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Abstract

While knowledge management (KM) is becoming an established discipline with many applications and techniques, its adoption in healthcare has been challenging. It facilitates the creation, identification, acquisition, development, preservation, dissemination, and finally utilization of various facets of a healthcare enterprise's knowledge assets. Knowledge identification and preservation are two facets of knowledge capitalization's operations. Knowledge cartography is used nowadays as a tool for knowledge identification, sharing, and decision support. In this paper, we propose a Know-How and Knowing-That cartography for Healthcare Information System (HIS) and clinical decision support in the context of the organization of protection of the motor disabled children of Sfax-Tunisia (ASHMS). In fact, this cartography enables decision makers with general and detailed visibility of Know-How and Knowing-That mobilized in the ASHMS. It also facilitates clinical decision support by proposing the most appropriate alternatives for the continued treatment (or cessation) of each motor disabled child receiving treatment.

Keywords: Knowledge management in healthcare, Know-How and Knowing-That cartography, clinical Decision Support System

1. Introduction

Organizations are aware of integrating Knowledge Management (KM) in their strategies in order to improve efficiency, success, and create sustainable competitive advantage. KM is a multidisciplinary managerial approach encompassing all the initiatives, techniques, and methods used to identify, organize, analyze, memorize, and share knowledge within the organization (Alavi & Leidner, 2001). KM aims to locate, make visible organization knowledge, keep it, access it and update it, as well as know how to disseminate it, use it and enhance it (Grundstein, 2009).KM is integrated in many fields such as medicine, economics, education, and others. Particularly, the healthcare sector is now confronted with major transformation fuelled by knowledge explosion in biomedical sciences, medical imaging and other fields. This transformation is justified by the evolution of the digital age as well as the complexity and the versatility of this field.

For healthcare institutions, the goal of integrating KM is to deliver quality healthcare services to patients and to improve health by transferring essential knowledge among healthcare professionals at the right time with the aim of serving a particular health goal. Taking into account the different users and producers of knowledge, the heterogeneity of healthcare professionals (having different specialties) and their geographical dispersion, we propose a knowledge cartography targeting the facilitation of this healthcare scenario by identifying, locating, and sharing knowledge among healthcare professionals.

Knowledge cartography is the set of processes, tools and methods for knowledge analysis used to discover its characteristics, meanings and visualization (IBM Global Service[1]). It is defined as a tool for knowledge representation and visualization using graphical entities to convey meaning for knowledge sharing, transfer and creation between at least two persons (Grey, 1999; Speel, Shadbolt, De Vries, Van Dam & O'Hara, 1999; Vail, 1999; Hylton, 2002; Vestal, 2005; Burkhard, 2005; Ebener et al., 2006; Bertschi et al., 2011; Aslizadeh & Ghaderi, 2015).Knowledge cartography is used as a KM tool (Ebener et al., 2006; Grundstein, 2009; Lavkush, 2013).In this paper, we propose a Know-How and Knowing-That cartography experimented in the ASHMS to better identify Know-How and Knowing-That. Know-How and Knowing-That are two types of knowledge and are used instead of knowledge to distinguish between its different natures. These two types are important and complementary in organizations. "It is common in epistemology to distinguish among three kinds of knowledge. There's the kind of knowledge you have when it is truly said of you that you know how to do something – say, ride a bicycle. There's the kind of knowledge you have when it is truly said of you that you know a person – say, your best friend.And there's the kind of knowledge you have when it is truly said of you that you know that some fact is true – say, that the Red Sox won the 2004 World Series" (Fantl, 2012)[2]. Know-How is considered as the capacity to perform an action whereas Knowing-That is a belief state (Ghrab, Saad, Kassel & Gargouri, 2016) which represents a propositional attitude of having some attitude, stance, take, or opinion about a proposition or about the potential state of affairs in which that proposition is true (Schwitzgebel, 2014).

This paper is structured as follows: first, we stress the importance of Healthcare Knowledge Management (HKM) and present related works in this field. Second, we detail our theoretical framework for Know-How and Knowing-That cartography. Third, we present the results of our experimentation of Know-How and Knowing-That cartography in the ASHMS. Then, we outline lessons learned and the evaluation of this cartography in the ASHMS. Finally, we consider the contributions treated in this paper and present our future works.

2. Knowledge Management in Healthcare

Existing literature proposes a number of definitions for HKM (Morr & Subercaze, 2010; Rocha et al., 2012). Broadly speaking, HKM is defined as the confluence of formal methodologies and techniques to facilitate the creation, identification, acquisition, development, preservation, dissemination, modeling, and finally, utilization of various facets of a given healthcare enterprise's knowledge assets (Cheah & Abidi, 1999; Leary, 1998). To enhance growth, development, communication, and knowledge preservation in healthcare organizations, HKM allows healthcare professionals to reach rapid and assertive responses linked with the decisions they need to take (Rocha et al., 2012) to share tacit knowledge, collaborate, exchange, and identify the most crucial knowledge, preserve some knowledge at risk of loss, and improve the care quality and healthcare delivery (Morr & Subercaze, 2010).

