Knowledge Management for Virtual Reality Applications in a Home Rehabilitation Virtual Network

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Abstract: This paper describes the reference architecture to support a multi-user virtual healthcare network that enables rehabilitation and social reintegration of people with disabilities. The network, based on a virtual collaborative environment supported by the www, includes collaboration and interpersonal communication devices and data collection mechanisms that provide knowledge management for the system and effectiveness evaluation.

The Virtual Network (VN) allows the rehabilitation patients spread in geographically dispersed areas, a very frequent reality in the considered context, to access a distributed virtual platform able to offer communication and shared knowledge with doctors, nurses, therapists, social workers and other people involved in the process of rehabilitation. VN solutions allow building a virtual shared space, a context of understanding and knowledge where the "real world" knowledge affects virtual interaction and virtual interaction modifies "real world" therapies.

The main aim of the VN is to achieve a higher quality of life for the people with disabilities and, in the long term, from the economic point of view, to produce important savings/profits and bring about feasible ways to improving/re-organizing health care services. The present paper illustrates our team's first steps in building such a network in Romania.

The first section establishes the link between the virtual reality and the medical rehabilitation as an important branch of the healthcare system. Several applications in the field are presented here.

The second section focuses on two main aspects: on the one hand, the current Romanian reality of medical rehabilitation and, on the other hand, the existing possibilities to build a VN for rehabilitation as a solution to the main problems Romania has in this field.

The third section is a technical preamble to the knowledge sharing process particularized for a healthcare VN in section number four.

The last part of the paper includes both pro and cons arguments for the designing of a VN as a solution to the discrepancy between the demand and the real current hospitals' supply of medical rehabilitation in Romania.

Keywords: home rehabilitation, virtual reality, virtual healthcare network, virtual organization, knowledge sharing models, information broker agent, personal healthcare agent

1. Virtual reality in home rehabilitation

Generally speaking, *Virtual environments (VEs)* present a unified workspace allowing more or less complete functionality without requiring that all the functions to be located in the same physical space. According to Pratt, Zyda, and Kelleher (1995) „*a virtual world* is an application that lets users navigate and interact with a three-dimensional, computer-generated (and computer-maintained) environment in real time. This type of system has three major elements: *interaction, 3-D graphics,* and *immersion*".

Virtual reality (VR) is an emerging technology that alters the way on which individuals interact with computers. „Virtual reality is a fully three-dimensional computer-generated „world" in which a person can move about and interact as if he actually were in an imaginary place. This is accomplished by totally immersing the person's senses...using a head-mounted display (HMD)" or some other immersive display device, and an interaction device such as a DataGlove™ or a joystick (Satava 1993).

VEs and VR are also used today to develop skills, and to train the people with disabilities. Among the Health-Care Applications of VEs Satava (1995) includes „Skill enhancement and rehabilitation". These particular applications include those that provide training in the use of equipment, those that allow the exploration of virtual space, those that augment physical abilities, and those that teach skills (see Table 1 (Moline 1998)).

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Table 1: Applications for skills enhancement and rehabilitation

Application	Examples	Who/Where
Training in use of equipment	Training disabled children to control motorized wheelchairs	Dean Imman, University of Oregon
Exploration of „physical space"	Providing virtual environments for exploration in a wheelchair	Greenleaf Medical Systems, Palo Alto, CA
Empowerment of the disabled using an eyetracker device	Providing a quadriplegic child the opportunity to develop interactions with the outside world before its disability causes him/her to become too introverted to communicate	David Warner, Human Performance Institute of Loma Linda University Medical Center, CA
Use of virtual reality to enhance vision of the visually impaired	Providing a virtual computer monitor that moves the user's line of sight across an enlarged virtual monitor --- Providing vision enhancement --- Using glasses that display a television image to help Parkinson's disease patients overcome their halting, hesitant gait	--- University Applied Physics Laboratory at The John Hopkins University, Baltimore, MD --- Suzanne Weghorst, University of Washington
Train to Travel project	Substituting virtual reality bus rides for the real thing to train individuals to use the public transportation system independently	University of Dayton Research Institute, OH, and Miami Valley Regional Transit Authority, FL

All of these applications bring the real world closer for the people who need and want to be an active part of it, those with different disabilities. The *Train to Travel* project, for example, „substitutes [VR] bus rides for the real thing. Students learn independently in the classroom, eliminating the need for a teacher to accompany or follow them on real trips" (Buckert-Donelson 1995a). They „… use interactive multimedia to recognize landmarks and learn what to do in case of an emergency. When they master basic skills, they progress to the VR environment, where they use an HMD system with head tracking to look around a computer-generated landscape" (Buckert-Donelson 1995b).

In this context, a virtual healthcare network (VHN) can be described as an environment where data and knowledge of medical interest can be stored, processed and made available to the appropriate actors within a distributed system. Among the projects of VN that have been developed lately: a virtual hospital in Finland (ATULINE), the Stroke Center Enchede (Nederland), the SYSCO Health Care System (USA) etc.

2. Home rehabilitation – a realistic solution for the Romanian healthcare system?

Rehabilitation is a concept that should involve the entire healthcare system, and at the same time it is a special medical therapeutic section connected to the diagnosis and recovery programs.

