

CRITICAL ANALYSIS OF THE MODELS OF DOROTHY LEONARD-BARTON AND NONAKA & TAKEUCHI FOR CREATION AND DIFFUSION OF KNOWLEDGE IN ORGANIZATIONS

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Abstract: The objective of this article was to assess critically the knowledge diffusion models proposed by Dorothy Leonard-Barton in 1992 and by Nonaka and Takeuchi in 1994 to identify the major methodological, structural, and conceptual differences between them, highlighting advantages and limitations. For this, a review of the theoretical structure, categories, descriptive elements, and operation of each model was conducted based on the cases of Chaparral Steel and Honda companies. Methodological and conceptual conflicts were identified, as well as convergences between the models. It was concluded that the models, despite the differences, can be adopted simultaneously in an organization.

Keywords: Organizational Knowledge; Diffusion of Knowledge; Innovation.

ANÁLISE CRÍTICA DOS MODELOS DE DOROTHY LEONARD-BARTON E DE NONAKA & TAKEUCHI PARA CRIAÇÃO E DIFUSÃO DO CONHECIMENTO NAS ORGANIZAÇÕES

Resumo: O objetivo deste trabalho foi analisar criticamente os modelos de difusão do conhecimento propostos por Dorothy Leonard-Barton em 1992 e por Nonaka e Takeuchi em 1994, a fim de identificar as principais diferenças metodológicas, estruturais e conceituais entre eles, evidenciando suas vantagens e limitações. Para isso, realizou-se uma revisão na estrutura teórica de cada modelo, suas categorias, elementos descritivos e operacionalização, comparando os casos das empresas Chaparral Steel e Honda. Foram identificados conflitos metodológicos e conceituais, bem como convergências entre os modelos. Concluiu-se que os modelos analisados, apesar das diferenças, podem ser adotados simultaneamente em uma organização.

Palavras-chave: Conhecimento Organizacional; Difusão do Conhecimento; Inovação.

1. INTRODUCTION

The knowledge and experiences acquired over the years are among the greatest assets of any organization. Organizational knowledge results from personal and collective experience that, whether explicitly or not, can be put into practice for the fulfillment of strategic and operational objectives. There are several ways of storing this knowledge in the business environment: it can reside in people, it can be incorporated into documented information or it can also be reflected in the organization's processes, products, and services [1].

The great challenge that appears in the organizational environment is the efficient management of knowledge to the point of transforming it into an available resource, to allow its sharing, explanation, and storage [2]. In this way, the knowledge that exists in people's minds and the practical actions of their work can be externalized, that is, registered and preserved as an organizational memorial and, later, disseminated. Doing good management of this resource is an essential activity for the smooth running of the organization, which is a condition to ensure a competitive advantage and an environment conducive to innovation.

In this context, given the need to promote knowledge management and aiming at achieving organizational excellence, the authors Dorothy Leonard-Barton in 1992 [3] and Nonaka and Takeuchi in 1994 [4] presented two models that established elements for knowledge management in organizations. The present study aims to critically analyze these models, to identify the main methodological, structural, and conceptual differences between them, highlighting their advantages and limitations.

Two questions guided this research, namely: Is there a methodological or conceptual conflict between the two proposals? Is it possible to develop an approach combining all or part of the models? If so, what would be the advantage? To answer them, a review was made of the theoretical structure of each model, and, based on this theoretical basis, a comparative study was developed with its main categories and descriptive elements to assess its operationalization.

2. THE MODELS OF NONAKA & TAKEUCHI AND DOROTHY LEONARD-BARTON

2.1. Nonaka & Takeuchi Model

According to Nonaka & Takeuchi [4], the centerpiece of the Japanese approach is the recognition that the creation of new knowledge is not simply a matter of processing objective information. In this creation, it is necessary to explore tacit knowledge and often highly subjective intuitions, which makes the organization not as a machine, but as a living organism where everyone is responsible for the creation of knowledge.

Nonaka & Takeuchi [4] say that the Japanese tend to emphasize tacit knowledge, but in the view of the authors' tacit and explicit knowledge are not separate entities, they interact with each other in exchanging creative activities of human beings.

The SECI model proposed by Nonaka & Takeuchi [4] is anchored on the assumption that knowledge is created from the social interaction of tacit and explicit knowledge and this allows postulating different ways of converting knowledge, namely: (1) Socialization - is the conversion of tacit knowledge to tacit knowledge, it is a process of sharing individual experiences, absorbed tacitly to create knowledge. (2) Externalization - is a process of articulating tacit knowledge into explicit concepts,

using metaphors, analogies, concepts, hypotheses, or models in the knowledge creation process [4]. The authors suggest the use of these mechanisms as an effective conversion method. (3) Combination - is the conversion of explicit to explicit knowledge and can occur in the organization by combining several explicit pieces of knowledge into one. (4) Internalization - is the process of incorporating explicit knowledge into tacit knowledge [4]. When new explicit knowledge is shared across the organization, employees begin to internalize it. The new knowledge serves to expand and reshape individual tacit knowledge [5].