[1]http ://www.cisco.com/c/en*c*a/*services/partners/global − services − alliances/global − services − alliances − ibm.html*

[2] Retrieved from https://plato.stanford.edu/entries/knowledge-how/

HKM proposes tools and methodologies for the creation, identification, acquisition, development, preservation, dissemination, sharing, and utilization of medical knowledge in healthcare organizations (Abidi, 2001). We distinguish between HKM methods and tools derived from knowledge engineering for knowledge modeling in the form of ontologies and those for the identification and preservation of medical knowledge.

2.1 Tools and Methods for the Identification and Preservation of Medical Knowledge

Healthcare information systems (HIS) are used as tools for medical knowledge identification and preservation. HIS provide multiple users with a wide array of services that can be summarized as the generation of information enabling decision makers at all levels of the health system to identify problems and needs, make evidence-based decisions on health policy, allocate scarce resources optimally, and improve healthcare delivery (Abidi, 2001). For HIS, it is important to consider clinical decision support systems (CDSS). A decision support system "is defined as a system in which one or more computers and computer programs assist in decision making by providing information[3]". A CDSS is more specifically defined "as software, a program created to help clinicians reach decisions with better accuracy" (Algarin, 2011, p 2).CDSS are created to help clinicians, staff, patients, and other individuals with knowledge and person-specific information providing, intelligently and data at appropriate times, to enhance provision of healthcare services (Berner, 2009). In addition to that, CDSS inform decisions, thus leading to better accuracy, avoiding errors and improving efficiency (Algarin, 2011).

Some of these systems use web techniques like web 2.0 (Wright et al., 2009), semantic web services (Khan & Hederman, 2012) and frameworks for clinical decision support (Lee et al., 2012). Searching, retrieving, browsing and annotation are semantic web services used to answer the care practitioners' needs (Khan & Hederman, 2012). They enable automatic discovery, selection, composition, and Web-based services execution.

2.2 Medical Ontologies

Most research in the medical field is based on the use of medical ontology as a source of exploration of the semantics of a given domain (Charlet, Mazuel, Declerck, Miroux & Gayet, 2014; Batrancourt, Dojat, Gibaud & Kassel, 2015; Richard, Aimé, Krebs & Charlet, 2015; Camara, Desprès, Djedidi & Lo, 2016).The IDOSCHISTO is a modular processes' ontology of infectious diseases' propagation. It is proposed by Camara, et al. (2016) and aims at modeling knowledge related to the infectious diseases' propagation process. It is designed as an extension of the core infectious disease ontology (IDO-Core) and entirely or partially reuses several biomedical domain ontologies dealing with infectious disease issues. The advantages of this ontology are to use an abstraction-layered, multi-perspective modularization and reuse of existing ontologies.

The OntoNeuroLog is a multilayer kernel ontology of instruments for neurological, behavioral and cognitive assessments (Batrancourt et al., 2015). It provides a taxonomy of instruments highlighting the common structure of the instruments, their function and the result of recording their evaluation. This ontology uses concepts for the representation of instruments to assess brain and cognitive functions and human behavior.

The ONTOPSYCHIA is a psychiatric ontology based on the Patient Discharges Summaries (PDS) (Richard et al., 2015). It is composed of three modules: 1) a module for social disorders, 2) a module for mental disorders and 3) a module for appropriate treatments. This ontology integrates the social aspect of the patient life like patient health, symptoms, treatments, and relations between family members.

In addition to ontologies proposed in the medical field, we stress the importance of methods and tools for knowledge identification and preservation (Panahi, Watson & Partridge, 2012; Wright et al., 2009). For example, social media techniques are used by (Panahi et al., 2012) to facilitate tacit knowledge sharing among healthcare professionals in the form of personal clinical opinion (e.g. message or comment), clinical experience, lessons learned, demonstration of clinical skills through videos, best practices used, developing case-specific discussions or questions surrounding clinical issues.

