolation stage**. There is low awareness of the possibilities of synergies and increase in effectiveness thanks to the coordination of both tools.

In the next stage, **independence**, the organisation has basic awareness of common foundations and possible positive effects obtained by cooperation between KM and BI. The management applies first trials of interaction between the systems that have been isolated so far.

In the third stage of **complementarity,** the management integrates both tools. The mutual combination is no longer based on using common principles of operation but complementary application of KM and BI is planned consciously.

The company is fully able to use the synergic effects in the last stage, **synergy**. We can register an increase in effectiveness and a positive impact on overall performance of the company (Sabherwal and Becerra-Fernandez 2013).

3. METHODOLOGY

The following chapter summarises the basic characteristics of research case studies and presents the progress and preparation of the presented research.

3.1. Case Study

The method of research case study was used to check the presented system of a potential effective connection of knowledge management and business intelligence in an organisation. Since this is pilot testing of a

newly suggested structure, the application of a research case study as a tool of qualitative research seems to be a suitable choice (Štrach 2007).

Recent publications point out that such methods have a strong position in the research methodology. The case study provides a comprehensive view of the selected unit (individual, a small group, organisation, community or even nation) within the studied topic. It also allows for the future application of principles and instructions from the pilot study in further situations (Burkholder et al. 2020). When researchers decide to include a case study, they have to make a crucial decision containing two basic elements: defining the case and limitations of the case. The first part concerns a clear and specific designation of the case, which can be any unit stated above. Limitation limits the scope – what is and what is not included in the case in terms of time, structure or other points of view (Yin 2018).

Takahashi and Araujo also refute some criticism that points out the size of the selected sample. The case study focuses on a small sample of examined units. The study examines the issue in depth (not width) and it is used to deepen the theoretical and empirical knowledge but it may also refute and question established approaches and ideas. Those are often caused by the complexity and extensiveness of the examined phenomenon, not by the internal limitations of the selected method (Takahashi and Araujo 2019).

3.2. Research design

Based on the literary review, tools used for knowledge sharing and conversion within an organisation were identified (Baldé 2015; Baldé, Ferreira, and Maynard 2018; Nonaka, Toyama, and Konno 2000a; Faith and Seeam 2018b; Farnese et al. 2019a; López-Sáez et al. 2010a; Lee and Kelkar 2013; Amidon and Mahdjoubi n.d.; Mohamad, Jayakrishnan, and Mohd Yusof 2022; Nonaka and Konno 1998). The authors assigned the acquired knowledge and tools to the individual conversion processes of the SECI model, shown in Table 1. Subsequently, with respect to the possibility to use business intelligence within the individual methods and tools, the tools were eliminated and their final selection is shown in Table 3.

Based on the literary research, approaches to maturity of the application of KM and BI were prepared. Four levels of engagement of business intelligence within the application of the individual methods of sharing knowledge were applied in the case study:

- Status 0: Zero application, no awareness of the possibility of implementing BI.
- Status 1: Sporadic use of BI for specific tasks.
- Status 2: BI as a support of monitoring performance in the context of set objectives. BI application established in the organisation.
- Status 3: BI as a key source of input information, automatic implementation in processes.

The combination of researching the available methods promoting the individual stages of knowledge conversion in Nonaka's SECI model and the four-level classification of engagement of business intelligence was used as a basis for a case study applied in three selected companies.

Three companies were nominated for the pilot study to test the designed model. Each company belonged to a different size category for the purpose of comparison. All companies asked for anonymity when presenting the study; therefore, they will be marked as A, B and C. The basic characteristics of the study participants are presented in Table 2:

Table 2. Characteristics of researched companies. (Source: own processing)

Company	Size	Line of business	Representative
A	Small, start-up (up to 50 employees)	IT	IT analyst
B	Medium (up to 250 employees)	Construction	CEO's office manager
C	Large (over 250 employees)	Logistics, shipping	System quality analyst

4. Research Results

The addressed employees were asked to determine the current engagement of BI within the application of the individual methods and to determine the potential of using data analytics that could be optimally achieved in their organisation. For the sake of clarity, the recorded results are divided into two parts and the potentially possible applications contain the letter 'p (potential)' for easier identification. Table 3. sums up obtained outputs.

