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Assessment of Operational Experience as Strategy for Knowledge Acquisition and Learning in Organizations

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1. Introduction

In the current economic environment characterized by increasing competition and the pursuit of excellence, companies need to increase the efficiency of their production processes and management. In this sense, the policy of continuous improvement in organizations must be based on knowledge acquisition according to the experience of the company in the development of their activities and learning through the analysis of the operational experience. In recent literature several authors have found evidence of how the communications about observations, experiences and incidents are an important requisite for learning (Edmondson 1996; Van Dyck et al., 2005; Solana and Pérez, 2011). Even incidents without severe consequences also have considerable learning potential (Homsma et al., 2009).

Researchers have recognized the significance of organizational learning and its related concepts like the process of improving actions through better knowledge and understanding (Fiol and Lyles, 1985); the collective ability of a group to continuously expand its capacity to create the future in terms of personal mastery, shared vision, systems thinking, and team learning (Senge, 1990), identifying four necessary components: knowledge acquisition, information distribution, information interpretation and organizational memory (Huber, 1991); a structured and systematic method applied by an organization to motivate employees to learn (Dodgson, 1993). A gradual learning process by which staff learns through experiences and cooperate with other colleagues (Marchand et al., 2000).

The analysis of operating experience in organizations, whether it is a requirement that comes from external bodies, as if it is a policy promoted internally to the organization, is a relevant strategy of acquiring knowledge and learning for companies (Pérez and Solana, 2011). This strategy has proven effective in industries such as nuclear, to maintain a high level of efficiency and contribute to the improvement of processes and activities in such organizations, being able to apply this methodology in other companies and activity sectors. The implementation of organizational learning programs requires that the managerial attention should create opportunities for the work staff to engage in communication about incidents in order to allow for the development of shared knowledge about error incidents. Opportunities for employees to interact and discuss incidents openly may promote organizational learning (Homsma et al., 2009).

In this chapter we will explain how companies can develop organizational learning programs based on an adequate strategy of acquiring knowledge through the analysis of the experiences of its activity, a strategy which at the same time is based on the communication processes, sharing of knowledge, workflow management and collaboration. This work presents a model of knowledge acquisition and organizational learning that can serve as reference and be applied in different companies to improve their operational and management processes. The model is based on processes developed by the nuclear industry and is the result of the strict regulation and controls of its activity.
Following the chapter deepens first on the acquisition of knowledge in organizations and their relationship to organizational learning, for which a review of literature on the subject is realized by taking as a focus the experience based learning. Secondly, it discusses the need to establish formal procedures in organizations of knowledge acquisition in order to develop organizational learning, procedures that can be implemented with the help of techniques to design and specify complex workflow based on collaboration and sharing of knowledge. In this regard, it is presented workflow and Petri nets as a suitable technique for the specification of workflow processes with these characteristics. Then it is developed a methodology that enables organizations to implement a program of acquiring knowledge based on the phases of communication of experiences, event analysis, evaluation and implementation of improvement actions. This methodology of work it is formally specified as a learning model based on operating experience of the organization, a model that has been successfully implemented in the nuclear industry and can be applied to other companies. Finally, we present the conclusions and future lines of work.

2. Review of literature

In the next paragraph we present a review of the literature for the two disciplines that are studied in this chapter, knowledge management and organizational learning, and discuss the various theories and approaches on how organizations acquire knowledge and its relationship with organizational learning.

2.1 Knowledge management

The information is the result of the interpretation of data resulting from the observation (Buckland, 1991), however the next cognitive level, knowledge, represents a contribution of value-added to information: theoretical and practical understanding of a subject, synthesis process in which the information is compared to another and combined to establish meaningful relationships, applied information or the result of adding the experience to information. In addition, the various representations of knowledge (observations, rules, procedures, guidelines) have to be interpreted by the people, putting knowledge in context to apply it when necessary to act in a certain situation (Lueg, 2002). However, the acquisition and interpretation of knowledge in organizations is a complex matter, in so far as it is not presented as a monolithic image, but as an heterogeneous and dynamic system of different knowledge (Bonifacio et al., 2000) that are dynamically created in time (Newell, 1982).
Although there is no unique definition of Knowledge Management (KM) universally accepted, it should be noted some especially interesting. Lueg (2002) refers to KM as the discipline that deals with the collection and dissemination of knowledge for the benefit of an organization and the people who make and Swan et al. (1999) defines it as any process or

practice of creating, acquiring, sharing and use of knowledge to improve learning and performance of organizations.

Some authors relate the knowledge management with learning in organizations (Nonaka and Johansson, 1985; Huber, 1991; Quinn, 1992), in this sense Dodgson, (1993) links the Organizational Learning (OL) with the ways in which companies build, increase and organize the knowledge and, Sánchez and Heene, (1997) associate it with the processes of creating new knowledge in the bosom of individuals and groups within a company, and processes to effectively enhance the knowledge within the organization. Organizational learning is linked to the processes through which the organization creates knowledge or expands the knowledge base that has, line in which are also located the contributions of Nonaka, who considers knowledge creation as the central core of organizational learning (Nonaka and Takeuchi, 1995; Nonaka and Ichijo, 1997; Nonaka, et al., 1998).

Other authors that relate KM in the organization with the concept of organizational learning make it from different points of view: Amponsem (1991) associates organizational learning to the process through which individual knowledge becomes in knowledge of the entire organization; Marengo (1991) considers organizational learning as the process of generating new organizational competencies that involve knowledge creation in turn; Andreu and Ciborra (1994), Revilla (1995) and Andreu and Sieber (1998) associate organizational learning with the process of problem solving that enables to expand the knowledge base of the organization through the incorporation of the generated knowledge.

From the management point of view, the inclusion of the organizations into the knowledge economy requires the reorganization that allows them to integrate the knowledge in their conventional operation in order to convert it in a true strategic active (González et al., 2009). The recent literature shows the explanatory power of knowledge management on the organizational performance (Pedraja et al., 2009) what makes knowledge management a fundamental discipline for business competitiveness. Organizational effectiveness requires achieve an effective integration of specialized knowledge (Grant, 1996) that together with the management of intangible assets are key factors for obtaining competitive advantages by organizations (Teece, 1998).

Finally, within the literature review, a series of recent works of special interest are included below, analysing various issues relating to knowledge management.

2.2 Organizational learning

The concept of OL is taking a significant rise in both the academic and business context, by contributing to the improvement of the understanding of organizations and their activities. However, organizational learning is faced with a relative lack of empirical works, and in particular of case studies, to try to induce theory from practice.

The organizational learning literature has taken mainly two perspectives (Durand et al. 1996; Von Krogh, 1998; Easterby-Smith et al. 1998; Gherardi, 1999): the cognitive (or perceptual) and the social (or constructive). Spender (1996 a), Backler (1995), Cook and Brown (1999) also identify two approaches about the nature of knowledge; which emphasized that the knowledge is or has and the one who believes that knowledge is created, i.e. it is a process. These perspectives and approaches are related, so two fundamental approaches can be considered: the cognitive-possession and the social process.

