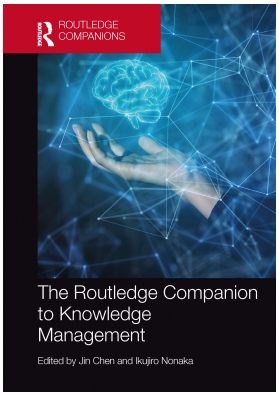

The Routledge Companion to Knowledge Management

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The Spiral of Knowledge Creation in a Dynamic and Evolving Business Environment

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THE SPIRAL OF KNOWLEDGE CREATION IN A DYNAMIC AND EVOLVING BUSINESS ENVIRONMENT

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A Glance at Knowledge-based Economy: Knowledge, Innovation and Competitiveness

In recent years, there has been a growing interest among companies, institutions and scholars in the knowledge-based economy, which has led to studies, research and institutional debates.

Knowledge-based economy has been identified as one of the pillars of the 21st century.

Since the Lisbon European Council in 2000 fixed the goal for Europe to "become the most competitive and dynamic knowledge-based economy in the world", the theory of knowledge management (KM) has attracted the attention of multiple stakeholders and policy makers interested in promoting smart, sustainable and socially inclusive growth.

One of the main features of knowledge-based economy is that it is rooted in intellectual capital, skills, dynamic capabilities and the ability of organisations to enable them. The basic factors include "a greater reliance on intellectual capabilities than on physical inputs or natural resources, combined with efforts to integrate improvements in every stage of the production process, from the R&D lab to the factory floor to the interface with customers" (Powell and Snellman, 2004, p. 201).

As the French philosopher Jean Francois Lyotard already theorised in the late 1970s in his seminal work *The Postmodern Condition: A Report on Knowledge*, knowledge acquisition is not the final aim but is functional to the achievement of economic objectives (Olson and Lyotard, 1995).

With this in mind, the importance of "knowledge" grew on the wake of Nelson and Winter's evolutionary theories of economic change (1985), becoming the main driving force of the development and growth process and supplanting the central role played by "material" resources in Ford's *weltanshauung*.

Over the years, there has been a growing awareness that the "fast development of technologies and the rapidly changing markets, combined with increased global competition and changing customer demands, imply that a company focused just on production capacity and cost reduction can only generate a temporary competitive advantage" (Cillo et al., 2019, p. 532).

In particular, the spread of technology innovation enabled by the "Knowledge Society" have triggered a disruptive development that has transformed the characteristics of work

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as well as the organisation of production, leading tangible and intangible assets to play a different role in businesses (Castelfranchi, 2007). This confirms that the basic neoclassical assumptions about profit maximisation and market equilibrium are not adequate to capture the dynamics of technological innovation and competition between companies.

These transformations are closely linked to the rising role of "intangible" capital in gross domestic product (Abramovitz and David, 1996). As a matter of fact, interest of companies in intangible assets and knowledge has grown significantly in many OECD countries, leading intangible investment to exceed tangible investment (Laghi et al., 2020).

In this context, KM has been identified as a strategic managerial process for gaining a competitive advantage. In particular, it is based on the assumption that tangible resources lead to a competitive advantage only if they are managed with specific knowledge (Grant, 1996). The advantage lies in differentiation and, in particular, in the complexity of imitating knowledge (Nonaka, 1994; Nonaka and Takeuchi, 1995; Meroño-Cerdán, Soto-Acosta and López-Nicolás, 2008).

Following these basic factors, over the past 20 years, KM theory has evolved in its capacity to interpret institutional, social and economic phenomena, providing conceptual and operational tools to manage ongoing change.

A first issue arose, with regard to the types of knowledge and their interaction.

Scholars have recognised three main forms of knowledge: explicit, implicit and tacit knowledge. These different types of knowledge work together: explicit knowledge resides in documented information; implicit knowledge is based on applied information; tacit knowledge, which plays a strategic role for the competitive advantage of businesses, is linked to the so-called "understood information".

Within the multitude of theories, constructs and tools developed in the scientific literature to explain the contribution of knowledge to the development and growth of organisations, the knowledge creation model developed by Nonaka and Takeuchi is widely recognised as a theoretical milestone. In particular, it emphasises on the role of tacit and explicit knowledge in organisations.

The model was first presented in 1991 by Nonaka, although it was later extended and deepened in the popular book *The Knowledge Creating Company* by Nonaka and Takeuchi (1995).

It is based on four main dimensions of knowledge and is generally referred to as SECI model (the acronym refers to the processes of Socialisation, Externalisation, Combination, and Internalisation).

The SECI model has achieved widespread success, particularly among managers and entrepreneurs, thanks to its practical nature and clear description of knowledge types, starting from the difference between tacit and explicit knowledge already promoted in management theory by Polanyi (1958).

The model stands out because it defines knowledge creation as a dynamic process based on the continuous interaction between tacit and explicit knowledge and across different levels (individual, organisational, inter-organisational) (Nonaka, 1994; Nonaka and Takeuchi, 1995; von Krogh et al., 2001; Ngai, Jin and Liang, 2008; Terhorst et al., 2018).

The central theoretical and practical implication of the model is that in order to improve both tacit and explicit knowledge stocks, companies must continuously promote knowledge sharing between individuals and groups.

A second issue arose in the scientific debate concerning the balance between *internal* and *external resources* of organisations, to deal with *continuous innovation*.

To survive and to compete in a dynamic environment, companies should develop high capabilities and sufficient knowledge capital to innovate continuously and to gain a competitive advantage (Lianto, Dachyar and Soemardi, 2018). On the other hand, to innovate continuously, companies need to focus on a long-term perspective and also acquire the wisdom to ensure that their interests are aligned with those of society (Nonaka and Tekeuchi, 2009).

Innovation is the consequence of new knowledge acquired through cumulative processes of various exchanges of internal and external knowledge (Menon and Pfeffer, 2003). For this reason, internal and external knowledge are seen as complementary in the innovation strategy.

Since innovation is the result of the ability to share, combine and create new knowledge, a balanced mix of internal and external knowledge sources can also enable better exploitation of business opportunities (Vrontis et al., 2017).

This phenomenon is consistent with the open innovation paradigm, according to which much of the knowledge needed to create new products and services comes from outside and explains why companies increasingly need to collaborate with other players to strengthen their innovative capacity (Vrontis et al., 2017).

According to Nonaka and Toyama (2007), "as knowledge is created in dynamic interactions with the environment, managing the knowledge creating process requires the ability to foster and manage those interactions according to the situation" (p. 377).

In line with this perspective, Zhang and Huang (2020) explored the knowledge creation and conversion model by studying knowledge flows within and between organisations on the basis of open innovation principles.

A third relevant issue regarding the KM theory is the emerging risks and opportunities concerning information and communication technologies (ICTs) that is attracting attention from several research perspectives. Among the many contributions made in this direction, several studies have explored the role of KM (Caputo et al., 2019).