2.3 Research Problem

When we analyze the nature of knowledge treated in HKM, especially in medical ontologies and HIS, we notice that knowledge taken into account is mainly explicit. In the medical field, the tacit dimension of knowledge is more important. A big part of the organization's medical knowledge is tacit and embodied in the minds of healthcare professionals, in their habits and experiences. Characterized by its fertility and its complexity, the medical field requires transferring, sharing and exchanging tacit knowledge to avoid knowledge loss in order to improve care quality, promote socialization among healthcare professionals and create new tacit knowledge in this knowledge intensive expert domain. The methods already detailed are used mainly for modeling explicit knowledge but not for transferring tacit

[3] Extracted from Dictionary.com, "Collins english dictionary - complete unabridged 10th edition," March 2011.

knowledge. That is why, we pay particular attention to this type of knowledge. In this study, we propose a Know-How and Knowing-That cartography to better manage this type of knowledge. Our proposed cartography also incorporates explicit knowledge. Often, it is presumed that explicit knowledge is easier to manage; however, existing research studies indicates that this can also be a difficult undertaking for many organizations (Polanyi, 1967). In this study, Know-How is the capacity to perform an action and Knowing-That is a propositional attitude related to a description (Ghrab et al., 2016).

3. A Theoretical Framework for Know-How and Knowing-That Cartography

The aim of this section is to present our theoretical framework for Know-How and Knowing-That cartography. More specifically, we are interested in exploring Know-How and Knowing-That cartography as well as its characteristics. In order to enhance the quality of Know-How and Knowing-That cartography, we are going to identify the requirements that this cartography is expected to satisfy. First of all, the user should be able to navigate, and understand how the knowledge is characterized and how to find it. Secondly, the cartography should lead to generating specific views for visualizing the organization's processes, personnel and Know-How and Knowing-That mobilized in a given process. Each view represents a specific map and provides the user with a global and a detailed visualization of its request in the beginning. Thirdly, the cartography is expected to facilitate the user's easy navigation in the Know-How and Knowing-That cartography. At any given time, the user must be able to identify and locate his destination.

The concepts mapped in the Know-How and Knowing-That cartography (Know-How, Knowing-That, process, collective, organization, action) are already defined by our core ontology COOK (Core Ontology of Organization's Know-How and Knowing-That).The specificity of our Know-How and Knowing-That cartography is the contextualization of Know-How: Who holds Know-How (person or collective)? How is the Know-How used? In which process is Know-How mobilized? What action is Know-How relative to? Is this action individual or collective? Is Know-How internal or external to the organization? Is it individual or collective? Is it tacit or explicit? If explicit, where is it stored? What is the type of this support (paper or numerical device)?

Our proposed theoretical framework is composed of three steps: 1) conceptual analysis of the concepts of Know-How and Knowing-That, 2) proposition of a Core ontology of Know-How Organization and Knowing-That (COOK) and 3) iconic graphic language proposition. This framework is implemented in a decision support system K-DSS (Crucial Knowledge Decision Support System) (Saad, Rosenthal-Sabroux & Grundstein, 2005) which includes a new component CK-Cartography (Crucial Know-How and Knowing-That Cartography) for the generation of Know-How and Knowing-That cartography (Ghrab, Saad, Kassel & Gargouri, 2017). We shall elaborate on each phase of this framework in the next sections.

3.1 Conceptual Analysis of the Concepts of Know-How and Knowing-That

This phase differentiates between Know-How and Knowing-That and proposes rigorous definitions for these concepts. Thus, we shall first go through the definition of knowledge which is an abstract notion discussed in different disciplines. Many knowledge definitions are proposed in the literature, but it is difficult to attribute a unique and consensual definition to knowledge while taking into account the different concepts related to it and its use domain. According to Burkhard (2005), the need for knowledge in organizations restricts its definition. If the organization's objective is to ensure a given solution's storage, then knowledge is defined as an object. While the organization's objective is the optimization of the knowledge processes such as identification, creation, or sharing, knowledge is defined as a process. In this paper, knowledge is not an object (Grundstein, 2009). It is related and mobilized in human action (Grundstein, 2009). It is related to the organization's processes (Moigne, 1994; Nonaka & Takeuchi, 1997). We partially share this point of view. In fact, some knowledge can be linked to actions (for example, knowledge related to the detection of a disease) or to descriptions (for example, knowledge related to or about a specific disease). The first type is known as Know-How and the second type is Known as Knowing-That. This first type is not taken into account in most definitions of knowledge. In an organizational context, these two types of knowledge are more important and are closely dependent. This distinction is also proposed in epistemology (Fantl, 2012).

3.2 Proposition of COOK Core Ontology

The aim of this phase is to propose a Core Ontology of Know-How and Knowing-That (COOK) which determines the main concepts related to Know-How and Knowing-That (like action, person, description) independently of any knowledge domain. COOK ontology is detailed in (Ghrab et al., 2016). COOK is built through the re-use of existing ontologies. Know-

How is defined as the capacity to perform a given type of action (e.g. Know how serves to diagnose the child's locomotion) whereas Knowing-That is a belief state related to a description which can be factual or prescriptive (e.g. Know the child's locomotion measurement). COOK's ontology highlights the internal/external dimension of Know-How and Knowing-That as well as the individual/collective dimension.

