

THE EVOLUTION OF NONAKA'S THOUGHTS ON KNOWLEDGE MANAGEMENT: A REVIEW

¹Khuram Shahzad, ²Naveda Kitchlew, ³Sami Ullah Bajwa and ⁴Shrafat Ali Sair

^{1,2,3}School of Business and Economics, University of Management & Technology, , Lahore, Pakistan

⁴School of Business Administration, National College of Business Administration & Economics, Lahore, Pakistan

¹Corresponding Author: urideal@gmail.com

ABSTRACT: *The main objective of this conceptual paper is to capture the thought-development process of Ikujiro Nonaka on Knowledge Management based on his theoretical and conceptual contributions toward knowledge and its management in organizations. Our analysis reveals that the field of knowledge management after having decade's long debates on kinds and types of knowledge and distinction between information management and knowledge management has finally tended to delve into an amalgamation-based approach.*

IKUJIRO NONAKA PROFILE

Ikujiro Nonaka, born in 1935, is known as one of the gurus in Knowledge Management field especially because of its valuable contribution toward the conceptualization of Knowledge Creation and Innovation Management in business firms. Nonaka got the attention of US management circles when he published his very influential article titled "The New Product Development Game" in 1986 followed by "A Dynamic Theory of Knowledge Creation" in 1991. The Wall Street Journal in 2008 rated him as one of the top 20 "most influential business thinkers". He is also acknowledged as the nation's most significant management scholar in Japan. He has served Japan-America Institute of Management Science (JAIMA) as president in Honolulu and has been a visiting scholar at number of leading universities of the world such as University of California, Helsinki School of Economics etc.

Ikujiro Nonaka earned his MBA in 1968 and then PhD in 1972 from University of California, Berkely. In 1977 he started his career in pedagogy as professor in Nanzan University, Japan. Nonaka initiated his scholarly work by studying and comparing the prevailing management practices' gaps among Japanese firms and the rest of the world. His aim was to increase the productivity of Japanese firms through efficient information processing, efficient and effective use of knowledge. His scholarly work has been more grounded on the constructionist understanding and particularly around Japanese culture. However, at a later stage he did consider the East-West differences in terms of knowledge creation and knowledge management practices.

METHODOLOGICAL APPROACH OF THE REVIEW

This paper follows the chronological order to review almost all the journals' publications of Nonaka. Since the main aim of this paper is to see how Nonaka developed his thoughts in the field of knowledge management, chronological order seems more suitable for this. Framework of this review is based on Nonaka's research questions along with dependent/independent variables of interest followed by the level of analysis i.e. individual, group, organization, level of abstract i.e. strategy, structure, culture etc., and the new idea/theme presented by Ikujiro Nonaka. This review covers Ikujiro Nonaka's journal publications from 1986 to 2015.

OVERVIEW AND ANALYSIS OF NONAKA'S INTELLECTUAL DEVELOPMENTS IN KNOWLEDGE MANAGEMENT

Recognition of knowledge as fine instrument of organizational success and competitiveness came to fore with Nonaka's deliberations on underlying features of the successes of Japanese companies in comparison to their international competitors. In the very first of his article related to knowledge management, published in 1985, Nonaka attempted to study the reasons which made Japanese firm's success in comparison to American companies, despite of the fact that American schools of management at that time were regarded to be much sophisticated and the managerial skills they were inculcating in business students were deemed considerably advanced than that of Japanese professionals [1]. Prevalent thought of the time accrued the notion that American firms concentrated more in developing "hard skills" of strategy, namely structure and systems, whereas Japanese business practices were significantly centered on "soft skills" – staff, style and sub-ordinate goals. Nonaka argued that although Japanese firm were vulnerable to increasing complexity and dynamism in their business environment, better management of soft skills within Japanese firms endowed them with the strength to effectively & efficiently acquire information, process it to create a fit between environmental challenges and organizational activities. Nonaka concluded that internal coordination and staff relationship within Japanese firms lend a hand to produce well considerate information sharing among all echelons of organization and creates knowledge about action-outcome relationship and the effect of environment on these developed relations. Japanese firm capitalize on this knowledge and thus form what we call a 'learning organization'.