Table 3. Results of qualitative research - level of engagement of BI in KM. (Source: own processing)

Methods of sharing knowledge in the individual modes / Level of engagement of business intelligence	**Status 0**	**Status 1**	**Status 2**	**Status 3**	**Status 0**	**Status 1**	**Status 2**	**Status 3**
	Current application				**Potential – optimal application**			
Socialisation mode								
Observation, monitoring of the workplace, on the job training	A, C		B		Cp		Ap	Bp
Listening	B, C	A			Bp, Cp		Ap	
Guidance (mentor x apprentice)	C	A, B			Cp	Bp	Ap	
Group work, joint projects		A, C		B			Cp	Ap, Bp
Provision of training and workshops		A, B, C				Cp		Ap, Bp
Informal meetings outside the workplace	A, B	C				Bp, Cp	Ap	
Preparation of training plans	A	B, C					Ap, Bp, Cp	
Externalisation mode								
Dialogue	B, C	A			Bp, Cp		Ap	

Discussion forum, interviews with experts	B, C	A			Bp, Cp		Ap	
Minutes from meetings, newsletters		A, B, C				Bp, Cp		Ap
Written documentation (standards, directives)		A, B	C			Bp		Ap, Cp
Seminar records		A, B, C				Bp, Cp	Ap	
Lessons learned records		A, B, C					Bp	Ap, Cp
Handbooks		A, B	C			Bp		Ap, Cp
Combination mode								
Communication networks, web fora	A		B, C				Ap, Cp	Bp
Organising conferences	A, B	C				Cp	Ap, Bp	
Intranet	A, B		C				Ap, Bp	Cp
E-learning	A, B		C				Ap, Bp	Cp
Database of best practices, information storage	B	A, C					Bp	Ap, Cp
Systematisation of terms in the knowledge system	B	A, C				Cp	Bp	Ap
Database updates	B	A	C					Ap, Bp, Cp
Internalisation mode								
Practice simulation	B	A	C			Bp	Ap	Cp
Learning by doing	B	A, C			Bp	Cp	Ap	
Trial x error	B	A, C			Bp	Cp	Ap	
Lectures	A, B	A, C			Bp	Cp	Ap	
Training programmes	A	B	C				Ap, Bp	Cp
Encouraging workers to use explicit knowledge in organisational measures	A, B	A, C			Bp		Ap, Cp	
Suggesting available banks of explicit knowledge	A, B	A, B, C					Ap, Bp, Cp	

The graphic illustration (see Figure 6) of the results could be performed after converting the verbal answers into numerical expression. The defined levels of maturity of BI implementation were assigned a score identical to the designation (0-3). Table 4 summarises the achieved results in all modes of Nonaka's model as well as for the addressed companies.

Table 4. Results in numeric expression. (Source: own processing)

Mode of knowledge sharing / Corporate setting	**Current situation**				**Potential – possible future status**			
	A	B	C	Sum	Ap	Bp	Cp	Sum
Socialisation mode	4	8	4	16	16	13	6	35
Externalisation mode	7	5	6	18	18	6	11	35
Combination mode	3	2	11	16	17	16	16	49
Internalisation mode	2	2	9	13	14	5	13	32
Sum	16	17	30		65	40	46	

Figure 6 shows the graphic illustration where the solid line indicates the level of current application and the broken line indicates the estimated potential of the application of business intelligence.

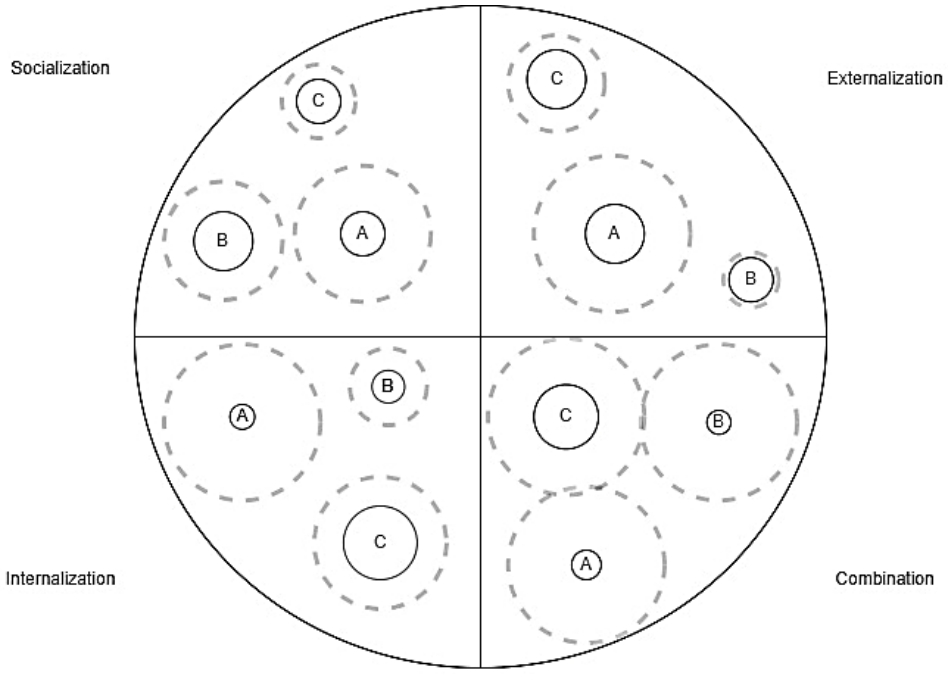


Figure 6. : Graphic illustration of current and potential application BI tools in KM. (Source: own processing)