Basically, *Rehabilitation* is a process of helping people to reach the fullest physical, psychological, social, vocational and educational potential level. All of these goals of the rehabilitation process depend of the patient's physiological or anatomic impairment, on their willing to be rehabilitated and environmental limitation. Rehabilitation consists in "the use of all means aimed at reducing the impact of disabling and handicapping conditions and at enabling people with disabilities to achieve optimal social integration" (World Health Organization).

In this section we focus on the particularities and the problems of the rehabilitation system in Romania, trying to find an appropriate answer to its.

2.1 The current Romanian rehabilitation system in figures

Medical rehabilitation occurs as a distinct branch of the Romanian healthcare system in earlier '70s. In the decade 1970-1980, the ambulatory network was designed, and the first rehabilitation clinics within the existent hospitals occur. In 1984 the design of the neurological rehabilitation program was started, including the University Clinics in Bucharest, Timisoara, Iasi, Cluj and Targu-Mures, and having as a main result the

only one medical facility entirely dedicated to the rehabilitation services, the National Institute of Rehabilitation, Physical Medicine and Balneo-climatology from Bucharest (INRMFB).

The total supply on the medical rehabilitation field in Romania today is presented in Table 2.

Table 2: Romanian hospitals' total supply for rehabilitation services

Crt. No.	Institution	Type/Characteristics	Total number of hospital beds
1.	INRMFB	National Institute containing 3 Medical Rehabilitation Clinics with an Average of 75 beds	225
2.	Bucharest, Timisoara, Iasi, Cluj, Targu-Mures	University Clinics with an Average of 60 beds	300
3.	County Hospitals	Rehabilitation Clinics within each of the 41 county hospitals with an Average of 25 beds	1025
4.	Private Hospitals	None	-
TOTAL			1,550 beds

In 2006 this capacity succeeds to cover between 25% and 30% of the real demand for medical rehabilitation services. According with the Statistics Department of the INRMFB, this percentage will decrease continuously due to the following factors:

- the increasing number of strokes among the adults and young people;
- the decreasing of the average age with maximum risk of strokes from 50 years old in the '90s, at 40 years old in 2000;
- the permanent increase of the traffic and work accidents;
- the demographic phenomenon of increasing the aged people, i.e. that segment of the population with the highest risk for neurological problems;
- the hospitalization of those patients who didn't need an in-patient system (for example the ones who requires just post-traumatic treatment), but who are integrated in this classic system because of the huge distance between the hospital and their home.

In order to increase the ratio offer/demand for rehabilitation services, in some cases the hospitals' managers succeed to find some pseudo-solution for the people that need specialized medical assistance, but who can be hospitalized only if they are willing to wait between 2.5 – 3 months. Such pseudo-solutions for the INRMFB consist in programs as:

- Outpatient – the patient come into the hospital just to receive the treatment; and
- Hospital by day patient – the patient is hospitalized only during the day and is supervised to accomplish his rehabilitation program, without receiving any medication or food from the hospital.

The biggest clinic of INRMFB - Clinic III Filantropia with 85 beds - succeeds in this way in 2006, to have a record number of 2,489 hospitalized patients, even if it can offers only 85 x 2 = 160 hospitalizations per month, so a total of 1,920 patients per year! This surplus of 23% non-in-patients plus a 10% from the in-patients for whom the hospitalization isn't compulsory, constitute the group of patients to whom the existence of a *home rehabilitation system is the best solution for recovering*, both as effectiveness and from economic considerations (hospital and patients costs/savings).

But still, is the home rehabilitation system a feasible solution for Romania today? We will try to give an answer in the next two paragraphs.

2.2 The required infrastructure for sustaining a rehabilitation VN

In order to design a functional VN for home rehabilitation, a set of conditions has to be fulfilled:

1. First of all, every patient enrolled into the VN must to have access to a PC connected via Internet with the entire network. From this perspective, according with the European Foundation for the Improvement of Living and Working Conditions (www.eurofound.europa.eu), in 2005 Romania has the lowest density of computers at 1,000 inhabitants, namely a quarter from the average number in the EU countries. This could be a serious constraint of building a VN for home rehabilitation. Fortunately, in the last 2 years the Romanian IT&C sector had the highest growing rhythm (45% per year) among the Central and Eastern

EU countries (according with the Economist Intelligence Unit (EIU), www.eiu.com), the number of Internet connections increasing with 100% every year.

2. Secondly, each computer has to be equipped with the dedicated software for the particular rehabilitation program a certain patient follows. Even if this kind of software is very expensive (especially if we compare its prices with the Average Net Earnings in Romania – 302 Euros per month in May 2007), there are good chances for it to be designing by the Romanian IT specialists. In this area, Romania has not only the highest number of IT&C certified specialists at 1,000 inhabitants from Europe (higher than USA or Russia), but also they are worldwide recognized for their competence and skills.
3. Third, even for a pilot rehabilitation VN, the necessary investment funds are considerable. Until now, we had identified more possible financing sources for the initial investment in equipments: national and EU funds for R&D programs, Health Ministry's budget, and cooperation with the (IT&C) business environment.