The cognitive perspective takes two orientations (Cook and Yanow, 1996); the first that focuses the learning of the organizations in the processes of learning of individuals and assumes that organizations can learn as they have the same or similar skills that the

Author	Objective of the study	Main result
Bueno et al. (2004)	Design a model for the analysis of the conceptual relationships between business processes and knowledge processes.	Knowledge processes explain the critical intangible resources and the essential capabilities for organisational achievement. Learning processes contribute to the improvement of business processes.
Kuan (2005)	Studies the KM in small and medium enterprises (SMEs)	Identify the critical success factors that can act as a list of items for SMEs to address when adopting KM.
Teresa et al. (2006)	Develop a strategic contingency model to identify the interrelationships among KM capability and innovation	KM capability could enhance organizational learning and knowledge integration; levels of organizational learning, knowledge integration, and KM capability have significant impact on a firm's innovation.
Moreno and Pelayo (2007)	Integrate in a model of internal knowledge management the human, technological and organizational focus.	The KM promotes organizational learning. The technological, human and organizational factors are enablers of organizational learning (model Thalec).
Chin and Siong (2009)	Explore KM performance measurement from the angle of KM process effectiveness	Significant interactions were found between KM success factors (business strategy, K audit, K map, KM team) and KM elements of strategies (technology, culture, leadership, measurement) with KM process effectiveness.
Krogh, Nonaka and Rechsteiner (2011)	Investigate the leadership in organizational knowledge creation	Develop a framework for leadership in organizational knowledge creation based on three layers: a core layer of local knowledge creation; a layer that provides the resources and context; and a structural layer that forms the overall frame and direction for knowledge creation.

Table 1. Review of recent literature on KM

individuals (Cyert and March, 1963; Daft and Weick, 1984; Levitt and March, 1988; Weick, 1991), while the second considers the organizational learning as the learning from individuals in organizational contexts (Simon, 1991; March and Olsen, 1976; Shrivastava, 1983). The organizational learning is perceived as something more than the sum of individual learning of its members, while emphasizing the key role of individuals and their learning (Huysman, 1999).

In the social perspective, learning has a relational character that takes on special importance the context and the dynamics of organizational change (Lave and Wenger, 1991; Brown and

Duguid, 1991; Blackler, 1993; Weick and Roberts, 1993; Weick and Westley, 1996; Cook and Yanow, 1996; Spender, 1996 b; Sánchez and Heene, 1997; Dixon, 1994; Gherardi and Nicolini, 2000), is not based on the individual but arises from social interactions and is acquired through participation in the daily practice of the organization. Focuses on the way in which people interpret or give meaning to their work experiences. The social perspective understands the knowledge as a process of construction or creation. In this sense, the activity theory of Vygotsky (1962) maintains that the knowledge is continuously evolving and considers that it is not something that people and organizations have but something they do, which is constantly built and developed.

On the other hand, Hendlund (1994) and Nonaka (1994) studied the interaction between individual and collective knowledge and how the individual knowledge contributes to the collective. In this sense, it is not necessary that the members of the organization learn what others know, but join and integrate their knowledge (Grant, 1996).

The literature of the organizational learning is also referred to the concept "learning organization" (Senge, 1990; Goh and Richards, 1997; Leonard, 1992; Ulrich et al., 1993) in reference to the organizations that have institutionalized processes of reflection and evaluation that allows them to acquire a new competence, learning to learn, and create shared knowledge. A learning organization is one that builds intentionally structures and strategies to maximize organizational learning (Dogson, 1993) and formalizes learning methods (Moreno and Pelayo, 2007).

The knowledge of an organization is continuously created through activities that are developed (Tsoukas, 1996) and the people for their participation in the same accumulate knowledge through experience (Nonaka, 1994). Learning is the process whereby knowledge is created through the transformation of experience (Kolb, 1984). However, these aspects while necessary, are not sufficient, since the organizational knowledge should be shared, it is conditioned by people can establish formal and informal relations and the need of an evaluation from the observation of the organization of itself (Von Krogh et al., 1994).

In this sense, the organizations which are willing to implement the management of knowledge, must be able to collect in a formal way the experience of the organization, which is ultimately determined by the interaction between people and their organizational structures, and between the organization and its environment (companies of the same sector of activity, customers and suppliers). The experiences that in an organization contribute to a greater extent to the acquisition of knowledge and organizational learning originate in the activity itself that this develops, materialized across their business processes, but also on the experiences and knowledge shared with other organizations (enterprises in the same sector), or that are acquired through the surveillance activities of competition.

3. Processes specification: Workflow and Petri nets

A business process can be defined as the set of activities and performances to be carried out in an integrated manner to achieve a more general organizational goal. These processes are usually performed within an organizational structure in which there are various functional roles and hierarchical relationships. A process can be developed entirely in a single business unit or can be applied to various and even to different organizations (inter-organizational processes) as the processes with customers and suppliers, or collaborative processes in which knowledge is shared between different organizations.

Business processes can involve formal or relatively informal interactions among participants. Some of the activities of the process can be automated, in which case it is the system the responsible for carry them out. Manual activities however, are outside the control of the system being made directly by people (WFMC-TC00-1011 Issue 3.0, 1999). The business processes of organizations, generally involve the development of complex workflows that are part of their daily activity.

A workflow refers to a process or work procedure (susceptible to be automated using informatics methods and systems) in which involves different knowledge (relational data, documents, experience) and the tasks performed by the participants according to a defined set of rules, to contribute to the achievement of a business objective (Hollingsworth, 1995).

The design of workflows requires develop specifications that describe an abstraction of the processes of the company. The workflow specification languages are used for this purpose to create workflow models that support the structure of the process activities (control flow) and the exchange of information (data flow) between such activities (Mentzas et al. 2001).

The classic model of representation allows to specify the workflow based on a set of activities (with a total or partial order) and its dependencies, and enables reference the objects are handled (resources, knowledge) and the actors involved in the process (people, according to their role, and the system that can automate some activities).

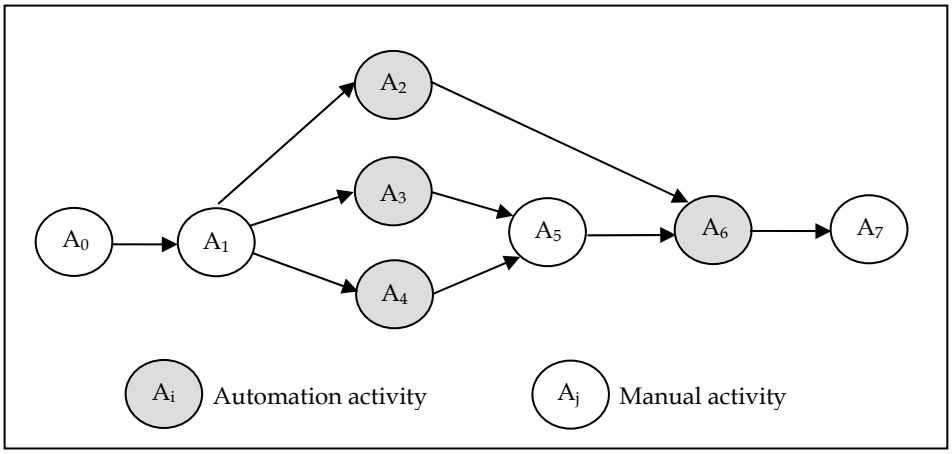


Fig. 1. Workflow model based on activities

This technique is suitable to model processes from a logical point of view, but is insufficient when you need to have a detailed specification when you want to automate such processes. The use of formal techniques that offer a greater capacity for analysis and verification of the process that is being designed help to overcome this limitation (Solana, 2006).