5. Discussion

As far as the assessment of the current connection and application of business intelligence within knowledge management is concerned, organisation C, i.e., the large organisation, has made the most progress according to the results. This could be explained by a longer company history and thus a better use of the experience acquired within work with data, information or knowledge (value 30). Organisation A and organisation B achieved half the value (16 and 17) in the self-assessment of the current situation. As the results of the assessment of the business intelligence application potential imply, the organisations are aware of the possibilities and advantages that the

future application offers. Especially the potential values of the small, start-up company correspond with the optimistic expectations related to the future development of the small organisation (from 16 to 65). The largest company from the presented study, organisation C, is more cautious about further expansion and estimates improvement at a lower value (from 30 to 46). The medium-sized company thinks similarly to the large company and cautiously estimates expansion of the engagement of business intelligence within knowledge management from 17 to 40.

As far as the individual modes are concerned, the differences were not large (16, 18, 16 and 13). The data analysis is most frequently used in knowledge conversion within externalisation when tacit knowledge transforms into explicit knowledge. The knowledge hidden so far is expressed. The use of databases and information and telecommunication technologies facilitates this method of knowledge conversion (López-Sáez et al. 2010b), computer systems are used for obtaining information and knowledge, and also as a database for storing such information and knowledge (Faith and Seeam 2018a). The analysis of such recorded knowledge and its assessment using business intelligence has its place in the companies. The formalisation also leads to new knowledge, accessible and available to all other co-workers in the future (Farnese et al. 2019b).

Tools applied in the combination mode excel in the assessment of the potential (value 49). In this mode, explicit knowledge is knowledge collected inside or outside the organisation and then combined, modified or processed to create new knowledge. The new explicit knowledge is then spread among the members of the organisation (Nonaka, Toyama, and Konno 2000b). These processes of sharing information create a higher level of knowledge such as models, best practices, handbooks and information that may also spread without interpersonal relations (Farnese et al. 2019b; van den Hooff and de Ridder 2004). The application of business intelligence is thus obvious and the addressed companies assess this issue the same way.

In the future, the companies see a similar application of BI in the externalisation mode (35) as well as in socialisation (also 35). The results indicate an increase in the scope of the business intelligence application in the records and analysis of the transformation of tacit knowledge to explicit knowledge, but they also see a potential in the transformation of tacit knowledge to tacit. This knowledge conversion is performed at an interpersonal level and allows defining patterns of 'how to do things' or reckon with events, beliefs, representations of objects and models of professional practices (Farnese et al. 2019b). Acquisition occurs with the use of observation, imitation and practice, which is a typical example of sharing knowledge from a mentor to the apprentice; in business, the same training principle is used, known as on-the-job training (Nonaka 1991). The addressed companies chose group work, joint projects or provision of training and workshops as other methods where BI can be used.

6. Conclusion

The objective of the presented study was to find a suitable connection between business intelligence and knowledge management. Most companies, more or less, work with both tools. However, the scientific community deals with the two methods separately, as the extensive literary research showed. However, its thorough processing indicated a suitable connection thanks to the case study using an example of specific methods and techniques. The individual modes of Nonaka's model may be very abstract for managers within operative management. Therefore, specific tools applied to a specific type of knowledge conversion were selected. The main contribution thus lies in the thorough assessment and systematisation of the methods used in knowledge management, as well as in the outline of the optimal use of data analytics in selected processes.

The study has its limitations, just like other studies. The study only refers to three companies and the presented output thus only reflects the reality using a very small sample. However, this deficiency is outweighed by the contributions that the case study offers, characterised above. The

verification of the presented approach was also performed only in companies operating on the Czech market. However, this sample was found sufficient for the fulfilment of the original intention of the long-term study.

The study can be extended in several different directions in further stages. The qualitative research can focus on in-depth interviews in the individual companies in the specified area. A more extensive questionnaire survey could be performed using quantitative research to supplement the already obtained outputs based on qualitative collection of information. Also, based on the available outcomes, the future study could focus on suggesting recommendations related to the individual methods used within knowledge management so that the tools of business intelligence could be applied in the most effective way.

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