



## THE CODIFICATION OF KNOWLEDGE: INCENTIVE STRUCTURE, COST/BENEFIT TENSION AND THE DECISION MAKING PROCESS

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### Abstract

The codification process of specific knowledge inside an organization involves costs, dictated by its nature as well as by its context. As we understand that the codification decision depends on the incentive structure and on the costs and benefits involved in the process, the boundaries between tacit and codified organizational knowledge turn endogenous. Specific knowledge codification investment decisions should be taken only after the designation of the elements that determine the cost/benefit structure and the heedful assessment of its impacts on the creation, sharing and diffusion of knowledge.

**Key words:** Reutilization economies, decision making, knowledge economy, knowledge codification.

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### INTRODUCTION

Although the importance of human capital has been increasing recently compared to other organizational assets, its intangibility and the lack of generally accepted principles make it difficult to value. As firm's competitive advantage is increasingly based on their human assets, the origins of the value added by this asset has to be assessed.

Firm's specific knowledge is an essential element to determine its market value. This knowledge rises from the individual and collective creative processes driven by organization's employees and can trigger off innovations in company's products and processes. The information that a person acquires, generates, gathers, and turns into knowledge and decisions has benefits and costs. The value added

by this knowledge is what differentiates companies in the market place and what makes them more profitable.

To extract the value created by employee's knowledge, firms have to choose to keep it in the tacit or codified form. Firms have to balance the advantages and disadvantages of specific knowledge codification and the costs and benefits resulted from this process. Primarily, firms have to understand that the management of knowledge in the tacit form requires different activities from that in the codified form.

In this paper, we recognize the codification of specific knowledge as an economic activity, subject to their costs and benefits. This perspective emerges from the differences between the concepts of knowledge and information and from its interactions, as well as from the boundaries between tacit and codified knowledge. It also derives from the assessment of the reutilization economies generated by firm's codified knowledge and the alignment between its strategy and knowledge management. We introduce a model for firm's specific knowledge codification decision making based on the assumption that the boundaries between tacit and codified knowledge are endogenous.

## **KNOWLEDGE AND INFORMATION**

For Cohendet and Steinmueller (2000), the fact that information depends on the context in which it is used has created two distinct approaches to explain the differences between knowledge and information. The first approach explains that this difference rises from the costs and the complexity involved in the creation of the necessary conditions to the codification of knowledge into information. The other admits that these conditions depend not only on the context of information, but also on receiver's identity and capacities.

First approach supporters (COWAN *et al.*, 1997; 2000) believe that informational flux enhancement propitiates new ways to create and reproduce knowledge. Although they admit the existence of "non-codifiable" knowledge, they look to create methods aimed to establish the proper conditions to explicit "codifiable" knowledge. They state that the degree of knowledge codification depends on the underlying cost/benefit relation and that codified knowledge exchange contexts can be created if the required investment is economically viable.

Those that support the second approach (ANCORI *et al.*, 2000) defend that the increasing informational flow is accompanied and mediated by social activities and networks that reproduce the utilization and understanding capabilities of the available information. They believe that these capabilities involve a high degree of tacit abilities, knowledge and cognition and that the reproduction of these capabilities is fundamentally distinct from the codification process.

In this article, we adopt the first approach, based on the works of Cowan & Foray (1997), Cowan *et al.* (2000) and David & Foray (2003), to explain the differences between knowledge and information and to determine under which conditions and to what degree the codification process occurs.

Whereas information is understood as a collection of structured and formatted data that remain lethargic and passive until it is used by those who have sufficient knowledge to understand and process it, knowledge focuses on cognitive capacities and gives to its owner the capacity to act physically or intellectually (DAVID & FORAY, 2003). For these authors, knowledge and information reproduction conditions also emphasize the differences between them. While the reproduction costs of information are marginal, knowledge reproduction costs lie on the use and transmission of cognitive capacities, therefore much more complex and expensive than information.