In general, systems are increasingly oriented towards the idea of process, which is leading to the development of collaborative environments that have ever greater capabilities to manage the knowledge of organizations.

3.1 Petri nets

In the literature on information systems have been proposed various techniques to model the process perspective. Some of these techniques are not formal in the sense that the diagrams used have not a defined formal semantics. This kind of techniques (Data Flow Diagram or Structured Analysis and Design Technique) but allow to design and discuss about processes, are not the most appropriate when it is trying to design complex workflow processes, because they are incomplete and subjective (Aalst, 2002).

However, Petri nets for its formal semantics are an effective tool for modeling and analyzing business processes of organizations, and its main features include: 1) provide a natural form of representation and a high expressiveness, 2) its graphical language allows to specify complex workflows according to the workflow primitives of Workflow Management Coalition[1] (WfMC), 3) the theory of Petri nets provides a powerful analysis tool to verify the correctness of the definition of workflow processes and 4) Petri nets can represent the states of a process as elements of "first class", in contrast to other modeling techniques that focus exclusively on the active parts of the process, on the activities.

In this chapter the Petri nets are used to formally specify the model of knowledge acquisition and organizational learning that is presented, which has interest as case of study, because it allows to contrast some of the theories and ideas developed by the different authors to which we have referred above.

3.2 Formalization of Petri nets

A Petri net is a directed graph that uses two different types of nodes, called places and transitions. The places are represented by circles (○) and the transitions as rectangles (□). The nodes are connected to each other through directed arcs (○ → □) and are not allowed connections between two nodes of the same type.

The formal definitions that constitute the basic theoretical framework of this technique and that we have considered convenient to collect are the following (Aalst, 1998):

Definition 1. (Petri net). A Petri net is a triple (P, T, F), where:

- P is a finite set of places.
- T is a finite set of transitions, such that ($P \cap T = \Phi$).
- $F \subseteq (P \times T) \cup (T \times P)$ is a set of arcs (flow relation).

The arcs are considered of weight one because in the context of workflow processes the places are achieved when certain conditions are fulfilled.

Definition 2. (Input place). A place p is called an input place of a transition t iff there exists a directed arc from p to t.

Definition 3. (Output place). The place p is called an output place of transition t iff there exists a directed arc from t to p.

Be the place p and the transition t, then:

- $\bullet t$ denote the set of input places for a transition t.
- $t\bullet$ is the set of output places for a transition t.
- $\bullet p$ denote the set of transitions sharing p as output place.

[1] Founded in May 1993 is a global organization of adopters, developers, consultants, analysts, as well as university and research groups engaged in workflow and Business Process Management (BPM). The WfMC creates and contributes to process related standards and interoperability of workflow management systems. http://www.wfmc.org.

- $p^{\bullet}$ is the set of transitions sharing p as an input place.

Definition 4. (State of a Petri net). The state M of a Petri net is a distribution of tokens (●) over places. We will denote $n_1p_1 + n_2p_2 + n_3p_3 + \ldots + n_kp_k$, the state of a Petri net such that there are n_1 tokens in the place p_1, n_2 tokens in p_2, n_3 tokens in p_3 and so on n_k tokens in the place p_k. The number of tokens can change during the execution.

Transitions are the active components in a Petri net, change the state of the net according to the following firing rules:

1. A transition t is said to be enabled iff each input place p of t contains at least one token.
2. An enabled transition may fire. If a transition t fires, then t consumes one token from each input place p of t and produces one token in each output place p of t.

Given a Petri net (P, T, F) and a state M_1, we establish the following notations:

- $M_1 \rightarrow^{t} M_2$: transition t is enabled in state M_1 and firing t in M_1 results in state M_2.
- $M_1 \rightarrow M_2$: there is a transition t such that $M_1 \rightarrow^{t} M_2$.
- $M_1 \rightarrow^{\sigma} M_n$: the firing sequence σ = t1, t2…, tn-1 leads from state M_1 to state M_n, i.e., $M_1 \rightarrow^{t1} M_2 \rightarrow^{t2} \ldots \rightarrow^{tn-1} M_n$.

3.3 Workflow nets

The Petri nets that are applied to modeling of workflow processes are called workflow nets (WF-net), are based in network theory proposed by Carl Adam Petri at the beginning of sixties (Petri, 1962) and whose basic theoretical principles have just presented.

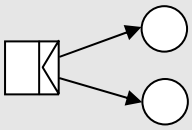
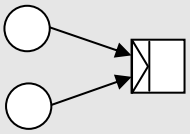
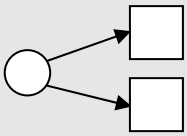
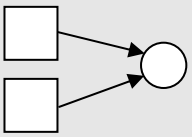
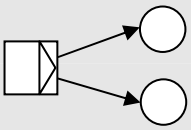
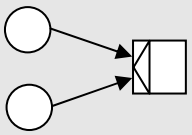
The workflow nets allow to define the workflow processes, modeling using graphical elements the process activities (transitions), the states (places) that can be found as a result of the development of such activities and the dynamics of the process. In a workflow net the transitions are the active parts of process, the places are the passive parts and the arcs between transitions and places represent relations of causality (Aalst, 2002).

The workflow nets let model different cases or instances of the process, as layers in the WF-net which are represented by tokens (●) on the network places. The overlapping of the different cases allow to view the execution status of the process and perform an analysis of its situation in a certain moment (eg. when a place has a large number of tokens, indicates that there is a bottleneck in that place).

The workflow nets can represent the routing or dynamic of transitions between the process places, for which are used routing constructors. The constructors AND-split, AND-join, OR-split and OR-join, allow to represent sequential models, conditional, parallel and iterative. It is also possible to represent under what conditions are triggered the execution of the activities, for which are used attributes or control variables.

The AND-split constructor allows to model that multiple activities are executed simultaneously. The AND-join constructor models the synchronization of two or more activities whose execution can be developed in parallel, so that the next activity does not start until they are completed. The OR-split constructor (it is a exclusive OR) models the case that for a given activity, as a result of compliance with certain conditions, begins a single subsequent activity. The OR-join constructor models the case in which a certain activity begins after the completion of one of the alternatives precedents activities, not being required the synchronization of these (WfMC-TC00-1011 Issue 3.0, 1999).

The difference between explicit OR and implicit OR is that in the latter case, the time of the election, which is normally done in terms of fulfillment of some condition, is made as late as possible.

Constructor	Graphic notation	Constructor	Graphic notation
AND-split		AND-join	
Implicit OR-split		Implicit OR-join	
Explicit OR-split		Explicit OR-join	

Source: Elaborated by the authors from Aalst (1998)

Fig. 2. Symbolic notation of constructors for workflow nets

4. Organizational knowledge and learning model

The next paragraph contains the empirical development of research, which has designed a model of knowledge acquisition based on analysis and evaluation of operational experience and has developed an organizational learning system that has been brought to practice successfully in Nuclenor, company that manages the operation of the nuclear power plant of Santa María de Garoña in Spain. Following are commented the background and organizational context in which the work has been developed, are characterized the organizational roles involved in the model and are described the activities of the process of analysis of operational experience and acquisition of knowledge, to finalize presenting learning model developed using workflow nets as a technique of specification.