After one year, in his next article, Nonaka further explored the dynamics of information exchange within Japanese firms. His approach of considering information processing as root of knowledge creation and subsequently leading towards organizational success remained unchanged, however he went a step ahead in contemplating that nature and apparatus of this information exchange [2]. Unit of analysis of this paper again was organizations; comparison was made of the organizational systems of managing in American and Japanese firms. Nonaka noted that in most of

the cases, Japanese senior managers access a great deal of information and throw it on junior managers – a process he named ‘Variety Amplification’. Furthermore, tendency of variety amplification in Japanese managers was found at a greater extent as compared to American managers who usually provide selective information to their subordinates. Once prone to this excessive information, task of junior managers in Japanese firms becomes a rigorous group discussion in concluding the course of action. Nonaka named this process of processing information and reaching conclusion by junior managers as variety reduction. The paper thus concluded that knowledge takes place and gets shared through the continuous process of variety amplification and variety reduction. While he suggested the framework of information processing in this article, Nonaka’s next endeavor was to focus on the process of obtaining information from the environment. As it can be observed, organizations acquire selective information from the environment and also tend to look at available information through their own unique prism. That is why, different firms operating in one industry look at the external phenomenon differently and interpret information in their unique way.

Nonaka in his third publication, which he wrote with other colleagues in 1988, argued that manager’s strategic orientation is primarily focused on opportunities and threats in the market and since managers have their own unique perception, their recognition of opportunity and threats provide a gateway for the decisions as to what sort of information is required and how would it be solicited [3]. To prove this hypothesis, Nonaka again used a cross-cultural method of study and observed patterns of opportunity and threats recognition among Japanese and American managers. At this stage, it could be observed that Nonaka’s quest of understanding knowledge management and learning organization proceeded in a logical sequence. At the outset he proposed that an organization’s strength in global competition is in being a learning organization. A firm becomes a learning organization when it acquires information from environment and processes it to learn the relationship between actions and outcomes and effect of environment on it. This information processing creates a rich knowledge which is shared among all echelons of an organization. At the next step, Nonaka observed the process of information processing and proposed that senior managers perform variety amplification by obtaining information and throwing it to junior manager who perform variety reduction by collectively processing the information and devising the course of action. Finally, he observed that the nature of information accessed from environment depends on managers’ recognition and definition of threats and opportunities.

While the focus of the first three articles was on exploring how learning organization evolves, the focus of his fourth and fifth article, both published in 1988, is on studying the impact it may have on organizations, and especially on organizations’ systems [3, 4]. The basic theory of management posits it as a function of planning and controlling the patterns of organizational activities like

resource deployment, structures, processes and cultures etc. This planning and control establishes and tends to maintain an order and equilibrium in the organization. Nonaka in this article argued that an order can be maintained through education as well as through information. In a sense, managing processes means managing the information about processes and therefore it can be construed that creating information is actually creating meaning for something. He further emphasizes that organizations are now living in a chaotic world where chaos is created by interplay of different forces in the environment, and even sometimes is instigated proactively by organizations themselves. In an open system organization context, the process of interaction between environmental chaos and internal processes is a must. Companies’ strategic vision implies positioning it in the environment and see how it best fits. Subsequently, firms remain abreast with changes in the environment and keep on adjusting themselves accordingly. Internal processes, culture, leadership, etc. also transform during the process as we see that bureaucratic system of management has become obsolete in today’s chaotic world. The chaos in environment forces firms strategic orientation to continuously transform and adjust which ignites the creative and dynamic process of creating and processing information. With this background discussion Nonaka discussed the role of information in self-renewal by creating an organizational order in chaotic environment.

In his next article, Nonaka highlighted another dimension, namely innovation, for self-renewal of the organization [5]. In order to compete and survive, firms have to continuously innovate, develop new strategies and create new products and features. Discussing the case example of Canon Personal Copier, he discussed the process involved in creation of new product which primarily depends on solicitation of information from external and internal quarters of an organization and its effective transformation into the manifestation of new products. The example case showed how information augmented the product development process and in parallel bolstered the self-renewal process of the organization. Both of these articles on self-renewal share same theatrical underpinnings and while first article discussed the process in a broader context, the later provided a concrete example to demonstrate the role of information management and knowledge creation in organizational transformation.