In the paper *From information processing to knowledge creation: A paradigm shift in business* management, Nonaka, Umemoto and Senoo (1996) have shown how information technology (IT) can enable the process of "the knowledge-creating company". The authors present the theory of organisational knowledge creation as a management paradigm for the emerging "knowledge society" and provide several practical examples and applications.

The emerging challenges and opportunities derived from ICTs for KM are attracting interest and efforts from multidisciplinary scientists, promoting the integration and cross-fertilisation of research domains.

In particular, the spread of the Industry 4.0 paradigm has opened a new era, described as "The Fourth Industrial Revolution", which has been leading to the digitisation of all industrial processes, as well as the integration of different aspects of production and the interconnection between different departments and functions. In this scenario, companies are adopting technology to develop process and product innovations and to achieve greater value. To successfully manage these processes, companies need to develop knowledge, processes and infrastructure (Caputo et al., 2019). Knowledge management in the context of Industry 4.0 (KM 4.0) has a strategic and operational function which includes both exploration and exploitation processes. KM 4.0 enables value generation through improved knowledge generation and utilisation capabilities and facilitates the development of collective human-machine intelligence (Ansari, 2019).

In this context, the model of knowledge creation introduced by Nonaka is a useful tool for interpreting and addressing economic and social challenges, calling for new studies on

the antecedents of knowledge creation, the mediating factors and the main impacts at individual, organisational and inter-organisational levels.

Towards a Theory of Knowledge Acquisition and Creation

According to knowledge-based theory, knowledge is the main source of competitive advantage (Foss, 1996; Grant, 1996). In particular, the development of efficient processes for the extraction and creation of value through KM becomes a strategic factor in improving performance (Hsu and Sabherwal, 2011)

To this end, the SECI model described an interaction process through which knowledge is transmitted in a spiral dynamic, where the value of knowledge increases through interactions between individuals and groups. The model highlights that the simple existence of knowledge is not sufficient to achieve a sustainable competitive advantage: knowledge only leads to added value when organisations manage it in an appropriate way.

In this scenario, the transition to knowledge-based economy requires a semantic change in the conceptualisation of knowledge and information and indicates an alternative perspective in the scientific literature.

As Wallace (2007) points out,

> the presentation of the relationships among data, information, knowledge, and sometimes wisdom in a hierarchical arrangement has been part of the language of information science for many years. […] The ubiquity of the notion of a hierarchy is embedded in the use of the acronym DIKW as a shorthand representation for the data-to-information-to-knowledge-to-wisdom transformation.

The popular data-to-information-to-knowledge-to-wisdom (DIKW) paradigm emphasises that the integration of data leads to information, and the integration of information, in turn, leads to the creation of knowledge (Hicks, Dattero and Galup, 2007).

Therefore, KM has more elements of complexity than data or information (Al-Alawi, Al-Marzooqi and Mohammed, 2007), becoming a source of competitive advantage only when it is spread to create new organisational knowledge or innovation (Kinnear and Sutherland, 2000).

The development of both theory and practice in this emerging field is being driven by two main strategic issues: on one hand, since knowledge generally is embedded in peoples' heads (Lee and Yang, 2000), managers and scholars have extensively analysed how to facilitate the conversion of tacit knowledge into explicit knowledge; on the other hand, since internal knowledge is not enough to create innovation, a plethora of research in recent years has questioned how to integrate and balance internal knowledge with knowledge acquired outside the company. In particular, some studies have focused their attention on how to explore and exploit external knowledge in order to achieve a competitive advantage.

Tacit and Explicit Knowledge

Reciprocal influence between tacit and explicit knowledge constitutes the foundation of knowledge creation. According to Nonaka and Takeuchi (1995), this process is characterised by holistic dynamics, which, through the transformation of knowledge from tacit to explicit, bring to life a new type of knowledge.

As the SECI model underlines, knowledge creates value through the interaction between individuals and groups at different organisational levels.

Following Penrose (1959) and Polanyi's (1958) insights, management studies generally make a difference between explicit and tacit forms of knowledge.

Polanyi (1967) stated that the relationship between tacit and explicit knowledge can be symbolised through the metaphorical image of an iceberg.

Explicit knowledge represents the visible part of the iceberg above the surface of the water: it is knowledge which we consciously manage, encode and transfer through formal language. To cite some practical examples, we can refer to the various forms of institutional communication, training and brainstorming initiatives, such as conferences and training courses, as well as tools to codify, share or protect knowledge, such as websites, social media, databases, manuals and patents.

Explicit knowledge, however, relies on a deeper system of tacit knowledge and is therefore associated with the submerged part of the iceberg. It is linked to the know-how of individuals, embedded in the specific work context and based on routines and habits of which individuals are often unaware (Warnier, 1999).

The concept of tacit knowledge indicates the different forms of knowledge that cannot be explicitly expressed and codified through documents. The complexity of this form of knowledge is also due to its cognitive and technical nature: the cognitive nature relates to the mental models, beliefs and scripts that underlie individuals' perceptions; on the other hand, the technical component of knowledge concerns the know-how and professional skills.

Although this knowledge is managed at an unconscious level, it can be used by individuals in problem-solving and decision-making processes (Reber, 1989).

Although tacit knowledge has been neglected in the KM literature, in recent years, it has been recognised as a key factor in managing globalisation, complexity and turbulence associated with the exponential progress of IT (Howells, 1996; Johannessen, Olaisen and Olsen, 2001).

In particular, the consolidation of the resource-based view of companies has led the managerial literature to consider tacit knowledge as central to the acquisition of a sustainable competitive advantage. As a matter of fact, tacit knowledge is rare and difficult to imitate and transfer (Ambrosini and Bowman, 2001). Since it can be transferred only through personal interaction, it plays a critical role in differentiation and innovation strategies (Senker, 2005).

Explicit knowledge, on the other hand, is rational, sequential and theoretical in nature.

According to Nonaka and Takeuchi (1995), while tacit knowledge is individual, context-specific and difficult to transmit, explicit knowledge is codified and as such can be disseminated through formal language such as documents, operating procedures and manuals.

In this context, information systems can play a strategic role in accelerating the dissemination of explicit knowledge resources within organisations, e.g. through intranets, or at the inter-company level through the internet, based on a structured, managed and scientific learning process.

External and Internal Knowledge Sources

One of the most strategic decisions that companies have to make when faced with the challenges of knowledge creation and innovation concerns sourcing strategy. In particular, companies have to decide whether to create valuable knowledge internally or through external sourcing.

Consistent with the early studies conducted to explore the effects of boundary spanning in innovative environments, several researches related to R&D management have shown that in a dynamic high-tech research environment, the ability to cross organisational boundaries is extremely important (Ebadi and Utterback, 1984)

To this aim, KM strategy should be conceptually differentiated into two sub-dimensions: internally and externally oriented strategy (Choi, Poon and Davis, 2008).

The internally oriented strategy stresses the role of knowledge creation and sharing within the organisation; on the other hand, the externally oriented strategy highlights the function of learning, imitation and knowledge transfer at an inter-organisational level (Choi, Poon and Davis, 2008).