### **SPECIFIC KNOWLEDGE AND GENERIC KNOWLEDGE**

Daniele's (1998) concept of specific knowledge is equivalent to the usual concept of know-how: it is the innumerable behaviors, cutoffs and complex solutions developed by individuals that act in specific domains of the firm. Generally, specific knowledge resides in employee's minds and become accessible in the moment of knowledge creation. Its sphere is limited to the individual or to the firm he works for. Contrary to that, generic knowledge can be found in the public domain and is available for everyone at accessible prices.

The author argues that the solution for most of the technological problems implies the use of varied quantities of knowledge. Some are generic, as scientific knowledge and knowledge applied to mechanics, electronics and computing. Some other portions of knowledge are specific to particular ways to do things and to user's or producer's experience. Some aspects of this knowledge can be articulated, described in articles and manuals and taught in school. Others are inherently tacit and can only be learned through practice and observation.

Specific knowledge can be maintained through the routines and through the formal and informal processes that organizations develop when realizing their regular business activities and is the base of organizational memory (NELSON & WINTER, 1982). This type of knowledge is related to products and processes and it is created through the learning-by-doing and learning-by-using processes inside the organization (DOSI, 1988b).

### **TACIT KNOWLEDGE AND CODIFIED KNOWLEDGE**

Knowledge evolution and diffusion processes imply the change of its nature between the tacit and codified form. Generally, knowledge appears in a purely

tacit form. As knowledge is explored, used and better understood, a smaller part remains implicit to one or more individuals and a greater part is expressed through systematized information that can be retransmitted at a lower cost (COWAN & FORAY, 1997).

Codified knowledge and tacit knowledge are complementary not substitutes. The codification process does not provide all the knowledge required for action. Some degree of tacit knowledge is always necessary for the utilization of codified knowledge. That's why codification can not be reckoned as a simple conversion of tacit knowledge into codified knowledge.

Knowledge codification involves the externalization of memory (FAVEREAU *apud* DAVID & FORAY, 2003). Through codification, knowledge is detached from the individual, as generated memory and communication capacities become independent<sup>1</sup>. What is externalized and stored is a learning program to stabilize and reproduce knowledge, not the total knowledge. As we consider the codification of knowledge a process intended to reduce human knowledge into information, we assume that part of the original knowledge is altered and some meanings may be lost (GOODY *apud* DAVID & FORAY, 2003).

Some activities involve knowledge that is not explicit, knowledge that is beyond the texts referred to those activities. Cowan *et al.* (2000) present two explanations for the implicitness of some sorts of knowledge: it can not be articulated or it remains implicit as codification costs are prohibitively expensive. While knowledge articulation implies some degree of codification, knowledge may remain partially or totally implicit if codification process implied costs are too high. In the latter case, a new sort of knowledge emerges: knowledge that can be codified but can not be articulated.

Those authors state that knowledge codification degree depends on the costs and benefits involved in the codification process. The codification costs of some sorts of knowledge can reduce codification incentives as it diminishes the investment rate of return. A low rate of return can stimulate the maintenance of a large portion of knowledge in the tacit form.

Overall, the codification degree of organizational knowledge is a strategic choice of the firm. According to Hansen *et al.* (1999) knowledge, based firms adopt a codification strategy or a personalization strategy contingent to firm's value creation process (through "reutilization economies" or "specialization economies").

As we understand that the decision to codify articulated knowledge relies on the underlying incentive structure and on the costs and benefits involved in the process, the boundaries between tacit and codified knowledge become endogenous. Firm's strategic positioning, its cost-benefit structure and the resulting incentive structure determine knowledge codification dynamics.

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<sup>1</sup> To keep memory and communication capabilities, codified knowledge language has to be remembered and the media in which codified knowledge was stored has to be preserved.

For Cowan *et al.* (2000), to locate the sources and assess the magnitude of the costs and benefits involved in knowledge codification processes it is primal to identify knowledge context. Codification incentives will mainly depend on the existing language and models. As the language and models necessary to knowledge codification are diffused, the irreversible fixed costs incurred in the creation of models and in the creation of a common vocabulary are already sunk. The costs involved in the codification process will then be marginal.

