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Knowledge engineering in the insurance industry: a process improvement-oriented approach

Abstract:
Organizations are a set of processes, some of which can be knowledge intensive (KIBPs). Nowadays, knowledge is a critical factor of success for competitiveness in organizations and needs to be managed, even more in KIBPs. CommonKADS is a knowledge engineering methodology that aims to build industry-quality-knowledge systems, for improving organizational processes. However there is a lack of theoretical-empirical studies about innovation in KIBPs using CommonKADS in the insurance industry. Consequently, this study aims to explore how KIBP improvement can be supported by CommonKADS in practice, showing the case of a Peruvian insurance company. A literature review has been made to explore these concepts and their relationships, and then, a case of KIBP improvement was analyzed in a core process within a large-sized Peruvian insurance company. According to literature, some findings were identified: 1) when well applied; CommonKADS can trigger innovation in KIBPs, producing improvements in many organizational dimensions, such as efficiency, effectiveness and sustainability. 2) There are knowledge management processes within KIBPs that need to be identified, managed and, if possible, automated. 3) Information Technology, together with CommonKADS methodology, plays and strategic role in KIBPs innovation, by supporting automation of knowledge processes and also providing other results such as flexibility, scalability, efficiency and valuable information.
Key-Words: CommonKADS; Knowledge; Innovation; Knowledge Management; Industry.

1.Introduction

In the current context of a globalized economy, knowledge is a key factor of competitiveness and differentiation (DRUCKER, 1993; DAVENPORT, 2006; NONAKA; TAKEUCHI, 1995; SENGE, 2006).

Organizations use business processes and knowledge to create and deliver gods and services (HARRINGTON, 1997; GONÇALVES, 2000a). Thus, processes are the value-chain

in organizations. Organization competitiveness is usually related to the success in process management (HARRINGTON, 1993; DAVILA CALLE et al., 2008).

In some business processes, knowledge is the main resource and/or product. Therefore, A business process is defined as knowledge-intensive (KIBP) when it has high task complexity and high knowledge intensity (DALMARIS et al., 2007) and relies on extensive human knowledge and involvement (ISIK et al., 2013).

On the other hand, Knowledge engineering "enables one to spot the opportunities and bottlenecks in how organizations develop, distribute and apply their knowledge resources, and so gives tools for corporate knowledge management" (SCHREIBER et al., 2000, p.7). So, when knowledge engineering is applied in KIBP, opportunities and added value for the business can increase significantly.

Many studies have addressed process improvement or process innovation in organizations. Likewise, knowledge engineering area has been the subject of a considerable amount of studies. However, there is a lack of theoretical-empirical studies about real cases of knowledge engineering application in knowledge-intensive business process specifically in the insurance industry.

In this context, the next question emerges: How can Knowledge Engineering contribute to improve core KIBPs? This article aims to present a case about the use of knowledge engineering approach to improve a KIBP in the insurance industry.

This paper is organized as follows. In the section 2, the methodology used for this research is presented. Section 3 presents a literature review about KIBP, Knowledge engineering and CommonKADS, focusing in one of its tools: Organizational Model. A case of improving KIBP in an insurance industry using CommonKADS is presented in the section 4. Finally, a conclusion and some implications are given in the end.

2. Methodology

This study research has a pragmatic philosophy conception because is intended to understand actions and its consequences towards real world practices (CRESWELL, 2002). Considering the adopted philosophy, the study uses qualitative methods to describe and analyze data and results, in a set of steps oriented to produce a flexible and descriptive final report (CRESWELL, 2002).

Two techniques were used to implement the research: Literature review and study case. First, a literature review was made to characterize and define a set of conceptual

elements about KIBP and knowledge engineering used for this study and to identify how these concepts are related.

Then, the set of categories and relations founded in this literature review were used to analyze the process improvement case in a core process in a large-sized Peruvian insurance company, using CommonKADS methodology. Data was collected from two interviews, with the IT project leader and with the business project manager involved in the innovation case. On the other hand, a set of historical records was collected from project office repository in order to complement and explain the main issues discussed in the interviews.

3. Literature Review.

According with the objectives of this research, some literature about Knowledge intensive business processes, Knowledge engineering and Common KADS was explored in this section.