Internal knowledge creation occurs within the boundaries of the company, for example, through internal R&D activities. In these cases, as several studies point out, a companies' ability to innovate depends largely on its internal capabilities and resources (Becheikh, Landry and Amara, 2006).

However, many companies increasingly rely on knowledge acquired from external sources to enable the development of internal capabilities (Kim, 1997).

In recent years, many management studies have shown that the use of external knowledge sources are crucial to increase the innovation capacity of a company (Caloghirou, Kastelli and Tsakanikas, 2004; Cassiman and Veugelers, 2006). For example, research on strategic alliances (Grant and Baden-Fuller, 2004; Khamseh and Jolly, 2014) and joint ventures (Inkpen and Dinur, 1998; Dhanaraj et al., 2004) stress the importance of acquiring knowledge from external sources. In particular, it has been shown that heterogeneous knowledge enhances innovation success: on one hand, by providing multiple learning opportunities and, on the other hand, by diversifying risk (Rodan, 2002; Ye, Hao and Patel, 2016).

In this context, Nonaka and Takeuchi (1995) emphasise the crucial role of the interaction between individuals and their organisations in the creation and acquisition of knowledge and also highlight the importance of external knowledge in the innovation process.

Knowledge creation based on external sources takes place when boundary spanners bring in new knowledge through acquisition or imitation. This knowledge is then shared with the whole organisation. A practical example of this is the learning that takes place through conference attendance or through training activities provided by suppliers of new technological services and products.

Both types of sourcing are important for the company and are generally seen as mutually interdependent and complementary (Bierly and Chakrabarti, 1996).

Therefore, several studies have argued that in order to improve innovative performance and achieve a competitive advantage, companies should integrate internal and external knowledge (Iansiti and Clark, 1994).

Although numerous studies have shown that both learning from external and internal sources are important sources for knowledge creation, another key element needs to be considered: the ability to explore, absorb and exploit knowledge.

Since it is not possible to create new knowledge without considering already existing knowledge, several studies pay specific attention to *absorptive capacity* as the capacity to explore and exploit technological opportunities developed outside the company (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998; Zahra and George, 2002).

The concept of *absorptive capacity* was introduced by Kedia and Bhagat (1988). However, it was the conceptualisation proposed in the seminal studies of Cohen and Levinthal (1989) that made this construct so influential in the management and organisational literature.

Cohen and Levinthal (1990) defined absorptive capacity as "[…] an ability to recognise the value of new information, assimilate it, and apply it for business purposes" (p. 128).

Based on the Cohen and Levinthal (1989, 1990) studies, Zahra and George (2002) added that absorptive capacity is "a dynamic capability that influences the creation of other organisational competencies and provides the company with multiple sources of competitive advantage (p. 186)". In particular, absorptive capacity implies the ability to manage the tacit nature of the absorbed knowledge (Mowery and Oxley, 1995) and requires particular attention on the ability to solve problems and to learn (Kim, 1997). In light of these observations, absorptive capacity can be defined as "a set of organisational routines and processes through which companies acquire, assimilate, transform, and exploit knowledge to produce a dynamic organisational capability" (Zahra and George, 2002; p. 187).

In this context, *organisational ambidexterity* has catalysed growing attention (Adler et al., 1999; Gibson and Birkinshaw, 2004).

When a company is ambidextrous, it is able to both exploit existing expertise and explore new opportunities, thereby improving its performance (Carayannis and Rakhmatullin, 2014) and achieving competitive advantage (Del Giudice, Della Peruta and Maggioni, 2013). In particular, companies access different ideas and knowledge through collaboration with customers, suppliers, competitors, consultants, universities and research centres (Vrontis et al., 2017) and subsequently exploit this knowledge to create new innovative products and services (Del Giudice and Straub, 2011; Del Giudice and Maggioni, 2014).

As a result, many studies have analysed the spiral of knowledge creation process within the "open innovation" paradigm (Martin and Allen, 2013; Wu and Hu, 2018; Bereznoy, Meissner and Scuotto, 2021).

Coherently with the "open innovation" paradigm postulated by Chesbrough (2003, 2006), the effectiveness of innovation is closely linked to openness and co-operation mechanisms with external parties. In this vein, these studies explore the impact of stakeholder relations on a company's ability to "absorb" external knowledge (Cohen, Levinthal, 1989, 1990).

Open innovation is generally described as a distributed innovation process in which knowledge flows across company boundaries (Chesbrough and Bogers, 2014).

Based on Vygotskian theory, this paradigm requires decentralisation of research and development activities and a lean configuration of the organisation.

Coherent with what Hewitt and Scardamalia (1998) point out about "Distributed Knowledge Building Processes", the open innovation approach highlights that "knowledge exists in the way that social groups communicate, make use of symbols and tools, and organise their belief systems" (p. 77).

Since "the theory of the knowledge-creating company explains the differences among companies not as a result of market failure, but as a result of the company's visions of the future and strategy" (Nonaka and Toyama, 2005, p. 419), companies should improve their orientation towards openness and collaboration in order to access knowledge of the external environment (Scuotto et al., 2020) and to actively participate in the process of value co-creation with the innovation ecosystem according to the quadruple helix approach (Carayannis and Campbell, 2010; Carayannis and Rakhmatullin, 2014; Del Giudice, Carayannis and Maggioni, 2017; Abdulkader et al., 2020).

As Krogh, Nonaka and Aben argue (2001),

> companies can leverage their knowledge throughout the organisation, expand their knowledge based on existing expertise, appropriate knowledge from partners and other

> organisations, and develop completely new expertise by probing new technologies or markets. The two core processes of knowledge creation and transfer are central to the execution of these strategies, as are the company's domains of knowledge (p. 421).

However, collaboration processes between individuals within and across organisations have several factors that inhibit knowledge sharing. These factors are syntactic (lack of knowledge sharing), semantic (lack of knowledge translation) and pragmatic (lack of interest in sharing knowledge) in nature (Bartel and Garud, 2009).

However, tacit knowledge can be difficult to transfer and share. It is embedded in the actions, values, emotions, professional experience and know-how of individuals.

While explicit knowledge is easy to codify and transfer, tacit knowledge has several limitations that may inhibit sharing processes at an organisational and inter-organisational level (Nonaka and Takeuchi, 1995). Several scholars confirm that individuals possess both tacit and explicit knowledge. Only explicit knowledge is available, codified and sharable. Tacit knowledge, on the other hand, resides in people, is not codified and therefore its socialisation is problematic (Song and Chermack, 2008). This explains why organisational behaviour and knowledge management literature has dedicated a lot of attention to informal knowledge and learning processes (Hoe, 2006).

Despite numerous interdisciplinary studies, many challenges remain.

The Spiral of Knowledge Creation

Knowledge Creation as a Dynamic and Dialectic Process

As authors Ichijo and Nonaka (2007) highlight in their book *Knowledge Creation and Management: New Challenges for Managers*, rapid changes in the competitive environment and pressing stakeholder expectations related to environmental, social and economic issues have created new challenges for practitioners and scholars.