The SECI model proposes, in addition to the four modes of knowledge conversion, five enabling conditions that promote the knowledge spiral [4]. Are they: (1) Intent - the organization's aspirations, which provide criteria for judging the veracity of a given knowledge (2) Autonomy - at the individual level all members of an organization must act autonomously depending on the circumstances This autonomy increases the chance of introducing unexpected opportunities and self-motivation to create new knowledge. (3) Fluctuation and creative chaos - are the condition that promotes the interaction between the organization and the external environment. When fluctuation is introduced, there is a "breakdown" of routines, habits, and cognitive structures, providing an opportunity to reconsider our fundamental thinking and perspectives. (4) Redundancy - refers to the intentional overlapping of information about the organization's activities. (5) Variety of requirements - implies quick and distributed access to the information within the organization, because the internal diversity of the company must match the diversity of the environment. This characteristic allows the organization to face several challenges imposed by the environment.

The five enabling conditions combined with the different forms of knowledge conversion proposed by Nonaka & Takeuchi [4] make up an integrated model of five phases of the knowledge creation process. Are they: (1) Sharing tacit knowledge- which corresponds to socialization (2) Creation of the concept - in which tacit knowledge is converted into explicit knowledge in the form of a new concept (3) Justification of the concept - for the company to determine whether the concept is valid. (4) Construction of an archetype - phase in which prototypes are built from the concept. (5) Dissemination of knowledge - which corresponds to the expansion and diffusion of a division to others, or even to external components, such as customers, suppliers, and universities.

2.2. Dorothy Leonard-Barton Model

The model proposed by Leonard-Barton [3] is based on four knowledge-renewing activities: integrated problem solving; implementation of new technologies and technical instrumentation; experimentation and importation of know-how.

The combination of these activities forms strategic skills, which constitute a competitive advantage for the company. However, according to Leonard-Barton [3], strategic skills or strategic technological skills in companies that are based on the technology will only have a real effect if they obtain superior knowledge than their competitors. Strategic skills can be defined as: Supplementary, which are those that give value to strategic skills, but can be imitated; Enablers, which are necessary, but do not confer competitive advantage alone; and Strategic, which are those that give a competitive advantage.

In the Leonard-Barton model [3], the author considers four factors in strategic skills, which through these will coexist or not a competitive advantage, namely: (1) Knowledge

and qualification of the employee - which is the dimension most associated with strategic skills, as it encompasses the organization's unique techniques. (2) Physical technical systems - which is the explanation of the organization's knowledge in physical systems over time, such as databases and machinery. (3) Management systems - which is the knowledge accumulated by the employee and which flows through the management system through routine activities and the flow can be encouraged or blocked when the activity that generates knowledge is unwanted. (4) Values and norms - that determine the types of knowledge to be sought, the values being considered as a filter, and control of knowledge.

After defining strategic skills, Leonard-Barton [3] proposes a structure for knowledge-generating activities with the following premise It is activities and not financial goals or rewards, or even qualifications, that create a company's skills. There are four knowledge-generating activities, according to the author: (1) Creative and shared problem-solving - which suggests that several authors participate in problem-solving, including any employee of the organization. (2) Integration of new technologies and methodologies- which when seen as an innovative act can constitute a competitive advantage. (3) Experimentation and prototyping- which is approached by the author, how to try something outside the company's comfortable limit. (4) Knowledge import- which is when knowledge comes from other organizations, which can be partners, universities, suppliers, and others, which is a good source of knowledge [3].

The author foresees in her model strategic limitations and makes the following statement: The strategic limitations originate from the same activities that generate strategic skills, although in another form [3]. Finally, it brings four dimensions interrelated with a strategic limitation: Limited problem solving, Sterile implementation/inability to innovate, limited experimentation, and discarding new knowledge.

3. COMPARATIVE STUDY BETWEEN THE TWO MODELS

The methodology in this study is the bibliographic review. To analyze the operationalization and conflicts of the models proposed by Leonard-Barton [3] and Nonaka & Takeuchi [4], a comparison was made between the case studies presented by the authors, which are: Honda presented by Nonaka & Takeuchi, and the Chaparral steel plant presented by Leonard-Barton (Table 1).

Table 1. Characteristics of Chaparral Steel and Honda.