Two relations are defined in COOK: the relation "is borne by" and the relation "has for theme." The first relation is defined between (i) a Know-How and a Person or a collective or (ii) a Knowing-That and a Person or a collective. For example, "Know-How to detect a disease" is a Know-How borne by the healthcare professional x. As for the second relation, it is defined between (i) a Know-How and an action (i.e. "Know how to diagnose the child's locomotion" has for theme the action "to diagnose the child's locomotion") or (ii) a Knowing-That and a description (e.g. "Know the child's locomotion measurement" has for theme the description "child's locomotion measurement"). COOK's ontology is based on the first phase of our theoretical framework (conceptual analysis of Know-How and Knowing-That) and is used as input for the third phase that is detailed in the next section.

3.3 Iconic Graphic Language

The iconic graphic language proposed as part of the COOK ontology supports the different phases detailed in our theoretical framework. It visually differentiates between Know-How, Knowing-That, the different concepts (like actor, collective, Know-How, Knowing-That), and relations (*has for theme*, *is borne by*) as defined in the COOK ontology. The graphic language is designed to be simple and easily understood by users. Thus, we use simple form or pictogram referring to each concept to be visualized. To that end, we focus mainly on Gestalt theory and graphic semiotics (Bertin, 2010). The semiotics of Bertin (2010) is the study of signs and sign systems ((Lamy, Duclos, Bar-Hen, Ouvrard & Venot, 2008). Many visual variables are proposed in semiotics, we use form, color, and size of visual variables in the design of graphic language. In order to distinguish between concepts, we attribute a specific pictogram or a specific form for each concept (Table 1).

Pictogram/Form	**Signification**
Circle	Know-How
Oval	Knowing-That
Rectangle	Process
Rectangle with rounded corners	Action
	Organization
	Actor
	Volunteer
	Collective
	Paper
	Digital
	Individual
	Collective
	External
	Internal

Table 1. List of pictograms and forms used

In order to distinguish between the concepts' characteristics in Know-How and Knowing-That cartography, we use the visual variables size and color. These concepts are process, Know-How and Knowing-That.

This study uses Saad et al.'s (2005) method to identify Know-How and Knowing-That in this knowledge domain. It is worth noting that we distinguish between "non-crucial Know-How/Knowing-That," "Likely crucial Know-How/Knowing-That," and "Crucial Know-How/Knowing-That" which are referred to Cl1 (blue color), Cl2 (green color), and Cl3 (red color) decision classes (Table 2). Cl1 refers to knowledge which is not necessary to capitalize.

The decision class Cl1 refers to Know-How/Knowing-That which is not necessary to capitalize it. The decision class Cl2 refers to Know-How/Knowing-That which can be beneficial to capitalize it in the short or medium term and Cl3 refers to Know-How/Knowing-That which is necessary to capitalize it in the organization.

Color	Signification
	Tacit/unsharable Know-How
	Tacit/sharable Know-How
	Explicit/unsharable Know-How or Knowing-That
	Explicit/sharable Know-How or Knowing-That
	OP (Organizational Process) Process
	Sensitive Process. A sensitive process is a particular OP
	TLP (Third level Process) Process
	SLP (Second level Process) Process
	FLP (First level Process) Process
	Crucial Know-How or Knowing-That (belongs to decision class CL3)
	Likely Crucial Know-How or Knowing-That (belongs to decision class CL2)
	Non Crucial Know-How or Knowing-That (belongs to decision class CL1)

Table 2. List of visual variables used for concepts' characterization

4. Experimentation of Know-How and Knowing-That Cartography in the ASHMS

Know-How and Knowing-That cartography generated by CK-Cartography is experimented in the Association of Protection of Motor Disabled of Sfax (ASHMS), a knowledge intensive scenario in which many Know-How and Knowing-That are mobilized. This study is the result of 5 years of a PhD study in computer science. The study started as part of the EGIDE/CMCU (*Joint Committee of University Cooperation [Comité Mixte de Coopération Universitaire]*) project under the program PHC-Utique, which started in 2010 and ended in 2013. The aim of this project is the development of a knowledge management system for crucial knowledge to improve medical and social care of disabled children. The partners of this project are MIS laboratory (*Modeling, Information, System* laboratory) at the University of Picardie Jules Verne, Amiens-France, MIRACL laboratory (*Multimedia, InfoRmation systems and Advanced Computing Laboratory)* at the University of Sfax, Sfax-Tunisia and the ASHMS. The first results of this project were published as a doctoral study (Turki, 2012). This study proposed a multicriteria method and a core ontology of organization's processes for the identification of sensitive processes. The application context of this thesis is the ASHMS.