In this framework, knowledge generation is crucial to ensure the adaptation of companies to the external environment. As theorised by Nonaka (1994), it can be described as a systemic, dynamic and continuous process that emerges and recurs over time.

As previously mentioned, the codification and conversion of tacit knowledge is a strategic factor for creating new knowledge and presents enormous challenges (Nonaka, 2004).

Reviewing the main managerial and organisational studies, Hicks, Dattero and Galup (2007) developed a metaphor for knowledge management (KM) defining it as "explicit islands in a tacit sea". The authors specified that explicit knowledge is comparable to an island sustained by the tacit knowledge sea. Moreover, they stated that tacit knowledge is crucial for creating, executing and maintaining explicit knowledge.

Tacit and explicit knowledge have a complementary nature. Through a dynamic process, the conversion from one state to the other is facilitated by social interaction. In addition, the conversion of tacit knowledge into explicit knowledge develops the conditions to enable the process of knowledge generalisation from the individual level to the organisational and inter-organisational level (Herschel, Nemati and Steiger, 2001; Choo, 2006).

While individuals have a strategic role in developing new knowledge, organisations articulate and amplify this knowledge (Nonaka, 1994).

Starting from the premise that knowledge creation is based on the interaction between tacit and explicit knowledge, Nonaka and Takeuchi (1995) develop a matrix model where four different modes of knowledge conversion operate.

Individual knowledge is socialised and becomes, "part of the knowledge network of an organisation" (Nonaka, 1994, pp. 17–18). More specifically, knowledge creation amplifies individual knowledge and crystallises it as part of an organisation's knowledge system (Nonaka, Takeuchi and Umemoto, 2014).

This process is labelled as a "spiral" and involves an interplay between socialisation (from tacit to tacit knowledge), externalisation (from tacit to explicit knowledge), combination (from explicit to explicit knowledge) and internalisation (from explicit to tacit/implicit knowledge).

The SECI model, unlike previous KM models, is not based on a sequential evolution of knowledge, but develops a holistic dynamic in which the conversion of knowledge from one type to another leads to a new quality of knowledge (Bandera et al., 2017).

The dynamic interaction between knowledge dimensions generates a spiral conversion process that fosters a quantitative and qualitative expansion of knowledge. In this sense, one of the main practical implications of the model is that organisations should combine and co-ordinate all modes of conversion through different policies and practices (Nonaka, 1994).

While the volume *Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation* (Nonaka and Tekeuchi, 1995) emphasised the difference between "explicit knowledge" and "tacit knowledge", *The Wise Company: How Companies Create Continuous Innovation* (Nonaka and Tekeuchi, 2019) addresses the gap between knowledge creation and knowledge practice and, in particular, the overcoming of the "SECI block". As a matter of fact, the process of knowledge creation in the SECI model can be blocked if an organisation is not able to implement the sequential, horizontal movement from socialisation to externalisation, combination and internationalisation, or if organisations are not able to make a vertical leap from one cycle of SECI to the next. Referring to several business cases, the authors highlight some leadership practices that characterise the wise company. The study, in particular, focuses on the need for organisations to create new common meanings through human interactions and recalls the Japanese concept of "ba" already introduced in 1998 by Nonaka and Konno in order to better understand the fundamental conditions for nurturing knowledge creation.

"Ba" can roughly be translated to the English word "place" and can be described as a platform at the basis of individual and organisational knowledge development. This shared space can be physical, such as the workplace, or virtual, such as teleconferences. It can also be mental, such as shared experiences.

Drawing on internal knowledge resources, organisations develop new knowledge through the SECI dynamic that resides in "ba". This process is continuous. In fact, new knowledge forms the foundation for a new spiral of knowledge creation (Nonaka, Toyama and Konno, 2000; Nonaka, Konno and Toyama, 2001; Nonaka, Toyama and Byosière, 2001).

Nonaka and Toyama (2003) further extended the knowledge creation model and the concept of "ba" by integrating the perspective of dialectical thinking. In particular, the authors highlight how the dynamic relations at individual, intra-organisational and inter-organisational level could generate various idiosyncratic effects in the knowledge creation process. In order to manage such effects, companies should improve "synthesis capabilities" starting from the knowledge vision and "ba", considering also human resource management policies and organisational structures, incentive systems and leadership models (Nonaka and Toyama, 2002, 2003). In this context, Nonaka et al. (2006) point out that "[…] knowledge originates in ba, and therefore the concept of ba assumes a particular importance in organisational knowledge creation theory".

Thus, the concept of "ba" occupies a strategic role in Nonaka's studies. Despite numerous research findings in this area, further studies are needed (Nonaka, Von Krogh and Voelpel, 2006; Nonaka and Von Krogh, 2009), also in light of recent social, organisational and economic changes imposed by technological advancement and, in particular, by COVID-19, which has induced emerging KM strategies, new organisational models and different ways of working.

The Four Dimensions

To depict the knowledge conversion process, the SECI model introduces four main dimensions: Socialisation; Externalisation; Combination; Internalisation (Nonaka, 1994).

The first stage of the spiral is *Socialisation*, which occurs when individuals exchange tacit knowledge. More specifically, Socialisation has been described as the conversion of tacit knowledge into more complex tacit knowledge throughout shared experiences, observation and imitation.

Since this process occurs even in the absence of formal language, tacit knowledge formalisation is problematic. The main difficulty lies in enucleating tacit knowledge from the context and time in which it occurred. Hence, its sharing and acquisition can only occur when individuals directly share work experiences. Working side by side, for example, promotes learning and the acquisition of tacit knowledge. A practical example of this is apprenticeship programmes in which new recruits acquire tacit knowledge by observing the work of senior colleagues (Nonaka and Toyama, 2003). Socialisation can also take place through informal social interactions, where tacit knowledge, values and mental models can be shared. A practical example is lunchtime chats or tea breaks with colleagues (Yoshimichi, 2011).

Basically, this first stage concerns the interpersonal level and, in particular, the sharing of values, beliefs, models and working practices. Therefore, the main factor for enabling socialisation is experience.

Assuming that according to Nonaka and Konno (2005) the simple transfer of information is meaningless if it is unrelated to specific context, we can state that shared experiences and mental models promote socialisation through the creation of a common "field" of interactions.

The next mode of knowledge conversion is *Externalisation* through which tacit knowledge is converted into new explicit knowledge through formal documents or explicit activities. Individuals encode tacit knowledge and use dialogue, metaphors and group comparisons to externalise knowledge.

Externalisation is based on the conversion of tacit knowledge into explicit knowledge (Nonaka and Takeuchi, 1995).

Since "members come and go, and leadership changes, but the memories of organisations retain certain behaviours, mind maps, norms and values over time" (Hedberg, 1981, p. 6), it is necessary that this knowledge becomes an organisational resource and not only of the individuals directly involved.

Therefore, an important issue is the generation of crystallised knowledge through metaphors, concepts and models, which represents the "organisational memory" and leads to new knowledge that can be used by other members of the organisation (Hedberg, 1981). Hence, as a result of this dynamic, knowledge can be shared between individuals and becomes the basis of new knowledge.