3.1 Knowledge intensive business processes (KIBP)

A process is a set of people, resources and materials in work-activities logically connected that produce a result of value for a customer. For Harrington and Harrington (1997) a process makes use of organizational resources, receives an input and delivers a valuable product for an internal or an external customer. In the business context, business processes supporting the organization's goals using a set of resources in order to produce value for the customer.

Business processes have two basic characteristics: They are inter-functional - because they cross boundaries of functional areas -, and they have customers, internal or external - because they deliver a product to "someone" – (GONÇALVES, 2000b).

The existence of a good or service is always supported by a set of processes. For that reason, business processes are value flows that must be identified, analyzed and continuously improved to meet customer needs (HARRINGTON; HARRINGTON, 1997; GONÇALVES, 2000a). Hence, an efficient business processes management will have direct impact on the quality of products provided by the company, and consequently, will increase its competitive advantage.

A “knowledge intensive” (KIBP) is a particular type of business process with high task complexity and high knowledge intensity (DALMARIS et al., 2007). Also for Isik et al. (2013,p.516) “KIBPs rely on extensive human involvement and knowledge, whereas in non-KIBPs expert knowledge is less critical”.

The definitions of Knowledge diverge/are: According to CEN (2004, p.6), "Knowledge is the combination of data and information, to which is added expert opinion, skills and experience, to result in a valuable asset which can be used to aid decision making. Knowledge may be explicit and/or tacit, individual and/or collective". In summary, knowledge is a valuable asset that born as a result of conscious processing of information through an individual process in a specific context (NORTH; RIVAS, 2007).

The literature converges towards the notion that knowledge is the more critical resource in KIBPs. Considering this, a successful knowledge management, promotes and increases the probability of successful KIBPs management.

Before being managed, a KIBPs need to be identified. There are not clearly boundaries between KIBP e non-KIBP but academic literature identifies a set of characteristics about KIBP that can help the identification process.

In this line, a literature review made by Isik et al (2013) identifies some KIBP characteristics, for example: a KIBP usually need a lot of creativity and tends to be more complex and hard to automate than non-KIBP processes. All characteristics identified by Isik et al. (2013) are presented in table 1.

Table 1- Comparison between KIBP and non-KIBP characteristics.

KIBP	Non-KIBP
Mostly complex	Simple or complex
Mostly hard to automate	Mostly easy to automate
Mostly repeatable	Highly repeatable
Predictable or unpredictable	Highly predictable
Need lots of creativity	Need less creativity
Structured or semi/unstructured	Structured

Source: ISIK et al. (2013, p.519)

When identified, a KIBP can be analyzed with a holistic and critical view in order to be improved. Managing a KIBP involves the identification and managing of the critical knowledge in the process, and consequently, Knowledge Management area must be considered.

3.2 Knowledge engineering and CommonKADS

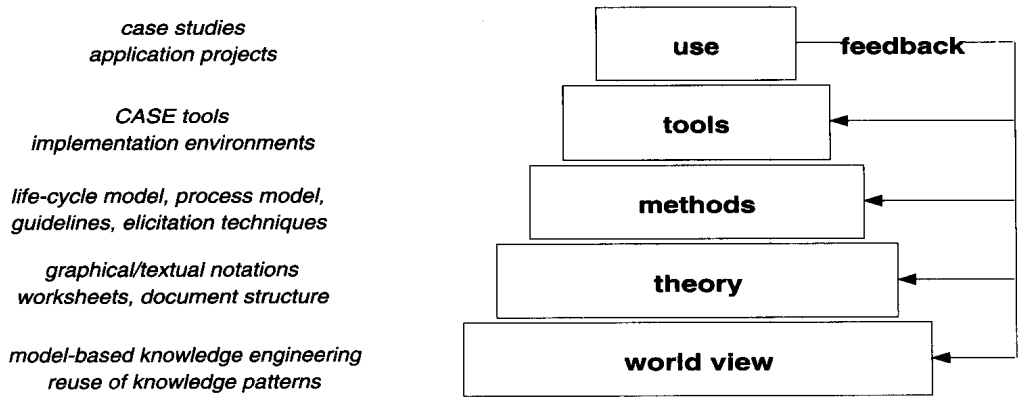
For Schreiber et al (2002), knowledge engineering is a methodology that produces knowledge systems as a main output. In addition, a knowledge system is used in knowledge

management. Thus, knowledge engineering is to create useful artifacts to support knowledge management.