4.1 Background and organizational context

Currently the development of policies of continuous improvement in the organizations can be achieved through the implementation of organizational learning processes and the evaluation of operational experience, according to the phases of detection, communication, evaluation and, correction and improvement of findings, events or incidents reported.

Following is presented a methodology for the acquisition of knowledge and learning based on experience, this methodology is been used to improve the efficiency in Nuclear Power Plants, which for the strict and rigorous control that they are subjected, can provide the basis for other industries.

The Nuclear Security Council in Spain carried out periodically a review of the security of Nuclear Power Plants, through the evaluation of the operational experience required to the holders of energy production plants. It must demonstrate that the power plants maintain a

high level of efficiency and operational safety, through an adequate system of acquiring knowledge from the experience, so that the existence or the development of potentially dangerous states of the structures, systems and components will be detected and analyzed exhaustively taking measures and corrective and improvement actions which will be more suitable (GS-1.10/08, 2008).

An event is defined as any unwanted and unintentional sequence of occurrences that results or could potentially give rise to consequences in different areas of the organization as plant operation or safety, (PCN-A-039, 2010). While there may be various types of events according to their degree of importance and characteristics, much of the events can be categorized as minor incidents, that is, unexpected results, errors or incidences in the activity, conditions that detects any service of the organization, which is considered to have had or could have an impact on security, reliability of the installation, organizational efficiency, risk and the health of people, industrial plant equipment or environment.

The detection, correction and prevention of incidents are carried out mainly through two different processes: the analysis of operational experience and the probabilistic security analysis which works with historical data. In this paper we focus on the first process because it works on abnormal or unexpected events that correspond to situations that occur during the daily activity in the industrial installations. These events are unique opportunities to detect, analyze and correct imperfections of the organizational practices and human error.

The implementation of an organizational learning process of these characteristics, based on the analysis of the operational experience, requires to define the set of activities to follow in a methodological form, to carry out the evaluation of the events occurred in the organization, since these are detected until the actions to correct them are executed: record of the event, communication, evaluation and definition of actions to take, execution of these and close of the event. The aim of this process is to ensure that the appropriate actions are taken to increase the security and reliability of the industrial plant, and the efficiency in the management of the organization, taking into account for the future the recommendations and lessons learned issued from this analysis.

This learning process includes all the activities guided to compare the functioning of processes and activities of an organization with the established expectations. The activities and issues that must be corrected or improved are derived from the comparison between the results and expectations.

The working method employed, allow tracking of each situation and know the status of the events in its different phases; propose actions to take, and get reports for both the enterprise and other organizations. The aim pursued is to identify, document, analyze and evaluate inadequate trends, and adopt the actions to resolve the nonconformities detected.

The first phase in the evaluation of an event is to describe and record the circumstances that have surrounded the incident, which may occur as a result of inappropriate actions in the design, maintenance, non-fulfillment of procedures and practices, inappropriate communications or lack training (PG-017, 2007).

Once registered and documented the event, first the direct cause is analyzed, that is, the failure, action, omission or condition which immediately produces or leads to the occurrence of the event.

It then proceeds to perform the process of evaluation properly speaking, which starts by analyzing the root causes, that is, the fundamental causes that if are corrected will prevent the repetition of the event or adverse condition, and continues determining the corrective

actions that prevent the future recurrence of the condition or adverse trend that carries again to the event occurs. In this sense, it will record the set of actions to be performed, indicating if they involve the correction or improvement of some aspect, their priority and the training to give when appropriate, establishing the business unit that will implement (execute) them and within what time.
The actions to be executed by each business unit are communicated to the unit responsible, starting then the implementation phase of the actions; process that ends when the last action is executed, giving the incident by closed.
Likewise, the general coordinator of the process will carry out in parallel form the tasks of control and monitoring of the process on those events that are in evaluation or open (in phase of implementation of actions). The monitoring of the actions being executed will be recorded, indicating the date on which it is tracking, the evolution in the implementation of the action (difficulties, delays incurred, etc.), which may give rise to coordination actions when was necessary.

4.2 Organizational roles of the process

The process of knowledge acquisition and learning based on operating experience of the organization requires the coordination of the various business units and the participation of their staff. To implement this process in a satisfactory way in the organization it is necessary consider the following roles:
General Coordinator of the Process (GeCoorPr): is responsible for managing the program of operational experience, including the following tasks (PG-017, 2007):

- Tracing coordinators of the various units for the process be carried out satisfactorily.
- Maintain the database that supports the process updated, which involves record the events, determine the direct cause and appoint the coordinator responsible for its evaluation (BuUnCoor. Resp. Eval.).
- Perform the activities to control and monitor the implementation of actions to correct the events and incidents detected.

Business Unit Coordinators (BuUnCoor): the coordinators of each business unit are responsible for the performance of the following tasks (PCN-A-039, 2010):

- Verify the fulfillment of criteria for the event be analyzed and document the events generated by their unit, completing the report of the event.

Coordinators of business units responsible for evaluation (BuUnCoor Resp. Eval.): in this case the business unit coordinator has the following functions:

- Evaluate the events affecting their unit, for which they will generate an evaluation report, identify the root causes of the event and propose actions to perform by different units of the organization to correct the incident.
- Maintain the database of operational experience updated recording the information referred to above, including the evaluation report.
- Inform to the general coordinator when finalize the evaluation of the events.

Coordinators of business units responsible for execution (BuUnCoor Resp. Exec.): will be the responsible for the following functions:

- Lead the implementation of actions within the competence of their business unit.
- Inform to the general coordinator when the personnel of their business unit will go executing and closing the corrective actions assigned.

Personnel of the organization and external (PerOr-Ex): any person who while performing their job detects an incident, must inform the coordinator of the unit providing the necessary data to determine if applies record and evaluate the event.

4.3 Activities of knowledge acquisition and learning

The entire process by which the organization acquires knowledge from its experience and learn, begins with the detection and analysis of each event, and ends one the actions oriented to its correction or improvement are executed. The various activities that are part of this process of organizational learning are the following:

Activity code	Name	Description
Act. A	Detection and communication of the event.	Event detection and communication of it, usually by email, to BuUnCoor of the person who detects.
Act. B	Initial analysis and verification of criteria.	The BuUnCoor makes a preliminary analysis of the event and determines if it satisfies the criteria for reporting and analyzing.
Act. C	Fulfillment event report.	The incident is described fulfillment for it an event report, which is done by BuUnCoor following an established electronic format.
Act. D	Sending the event report to GeCoorPr	The BuUnCoor send by email the event to the GeCoorPr.
Act. E	Event record and sending to BuUnCoor Resp. Eval.	The GeCoorPr records the event, identifies the direct cause and assigns the unit responsible for the evaluation, sending the recorded event to BuUnCoor responsible for the evaluation.
Act. F	Identification of root causes and proposed actions	The BuUnCoor responsible for the evaluation determines and assigns the root causes and propose corrective and improvement actions to make, indicating: action number, description, priority, if require give training, the limit date of execution and the unit responsible for do it.
Act. G	End of the evaluation: record evaluation date and pass on to the open state.	The end of the evaluation implies that the event becomes opened setting the valuation date, from this point it will proceed to execute the actions set out to correct it.
Act. H	End of the evaluation: sending actions to BuUnCoor Resp. Exec.	When the BuUnCoor responsible for the evaluation indicates that it has finished (when all the actions must be implemented have been registered), the event and the whole of its information associated is sent to BuUnCoor of the units responsible for execution of the actions.
Act. I	Control and monitoring activities.	The GeCoorPr performs control activities and monitoring the execution of actions to avoid unwarranted delays and coordinating the process.
Act. J	Execution and closing actions by units.	The responsible for performing actions, execute them in time, indicating the date and documentation of closing, and inform to the GeCoorPr.
Act. K	Closing event when closing the last action.	Once has closed the last action assigned to the event, it is considered closed (set status to closed) and terminates the process.