As pointed out by Nonaka, von Krogh and Voelpel (2006), this process is at the basis of "synthesising", where new models or mind maps are created and linked to the organisation's knowledge system.

The next mode that characterises the spiral of knowledge is *Combination*, in which explicit knowledge is combined with other explicit knowledge at an intra- or inter-organisational level to form new, more complex explicit knowledge (Nonaka et al., 1996). For this reason, Wickes et al. (2003) describe combination as the conversion of explicit knowledge into more complex explicit knowledge.

The source of explicit knowledge may be internal or external to the company. Through formal interactions, such as meetings or working groups, various types of explicit knowledge are combined and modified to generate new explicit knowledge, which is then shared with members of the organisation (Alavi and Leidner, 2001).

Because of the explicit nature of knowledge, which enhances coded information sharing, IT can have a crucial role in the conversion process.

In particular, the adoption of digital communication networks and business intelligence systems can accelerate this mode of knowledge conversion. For this reason, an increasing number of studies in recent years have analysed the role of groupware, online databases, intranets and virtual communities in combining various types of explicit knowledge (Koh and Kim, 2004).

From these knowledge-sharing processes, higher-order knowledge is created through templates, best practices, manuals and information systems (Van den Hooff and Van Weenen, 2004). The high rate of formalisation of this knowledge guarantees its dissemination even in the absence of interpersonal relations.

The last mode of the SECI spiral is *Internalisation*. According to Nonaka and Takeuchi (2019), "explicit knowledge created and shared throughout an organisation is then converted into tacit knowledge by individuals. This stage can be understood as praxis, where knowledge is applied and used in practical situations and becomes the base for new routines" (p. XIII).

The acquisition of new explicit knowledge by individuals amplifies their tacit knowledge and becomes the basis for a new process of transfer and application in practical situations.

Internalisation is the process of transforming explicit knowledge into tacit knowledge. In order for the individual to internalise new knowledge, practical actions are required. In particular, individual learning can be facilitated by practical experiences, observation, direct social interactions and training programmes. Through training activities, individuals can acquire new knowledge by enriching their mental models and professional know-how.

This new internalised knowledge is re-socialised in the knowledge spiral, triggering further conversion processes.

The internalisation process can be fostered by various textual forms, such as written, video or audio modes. According to Nonaka and Takeuchi (1995), particularly, to foster the internalisation process, it is necessary to adopt documentation and manuals through which individuals can learn from the experience of other members of the organisation. Therefore, Nonaka (1994) calls the knowledge created by an internalisation process "operational knowledge".

The interaction between the described modes of conversion originates the spiral of knowledge generation (Nonaka, 1994).

The SECI model has been successfully applied in various disciplines, for instance, in engineering, and in other fields of research, such as general manufacturing (Li et al., 2018), automotive manufacturing (Erichsen et al., 2016) and software engineering (Chikh, 2011). Furthermore, the model has been applied in cross-cultural studies set in Japan (Bratianu, 2010), United Kingdom (Scully et al., 2013) and Africa (Ngulube, 2005).

Conclusions and Future Streams of Research

Following the growing debate about the knowledge society and the knowledge creation process, in this chapter, we have explained how during the past decade we have observed an increase of studies about organisational knowledge from various perspectives.

In this scenario, the main aim of the contribution was to try to systematise these considerations and provide an overview of the scholarly literature in the social sciences on creation, reshaping, accumulation and crystallisation of knowledge within and across company boundaries.

According to the knowledge-based view (KBV), we highlighted that knowledge is the primary source of having a competitive advantage (Grant, 1996). Thus, the dynamics by which organisations explore and exploit knowledge become a strategic factor for value creation.

Although previous studies have already analysed knowledge creation from multiple perspectives, there is still a lack of knowledge about how emerging social and economic challenges can affect the concept of "the knowledge-creating company" (Nonaka, Umemoto and Senoo, 1996).

Research on knowledge creation has clearly highlighted that new knowledge is created by exploiting prior knowledge. Hence, the role of existing knowledge is strategic and deserves specific attention. As a matter of fact, it is difficult for companies to create new knowledge if they do not have a strong existing knowledge base.

As a preview to Nonaka and Takeuchi's (1995) knowledge creation theory, we have also stressed how the reciprocal influence between tacit and explicit knowledge constitutes the source of knowledge creation.

The codification of tacit knowledge and the internalisation of explicit knowledge lead to new and superior knowledge. In particular, labelling knowledge as "new" highlights that organisations are not just processing information, unlike a computer system, but are using their resources to create a superior level of knowledge (Nonaka, 1994).

Explicit knowledge is codified and as such can be disseminated through formal language such as documents, operating procedures and manuals. In this context, an open research question is to what extent information systems can play a strategic role in accelerating the dissemination of explicit knowledge resources.

On the other hand, tacit knowledge is central to the acquisition of a sustainable competitive advantage. As a matter of fact, tacit knowledge is rare and difficult to imitate and transfer.

Even if tacit knowledge has been neglected in the KM literature, in recent years, it has been recognised as a key factor in managing social, environmental and economic challenges. However, a lack of knowledge still exists regarding the transmission of tacit knowledge. More specifically, new studies are needed on the role of informal learning programmes (Enos, Kehrhahn and Bell, 2003) and lean organisational structures (Dombrowski, Mielke and Engel, 2012).

Through our analyses, we have highlighted that one of the most strategic decisions which companies have to make when faced with the challenges of knowledge creation and innovation concerns sourcing strategy. Specifically, companies have to decide whether to develop knowledge from internal or external sources. The main challenge then, is how to share, absorb and retain external knowledge internally. In this context, based on Nonaka and Takeuchi's knowledge creation theory, several studies have analysed knowledge creation dynamics in an open innovation paradigm context (Žemaitis, 2014).

As Chesbrough (2012, p. 701) argues

> [...] to transfer knowledge effectively so that companies can really make use of it, you need a certain amount of creative abrasion and a certain amount of time together, working on the problem. Open innovation works best when people are collaborating side by side.

Despite several advancements in this domain, a specific research gap in the literature concerns the practical approaches that companies should adopt to improve the absorption of knowledge from open environments. Studies conducted on KM, however, focus mainly on the typology and transfer of knowledge (Nonaka and Konno, 1998). What is missing and deserves further investigation is the definition of new managerial and organisational tools to improve knowledge acquisition and learning for innovation development activities. Moreover, fresh studies are needed to investigate to what extent openness orientation leads to better performance. As a matter of fact, the openness-performance connection is not always positive (Huang, Chen and Liang, 2018).

Also, the interaction between tacit and explicit KM across company boundaries suggests future research stream in an open innovation context.

To fill these gaps, a new strand of studies is needed to investigate how opportunities and barriers posed by socio-economic context can facilitate, boost and humanise the knowledge creation process.

In line with the words of Nonaka and Tekeuchi (2011), in order to go beyond economic breakdowns of the past two decades caused by an overemphasis on explicit knowledge, which inhibits companies from dealing with emerging challenges, a new generation of wise leaders is needed.