In addition, Schreiber et al (2002) highlights that knowledge engineering has a set of concepts and methods for knowledge management, such as: Tools for mapping knowledge actions in knowledge oriented organizations, methods for task and agent analysis, methods for modeling knowledge knowledge-intensive activities, methods for defining knowledge structures, and others.

In this context, CommonKADS is a methodology of knowledge engineering originated "from the need to build industry-quality-knowledge systems in a large scale, in a structured, controllable and repeatable way" (SCHEREIBER et al, 2002, p.13). CommonCADS is based in a set of principles, guidelines, world view, that form the basis of the approach. These elements are shown in the Figure 1.

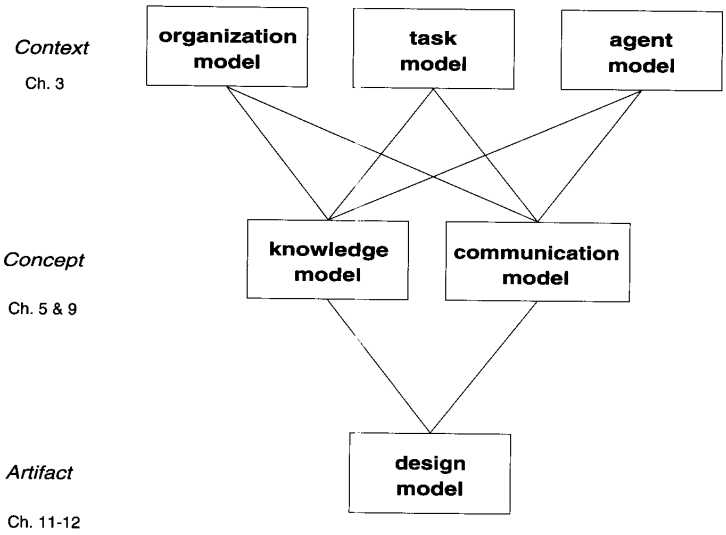
Figure 1- The building blocks of a methodology CommonKADS.



Source: SCHREIBER et al. (2002, p.15)

In the core of CommonKADS there are three groups of models that try to answer three types of questions. The first group, context models, focuses on understanding "why" a knowledge system is the potential solution for the problem. The second group, concept models, aims to explain "what" about the nature and the structure of knowledge involved. Finally, the design model explains "how" must knowledge be supported by a new computer system (SCHREIBER et al, 2002). CommonKADS models are presented in the Figure 2.

Figure 2- The CommonKADS model suite



Source: SCHREIBER et al. (2002, p.18)

3.3 Organization model

In the context level, the Model Organization of this methodology supports most features of the organization to discover problems and opportunities, establishing its feasibility and evaluating the possible impacts of development of these systems. At the concept level, the knowledge model of this methodology aims at specifying tasks intensive knowledge, explaining in detail the nature and structure of knowledge used in performing of a task. Have the artifact level, the Model Project aims to provide all detailing required for building a knowledge system (SCHREIBER et al. 2002).

Some of the steps of this methodology can be helped and improved using the modeling proposed by Bunge (2003) through the CESM (Composition - Environment - Structure - Mechanism) model ,which provides a systemic vision and can significantly contribute to the generation and elicitation structuring of knowledge in a specific domain .

4. Analysis and discussion of results

The company A had revenues of approximately US$ 1.2 billion during the year 2011, and is the leader in the Peruvian insurance market. The company A operates many types of insurance products (Life, Health, Car, Casualty, Unemployment, Accident and others) through its different sales channels (direct sales force, brokers, agents, banking retail, department stores, etc).

Sales channels as banks and department stores constitute “alternative channels”. In this type of channels, the priority is to commercialize massive products such as Accident, Unemployment and House insurance. The critical success factor is to have a competitive cost

of distribution and operation, and also to have simple products in order to facilitate sales processes (GALIZA, 2007).

In alternative channel business models, there are two business partners or 'players'. The bank or sales department, called partner, use their clients' database and distribution channels (agencies, sales force, sales processes) to sell the insurance policies, and sometimes, to provide the front end to customer service. In retribution, the partner receives a commission for insurances policies sold.