Table 2. Activities of the knowledge acquisition and learning process

Part of the activities outlined can be automated at least partially by the system itself triggering (from the database manager) processes that are associated with certain events:

Activity code	Automation process
Act. E	The event is sent to BuUnCoor Resp. Eval. when the incident is recorded in the database.
Act. G	The state of the event is changed as opened and the valuation date is set, when the BuUnCoor Resp. Eval. indicates that has completed its evaluation.
Act. H	It is automatically sent the record of the event and the actions that are determined to take to the BuUnCoor Rep. Exec. (may be several), once the BuUnCoor Resp. Eval. indicates that it has finished it.
Act. J	Are reported (by sending a message) to GeCoorPr when is registered the closing date of each action.
Act. K	It changes the state of the event to the closed state when the closing date is assigned to the last action.

Table 3. Activities which trigger automation processes

Figure 3 shows the flowchart of the process which has been described, indicating in grey colour the activities that are partially automated.

4.4 Model specification of organizational learning

The process of knowledge acquisition and organizational learning from the analysis of operational experience can be modeled formally applying the theory of Petri nets. This technical of specification is used with the purpose of any organization can develop and implement the process through an information system that helps to realize an efficient management of workflow and the issues analyzed.

The Petri net model presented allows to specify a complex organizational process, of structured type, with a high level of detail, both with respect to the activities that should be considered as the flow of information and communication that occur.

The organizational learning model presented has been implemented successfully in Nuclenor, company with 400 employees that manages the nuclear power plant of St. Mª de Garoña in Spain. The results achieved reveal a high degree of involvement of company staff in the communication of events and their active participation in all phases. For reasons of confidentiality does not provide specific data of the company in this regard, although it is an intensive program in knowledge management, both for the number of events analyzed (knowledge creation) as the quantity of actions implemented (organizational improvement) and knowledge sharing.

The experiences analyzed are a shared knowledge base that is available to all departments and personnel of the company, so that in the resolution of any problem or incident go first to the existing knowledge base and take into consideration the results derived from the analysis of similar operational experiences. By the importance of enhancing the security and efficiency of the installation, being an industrial company which is part of an strategic sector, this knowledge base also includes experiences reported by other Spanish and

international nuclear plants, so that the incidents could be applied to the nuclear plant are analyzed with the purpose of learn from the experience of other companies in the sector and avoid similar situations in the future.

The system now constitutes a program of organizational learning and continuous improvement for the company, which provides periodic evaluation of a set of performance indicators in the various departments and areas of the company (installation security, risk and health of people, internal management and environment).

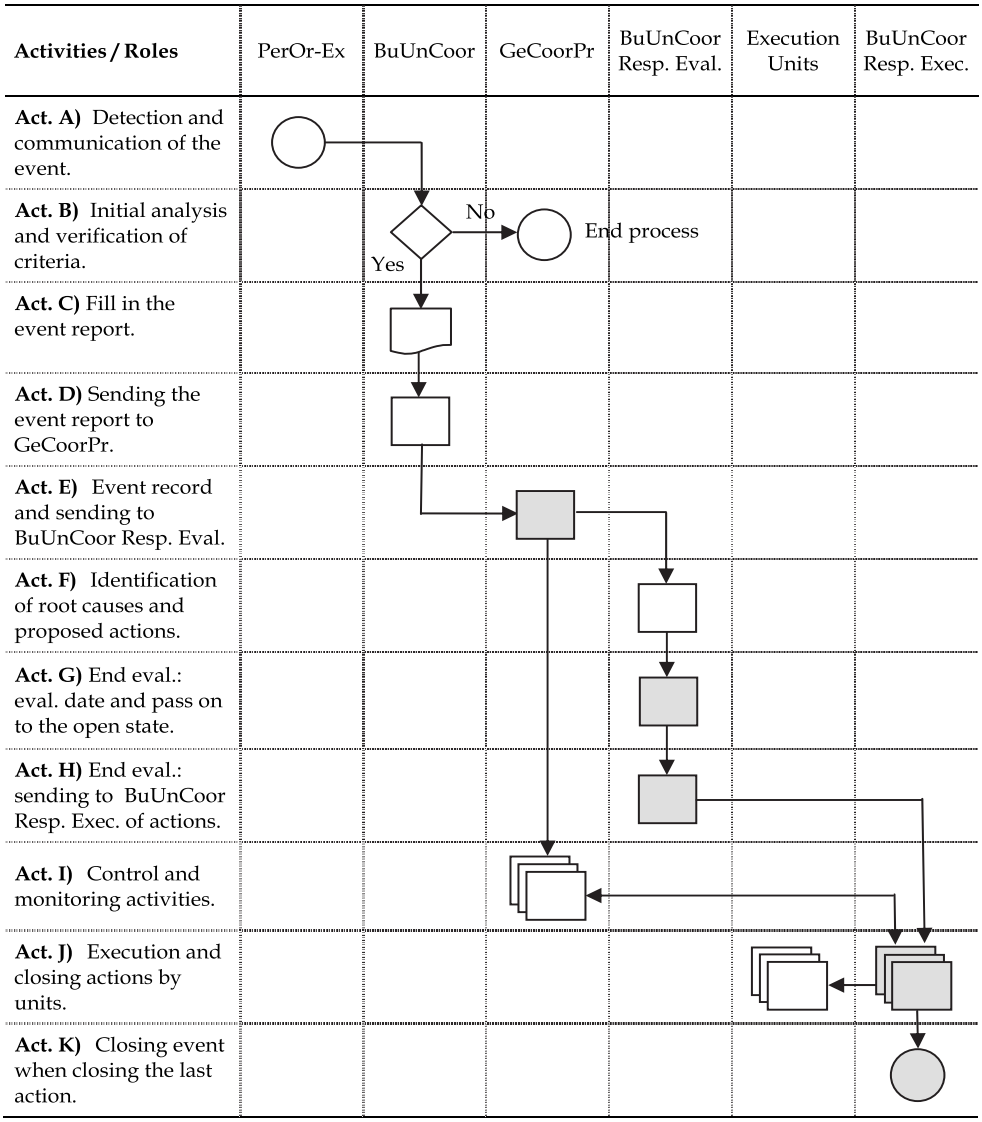


Fig. 3. Process diagram of knowledge acquisition and organizational learning

Based on the analysis performed in the preceding paragraphs, is presented below the workflow model that specifies the organizational learning process described in this chapter.