ASHMS is a non-profit association. Its goal is the protection of children with motor disabilities in different fields (social, medical, educational, familiar). We are particularly interested in the early care process of children diagnosed with a Cerebral Palsy (IMC). This process is complex, that is to say, it mobilizes an amount of knowledge which relates to different specialties (neonatology, neuro-pediatrics, physical medicine, orthopedics, physiotherapy, psychiatry, and occupational therapy). Some of this knowledge is stored in databases, medical records, and good practice guides. This codified knowledge is referred to as explicit knowledge. The other part, which is the most important, is embodied in the mind of healthcare professionals (doctors, healthcare technicians). In order to take collective/individual decisions

and to have suitable information for the examinations of the IMC child, healthcare professionals (having the same or different specialties) communicate, share, and exchange knowledge between each other.

Most healthcare professionals participating in the early care process of IMC children in the ASHMS are volunteers; and most of the knowledge produced and used in this process is volatile. Other healthcare professionals are affiliated with University Hospital, faculty of medicine, ASHMS or others. Some internal healthcare professionals (healthcare technicians) communicate with other external healthcare professionals (private doctor, healthcare technician, volunteer doctor) who are geographically dispersed. These are located in hospital-university, medicine faculty and other associations. For these reasons, the ASHMS healthcare professionals have difficulty acquiring appropriate knowledge, identifying knowledge stakeholders, communicating between healthcare professionals, and sharing and transferring their experiences, their points of view and their knowledge in the ASHMS or with other professionals affiliated to other organizations.

Know-How and Knowing-That cartography provides healthcare professionals with the opportunity to participate in the global evaluation of a child in despite of geographical limitations. In fact, a particular map of Know-How and Knowing-That cartography named personnel map visualizes the ASHMS healthcare professionals and distinguishes between internal/external and permanent/volunteer healthcare professionals (Figure 1). Different concepts visualized through the personnel map are managed by the iconic graphic language that we propose (Table 1). Through this map, it is possible to identify actors who hold crucial Know-How or Knowing-That, to locate such actors when the need arises and to identify the actions performed by each one of them. Most healthcare professionals involved in medical care are volunteers and are affiliated with other healthcare institutions (Habib Bourguiba University Hospital, the medical school) or the doctor's surgery (Figure 1).

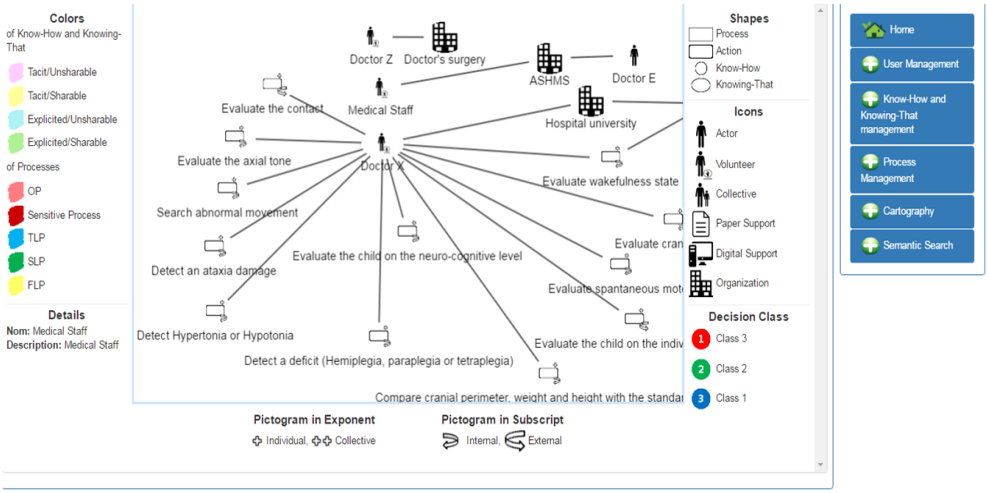

Figure 1. Screenshot of the personnel map

In Figure 1, healthcare professionals like "Doctor X" and "Doctor Z" are volunteers whereas "Doctor E" is an employee of the ASHMS. In addition, the Know-How and Knowing-That cartography offers the possibility to generate a Know-How and Knowing-That map, to visualize the set of Know-How and Knowing-That mobilized in a given process in the ASHMS. This enables us to easily identify Know-How or Knowing-That per healthcare professional, process, or action. This map makes it possible to share Know-How and Knowing-That during the global evaluation supporting decision makers to collectively take the best procedure to be followed in the rehabilitation or its stoppage. We present in Figure 2 the set of Know-How and Knowing-That mobilized in the ASHMS process "care process of IMC children in neuropediatrics (IMC having a hemiplegia)". In the beginning, this map visualizes the set of Know-How and Knowing-That mobilized in a single given process. Each Know-How or Knowing-That is mapped through a structure representing who holds it (an individual, a collective or an organization), where it is stored (in the mind of its stakeholders if it is tacit or in support if it is explicit) and which theme it has (an action or a description). In order to have more details about a Know-How or a Knowing-That, clicking on one of these two concepts leads to the mapping of its own information that is organized according to the structure we have already described (person, collective, action, support).