	Chaparral Steel	Honda
Location	USA	Japan
Product	Steel products	Automotive vehicles
Value	Market (1973): \$ 463 million / Sold in (2007) \$ 4.6 billion	Shares in 1980: US \$ 3.3 / Shares in 2018 US \$ 30
Top management role	Knowledge import	Encouraging slogan creation
How to externalize knowledge	Shared problem solving	Metaphors and analogies
How to consolidate knowledge	Experimentation	Ambiguity and redundancy
Success case	Increase in company value by 1000%	Honda City and 1000% share appreciation

Chaparral Steel is a steel company based in the United States and since its foundation has had a very flexible management model compared to its competitors. In this flexible model, neither the timecard nor fixed lunchtime was adopted, which is evident in the description by Leonard-Barton [3].

As for its horizontality, it is possible to perceive it from the role of problem-solver, which can be played by all employees of the organization. In this context, the manager plays the role of knowledge channeler, being the person responsible for seeking knowledge outside the company.

Chaparral Steel from 1980 to 2007 remained the second-largest producer of structural steel in the United States, without expanding into the market in other countries. Despite not having great growth in terms of market reach, it obtained a great increase in its value. When founded in 1973, it was worth the US \$ 463 million and was sold to Gerdau for 4.6 billion in 2007.

Nonaka & Takeuchi's approach [4] was based on the application of a questionnaire to Japanese managers of large organizations. A prominent company was Honda, a multinational automaker, which has had a wide reach since the study carried out by these authors, and which increased from ten times from 1980 to 2018.

Nonaka & Takeuchi [4] highlight the importance of individuals' highly subjective tacit knowledge in creating knowledge in this context. The Honda City project leader used the slogans "let's bet" with the idea of doing something never done before in the company and the evolutionary theory of the car to stimulate proposals that answered the following question: If the car were a living organism like should it evolve?

3.1. Operationalization of the Model Application

To compare the operationalization of the two models, a comparative table was created with the main categories and descriptive elements of each model to know the degree of difficulty in the implementation (A), adherence to the described processes (B), and the effectiveness in the results generated (C) (Tables 2 and 3).

Table 2. Operationalization of the Dorothy Leonard-Barton model - Chaparral case.

	A	B	C	Characteristics of the company
Creative and shared problem-solving employee knowledge and skills, values and standards, physical technical systems, management systems	1	5	5	High autonomy, horizontality
Implementation and integration: employee knowledge and qualification, values and standards, physical technical systems, management systems	3	5	3	Dynamic and not afraid of making mistakes
Experimentation: employee knowledge and qualification, values and standards, physical technical systems, management systems	1	5	5	Encouraging experimentation
Knowledge import: employee knowledge and qualification, values and standards, physical technical systems, management systems	5	3	3	The strategic limitation arises from the inhibition of the free flow of crucial knowledge

Dorothy's model is demonstrated in an industrial environment, in a medium-sized steel plant in the 90s, where the differential of this branch is in process technologies. It is very practical to apply the shared solution of problems and bring good results, but it is not demonstrated how this step can be applied in companies with defined R&D and where competitive differentiation is in the product and not in the process.

The high degree of autonomy of employees, horizontality, dynamism, and the fact that they are not afraid of making mistakes facilitate the implementation of the process. There is an incentive to experiment but inhibiting the free flow of knowledge can lead to strategic limitations (Table 2).

The model of Nonaka & Takeuchi [4] in the context of Honda is used in the product development process and has become a powerful tool in the ability to explain the idea of the project leader in a product. However, the Nonaka & Takeuchi [4] model lacks an explanation of how the slogan process was developed internally by the team members.

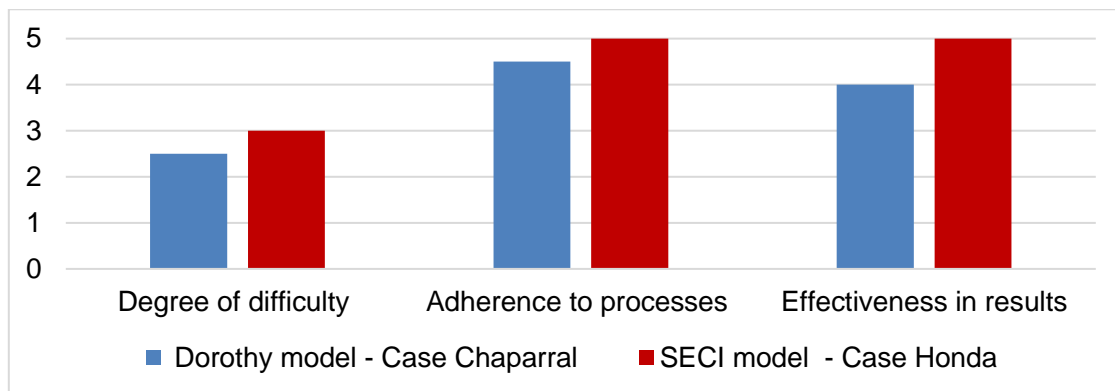
Table 3. Operationalization of the SECI model - Honda case.