Having argued substantially on the dynamics of information processing and creation of knowledge to its role in transformation and renewal of organizations, Nonaka’s next paper published in Harvard Business Review described the types of knowledge which a company has to establish to build and sustain its competitiveness in the market [6]. In this paper he argued that western management thought has remained overwhelmingly focused on considering organizations as information processing machines and trying to get the benefit of the information about processes and environmental dynamics. He compared this model of information processing with Japanese information management practices and maintained that leading Japanese companies like Honda and Canon actually not only

concentrate on processing objective information, but also take due note of the importance of that knowledge which resides inside human beings and cannot be described objectively. This knowledge is often characterized by subjective understandings, insights and hunches of employees named as tacit knowledge and require altogether a different approach and system to be channeled among members of the organization. In this article, he gave few concrete guidelines for sharing both explicit and tacit knowledge, including methods for sharing tacit to tacit, explicit to explicit, tacit to explicit and form explicit to tacit. Since transforming tacit knowledge into explicit is like expressing the in-expressible, a useful method for it could be to use symbolism and figurative language.

In his next article, Nonaka further explained the continuous interaction between tacit and explicit knowledge and proposed a theoretical model comprising of the constituent of knowledge creation [7]. It is also pertinent to note here that from 1984 to 1991, the only definition that Nonaka used for explaining knowledge management and learning organization was 'knowledge about action-outcome and impact of environment on it'. This conception gave the strong notion that knowledge actually is an outcome of the processing of information. Here, however, he came up with a more elaborative definition of knowledge and explained that information in essence is the flow of messages, whereas knowledge is created on the basis of these messages and also includes beliefs of its holders. This definition, as we can observe, is more inclined towards the inclusion of human element in processing of information into knowledge. In this article he discussed in detail the assumptions and theoretical dimension of knowledge creation and transformation and consequently named the aforementioned four knowledge creation dimension described in his previous article. He termed tacit to tacit exchange as Socializing, explicit to explicit as Combination, tacit to explicit as Externalization and explicit to tacit as Internalization. Furthermore, he meticulously discussed the steps thorough which knowledge is created. These steps include enlarging individual knowledge, sharing tacit knowledge, conceptualization & crystallization, justification and networking knowledge. The enabling factors in this process include intention, chaos, autonomy, redundancy and requisite variety. This article at its core is another, and more in-depth, attempt of Nonaka to understand the process through which knowledge is created and shared among organization, making it a learning organization.

The next article of Nonaka which he wrote with other colleagues got published in 1996 and was aimed at studying the role of Information Technology (IT) on the above mentioned process of knowledge creation [8]. In this article he studied all of the dimensions of this knowledge creation process and its enabling factors with a focus to describe how IT has supplemented this entire process. He also conducted a comparison of American and Japanese firms in their use of information technology and concluded that for all businesses operating in contemporary knowledge society, the course of becoming knowledge-creating company is characterized by effective use of increasingly proliferating information

technology tools and applications in the business management processes. In a way, Nonaka till this point described the well augured interplay of information, human beliefs and information technology for organizational competitiveness and renewal, besides conceptualizing and theorizing process of knowledge creation and transformation into as core strength for organizational success. As per his arguments, the prevailing sophistication in information and communication technology (ICT) seems to bring advancement in the methods and infrastructure for the creation of knowledge. However, at the same time it poses new challenges for human resources to get acquainted with rapidly changing ICT and comprehend the mounting flow of information.

Probably, keeping this point in mind, Nonaka co-authored another article that was published in 1997, in which he highlighted the need of dedicated human resources to use and take advantage of technology and information [9]. The article introduced the concept of knowledge activists who serve as knowledge enablers by energizing and synergizing efforts for knowledge creation throughout the organization. The knowledge agents serve as catalyst to creation of knowledge, connector of knowledge creation activities and bring foresight towards knowledge creation process. He discussed the concept of micro-communities for creation and connecting the widespread knowledge in organizations. It also signifies that besides undertaking initiatives for knowledge creation, the activists have to actively control the process and that knowledge activists are instrumental only when the knowledge creation is going on in its full swing, meaning that activists are not a substitute to knowledge creation activities, rather their role is to amplify it.