On the other hand, the insurance company receives information from the partner about every insurance policy sold (usually electronically), and starts an operative process in order to validate some business rules and register the sales. This way, the insurance company receives a premium for taking the risk on the insurance object.

In 2011, company A had revenues of about US$ 220 million per year by selling in alternative channels, and it had a 14 percent of average annual growing calculated from 2005 to 2011. On the other hand, the company was facing an increased number of difficulties produced by a set of structural operative problems. These problems on the operative process become evident through several signs such as:

- Poor standardization: One product one process. Every product commercialized through every alternative channel, had its own and particular flow and its own set of technological support, user procedures, inputs and outputs. Thus, there were 192 products and 192 different ways to operate.
- High human resources demands. Processes weren't totally automatized, so the company needed human control in all activities. In addition, the knowledge needed to operate every product was very high because the poor standardization and poor TI support. These elements increased significantly the cost of operation when sales were rising.
- High Operative Risks: Business rules were implemented in different ways for every product and there was not a central business rules repository, consequently, there was not a standardized TI architecture for business rules. As a result, TI process became inefficient and unstable when high sales volumes were processed.
- Poor service: the problems mentioned above frequently resulted on non-fulfillment in the service level agreement with the partners (banks or department stores).

The alternative channels sales' operation process is knowledge intensive (KIBP), according to definitions of Isik et al (2013) and Dalmaris et al (2007), because general knowledge about the client and expert knowledge about business rules and products are

combined and embedded in every activity inside the process. Knowledge was identified as a key resource embedded in the process, so knowledge management was considered to design the final solution. For that reason, an Organizational Model was made and underlined in order to obtain a systemic and relevant view of the problem, according SCHREIBER et al (2002).

- Considering the described context, a project was planned and implemented in order to improve the alternative channels sales' operation process. A subset of 18 products was selected from the universe of 192 product offered in alternative channels, these 18 products represent 92% of total revenues in the alternative channels business. According to Frishammar et al (2012) some key-antecedents were identified before the project:

- Strategy: Improve this operative process had a strategic alignment with company A's plan for 2010-2014. This plan stated that growing more than 20% per year in alternative channels would be one of the main objectives.
- Collaboration: An inter-functional team among internal subunits – such as Massive Operations, Organization Development, Process, IT – was created to develop innovative and systemic alternatives in order to solve the problem. Also, a communication bridge with some external key partners was developed in order to take important 'customer knowledge' and incorporate their needs into the final solution.
- Culture: The project was born with a high top management commitment, allocating all the necessary resources and the people with the right expertise for this project. Also, top management transmitted the team a very high level of motivation for being creative and innovative when developing the new process.

Different aspects related to people, resources e culture were identified, as shown in table 2.