## **STRATEGIC ALIGNMENT AND KNOWLEDGE MANAGEMENT**

The knowledge management strategy adopted by the firm, particularly the relevant knowledge codification degree, should be aligned to its strategy (HANSEN *et al.*, 1999). Organizations that adopt the codification strategy lean on the gains generated by knowledge reutilization economies. Knowledge reutilization saves work, reduces communication costs and enables firm's client base rapid enlargement.

Companies that adopt the personalization strategy lean on the gains generated by specialization and customization. As its growth rates tend to be much lower due to the cost and difficulties inherent to complex tacit knowledge sharing, the customized solutions offered to its clients allow profit margin enhancement.

According to Hansen *et al.* (1999), exclusive focus on a specific knowledge management strategy is not recommended. Companies that adopt the reutilization model should keep a small portion of their relevant knowledge in the tacit form. Likewise, companies that rely on the personalization strategy should codify part of its relevant knowledge into a database as to enable simple knowledge diffusion and the interaction of specialists in relevant issues.

The assessment of specific knowledge codification should be taken only after knowledge management strategy definition. The decision making model developed in this work should be employed under firm's strategic context.

## **REUTILIZATION ECONOMIES**

Organizational knowledge management generates increasing returns to scale build upon cost reduction or quality improvement of the products and services offered by the firm (OFEK & SARVARY, 2001). On the demand side, economies of scale are obtained through network externalities. New knowledge creation and its quick conversion into new and better products, services and processes renders benefits to clients that increase with the enhancement of clients' base. On the supply side, economies of scale are generated by knowledge reutilization. The

easy location of specialists and of specific codified knowledge and its adaptation to the reality of each client increase efficiency and reduce production variable costs.

Firm's emphasis on each form of economies of scale created by knowledge management directly affects its strategic position in the marketplace (OFEK & SARVARY, 2001: 1443). The previously mentioned knowledge management strategies determine how companies should explore their organizational knowledge, through reutilization economies or through network externalities.

Reutilization economies arise from the application and diffusion of organizational knowledge. Depending on codified knowledge complexity degree and on its strategic importance to the firm, knowledge reutilization economies can be significant. The resulting benefits from complex specific knowledge codification can be diminished or even eliminated by the costs incurred along the codification process and by the difficulty inherent to codification. Anyway, the degree of tacit knowledge required to the employment of codified knowledge can become prohibitively high. Specific knowledge of low complexity and high strategic importance has a significant scalability potential, offering large reutilization economies to the firm.

While specific knowledge codification can generate reutilization economies, it increases the risk of replication and loss of competitive advantage. Therefore, the benefits of strategic low complexity specific knowledge codification and the risks of losing control over organizational knowledge should be balanced.

## **THE CODIFICATION PROCESS**

Knowledge codification process can be separated into three phases: the development of a language, the construction of models and the creation of messages (COWAN & FORAY, 1997).

As the codification activity occurs in a new sphere or discipline, the development of a common language that allows the potential use and diffusion of information is required. Besides, the emergence of a common language rests on agents' understanding of stored knowledge. Different sorts of knowledge imply different sorts of language (e.g. music, films, software). The initial phase of the codification process takes the time necessary for the development of a common language to the agents. In this phase codification process related costs are major.

The second step comprehends the construction of models that are able to convert knowledge into information, what implies fundamental changes in the form which knowledge is organized. These models are learning programs used to stabilize and reproduce knowledge, thus covering only partially the tacit knowledge base that will be codified. As soon as the models and the subjacent language are

sufficiently developed, a "code book" is created and knowledge can be codified into information, transferred and reconstituted.

The last phase consists of knowledge transformation into information through the creation of decoded messages that express existent knowledge. The activities carried on this phase, knowledge acquisition, storing or transference, do have marginal costs. As codified knowledge is sufficiently diffused to stabilize the language, the informational flux can rapidly increase. A stable knowledge context does not imply language development termination. The codified knowledge base may still be nurtured with other terminologies and meanings.