Knowledge as core of the organizational competencies again came into consideration of Nonaka in his next article which he co-authored in 1998. The article was based on a comprehensive empirical investigation to support the idea that organizational capabilities are synonyms to the multilayered knowledge of the organization [10]. Analysis of empirical data regarding product development process of Japanese firms revealed that many important dimensions of organizational abilities, that play an immensely important role, have been somewhat overlooked. He described these capabilities as local, architectural and process capabilities and presented a model which suggests that local capabilities are embedded in individuals are transferable to other organizations, with the shift of these individuals in other organizations. These capabilities form the knowledge base layer of the company and produce architectural capabilities of the firm. When the knowledge base layer interacts with other functional areas, another layer emerges which Nonaka named as Knowledge Frame. This layer includes unique relationships between various functions of an organization. With the dynamic interaction between these functions, a special type of knowledge is produced which is named as process capabilities and is not transferable to other firms. This article highlights another important dimension of learning organization, i.e. how knowledge emanates in processes of organizations and becomes non-transferable to other organizations.

The transfer of knowledge or knowledge creation systems and processes is stream of research which Nonaka used in his next attempt published in the same year (1998). The spirit of comparison of Japanese and American practices concerning knowledge management is constant in this work as well. Nonaka seems to endorse the proposition widely accepted among scholars that Japanese culture is unique in its facets and offers inimitable traits of cooperation, trust, long term commitment and group behavior to Japanese firms, which other counterpart like Anglo-American firms does not enjoy [11]. He studied such unique characteristics and proposes a combination of such traits which formed a national innovation system of Japan. Two case studies were discussed to support this conception and furthermore that these traits cannot easily be applied in Anglo-American origin firms.

Knowledge, especially the tacit one, is difficult to imitate and so is the process of knowledge creation. In his article published in 1998, Nonaka reiterated his stance that traditional knowledge management practices focusing on explicit data and information are deficient and subsequently presented a framework for converting explicit knowledge into tacit knowledge named as A-action, R-reflex and T-trigger (ART) [12]. He carried out a scrupulous discussion on a contemporary concept of Ba— shared space which could be physical, cyber as well as mental and serves as a platform for creation of knowledge – and implemented this concept in his proposed ART framework. Nonaka used his SECI model of knowledge transformation and discussed application of Ba as ontological platform for creating knowledge. The article used iceberg metaphor to signify that major part of the knowledge of a person rests in tacit form and organizations should be diligent in transformation of this knowledge into explicit one, for which ART framework could be highly instrumental. Nonaka forwarded a complex proposition which suggested that ART system requires certain enabling factors which if provided furnish a base which then encounters active and dormant position of Ba. The knowledge will be created if Ba is present as well as active.

Nonaka, in the next article exhaustively discussed theoretical underpinnings of Ba [12]. It is also worth noting that here Nonaka presented another difference between information and knowledge. As described earlier, he asserted that stream of messages form information which in combination of personal beliefs transforms into what we call knowledge. In this article, he differentiated information from knowledge in relation to Ba. Accordingly, he proposed that information resides in media and networks and can be transferred, thereby making it more like a tangible thing, whereas knowledge rests in Ba and is intangible in nature. The discussion embraced consideration of Ba with an existentialist framework. Ba exists at many levels of organization and may be connected to form a broader Ba.

In his next article, published in 1999, Nonaka expanded his level of analysis and studies implications of Ba in a rather broader context i.e. inter firm relationships in the industry. The conception of the article is based on the notion that akin to its application at individual and group levels within

organization, Ba also can be applied to the context of inter-organizational level. Since industrial systems, such as industrial estates and districts, involve widespread and complex communications and interaction, this relationship can be studied in terms of knowledge spaces i.e. in terms of Ba [13]. The interplay of diverse patterns of interaction between firms operating in industrial districts spread knowledge which is more seized by active players and therefore it can be reckoned that quantum and nature of knowledge being produced in various districts depends on the nature of interaction of individual firms between themselves and with state actors. If the relationship between actors is transactional in nature, predominantly extrinsic knowledge will be exchanged, whereas in case of intimate relationship between the firms, implicit knowledge will get shared. Therefore, the district governments should devise their systems to encourage intimate as well as transactional relationship between firms operating in an industrial estate or districts and also build their support infrastructure accordingly.

In his next article, published in 2000, Nonaka continued to explore impact of Ba and SECI on knowledge creation and further broadened his approach by adding a third component – leadership in the dynamic model of organizational knowledge creation [14]. Taking Ba and SECI as tools, this article signifies importance of leadership in articulating organization's knowledge, vision and stimulating knowledge spiral. Conceptually, this article contributes that existing knowledge provides a base to the new knowledge creation and thus becomes part of the dynamic process, named spiral by Nonaka, for creating knowledge.