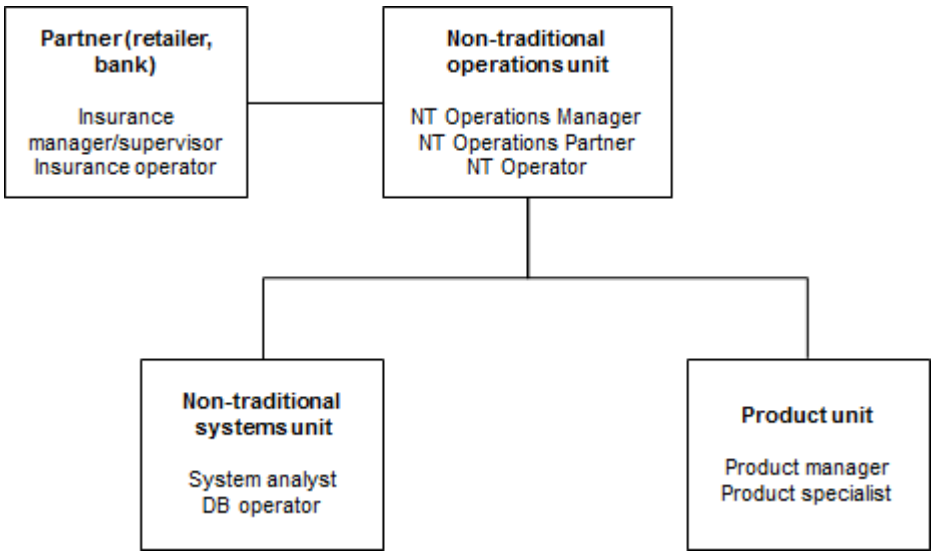
Table 2- Variant Aspects Worksheet OM-2

Organization Model	Variant Aspects Worksheet OM-2
STRUCTURE	See figure 3
PROCESS	See figure 4
PEOPLE	See figure 3
RESOURCES	- Contracts with partners (with responsibilities and Service level agreement). - Interchange information specifications - Core systems (Life, Health and General Insurance). - An inter-functional team among internal subunits – such as Massive Operations, Organization Development, Process, IT - was created for developing innovative and systemic alternatives in order to solve the problem. - Finally, a communication bridge with some external key partners was developed in order to take important 'customer knowledge' and incorporate their needs in the final solution.
KNOWLEDGE	**Business rules for each product:** Acceptance criteria, validation rules. **Partner Requirements:** SLAs, inputs, outputs, other specifications. **Tacit Knowledge about partner:** In collaborators who operates non-standardized products.
CULTURE AND POWER	High top management commitment, allocating all the necessary resources and the people with the right expertise for this project. Also, top management transmitted for the team a very high motivation for being creative and innovative when developed the new process.

Source: Authors, based in Schreiber et al. (2002, p.31).

Aspects identified in table 2 occur in a context characterized by a structure and some work teams. Figure 3 presents these elements.

Figure 3- Structure and people.

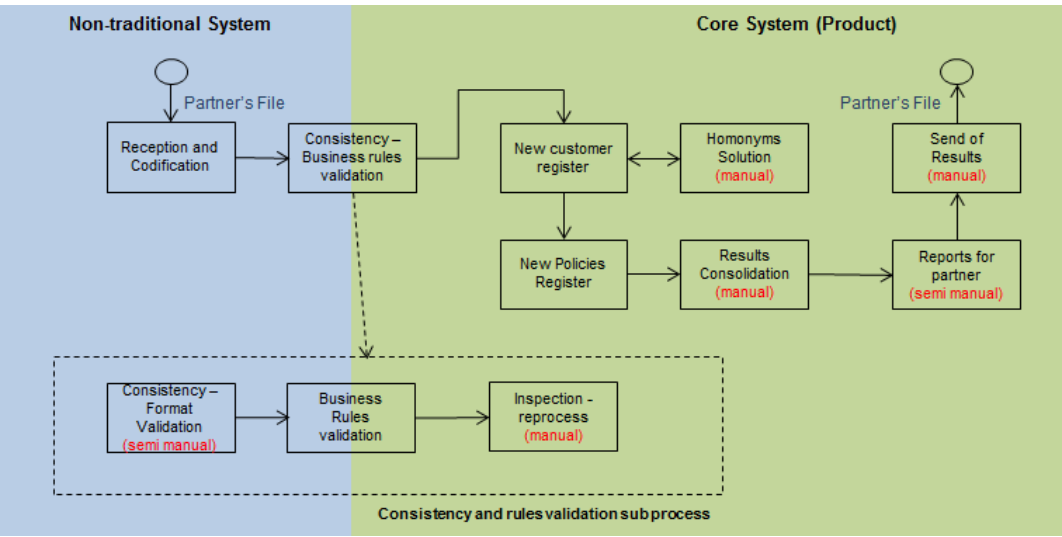


Source: Authors.

As specified before, the operation of the 18 insurance products on this project was very non-standardized and with a high number of manual activities. There is one operative process and consequently one set of IT support routines for each product.

Despite this, a unique process representation was made (without trying to represent the right process for each product) in order to identify the main problems, this representation is shown in Figure 4.

Figure 4- Current Process.



Source: Authors.

The process representation aimed to identify various improvement opportunities, basically a set of processes with knowledge that was not well managed, also a set of knowledge-intensive activities with high significance that were not automatized. Knowledge elements embedded in activities were analyzed and described, as shown in table 3.

Table 3- Knowledge Assets Worksheet OM-4.