In this framework, the contribution which managerial and organisational scientific literature can provide is to identify a clear theoretical framework to conceptualise and transfer the ancient Greek concept of *phronesis* into practice.

Only by investing in experiential knowledge, businesses can enable "people to make prudent judgments in a timely fashion, and to take actions guided by values, principles, and morals" (Nonaka and Tekeuchi, 2019, p. 25).

References

Abdulkader, B., Magni, D., Cillo, V., Papa, A., & Micera, R. (2020). Aligning firm's value system and open innovation: A new framework of business process management beyond the business model innovation. *Business Process Management Journal, 26*, 999–1020.

Abramovitz, M., & David, P. (1994). Convergence and deferred catch-up. Productivity leadership and the waning of American exceptionalism. In Landau, R., Taylor, T. & Wright, G. (Eds.). *The Mosaic of Economic Growth*. Stanford: Stanford University Press (pp. 21–62).

Adler, P. S., Goldoftas, B., & Levine, D. I. (1999). Flexibility versus efficiency? A case study of model changeovers in the Toyota production system. *Organization Science, 10*(1), 43–68

Al-Alawi, A. I., Al-Marzooqi, N. Y., & Mohammed, Y. F. (2007). Organizational culture and knowledge sharing: Critical success factors. *Journal of Knowledge Management, 11*(2), 22–42

Alavi, M., & Leidner, D. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly, 25*, 107–136.

Ambrosini, V., & Bowman, C. (2001). Tacit knowledge: Some suggestions for operationalization. *Journal of Management Studies, 38*, 811–829.

Ansari, F. (2019). Knowledge management 4.0: Theoretical and practical considerations in cyber physical production systems. *IFAC-PapersOnLine, 52*, 1597–1602.

Bandera, C., Keshtkar, F., Bartolacci, M. R., Neerudu, S., & Passerini, K. (2017). Knowledge management and the entrepreneur: Insights from Ikujiro Nonaka's Dynamic Knowledge Creation model (SECI). *International Journal of Innovation Studies, 1*, 163–174.

Bartel, C. A., & Garud, R. (2009). The role of narratives in sustaining organizational innovation. *Organization Science, 20*(1), 107–117.

Becheikh, N., Landry, R., & Amara, N. (2006). Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993–2003. *Technovation, 26*, 644–664.

Bereznoy, A., Meissner, D., & Scuotto, V. (2021). The intertwining of knowledge sharing and creation in the digital platform based ecosystem. A conceptual study on the lens of the open innovation approach. *Journal of Knowledge Management*, *25*(8), 2022–2042.

Bierly, P., & Chakrabarti, A. (1996). Generic knowledge strategies in the U.S. pharmaceutical industry. *Southern Medical Journal, 17*, 123–135.

Bratianu, C. (2010). A critical analysis of the Nonaka's model of knowledge dynamics. In *Proceedings of the 2nd European Conference on Intellectual Capital*, ISCTE Lisbon University Institute, Lisbon, Portugal, 29–30 March 2010, pp. 115–120.

Caloghirou, Y., Kastelli, I., & Tsakanikas, A. (2004). Internal capabilities and external knowledge sources: Complements or substitutes for innovative performance? *Technovation, 24*, 29–39.

Caputo, F., Papa, A., Cillo, V., & Giudice, M. (2019). Technology readiness for education 4.0: Barriers and opportunities in the digital world. In Ordóñez de Pablos, P., Lytras, M.D., Zhang, X. & Tai Chui, K. (Eds), *Opening up education for inclusivity across digital economies and societies,* Pennsylvania (USA): IGI Global.

Carayannis, E., & Campbell, D. J. (2010). Triple helix, quadruple helix and quintuple helix and how do knowledge, innovation and the environment relate to each other? A proposed framework for a trans-disciplinary analysis of sustainable development and social ecology. *International Journal of Social Ecology and Sustainable Development, 1*, 41–69.

Carayannis, E.G., & Rakhmatullin, R. (2014). The quadruple/quintuple innovation helixes and smart specialisation strategies for sustainable and inclusive growth in Europe and beyond. *Journal of the Knowledge Economy, 5*(2), 212–239.

Cassiman, B., & Veugelers, R. (2006). In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition. *Management Science, 52*, 68–82.

Castelfranchi, C. (2007). Six critical remarks on science and the construction of the knowledge society. *Journal of Science Communication, 6*(4), 1–3.

Chesbrough, H. (2003). Open innovation: The new imperative for creating and profiting from technology. Boston, Mass: Harvard Business School Press.

Chesbrough, H. (2006). Open business models: How to thrive in the new innovation landscape. Boston, Mass: Harvard Business School Press.

Chesbrough, H., & Bogers, M. (2014). Explicating open innovation: Clarifying an emerging paradigm for understanding innovation. In H. Chesbrough, W. Vanhaverbeke, & J. West (Eds.), *New frontiers in open innovation*. Oxford: University Press (pp. 3–28).

Chikh, A. (2011). A knowledge management framework in software requirements engineering based on the SECI model. *Journal of Software Engineering and Applications, 4*, 718–728.

Choi, B., Poon, S., & Davis, J. G. (2008). Effects of knowledge management strategy on organizational performance: A complementarity theory-based approach. *Omega-international Journal of Management Science, 36*, 235–251.

Choo, C.W. (2006). *The knowing organization*. New York: Oxford University Press.

Cillo, V., Garcia-Perez, A., Giudice, M., & Vicentini, F. (2019). Blue-collar workers, career success and innovation in manufacturing. *Career Development International, 24*, 529–544.

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: The two faces of R&D. *The Economic Journal, 99*, 569–596.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly, 35*, 128–152

Dhanaraj, C., Lyles, M. A., Steensma, H., & Tihanyi, L. (2004). Managing tacit and explicit knowledge transfer in IJVS: The role of relational embeddedness and the impact on performance. *Journal of International Business Studies, 35*, 428–442.

Del Giudice, M., Carayannis, E., & Maggioni, V. (2017). Global knowledge intensive enterprises and international technology transfer: Emerging perspectives from a quadruple helix environment. *The Journal of Technology Transfer, 42*, 229–235.

Del Giudice, M., Della Peruta, M. R., & Maggioni, V. (2013). Collective knowledge and organizational routines within academic communities of practice: An empirical research on science–entrepreneurs. *Journal of the Knowledge Economy, 4*(3), 260–278.

Del Giudice, M., & Maggioni, V. (2014). Managerial practices and operative directions of knowledge management within inter-firm networks: A global view. *Journal of Knowledge Management, 18*(5), 841–846.

Del Giudice, M., & Straub, D. (2011). Editor's comments: IT and entrepreneurism: An on-again, off-again love affair or a marriage? *MIS Quarterly, 35*(4), iii–viii.

Dombrowski, U., Mielke, T., & Engel, C. (2012). Knowledge management in lean production systems. *Procedia CIRP, 3*, 436–441.

Ebadi, Y. M., & Utterback, J. (1984). The effects of communication on technological innovation. *Management Science, 30*, 572–585.