The principle to follow in the different maps is to display details according to the user request. This prevents map overload, reduces visualized concepts and facilitates the accessibility of knowledge visualized in the map promoting understanding. It is possible, through this map, to visualize other Know-How and Knowing-That like composed or

substitutable Know-How or Knowing-That. In order to improve Know-How and Knowing-That cartography, Know-How can be grouped according to a criterion family (vulnerability, duration of use, degree of contribution) or according to decision classes (Cl1, Cl2, Cl3). This clustering is based on the use of distances which are calculated from the Know-How current position. The spring algorithm is responsible for the nodes' distribution (Know-How and Knowing-That) and guarantees a specific position for each node. The choice of a clustering criterion enables the mapping of Know-How and Knowing-That into groups. For example, in Figure 2, the clustering criterion is vulnerability. This criterion family contains other criteria such as scarcity, substitutability, complexity, and so on. For the complexity criterion, three echelons are defined: not complex, complex, and very complex. In fact, three groups can be identified on the map: the Know-How group G1,the evaluations of which regarding the criterion complexity are "non-complex", the Know-How group G2,the evaluations of which on the criterion complexity are "complex" and the Know-How group G3, the evaluations of which regarding the criterion complexity are "very complex". Each Know-How belongs to G1; its new position is the difference between its previous position before the choice of clustering criterion and a distance d that we have defined. Each Know-How belongs to G3; its new position representing this Know-How is the sum of its old position before the choice of the clustering criterion and the distance d. Finally, each Know-How belongs to G2, the position representing this Know-How does not change.

In Figure 2, the circle which represents "Know-How to evaluate spontaneous motor skills," is greater than the other circles, which means that this Know-How is complex: it is composed of other Know-How and Knowing-That. As a matter of fact, "Know-How to evaluate spontaneous motor skills" is a Know-How composed of "Know the development of psychomotor acquisition capacity," "Know the neurological anomaly for motor development," "Know how to find an abnormal movement," and "Know how to evaluate the axial tone." The "Know-How used to evaluate spontaneous motor skills" has many characteristics. It is linked to the action "evaluate spontaneous motor skills" which is an individual internal action. It is classified as tacit Know-How (pink color) and owned by the doctor X.

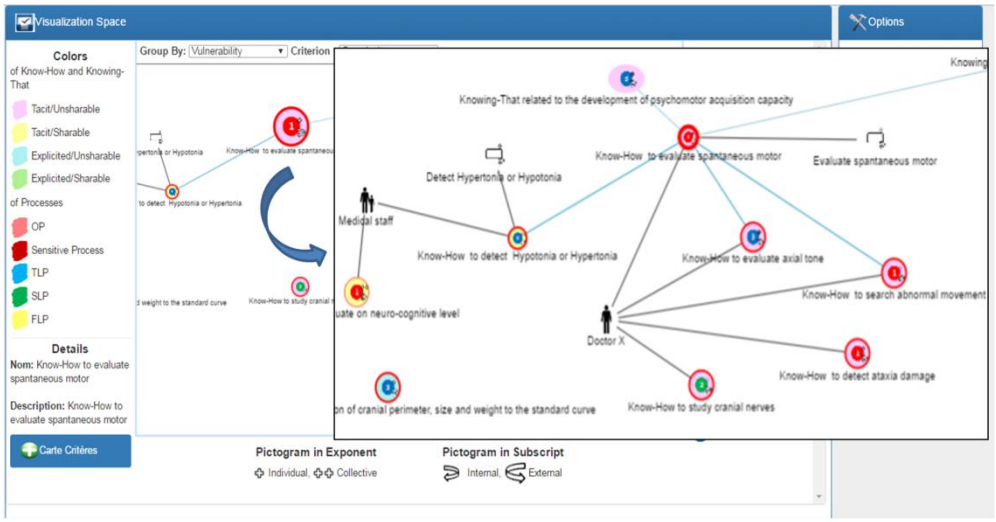

Figure 2. Screenshot of the Know-How and Knowing-That map related to "Know-How to evaluate spontaneous motor skills"

The different Know-How and Knowing-That represented in the Know-How and Knowing-That map are used during the global evaluation of a child. For healthcare professionals, this facilitates the identification of Know-How and Knowing-That that will be used to select the most suitable option as part of the collective decision making process. The quantity of Know-How and Knowing-That mobilized in each specialty and used during the global evaluation is important. In fact, it is difficult for healthcare professionals to simultaneously identify the highest priority in terms of Know-How and Knowing-That. However, the ranking map allows healthcare professionals to visualize crucial Know-How and Knowing-That in order to prioritize them and classify them in equivalence classes. This can speed up the decision making process and improve the care quality for IMC children. Figure 3 visualizes the set of crucial Know-How classified by priority.