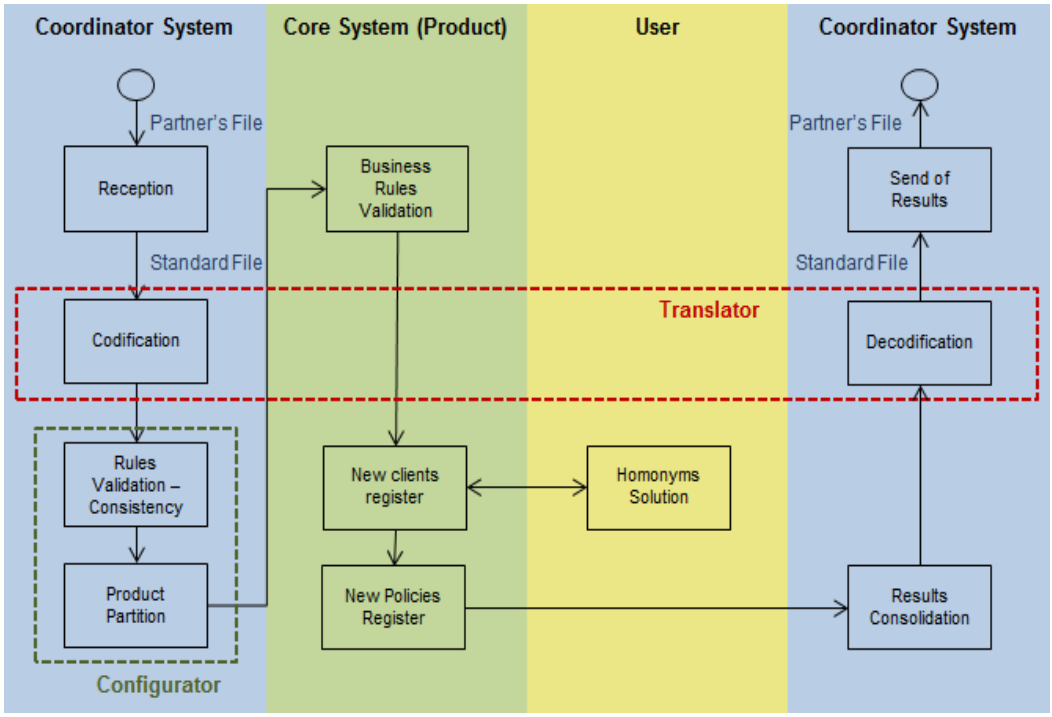
Organization Model		**Knowledge Assets Worksheet OM-4**				
KNOWLEDGE ASSET	POSESSED BY	USED IN	RIGHT FORM?	RIGHT PLACE?	RIGHT TIME?	RIGHT QUALITY?
Business rules for each product	Contracts / Product documentation / NT system	Consistency - business rules validation	No. It must be automatic	No. It has to be in NT System	No.	No. It is not centralized / updated.
Partner Requirements	Contracts / NT Operator / NT System	Reports for partner	No. It must be automatic	No. It has to be in NT System	No.	No. It is not centralized / updated.
Tacit knowledge about partner	NT Operator	Reports for partner	No. It must be explicit	No. It must be explicit	No.	No. It is not manageable.

Source: Authors, based in Schreiber et al. (2002, p.33).

The solution proposed was based on the elements shown above, mainly: strategy and critical success factor and the identification of knowledge as a resource and some knowledge intensive activities that need to be well managed.

The architecture of the new process is shown in the Figure 3 and each activity is explained as follows.

Figure 5 – Architecture for new operation process for alternative channels sales



Source: Authors.

First, the processes of the 18 products were unified into a new one. Second, the process was totally supported by TI, except one activity about "homonyms solution" that needs a user expertise and was not automatized in this project. Third, every activity started to have a set of result and control reports. Thus, and according to Attaran (2004), TI played a key role to achieve objectives in this innovation process.

On the first part of the process, managed by the new coordinator system, take place the reception of the consolidated file with sales sent by the partner for all the products commercialized. In this step, the aim is basically to register and to control some security protocols. Then the file, with a set of sale records with different structures depending on the product and the channel, is codified by an automatic translator in order to obtain a new file with standardized type of record that is easily recognized and processed in the next steps. This action gives flexibility to the process, making it independent of the channel file format.