Enos, M., Kehrhahn, M., & Bell, A. (2003). Informal learning and the transfer of learning: How managers develop proficiency. *Human Resource Development Quarterly, 14*, 369–387.

Erichsen, J. A., Pedersen, A. L., Steinert, M., & Welo, T. (2016). Using prototypes to leverage knowledge in product development: Examples from the automotive industry. *2016 Annual IEEE Systems Conference (SysCon)*, 1–6.

Foss, N. (1996). More critical comments on knowledge-based theories of the firm. *Organization Science, 7*, 519–523.

Gassmann, O., Enkel, E., & Chesbrough, H. (2010). The future of open innovation. *R&D Management, 40*(3), 213–221.

Gibson, C. B., & Birkinshaw, J. (2004). The antecedents, consequences, and mediating role of organizational ambidexterity. *Academy of Management Journal, 47*(2), 209–226.

Grant, R. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, *17*(Suppl 2), 109–122.

Grant, R., & Baden-Fuller, C. (2004). A knowledge accessing theory of strategic alliances. *Journal of Management Studies, 41*, 61–84.

Hedberg, B. (1981). How organizations learn and unlearn. In P. Nystrom & W. H. Starbuck (Eds.), *Handbook of organizational design* (Vol. 1). London: Cambridge University Press.

Herschel, R. T., Nemati, H., & Steiger, D. (2001). Tacit to explicit knowledge conversion: Knowledge exchange protocols. *Journal of Knowledge Management, 5*(1), 107–116.

Hewitt, J., & Scardamalia, M. (1998). Design principles for distributed knowledge building processes. *Educational Psychology Review, 10*, 75–96.

Hicks, R. C., Dattero, R., & Galup, S. D. (2007). A metaphor for knowledge management: Explicit islands in a tacit sea. *Journal of Knowledge Management, 11*(1), 5–16.

Hoe, S. (2006). Tacit knowledge, Nonaka and Takeuchi SECI model and informal knowledge processes. *International Journal of Organization Theory and Behavior, 9*, 490–502.

Howells, J. (1996). *Technology analysis & strategic management*. London: Taylor & Francis.

Hsu, I., & Sabherwal, R. (2011). From intellectual capital to firm performance: The mediating role of knowledge management capabilities. *IEEE Transactions on Engineering Management, 58*, 626–642.

Huang, S., Chen, J., & Liang, L. (2018). How open innovation performance responds to partner heterogeneity in China. *Management Decision, 56*, 26–46.

Iansiti, M., & Clark, K. (1994). Integration and dynamic capability: Evidence from product development in automobiles and mainframe computers. *Industrial and Corporate Change, 3*, 557–605.

Ichijo, K., & Nonaka, I. (2007). *Knowledge creation and management: New challenges for managers*. New York: Oxford University Press.

Inkpen, A. C., & Dinur, A. (1998). Knowledge management processes and international joint ventures. *Organization Science, 9*, 454–468.

Johannessen, J., Olaisen, J., & Olsen, B. (2001). Mismanagement of tacit knowledge: The importance of tacit knowledge, the danger of information technology, and what to do about it. *International Journal of Information Management, 21*, 3–20.

Kedia, B., & Bhagat, R. (1988). Cultural constraints on transfer of technology across nations: Implications for research in international and comparative management. *Academy of Management Review, 13*, 559–571.

Khamseh, H.M., & Jolly, D. (2014). Knowledge transfer in alliances: the moderating role of the alliance type. *Knowledge Management Research & Practice*, *12*(4), 409–420.

Kim, L. (1997). *From imitation to innovation: The dynamics of Korea's technological learning*. Cambridge, MA: Harvard Business School Press.

Kinnear, L., & Sutherland, M. (2000). Determinants of organisational commitment amongst knowledge workers. *South African Journal of Business Management, 31*(3), 106–112.

Koh, J., & Kim, Y. (2004). Knowledge sharing in virtual communities: An e-business perspective. *Expert Systems with Applications, 26*, 155–166.

Krogh, G., Nonaka, I., & Aben, M. (2001). Making the most of your company's knowledge: A strategic framework. *Long Range Planning, 34*, 421–439.

Laghi, E., Marcantonio, M. D., Cillo, V., & Paoloni, N. (2020). The relational side of intellectual capital: An empirical study on brand value evaluation and financial performance. *Journal of Intellectual Capital*. https://www.emerald.com/insight/content/doi/10.1108/JIC-05-2020-0167/full/html.

Lane, P. J., & Lubatkin, M. (1998). Relative absorptive capacity and interorganizational learning. *Strategic Management Journal, 19*, 461–477.

Lee, C. C., & Yang, J. (2000). Knowledge value chain. *Journal of Management Development, 19*, 783–794.

Li, Z., Wang, W. M., Liu, G., Liu, L., He, J., & Huang, G. Q. (2018). Toward open manufacturing: A cross-enterprises knowledge and services exchange framework based on blockchain and edge computing. *Industrial Management & Data Systems, 118*, 303–320.

Lianto, B., Dachyar, M., & Soemardi, T. (2018). Continuous innovation: A literature review and future perspective. *International Journal on Advanced Science, Engineering and Information Technology, 8*, 771–779.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science, 2*(1), 71–87.

Mårtensson, M. (2000). A critical review of knowledge management as a management tool. *Journal of Knowledge Management, 4*(3), 204–216.

Martin, D., & Allen, A. (2013). Intermediaries for open innovation: A competence-based comparison of knowledge transfer offices practices. *Technological Forecasting and Social Change, 80*(1), 38–49.

Menon, T., & Pfeffer, J. (2003). Valuing internal vs. external knowledge: Explaining the preference for outsiders. *Management Science, 49*, 497–513.

Meroño-Cerdán, Á. L., Soto-Acosta, P., & López-Nicolás, C. (2008). How do collaborative technologies affect innovation in SMEs? *International Journal of e-Collaboration, 4*, 33–50.

Mowery, D., & Oxley, J. (1995). Inward technology transfer and competitiveness: The role of national innovation systems. *Cambridge Journal of Economics, 19*, 67–93.

Ngai, E., Jin, C., & Liang, T. (2008). A qualitative study of inter-organizational knowledge management in complex products and systems development. *Wiley-Blackwell: R&D Management*, *38*(4), 421–440.

Ngulube, P. (2005). Using the SECI knowledge management model and other tools to communicate and manage tacit indigenous knowledge. *Innovation-the European Journal of Social Science Research, 27*, 21–30.

Nonaka, I. (1991) The knowledge creating company. *Harvard Business Review, 69*, 96–104.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science, 5*, 14–37.

Nonaka, I. (2004). The knowledge-creating company. In H. Takeuchi & I. Nonaka (Eds.), *Hitotsubashi on Knowledge Management*. Singapore: Wiley.

Nonaka, I., & Konno, N. (1998). The concept of "Ba": Building a foundation for knowledge creation. *California Management Review, 40*, 40–54.