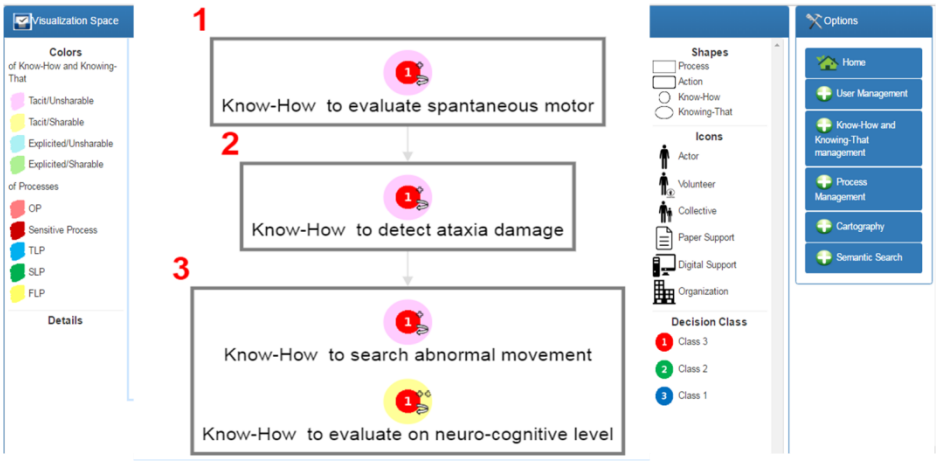

Figure 3.Screenshot of the ranking map

The "Know-How to evaluate spontaneous motor skills" is the Know-How which outclasses other crucial Know-How. The "Know-How to detect an abnormal movement" and the "Know-How to evaluate the child on a neuro-cognitive plan" have the same priority.

5. Lessons Learned and Evaluation

In the ASHMS, Know-How identification is a complex and difficult task because most healthcare professionals are volunteers which can cause Know-How volatility. The informal communication, the actors' geographical dispersion, the complexity of Know-How and Knowing-That in the medical field and the specificity of this domain requires the adoption of a specific methodology to take into account these specificities and to enhance knowledge identification and sharing. Particularly, Know-How and Knowing-That cartography is used in the ASHMS to effectively identify Know-How and Knowing-That as mobilized in the ASHMS processes as well as to guide healthcare professionals to take the suitable decision for the IMC child. Early in this project, healthcare professionals were not aware of the importance of sharing their Know-How, Knowing-That and experience with each other. This can be justified by the voluntary work of healthcare professionals and the research and scientific nature of IMC children care project. In fact, research results are still under validation and experimentation. This solution is still to be studied and validated. Many difficulties are mobilized in the ASHMS. We cite the complexity of the early care process in the medical scenario, the uncertainty of Know-How and Knowing-That, the difficulty in accessing Know-How and Knowing-That across the different specialties (e.g. neonatalogy, neuropediatry, physiotherapy) and the difficulty supporting healthcare professionals participation in the staff meeting every three months for the evaluation of IMC children health status,. Taking into account these difficulties, a collective decision should be taken by healthcare professionals for each IMC child rehabilitated in the ASHMS. Two decisions can be taken: the continuation of rehabilitation or its stoppage.

Taking into account the healthcare professionals' needs, we propose Know-How and Knowing-That cartography which is used almost by all healthcare professionals who are the users of this cartography. These users are integrated in the creation, modeling, and conception of Know-How and Knowing-That Cartography. Their needs and requirements are taken into account. The evaluation of Know-How and Knowing-That cartography is completed iteratively i.e. before, after, and during the construction of the cartography. Each phase of the theoretical framework of Know-How and Knowing-That cartography is validated by healthcare professionals. Moreover, each interface is validated by them. Occasionally, healthcare professionals suggest other information in different maps generated and a re-conception of some interfaces thanks to story-boards which are visual representations of how a user will interact with the interfaces of CK-Cartography. The storyboard is used to demonstrate the process that the user will go through when using Know-How and Knowing-That cartography. It is useful for determining healthcare professionals' requirements.

In our study, the story-boards are represented by the users of Know-How and Knowing-That cartography. Healthcare professionals propose graphical interfaces which guide and help during their use of the cartography. The models proposed by healthcare professionals are simple, they do not contain much information as they focus on a well-defined objective for each interface. For each phase of the design of Know-How and Knowing-That cartography, story-boards are used to validate the interfaces generated by the cartography. The degree of healthcare professionals' satisfaction about Know-How and Knowing-That cartography is studied in utility and usability tests illustrated in Figure 4.