## **KNOWLEDGE CODIFICATION POTENTIAL BENEFITS AND COSTS**

Knowledge codification provides potential benefits and costs that can only be generated in specific contexts and situations. Cohendet & Steinmueller (2000) point out the major elements of a generic cost/benefit structure:

### **Potential Costs**

The greatest opportunity cost of knowledge codification is the lower availability of resources to the creation of new and deeper tacit knowledge. Codification benefits magnitude should be properly assessed to determine the opportunity costs involved.

Although codified knowledge is easier to be appropriated by competitors, firm's control over tacit knowledge is very poor. Tacit knowledge is inside employee's minds and vanishes from organization's office as they are dismissed. Another important cost factor is the decoding and further comprehension of codified knowledge generated in some other context than the one initially anticipated. In some particular situations, the reading of the codes can become a long and expensive process.

### **Potential Benefits**

Knowledge codification generally reduces the costs and improves the credibility of the transferred information. Various functions related to knowledge acquisition (e.g. transport, transfer, reproduction, storage, access and search) have its costs dramatically diminished by knowledge codification.

Through codification, knowledge assumes commodity features. Knowledge can be more precisely described and detailed in terms of content and intellectual property, thus reducing operation's uncertainty and information asymmetries. The existence of a language of public domain which knowledge is codified reduces markets' information asymmetries, hence permitting consumers' free access to product properties.

Informational goods economic properties assimilated by knowledge when codified, as non-rivalry, scalability<sup>2</sup> and low reproduction costs, leverage codification benefits and reduce knowledge transfer costs. These properties also generate increasing returns to scale, since knowledge codification capacities enable firms to create, at the same cost, new and better knowledge based on the existent one.

## INCENTIVE STRUCTURE AND KNOWLEDGE CONTEXT

Cowan and Foray (1997) argue that knowledge codification process incentive structure will depend largely on the language and models in which codification will be based on. In stable contexts, language and models necessary for the creation of messages are recognized by the agents and the transmission of messages can be considered a knowledge transfer.

In a stable context, codification benefits are greater in ample systems with agents' coordination specific needs. The authors identify five scenarios in which these conditions occur:

- i) *Systems that embrace various agents in different localities* – benefits are generated by cooperative research with a spatial distribution of activities in diverse localities;
- ii) *Systems where innovations derive from knowledge recombination, reutilization and storage* – benefits derive from knowledge utilization in diverse activities and applications;
- iii) *Systems that do need memory (companies with long development cycles, high turnover rates and technological bifurcation)* – a small degree of codification increases the risks of losing a significant portion of the organizational knowledge;
- iv) *Systems that show specific needs to describe agent's procedures (to achieve specific quality patterns, to establish contractual relations with partners or to patent innovations)* – benefits come from the codification of the best practices in different areas;
- v) *Systems characterized by the intensive use of information technologies* – when tacit knowledge hinders potential productivity advances.

In changing contexts, knowledge codification benefits have a greater impact on language and models development. As codification occurs in a new field or

<sup>2</sup> An asset is considered non-rival in use if its consumption by one person does not reduce the available quantity for others. For a better understand of non-rivalry and scalability, see: Christiaans, T., *A Note on Public Goods: Non-Excludability Implies Joint Consumability*. Department of Economics, University of Siegen, Discussion Paper no. 68-98, September 1998; Shapiro, C. and Varian, Hal R., *Information Rules: A strategic Guide to the Network Economy*. Harvard Business School Press, Boston, 1999, chapters 1-2.



discipline, competition may emerge between distinct models and between the languages used to describe them. Until this competition is settled, knowledge diffusion will be problematic. Potential users will have communication difficulties and the value of knowledge codification will be minor.

Changing contexts also imply high irreversible costs destined to develop and learn a common language. This imposes the system an excess of inertia caused by knowledge codification investment low rate of return.

Network effects<sup>3</sup> are relevant for the codification process and for the underlying incentive structure. Network effects are meaningful whenever network size is central to the users and interconnectivity and compatibility are essential to product utility. If we take the product as codified knowledge, compatibility and interconnection will be determined by the development stage of the language and models that describe them. Thus, as smaller is the language development stage, the lower is the number of potential users and receptors, as well as knowledge codification benefits.