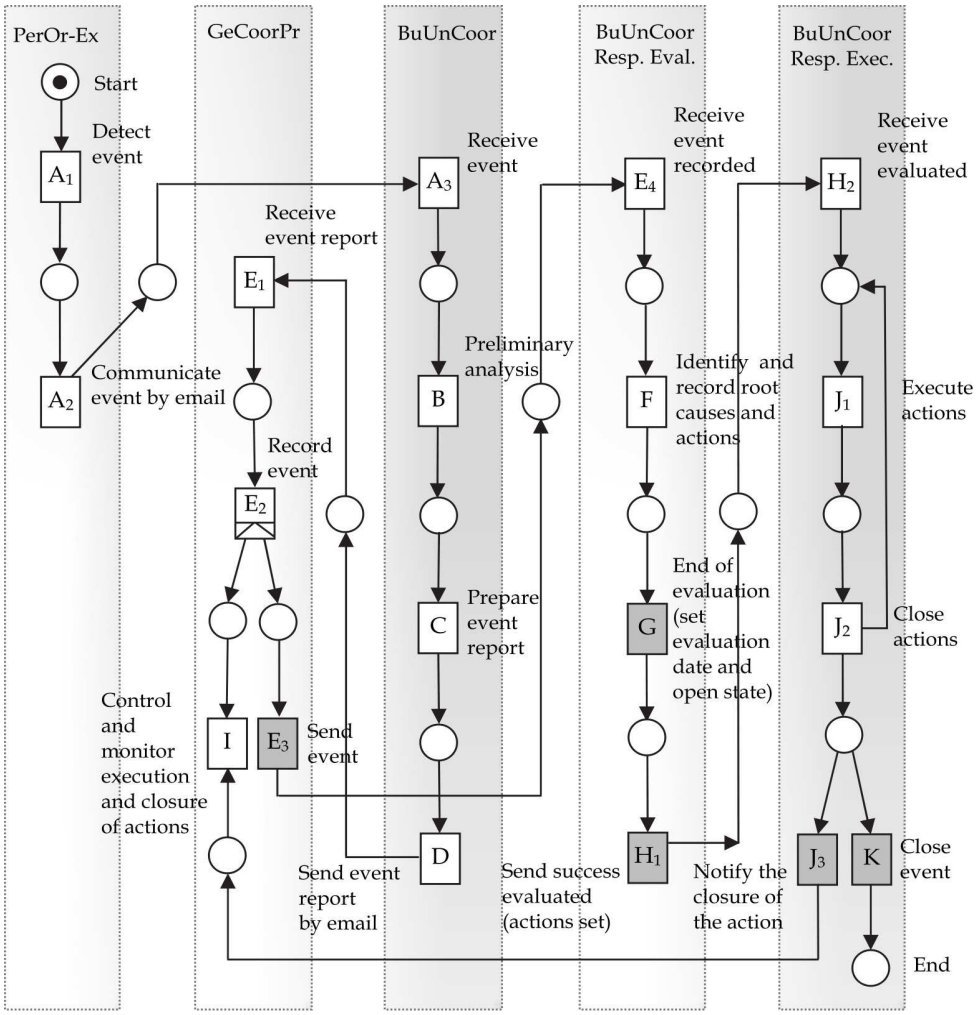


Fig. 4. Model for knowledge acquisition and organizational learning

5. Conclusion

This chapter has been addressed the organizational learning as one of the key approaches of knowledge management. Knowledge and learning are closely related, the organizational learning is the ability of the organization, from existing knowledge, create new knowledge or extend the knowledge base of the organization.

The organizations are complex systems in which the concept of learning can be applied to persons (individual learning) working teams (group learning) and organizations themselves

(organizational learning). Individuals learn from their experiences and errors, teams learn from shared experiences and work in groups and organizations learn from the activities and business processes that take place as part of their daily dynamic, in all these cases the experience is a key element of learning.

For learning to occur in the organization is necessary to establish the structures and mechanisms to convert knowledge of individuals and teams into collective knowledge. It is not sufficient to know that the organization learns from its experience, letting the learning and knowledge acquisition are developed in natural and spontaneous form, but to maximize learning the organization needs to develop relational contexts, workflows and formal learning processes, which help to institutionalize the knowledge so that it can be shared and used by the entire organization. In this sense, the organization should develop a core competency, learn to learn.

For the organization learn it is necessary to consider the perspectives: strategic, organizational, technological and human resources. In the strategic perspective will be necessary to align the organizational learning strategy with business strategy and objectives, in the organizational perspective will have been to create the structures and formal processes that support the learning strategy, in terms of technology will be require put into serve of the organization the technological advances to manage and share knowledge (collaborative systems and knowledge bases) and in the perspective of human resources will be necessary to coordinate human capital in a context of learning and knowledge sharing.

Along the chapter has addressed all these issues and how organizations can acquire knowledge through the analysis of experience in their activities. It has presented a methodology based on the procedures of the nuclear industry that allows other companies to implement programs of knowledge acquisition and organizational learning. The organizational learning model has been presented allows to obtain a valuable information from the analysis and evaluation of daily experience, processes that together with taking preventive, corrective and training actions, can improve greatly the efficiency of operative and management processes, avoiding future non-compliance, human errors and potentially dangerous state for people, structures and components of the organization.

The model of knowledge acquisition and organizational learning proposed has interest as empirical study, because it has been implemented successfully in the nuclear industry. This work has relevance to the business community because the model has been presented can be applied to other companies and activity sectors with the adaptations required for each particular business context. From an academic perspective, the case study makes contributions that allow contrast some of the theories of organizational learning and knowledge management have been shown in the review of literature, and may help to infer theory from practice in future works.

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7. References

Aalst, W. M. P. (2002). Making Work Flow: on the Application of Petri Nets to Business Process Management. En: J. Esparza, C. Lakos (Eds.): Lecture Notes in Computer

Science, Vol.2360, pp. 1-22: *23rd International Conference on Applications and Theory of Petri Nets*, Adelaide, Australia, Junio 2002. Springer Verlag.

Aalst, W. M. P. (1998). The Application of Petri Nets to Workflow Management. *The Journal of Circuits, Systems and Computers*, Vol. 8, No. 1, pp. 21-66.

Amponsem, H. (1991). *Organizational Learning through Internal Systems, Strategic Alliances and Networks*. Doctoral Tesis. Queen's University at Kingston. Canadá.

Andreu, R. & Ciborra, C. (1994). Information Systems for the Learning Organization. Conference on Information Technology and Organisational Change. Nijenrode University.

Andreu, R. & Ciborra, C. (1996). *Core Capabilities and Information Technology: An Organizational Learning Approach*. In: Moingeon, B. and Edmondson, A., Organizational Learning and Competitive Advantage. Sage.

Andreu, R. & Sieber, S. (1998). Knowledge and Problem Solving: a Proposal for a Model of Individual and Collective Learning. Working Paper, nº 99/1. IESE.

Blackler, F. (1995). Knowledge, Knowledge Work and Organisations: and Overview and Interpretation. *Journal of Management Studies*, Vol. 30, No. 6, pp. 863-884.

Blackler, F. (1993). Knowledge and the Theory of Organisations: Organisations as Activity Systems and the Reframing of Management. *Organisation Studies*, Vol. 16, No. 6, pp. 1021-1046.

Bonifacio, M.; Bouquet, P. & Manzardo, A. (2000). A Distributed Intelligence Paradigm for Knowledge Management. In: Staab, S. and O' Leary, D. (eds.) Bringing Knowledge to Business Processes. *Papers from the 2000 AAAI Spring Symposium*. Technical Report SS-00-03. ISBN 1-57735-109-6. The AAAI Press. CA, USA.