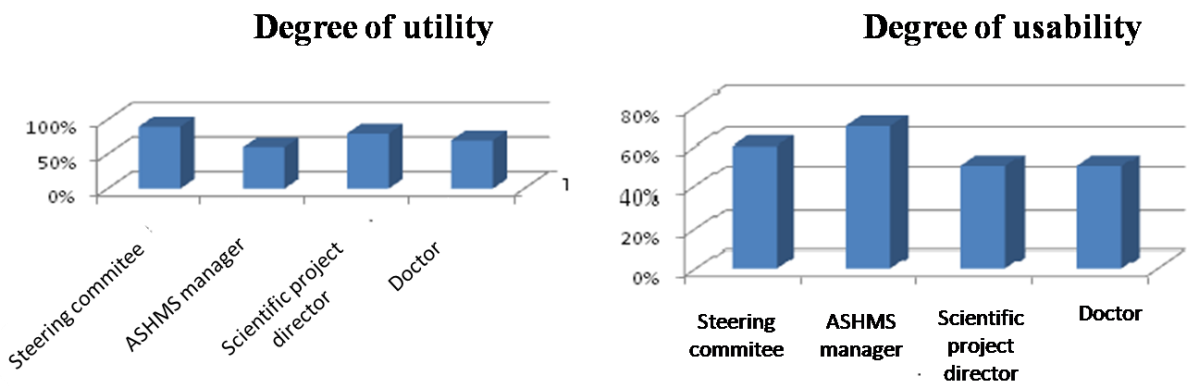

Figure 4. Degree of satisfaction of healthcare professionals about Know-How and Knowing-That cartography

Utility determines the system's suitability with the need of the user and usability considers the study of the use of the system's interfaces and its functionalities to achieve defined goals with efficiency and satisfaction.

7. Conclusion

In this paper, we propose a Know-How and Knowing-That cartography. This cartography was developed to facilitate Know-How and Knowing-That identification and to improve Know-How and Knowing-That sharability. The proposed cartography visualizes the different Know-How and Knowing-That mobilized in a given process for the performance of an action. Knowledge can be tacit, embedded in the stakeholder's mind, or explicated and stored in documents.

The Know-How and Knowing-That cartography is based on a theoretical framework which is composed of three steps: 1) conceptual analysis of Know-How and Knowing-That, 2) construction of COOK ontology and 3) proposition of iconic graphic language. The first step distinguishes between Know-How and Knowing-That which are considered two types of knowledge. Know-How is defined as the capacity to perform an action whereas Knowing-That is a belief state and is related to a description which can be factual or prescriptive (Ghrab et al., 2016). The second step takes into account the conceptual analysis of Know-How and Knowing-That. In this step, we identify the taxonomies of Know-How and Knowing-That. Finally, the last step presents the iconic graphic language proposed for Know-How and Knowing-That cartography. It is conceived to be easy to use and understood. This graphic language is responsible for the generation of pictograms, forms and colors related to the concepts identified in COOK ontology. Thanks to its abstraction levels, COOK can be reused in many different healthcare scenarios (home patient follow-up, social care, staff meeting discussion) and can also be used in fields outside the healthcare domain including economic, automobile, education, and others.

Know-How and Knowing-That cartography is experimented in the medical field (ASHMS) and is considered a service that helps healthcare professionals solve the problem of Know-How and Knowing-That identification, collective decision making, exchanging information and sharing Know-How and Knowing-That. Moreover, Know-How and Knowing-That cartography is defined as a clinical decision support which provides clinicians (doctors and healthcare technicians), staff and other individuals (administrators) with Know-How, Knowing-That, person-specific information, process-specific information, intelligently filtered and presented at appropriate times in order to enhance the early care process for children suffering from cerebral palsy. Know-How and Knowing-That cartography generates different map types: personnel map, Know-How and Knowing-That map and ranking map.

Know-How and Knowing-That map visualizes different Know-How and Knowing-That mobilized in a given process, its stakeholders, the support where stored explicated Know-How or Knowing-That and other useful information for decision makers and healthcare professionals alike. The personnel map represents healthcare professionals, their localization and the actions they perform. The ranking map guides decision makers to have a clear idea about the most pressing priority in terms of Know-How and Knowing-That during the early stages of care. The map process presents the different organizational processes whereas the process, personnel, Know-How and Knowing-That maps facilitate for different healthcare professionals to share the ASHMS objectives, healthcare Know-How, good practices, different medical patient records, and healthcare professionals implicated in the early care, as well as their location and their affiliation.

In future works, it would be interesting and valuable for IMC children's parents to propose a mobile application

which would grant them access to information about their child's evaluations, including the decisions taken by healthcare professionals relating to their child, their child's current health status and advice to support and promote their child's health and well-being. This is justified by the recent proliferation of technologies, especially in mobile health and patient/practitioner scheduling software which has proven to be both a significant opportunity and a challenge for healthcare professionals and patients to communicate directly and without any barriers.

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