## DECISION MAKING PROCESS

Supported by the theories developed by Cowan & Foray (1997) and Cowan *et al.* (2000) concerning knowledge codification incentive structures, we now propose a decision making model for the codification investment process based on the implied potential benefits and costs.

The presented decision flow (Figure 1) tries to clarify the determining elements, found in the minds of organization's employees, of specific knowledge codification process cost-benefit structure. Even though the incentive structure for specific knowledge codification is only partly represented, the identified factors are essential to determine the economic feasibility of codification investment.

Decision flow systematization becomes a useful exercise as we consider knowledge codification an investment that demands the allocation of tangible and human resources and implies economic viable solutions. Specific knowledge codification purposes are diverse, depending on its content and potential users. Yet, as any other investment, should generate a rate of return sufficient to cover all the opportunity costs involved.

The first step towards the assessment of specific knowledge codification feasibility is the codification context recognition. Thus, we need to pose the question: "Is knowledge context stable?" In stable contexts, where the language and the

<sup>3</sup> Network economies effects are significant whenever the size of the network is fundamental to the users or compatibility and interconnection are essential to product utility. For further analysis of network effects, see: Shapiro, C. and Varian, Hal R., *Information Rules: A strategic Guide to the Network Economy*. Harvard Business School Press, Boston, 1999, chapter 7.

models necessary for the creation of messages are known by the agents, information creation and transfer costs tend to be marginal. In changing contexts the development of a common language and of message transmission models imply high irreversible costs and dilated implementation periods, what makes the investment unfeasible.

Codified knowledge legal protection is another relevant factor under the incentive structure. In this context, we shall pose the question: "Is legal protection relevant?" Critical knowledge to firm's competitive advantage or to potential competitor's dismissal should be legally protected and transformed into intellectual property. Not legally protected codified specific knowledge can be easily accessed by rivals, turning firm's competitive position vulnerable. In case the legal protection of specific knowledge that is critical to firm's competitive advantage is not available, that knowledge should be kept in tacit form.

The context in which knowledge decoding takes place also affects codification incentives. Firms should question: "Does knowledge decoding take place in another context?" In contexts that are different from those initially anticipated, the decoding of messages that support the stabilization and the reproduction of existent specific knowledge may be damaged. Knowledge that is identified under an incomprehensible language may not be recovered.

Identify the required resources for specific knowledge codification and assess the impact of its unavailability to other relevant organizational activities is probably the most complex task in the decision process. The implied opportunity costs may be significant and should be faced with knowledge codification relevance to the business. Thus, a new question emerges: "Will the necessary resources to new knowledge creation be compromised?"

Specific knowledge importance to firm's competitive advantage should be assessed under the context of knowledge creation relevant to its activities. Knowledge codification investments not vital to competitive advantage should not be undertaken.

Finally, firm's dimensions and the interaction conditions between agents that should benefit from specific knowledge codification have to be considered. To this extent, a new question is posed: "Does knowledge codification take place in ample systems with specific needs of coordination between the agents?" The contexts identified by Cowan & Foray (1997) and introduced previously embrace most situations where codification benefits are significant. Anyway, we should always balance these benefits and the potential costs of the codification process. Codification investment should only be undertaken if potential benefits overcome potential costs.

For each portion of specific knowledge the firm intends to codify we shall go through the presented decision flow. Depending on the sort of knowledge and on the context it will be codified, some decisions might look irrelevant and decision

flow unfolding, necessary. It is important to bear in mind that the proposed model is generic, as it tries to identify the critical questions for knowledge codification decision making in all kinds of business.

Different companies in different industries should build up decision flows adapted to their realities and to their tacit organizational knowledge. The costs incurred in knowledge codification should always be compared to codification investment benefits. Even low cost codification investments should be avoided if we do not have any certainty about the respective return.

Human resource reallocation in knowledge codification processes should be carefully assessed, as they might be extremely high, particularly in firms that directly commercialize their human capital knowledge.