Brown, J. S. & Duguid, P. (1991). Organizational Learning and Communities of Practice: Toward a Unified View of Working, Learning and Innovation. *Organization Science*, Vol. 2, No. 1, pp. 40-57.

Buckland, M. K. (1991). *Information and Information Systems*. Praeger, New York.

Bueno, E.; Ordonez de Pablos, P. & Salmador M. P. (2004). Towards an integrative model of business, knowledge and organisational learning processes. *International Journal of Technology Management*, Vol. 27, No 6-7, pp. 562-574.

Chin, C. & Siong, C. (2009). Knowledge Management Process Effectiveness: Measurement of Preliminary Knowledge Management Implementation. *Knowledge Management Research & Practice*, Vol. 7, No. 2, pp. 142-151.

Cook, S. & Brown, J. S. (1999). Bridging Epistemologies: the Generative Dance between Organizational Knowing. Organization Science, Vol. 10, No. 4, pp. 381-400.

Cook S. & Yanow D. (1996). *Culture and organizational learning*. In: Cohen M., Sproull L., eds. Organizational learning. Califórnia: Sage. pp. 455-430.

Cyert, R. M. & March, J. G. (1963). *A Behavioural Theory of the Firm*. Prentice Hall, Englewood Cliffs, NJ.

Daft, R. L. & Weick, K. E. (1984). Toward a Model of Organisations as Interpretation Systems. *Academy of Management Review*, Vol. 9, No. 2, pp. 284-295.

Dixon, N. (1994). *The Organizational Learning Cycle*. McGraw-Hill.

Dodgson, M. (1993). Organizational Learning: a Review of Some Literatures. *Organization Studies*, Vol.14, No.3, pp. 375-394.

Durand, T.; Mounoud, E. & Ramanantsoa, B. (1996). Uncovering Strategic Assumptions: Understanding Managers Ability to Built Representations. *European Management Journal*, Vol. 14, No. 4, pp. 389-397.

Edmondson, A. (1996). Learning from Mistakes is Easier Said than Done: Group and Organizational Influences on the Detection and Correction of Human Error. *J Appl Behav Sci,* Vol. 32, No. 1, pp. 5-32.

Easterby-Smith, M., Snell, R.; Gherardi, S. (1998). Organizational learning: Diverging Communities of Practice?. *Management Learning*, Vol. 29, No. 3, pp. 259-272.

Fiol, C. M. & Lyles, M. A. (1985). Organizational Learning. *Academy of Management Review,* Vol. 10, No. 4, pp. 803-813.

Gherardi, S. (1999). Learning as Problem-driven or Learning in Face of Mystery? *Organization Studies*, Vol. 20, No. 1, pp. 101-24.

Gherardi, S. & Nicolini, D. (2000). To Transfer is to Transform: the Circulation of Safety Knowledge. *Organisation*, Vol. 7, No. 2, pp. 329-348.

Goh, S. & Richards, G. (1997). Benchmarking the Learning Capability of Organisations. *European Management Journal*. Vol. 15, No. 5, pp. 575-583.

González, A. J.; Joaquí, C. Z. & Collazos, C. A. (2009). Karagabi KMmodel: Modelo de Referencia para la Introducción de Iniciativas de Gestión del Conocimiento en Organizaciones basadas en Conocimiento. *Ingeniare*, Vol. 17, No. 2, pp. 223-235.

Grant, R. M. (1996). Toward a Knowledge-Based Theory of the Firm. *Strategic Management Journal*, Vol. 17, Winter Special Issue, pp. 109-122.

GS-1.10/08 (2008). *Guía de Seguridad nº 1.10. Revisiones Periódicas de la Seguridad de las Centrales Nucleares*. Colección Guías de Seguridad del CSN. Consejo de Seguridad Nuclear.

Hedlund, G. (1994). A Model of Knowledge Management and the N-Form Corporation. *Strategic Management Journal*, Vol. 15, pp. 73-90.

Hollingsworth, D. (1995). *The Workflow Reference Model*. Document number WFMC-TC00-1003 Issue 1.1. Workflow Management Coalition (WfMC).

Homsma, G. J.; Van Dyck, C.; De Gilder, D.; Koopman, P.L. & Elfring, T. (2009). Learning from Error: the Influence of Error Incident Characteristics. *Journal of Business Research*, Vol. 62, No. 1, pp. 115-122.

Huber, G. P. (1991). Organizational Learning: the Contributing Process and Literatures. *Organization Science*, Vol. 2, No. 1, pp. 88-115.

Huysman, M. (1999). Balancing Biases: a Critical Review of the Literature on Organisational Learning. In Easterby-Smith M., Burgoyne J. and Araujo L. *Organisational Learning and the Learning Organisation*, pp. 59-74. Sage, London.

Kolb, D. (1984). *Experiential Learning*. Englewood Cliffs, Prentice Hall.

Krogh, G.; Nonaka, I., and Rechsteiner, L. (2011). Leadership in Organizational Knowledge Creation: A Review and Framework. *Journal of Management Studies*. DOI: 10.1111/j.1467-6486.2010.00978.x

Kuan W. (2005). Critical Success Factors for Implementing Knowledge Management in Small and Medium Enterprises. *Industrial Management & Data Systems*, Vol. 105, No. 3, pp.261-279.

Lai, M.; Lin, Y.; Lin, L.; Wang, W. & Huang, H. (2009). Information Behavior and Value Creation Potential of Information Capital: Mediating Role of Organizational Learning. *Expert Systems with Applications*, Vol. 36, No. 1, pp. 542-550.

Lave, J. & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press. New York.

Leonard, D. (1992). The Factory as a Learning Laboratory. *Sloan Management Review*, Vol. 4, No. 1, pp. 23-38.

Levitt, B. & March, J. G. (1988). Organisational Learning. *Annual Review of Sociology*, Vol. 14, pp. 319-340.

Lueg, C. (2002). Presentación. Gestión del Conocimiento y Tecnologías de la Información: Relaciones y Perspectivas. Monografía: Gestión del Conocimiento y TIC. *Novática*, enero – febrero, No. 155, pp. 4-7.

March, J. G. & Olsen, J. P. (1976). *Organizational Learning and the Ambiguity of the Past*. In: March, J.G. and Olsen, J.P. (eds.), Ambiguity and Choice in Organizations, pp. 54-68. Universitetsforlaget. Bergen. Noruega.

Marchand, D. A.; Kettinger, W. J. & Rollins, J. D. (2000). Information Orientation: People, Technology and the Bottom Line. *MIT Sloan Management Review*, Vol. 41, No. 4, pp. 69-80.

Marengo, L. (1991). *Knowledge, Coordination and Learning in an Adaptive Model of the Firm*. Doctoral Tesis. Sussex University. U.K.

Mentzas, G.; Halaris, C. & Kavadias, S. (2001). Modelling Business Processes with Workflow Systems: an Evaluation of Alternative Approaches. *International Journal of Information Management*, Vol. 21, pp. 123-135.

Moreno, M. J. & Pelayo, Y. (2007). Thalec: Modelo para la Gestión Interna del Conocimiento. *Capital Humano*, No. 208, pp. 68-82.

Newell, A. (1982). The Knowledge Level. *Artificial Intelligence*, No. 18, pp. 87-127.