	A	B	C	Characteristics of the company
Socialization (tacit / tacit) Sharing tacit knowledge: intention, autonomy, fluctuation, and creative chaos, redundancy, variety of requirements	3	5	5	Use of metaphors and analogies, but when done with discipline it leads to a good result
Externalization (tacit / explicit) Concept creation: intention, autonomy, fluctuation and creative chaos, redundancy, variety of requirements	3	5	5	Use of figurative language and mental model (Tall Boy) for Externalization among members
Combination (explicit/explicit) Concept justification: intention, autonomy, fluctuation and creative chaos, redundancy, variety of requirements	3	5	5	The tall Boy concept justified by management
Combination (explicit/explicit) Construction of an archetype: intention, autonomy, fluctuation, and creative chaos, redundancy, variety of requirements	3	5	5	Honda CITY prototype creation
Internalization (explicit/tacit) Interactive dissemination of knowledge: intention, autonomy, fluctuation and creative chaos, redundancy, variety of requirements	3	5	5	Dissemination of knowledge in the organization and success of Honda CITY in the market

The use of metaphors, analogies, and figurative language is difficult to implement because it is very subjective, however, the Honda case proves that this method leads to excellent results.

From the values assigned in Tables 2 and 3 based on the cases presented by the authors, the results were averaged to generate the graph shown in Figure 1.

Figure 1. Comparison of the operationalization of the models.



Analyzing the results presented (Figure 1), it is possible to notice that, although Dorothy's model is easier to implement, the SECI model has greater adherence to the processes and generates better results.

3.2. Methodological and Conceptual Conflicts

To analyze the methods concerning methodological and conceptual conflicts, we started with methodological approaches and it was found that while Dorothy Leonard-Barton's model does a Top-Down approach, starting from the objective of creating and maintaining strategic skills that are built through managing knowledge-generating activities to achieve a competitive advantage, the SECI model takes a Bottom-Up approach, starting from the conversion of tacit knowledge into explicit and vice versa to achieve continuous innovation and competitive advantage.

As for the Maintenance of Competitive Advantage, Dorothy Leonard-Barton's model predicts the emergence of strategic limitations as inevitable, caused by the inhibition of the free flow of knowledge. Constant vigilance is necessary to avoid revolutionary changes (difficult to dismantle), being this model. In the SECI model, the enabling conditions, which occur through Intention, Autonomy, Fluctuation and creative Chaos, Redundancy, and Variety of requirements, generate a new spiral. The interaction of the two spirals promotes the emergence of continuous innovations, to maintain a competitive advantage.

As for the way of making knowledge explicit, Dorothy Leonard-Barton's model does not detail how verbal interactions between people occur when carrying out activities to provide learning and make knowledge explicit. In contrast, the SECI model establishes that metaphors and analogies are a means of making explicit tacit knowledge throughout the learning process.

As for the standardization of new knowledge, in Dorothy Leonard-Barton's model, new knowledge goes through experimentation and, if accepted, is implemented and integrated, this is standardized in the organization through imitation among peers (Chaparral case). In the SECI model, the new knowledge follows the path of socialization, externalization, combination, and internalization to be standardized in the organization.

4. CONCLUSION

The models presented treat people as creators of company knowledge. The SECI model brings outsourcing as a management tool, while the Dorothy Leonard-Barton model brings all employees as problem solvers, enabling horizontality in the organization's management.

In the comparative analysis of the models, it can be seen that, while the one by Nonaka & Takeuchi applies to any size of an organization, the one by Dorothy Leonard-Barton is not possible to make this observation due to the examples presented by the author.

The fact that, conceptually, Dorothy's model is based on strategic skills based on the current context, determining only the knowledge-generating activities to achieve them, makes it a fragile model, susceptible to strategic limitations as the context changes. Meanwhile, the SECI model is based on the exchange of tacit knowledge between employees and the systematic creation of knowledge of the organization, allowing for better adaptation to changes in the external environment.

In its operation, it was found that the model designed by Dorothy is quite dynamic, flexible, and easier to implement and that the SECI model, being more systematized, has a more laborious implementation, but leads to better results.

Throughout the study, advantages and limitations for each model were identified, however, despite their differences, it was concluded that the models can be adopted simultaneously in an organization, that is, they can be combined totally or partially. The advantage of this combination would be being able to adopt Dorothy's model for less complex projects, especially those related to the production process, giving dynamism and autonomy to the group involved. And for more robust projects, especially those related to the generation of new products with high market expectations, the company could adopt the SECI model, to obtain more effective results.

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