In 2006 Nonaka, in his conceptual paper, addressed the challenges faced by “Knowledge Management” to be acknowledged as a separate field/discipline by researchers and practitioners [15]. Because of the use of various normative theories from different disciplines “Knowledge Management” has been criticized due to its “conceptual plurality” and discrepancy in its “sources of knowledge”. Nonaka asserted that this confusion was because of variety of ontological and epistemological assumptions i.e. Positivism vs. Interpretative” and the classification of knowledge as “objective knowledge” or “subjective knowledge”. Nonaka held the view that criticism made on KM field was largely due to the classifications of its objectivity and subjectivity which was largely based on the ontological and epistemological assumption derived from the positivist and interpretative philosophies. Paper built its premise on the Phronetic research approach which endorsed the careful use of both philosophies in developing KM research rather than rejecting one because of the clashing assumptions of another.

The premise of thinking in terms of tacit and explicit knowledge, presented by Nonaka, provided foundation for increasing number of research and practices. However, understandably the conception also invited criticism on both conceptual and empirical grounds. In his paper, published in 2009, Nonaka conducted a comprehensive discussion on the ongoing debate and controversies and the theoretical milieu shaping these controversies [16]. He conducted a systematic

analysis of current research and concluded that the present debate fortify six streams of inquiry. Taking each of these streams as a research question, Nonaka carried out discussion and proposed a way forward for organizational knowledge creation theory. Accordingly, he proposed that the debate can be distilled in questions including; what is the status of “truth” in the definition of knowledge? Do tacit and explicit knowledge fall along a continuum? Is the tacit/explicit knowledge distinction along the continuum valuable for organization science? What is the conceptual basis of knowledge conversion? Given the relationship between tacit knowledge and social practices, how can the concept of knowledge conversion be upheld and finally what is the outcome of knowledge conversion? As we observe, the theme of this article stems from questioning the epistemological assumptions of knowledge creation theory, which Nonaka has presented. Providing the logical arguments and support by contemporary theories, he attempted to conclude the debate and subsequently suggested that aforementioned streams effectively provide basis of three streams of further inquiry, including; knowledge creation & social practices, social practices as a medium of conservation of existing tacit knowledge and existing routine, and impact of leadership in stimulating knowledge creation within organization.

In his article, published in 2012, Nonaka once again explored role of leadership in the dynamic process of knowledge creation. He conducted a literature review and analyses that present studies significantly focus on the role of top management and tend to ignore the role which middle and lower managerial level exert in the process [17]. To overcome this issue, he presented an approach which suggested that knowledge is created with interplay of three layers within organization. At level one– the core layer, knowledge actually gets created, at level two– conditional layer, conducive environment is provided whereas at the third level – structural layer, knowledge is articulated and structured in an overall framework.

However, in his recent article published in 2014, he went beyond his decade’s long debate of knowledge management processes and approaches, and introduced a new paradigm to look at organizations. Drawing on the fractal theory of natural sciences, he proposed that organizations are made up of dynamic fractals that are enabled by dynamic ‘Ba’, organizational synthesizing capability, and leader’s phronesis [18]. This concept furnishes that the new proposed form of organization (Dynamic Fractal Organizations) makes use of the triad relationship of knowledge that synthesis tacit and explicit knowledge, which thus create a new form of knowledge called ‘Phronesis’. The triad knowledge relationship facilitates dynamic synthesis of knowledge exploitation and exploration, which is essential for becoming sustainably innovative and hence getting sustainable competitive advantage in the knowledge economy. The new paradigm takes organization as ‘invisible organization’ which gets configured through dynamic synthesis of fractals, constituting dynamic Bas of internal and external actors.