Nonaka, I. (1994). A Dynamic Theory of Organisational Knowledge Creation. *Organisation Science*, No. 5, pp. 14-37.

Nonaka, I. & Ichijo, K. (1997). *Creating Knowledge in the Process Organization*. In: Shrivastava, P., Huff, A. S. and Dutton, J. E. (eds.), Advances in Strategic Management, Vol. 14, pp. 45-52. JAI Press, Inc.

Nonaka, I. & Johansson, J. K. (1985). Japanese Management: What about the "Hard" Skills?. *Academy of Management Review*, Vol. 10, No. 2, pp. 181-191.

Nonaka, I.; Reinmoeller, P. & Senoo, D. (1998). The "Art" of Knowledge: Systems to Capitalize on Market Knowledge. *European Management Journal*, Vol. 16, No. 6., pp. 673-684.

Nonaka, I. & Takeuchi, H. (1995). *The Knowledge-Creating Company*. Oxford University Press.

PCN-A-039 (2010). *Tratamiento de la Experiencia Operativa*. Nuclenor.

Pedraja, L.; Rodríguez, E. & Rodríguez, J. (2009). La Influencia de la Gestión del Conocimiento sobre la Eficacia Organizacional: un Estudio en Instituciones Públicas y Empresas Privadas. *Revista Facultad de Ingeniería*. No. 47, pp. 218-227.

Pérez, D. & Solana, P. (2011). *CRM 2.0 and E-government: Challenges for Public Administration and Social Effects*. Chapter six, in: Colomo-Palacios, R.; Varajão, J. & Soto-Acosta, P. (2012). *Customer Relationship Management and the Social and Semantic Web: Enabling Cliens Conexus*. DOI:10.4018/978-1-61350-044-6

Petri, C. A. (1962): Kommunikation mit Automaten. PhD thesis, Institut für Instrumentelle Mathematik, Bonn.

PG-017 (2007). *Seguimiento de Normativa y Tratamiento de la Experiencia Operativa Interna y Externa*. Nuclenor.

Quinn, J. B. (1992). *Intelligent Entreprise*. Free Press.

Redding, J. C. & Catalanello, R. F. (1994). *Strategic Readiness*. Jossey-Bass. San Francisco.

Revilla, E. (1995). *Factores Determinantes del Aprendizaje Organizativo: un Modelo de Desarrollo de Productos*. Doctoral Tesis. Valladolid University. Spain.

Sadiq, S. W. & Orlowska, M. E. (2000). On Capturing Exceptions in Workflow Process Models. *Business Information Systems, 4th International Conference on Business Information Systems*, pp. 3-19.

Sánchez, R. & Heene, A. (1997). *Strategic Learning and Knowledge Management*. John Wiley and Sons. Nueva York.

Senge, P. M. (1990). *The Fifth Discipline: the Art and Practice of the Learning Organization*, New York: Doubleday.

Shrivastava, P. (1983). A Typology of Organizational Learning Systems. *Journal of Management Science*, Vol. 20, pp. 2-24.

Simon, H. A. (1991). Bounded Rationality and Organizational Learning. *Organization Science*, Vol. 2, No. 1, pp. 125-134.

Solana, P. (2006). *Modelización de Sistemas de Información para la Automatización de Procesos de Negocio y el Control de la Documentación en las Organizaciones*. Doctoral Tesis. Cantabria University. Spain.

Solana, P. and Pérez, D. (2011). Security Model Applied to Electronic Records Management: Experiences and Results in the Nuclear Sector. *International Journal of Technology Management*, Vol. 54, No. 2/3, pp. 204–228.

Spender, J. C. (1996 a). Organizational Knowledge, Learning and Memory: Three Concepts in Search of a Theory. *Journal of Organizational Change Management*, Vol. 9, No. 1, pp. 63-78.

Spender, J. C. (1996 b). Making Knowledge the Basis of a Dynamic Theory of the Firm. *Strategic Management Journal*, Vol. 17, No. 1, pp. 45-62.

Swan, J.; Scarbrough, H. & Preston, J. (1999). Knowledge Management – the Next Fad to Forget People ?. *Proceedings of the 7th European Conference on Information Systems (ECIS' 99)*, Copenhagen, Denmark, pp. 668-678.

Teece, D. T. (1998). Capturing Value from Knowledge Assets: the New Economy, Markets for Know-How, and Intangible Assets. *California Management Review*, Vol. 40, No. 3, pp. 55-79.

Teresa L. J.; Chia-Ying L. & Tien-Shiang L. (2006). A Contingency Model for Knowledge Management Capability and Innovation. *Industrial Management & Data Systems*, Vol. 106, No. 6, pp. 855-877.

Tsoukas, H. (1996). The Firm as a Distributed Knowledge System: a Constructionist Approach. *Strategic Management Journal*, No. 17, pp. 11-25.

Ulrich, D.; Jick, T. & Von Glinow, M. A. (1993). High-impact Learning: Building and Diffusing Learning Capability. *Organizational Dynamics*, 22, 2, 52-79.

Van Dyck, C.; Frese, M.; Baer M. & Sonnentag, S. (2005). Organizational Error Management Culture and its Impact on Performance: a Two-Study Replication. *J Appl Psychol*, Vol. 90, No. 6, pp. 1228-1240.

Von Krogh, G. (1998). Care in Knowledge Creation. *California Management Review*, Vol. 40, No. 3, pp. 133-153.

Von Krogh, G.; Roos, J. & Slocum, K. (1994). An Essay on Corporate Epistemology. *Strategic Management Journal*, No. 15, pp. 53-71.

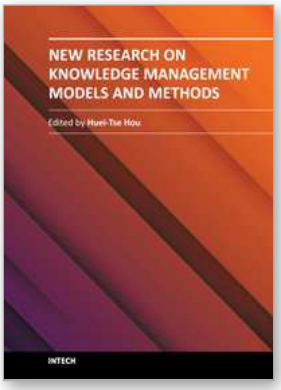
Vytgotsky, L. S. (1962). *Thought and Language*. MIT Press, Mass.

Weick, K. E. (1991). The Nontraditional Quality of Organisational Learning. *Organisation Science*, Vol. 2, No. 1, pp. 116-123.

Weick K. E. & Roberts, K. H. (1993). Collective Mind in Organizations: Heeding Interrelating on Flight Decks. *Administrative Science Quaterly*, Vol. 38, pp. 330-358.

Weick, K. E. & Westley, F. (1996). *Organizational Learning: Affirming an Oxymoron*. In Clegg, S.R., Hardy, C. and Nord, W.R. (Eds.). Handbook of organizational studies, Sage, pp. 440-458. London.

WFMC-TC00-1011 Issue 3.0 (1999). *Terminology & Glossary*, Workflow Management Coalition (WfMC).



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Due to the development of mobile and Web 2.0 technology, knowledge transfer, storage and retrieval have become much more rapid. In recent years, there have been more and more new and interesting findings in the research field of knowledge management. This book aims to introduce readers to the recent research topics, it is titled "New Research on Knowledge Management Models and Methods" and includes 19 chapters. Its focus is on the exploration of methods and models, covering the innovations of all knowledge management models and methods as well as deeper discussion. It is expected that this book provides relevant information about new research trends in comprehensive and novel knowledge management studies, and that it serves as an important resource for researchers, teachers and students, and for the development of practices in the knowledge management field.

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