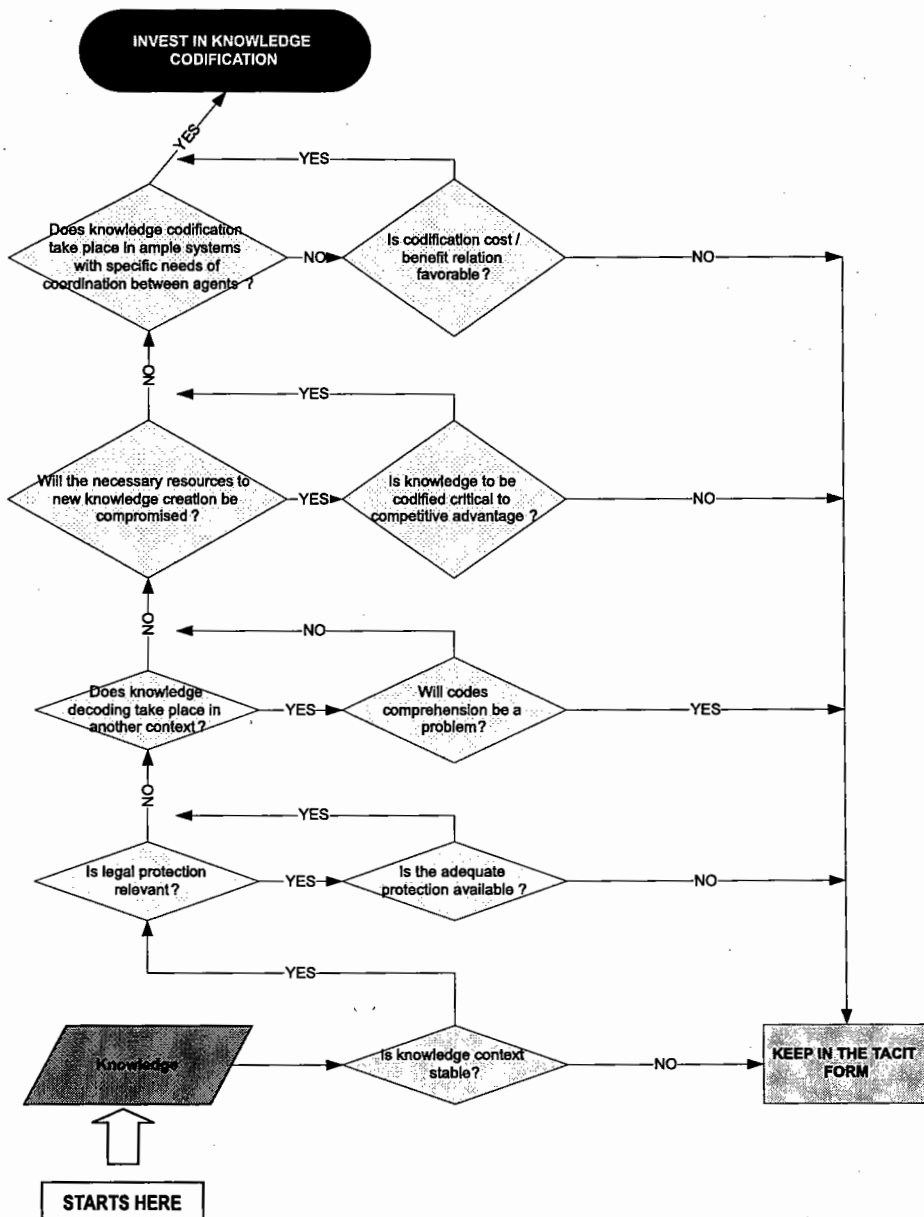
## **CONCLUSION**

This paper argues that organizational knowledge codification is an economic activity. Therefore, the relation between potential benefits and costs is crucial to knowledge codification decision making process. We assume that the boundaries between tacit and codified organizational knowledge are endogenous to the firm and investment decisions regarding specific knowledge codification should be assessed as a function of the underlying incentive structure.

We developed a decision making model for specific knowledge codification adaptable to different companies in different industries. The construction of the decision flow is relevant as we consider the codification of articulated tacit knowledge an investment that requires the allocation of tangible and human resources and that proves to be economically feasible.

FIGURE 1

Knowledge Codification Decision Process



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