Nonaka, I., & Konno, N. (2005). The concept of Ba: Building a foundation for knowledge creation. *Knowledge Management: Critical Perspectives on Business and Management, 2*, 53.

Nonaka, I., Konno, N., & Toyama, R. (2001). Emergence of "Ba". A conceptual framework for the continuous and self-transcending process of knowledge creation. In I. Nonaka & T. Nishigushi (Eds.), *Knowledge emergence. Social, technical and evolutionary dimensions of knowledge creation*. Oxford and New York: Oxford University Press, pp. 3–29.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating Company: How Japanese companies create the dynamics of innovation*. Oxford: Oxford University Press.

Nonaka, I., & Takeuchi, H. (2011). The wise leader. *Harvard Business Review, 89*(5), 58–67, 146.

Nonaka, I., & Takeuchi, H. (2019). *The wise company: How companies create continuous innovation*. New York: Oxford University Press

Nonaka, I., Takeuchi, H., & Umemoto, K. (2014). A theory of organizational knowledge creation. *International Journal of Technology Management, 11*, 833–845.

Nonaka, I., Toyama, R., & Konno, N. (2000). SECI, Ba and leadership: A unified model of dynamic knowledge creation. *Long Range Planning, 33*, 5–34.

Nonaka, I., & Toyama, R. (2002). A firm as a dialectical being: Towards a dynamic theory of a firm. *Industrial and Corporate Change, 11*, 995–1009.

Nonaka, I., & Toyama, R. (2003). The knowledge-creating theory revisited: Knowledge creation as a synthesizing process. *Knowledge Management Research & Practice, 1*, 2–10.

Nonaka, I., & Toyama, R. (2005). The theory of the knowledge-creating firm: Subjectivity, objectivity and synthesis. *Industrial and Corporate Change, 14*, 419–436.

Nonaka, I., & Toyama, R. (2007). Strategic management as distributed practical wisdom (phronesis). *Industrial and Corporate Change, 16*, 371–394.

Nonaka, I., Toyama, R., & Byosière, P. (2001). A theory of organizational knowledge creation: Understanding the dynamic process of creating knowledge. In M. Dierkes, A. B. Antel, J. Child, & I. Nonaka (Eds.), *Handbook of organizational learning and knowledge*. Oxford: Oxford University Press, pp. 491–517.

Nonaka, I., Umemoto, K., & Senoo, D. (1996). From information processing to knowledge creation: A Paradigm shift in business management. *Technology in Society, 18*, 203–218.

Nonaka, I., von Krogh, G., & Voelpel, S. (2006) Organizational knowledge creation theory: Evolutionary paths and future advances. *Organization Studies, 27*, 1179–1208.

Nonaka, I., & von Krogh, G. (2009) Tacit knowledge and knowledge conversion: Controversy and advancement in organizational knowledge creation theory. *Organization Science, 20*(3), May–June, 635–652.

Olson, G., & Lyotard, J. (1995). Resisting a discourse of mastery: A conversation with Jean-François Lyotard. *JAC, 15*(3), 391–410.

Penrose, E. (1959). *The theory of growth of the firm*. Oxford: Basil Blackwell.

Polanyi, M. (1958). Personal knowledge: Towards a post-critical philosophy. Chicago: University of Chicago Press.

Polanyi, M. (1967). *The tacit knowledge dimension*. London: Routledge & Kegan Paul.

Powell, W., & Snellman, K. (2004). The knowledge economy. *Review of Sociology, 30*, 199–220.

Reber, A. S. (1989). Implicit learning and tacit knowledge. *Journal of Experimental Psychology: General, 118*(3), 219–235.

Rodan, S. (2002). Innovation and heterogeneous knowledge in managerial contact networks. *Journal of Knowledge Management, 6*, 152–163.

Scully, J., Buttigieg, S., Fullard, A., Shaw, D., & Gregson, M. (2013). The role of SHRM in turning tacit knowledge into explicit knowledge: A cross-national study of the UK and Malta. *The International Journal of Human Resource Management, 24*, 2299–2320.

Scuotto, V., Beatrice, O., Valentina, C., Nicotra, M., Gioia, L., & Briamonte, M. F. (2020). Uncovering the micro-foundations of knowledge sharing in open innovation partnerships: An intention-based perspective of technology transfer. *Technological Forecasting and Social Change, 152*, 119906.

Senker, J. (2005). The contribution of tacit knowledge to innovation. *AI & Society, 7*, 208–224.

Song, J. H., & Chermack, T. J. (2008). A theoretical approach to the organizational knowledge formation process: Integrating the concepts of individual learning and learning organisation culture. *Human Resource Development Review, 7*(4), 424–442.

Terhorst, A., Lusher, D., Bolton, D., Elsum, I., & Wang, P. (2018). Tacit knowledge sharing in open innovation projects. *Project Management Journal, 49*, 19–25.

van den Hooff, B., & de Leeuw van Weenen, F. (2004). Committed to share: Commitment and CMC use as antecedents of knowledge sharing. *Knowledge and Process Management*, 11, 13–24.

von Krogh, G., Nonaka, I., & Aben, M. (2001). Making the most of your company's knowledge: A strategic framework. *Long Range Planning: International Journal of Strategic Management, 34*(4), 421–439.

Vrontis, D., Thrassou, A., Santoro, G., & Papa, A. (2017). Ambidexterity, external knowledge and performance in knowledge-intensive firms. *The Journal of Technology Transfer, 42*, 374–388.

Ye, J., Hao, B., & Patel, P. (2016). Orchestrating heterogeneous knowledge: The effects of internal and external knowledge heterogeneity on innovation performance. *IEEE Transactions on Engineering Management, 63*, 165–176.

Yoshimichi, A. (2011). An examination of the SECI model in Nonaka's theory in terms of the TEAM linguistic framework. *Yamanashi Glocal Studies; Bulletin of Faculty of Glocal Policy Management and Communications, 6*, 21–33.

Zhang, Z., & Huang, F. (2020). An extended SECI model to incorporate inter-organisational knowledge flows and open innovation. *International Journal of Knowledge Management Studies, 11*, 408.

Zahra, S., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review, 27*, 185–203.

Žemaitis, E. (2014). Knowledge management in open innovation paradigm context: High tech sector perspective. *Procedia – Social and Behavioral Sciences, 110*, 164–173.

Wallace, D. P. (2007). *Knowledge management: Historical and cross-disciplinary themes*. Westport, Conn: Libraries Unlimited, pp. 1–14.

Warnier, J.-P. (1999). *Construire la culture matérielle – L'homme qui pensait avec ses doigts*, Parigi: PUF.

Wickes, M., Leslie, A., Lettice, F., Feeney, A. & Everson, P. (2003). *A Perspective of Nonaka's SECI Model From Programme Management: Combining Management Information, Performance Measurement and Information Design*. 4th Organisational Knowledge, Learning and Capabilities Conference, Barcelona.

Wu, I., & Hu, Y. (2018). Open innovation based knowledge management implementation: A mediating role of knowledge management design. *Journal of Knowledge Management, 22*, 1736–1756.