After that, the file with standardized records goes through a first level of validations in order to confirm data format (numbers, size of strings, dates and positions) and also to confirm if the required data is complete according with the definition of the product sold in every record. Immediately, even in the coordinator system, the file received is partitioned in one file for each product in order to address each resulting file to the right core system. The

validation and partition logic represent an important knowledge that was embedded previously by a channel/product configurator, in other words, a knowledge application occurs (DALKIR, 2005).

Technological knowledge and knowledge about the product also are applied automatically in the next step. In the core system for each product, the new file is validated against a set of business rules. The file is validated in a vertical way, a TI technique that validate rules to each data field for all registers, minimizing from 200000 to 200 the number of transactions used for a file with 1000 records and 200 business rules. Records that fail the validation are saved as rejected. Records that are successfully validated are used to register the client and finally register the policy in the core system. Some clients have a homonyms problem; in this case the process triggers a report in order to notify the user who is expected to solve this problem. After all homonyms are solved the process continues automatically.

In the final part of the process, in the coordinator system, results are consolidated again in one file and subsequently they are decoded, in order to be sent to the partner in the 'same language' they were received. The partner also receives a set of personalized reports about correct and incorrect records, including the reasons for the incorrect ones.

As demonstrated, in the translator, external knowledge about each partner is embedded as a set of rules for codification and a set of criteria for designing the final reports. This knowledge is combined with internal knowledge generated in the process of giving the partner a personalized and valuable product. Consequently, according to Dalkir (2005), a knowledge acquisition process occurs when the translator is configured, and a knowledge application process during the operation supports the delivery of a better product.

Process innovation means finding and implementing new ways of manufacturing and delivering goods, faster, cheaper and in a more customizable way than any other competitor (TIDD et al., 2005). It includes process improvement and re-sequencing, better use of resources and benchmarking (ROSEMANN; VON BROCKE, 2010). Also, process innovation enables companies to perform a work activity in a radically new way (PAPINNIEMI, 1999, p.96).

Considering the definitions of process innovation, and the case described above on innovation in a knowledge intensive business process using CommonKADS, is pertinent to review the process innovation outcomes for this case, categorized by Frishammar et al (2012) in three dimensions: efficiency, effectiveness and sustainability.

Efficiency was improved in different ways. There were cost reductions on maintenance and operation of the new process. One person began to operate 9 products

instead of the 4 they did before the new process, and expert knowledge required to operate each product was embedded to the process/systems, becoming independent of the person.

On the other hand, processing times in servers decreased about 90% by using new processing techniques and a standardized process, and also IT area has now one process to maintain instead of the 18 processes it had before the solution. Implementation of new components, such as the configurator and the translator, gave more flexibility to the process and improved dramatically the time-to-market for new products. This time-to-market decreased from 22 days to 5 days, counted from the day the product is defined until the product is implemented and ready to operate.

Effectiveness can be seen mainly in an accomplishment of the service level agreement with partners: 98% after the solution, against less than 50% before it. Additionally a more valuable product was offered by giving a set of rich information important to solve operational problems and to develop some improved projects in the partner's sales process.

In the sustainability criteria, is important to highlight that the new process facilitates the user work, reducing manual tasks and also reducing stress for error or noise that happened in the old processes.

5. Conclusions and further research

This paper presented a case of innovation in a knowledge intensive business process in a Peruvian insurance company, using CommonKADS. In this case, the use of a knowledge management approach and IT played a key role for achieving valuable results in terms of efficiency, effectiveness and sustainability.

The main theoretical contribution of this study is to explore, analyze and link concepts such as KIBPs, knowledge management and specifically, CommonKADS as a set of tools for adding value in organizations that use knowledge. The study identified that knowledge is a critical resource that needs to be managed, mainly in KIBPs.

In addition, by showing the Organizational Model for the case presented, this paper aims to understand how the innovation process occurs in the practice by using CommonKADS. This was made analyzing the concepts collected in the theoretical review and showing a case study in the insurance industry, a kind of business poorly explored by the knowledge engineering literature.

Some limitations need to be stated. The study aimed to deepen prior knowledge about the characteristics of knowledge-intensive process innovation in order to understand how CommonKADS is used in an insurance company, and also to improve the knowledge basis

for new researches. Despite this, the results and relations identified in this case cannot be generalized for other insurance companies, other industries or other cultural contexts. Consequently, the study of new cases of CommonKADS application in KIBP processes, in different contexts is suggested.

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