Another stream of arguments in this article is dedicated to explain how fractal organizations ensure synthesis of knowledge exploration and exploitation. It proposes that multilevel Bas exist and enable exploration and exploitation of knowledge at various levels of organizations. Organization needs form that not only enables vertical and horizontal expansion of ‘Ba’ (which includes internal and external actors) but also have synthesizing capability for integration of knowledge that would simultaneously be explored and exploited. At one hand arguments are presented to establish that traditional Carnegie School’s dualistic approach of knowledge exploration and exploitation is no more valid. Rather, it suggests that there is no pure tacit and explicit forms of knowledge (every knowledge has both forms existent), exploration and exploitation also occurs simultaneously in organization but with varying degree. In exploration, tacit is embedded more whereas in the exploitation explicit form of knowledge predominately works. In the process of synthesizing exploration and exploitation, conversion of tacit to explicit and vice-versa keeps on happening which creates a practical wisdom that is referred as Phronesis. This third type of knowledge is connoted with practical knowledge which stems out of objective teleology, common good as value and practical wisdom that manifests in actions.

Nonaka’s changing thoughts on the nature of tacit-explicit, and exploration-exploitation dimensions and resultant synthesis indeed articulates its assertion as a new paradigm. However, this new conception lacks thoroughness of the discussion on the related concepts and underpinnings of the proposed paradigm. Furthermore, though it collates with complexity and chaos perspective of the organization and strategy, the new so called paradigm only makes comparison with information orientation of Carnegie school of management, and does not address the processes and issues related to operationalization of this concept.

REFERENCES

1. Nonaka, I. and J.K. Johansson, Japanese management: what about the “hard” skills? *Academy of Management Review*, **10**(2): p. 181-191, 1985.
2. Sullivan, J.J. and I. Nonaka, The application of organizational learning theory to Japanese and American management. *Journal of International Business Studies*, p. 127-147, 1986.
3. Sallivan, J., J. Sullivan, and I. Nonaka, Culture and strategic issue categorization theory. *Management International Review*, p. 6-10, 1988:.
4. Nonaka, I., Creating organizational order out of chaos: Self-renewal in Japanese firms. *California management review*, **30**(3): p. 57-73, 1988..
5. Nonaka, I. and T. Yamanouchi, Managing innovation as a self-renewing process. *Journal of Business Venturing*, **4**(5): p. 299-315, 1989.
6. Nonaka, I., The knowledge-creating company. *Harvard Business Review*, **69**(6): p. 96-104, 1991.

7. Nonaka, A Dynamic Theory of Organizational Knowledge Creation. *Organization Science*, **5**(1): p. 14-37, 1994.
8. Nonaka, K. Umemoto, and D. Senoo, From information processing to knowledge creation: a paradigm shift in business management. *Technology in society*, **18**(2): p. 203-218, 1996.
9. Von Krogh, G., I. Nonaka, and K. Ichijo, Develop knowledge activists! *European Management Journal*, **15**(5): p. 475-483, 1997.
10. Kusunoki, K., I. Nonaka, and A. Nagata, Organizational capabilities in product development of Japanese firms: a conceptual framework and empirical findings. *Organization Science*, **9**(6): p. 699-718, 1998.
11. Nonaka, T. Ray, and K. Umemoto, Japanese organizational knowledge creation in Anglo-American environments. *Prometheus*, **16**(4): p. 421-439, 1998.
12. Nonaka, P. Reinmoeller, and D. Senoo, TheART'of knowledge:: Systems to capitalize on market knowledge. *European Management Journal*, **16**(6): p. 673-684, 1998.
13. Corno, F., P. Reinmoeller, and I. Nonaka, Knowledge creation within industrial systems. *Journal of management and governance*, **3**(4): p. 379-394, 1999.
14. Nonaka, R. Toyama, and N. Konno, SECI, Ba and leadership: a unified model of dynamic knowledge creation. *Long range planning*, **33**(1): p. 5-34, 2000.
15. Nonaka and V. Peltokorpi, Objectivity and subjectivity in knowledge management: a review of 20 top articles. *Knowledge and Process Management*, **13**(2): p. 73-82, 2006.
16. Nonaka and G. Von Krogh, Perspective-tacit knowledge and knowledge conversion: Controversy and advancement in organizational knowledge creation theory. *Organization Science*, **20**(3): p. 635-652, 2009.
17. Von Krogh, G., I. Nonaka, and L. Rechsteiner, Leadership in organizational knowledge creation: A review and framework. *Journal of management studies*, **49**(1): p. 240-277, 2012.
18. Nonaka, et al., Dynamic fractal organizations for promoting knowledge-based transformation—A new paradigm for organizational theory. *European Management Journal*, **32**(1): p. 137-146, 2014.