2.3 Extend the real hospitals' offer vs Design a VN for home rehabilitation

Because the most important investment sources can be the public funds attracted through the Health Ministry's budget, a fair question has to receive an answer here: *why the Romanian government would want to invest public money in developing a VHN*? This question is more legitimate today when:

- among other medical fields, the rehabilitation systems is not a priority for the Romanian Government, so there are small chances to receive more money even to extend the in-patient system;
- lately, to reduce the number of hospitals beds for all the clinics, and to invest more in prevention activities is the Romanian Minister of Health's medium run strategy. But this strategy requires a solid educational program which, for the moment, doesn't exist in Romania.

In these hypotheses, an answer in cost/benefit terms is the most appropriate one and, as is results from Table 3, is the final argument in financing the design of the rehabilitation VN.

Table 3: In-patient vs Home rehabilitation system – cost analysis

System	Real/Estimated costs (Euro / day / patient)	Computing method
Classical in-patient	From 26 (Targu-Mures Clinic) to 48 (INRMFB)	Real costs in May 2007 (source – Monthly Financial Reports)
Home rehabilitation within a VN	From 8 to 12	Salaries: - 3 specialists (IT, MD and Physiotherapist) each day (16 hours) x (17.35$/hour[1)]) = 277.60$; - 1 Professional Nurse every night (8 hours) x (13,48$/hour[1)]) = 107.84$ Total costs with salaries = 385.44$/day Number of patients assisted through the VN: 64 (daily) + 8 (night) = 72 people Average cost with work force = 5.35$/patient Average total cost (including the equipments) = 5.35 x 2 = 10.7$ = 7.67 Euro/patient[2)] Maximum average cost including special intervention at patient's residence: 7.67 Euro + 4 Euro = 11.67 Euro/patient

[1)] www.worldsalaries.org
[2)] www.xe.com – July 16, 2007

Based on the above analysis we conclude that a VN for home rehabilitation is indeed a feasible solution for Romania's healthcare system.

3. Knowledge sharing in the healthcare VN for home rehabilitation

The healthcare network for home rehabilitation of people with disabilities is considered as being a *virtual organization (VO) with loosely coupled independent components, cooperating for a specific goal.* The fundamental aspect of virtual organizations, *the flexibility to offer healthcare services where and when they are most needed*, requires individuals and components to exchange knowledge for various reasons such as to establish common goals and diagnostics, synchronization of treatments, agreements between physicians

and other healthcare professionals (nurses, physiotherapists, social workers, members of patient family) in care procedures' planning etc.

It is a fact that a serious number of medical mistakes occurs from the incorrect or incomplete information about the patients' records and the lack of communication between the rehabilitation process' actors.

Due to the diversity of remnant symptoms of people with neurological disorders, a large number of health care professionals are involved in the care process of such patients. Those patients are transferred from one participating component to another during a *chain of care*. This chain may consist of a hospital, rehabilitation services, geriatric center, indoor and outdoor healthcare professionals, occupational therapists etc. These components actors work together a long period of time and use a large diversity of knowledge about the patient and his disorders.

Currently, the major part of knowledge and information exchange take place through personal contacts, phone calls and patient medical files.

Healthcare professionals frequently indicate that the information about the patient is incomplete and not timely available. In particular, the rehabilitation treatment can hardly ever been applied with the maximum efficiency. This process is a knowledge intensive operation that involves many medical professionals and data. The data and knowledge from the patients' records must be retrieved and used throughout the whole rehabilitation chain.

Understanding rehabilitation processes as chains needs all healthcare professionals just in time, involves standardization and the use of a new conception about the role of knowledge in these processes as the main ingredients of creating an *effective virtual network centered on the patient*.

A key requirement in the design of a VHN is to integrate the rehabilitation treatment with the new information and communication technology at home.

Many patients are elderly and chronically ill persons, which do not always have the physical and mental surplus in order to support a long period of treatment. The virtual organization of network challenges the course of treatment for rehabilitation by moving the healthcare practitioners from the hospital or care centers to the patient own home using the virtual reality and ITC.

Through a patient-centered rehabilitation process the network is designing, developing, deploying and implementing a flexible solution for the patient and permit the homecare practitioners to be in direct contact with the hospital while staying in the patient's home. The perspective for the patient is to get a better and more qualified course of treatment, avoiding many visits in the out-patients clinics and unnecessary hospitalization as a consequence of difficult transportation between home and hospital.

But the home care of patients requires *collection, interpretation* and *sharing* of large amounts of time dependent data and knowledge.

For knowledge to be shared effectively and efficiently between, within and across healthcare practitioners, those who possess knowledge (Provider Agents, see Figure 1) should make it available in an *accessible place* and *manner*. The actors who seek knowledge (Requester Agents) should first be aware of the knowledge locus and, second, be capable of interpreting the knowledge within their own context, prior to applying it. But this needs the existence of a Knowledge Sharing Network (KSN) as a type of network among patients, healthcare practitioners and hospital which have as main common characteristic the sharing of both *tacit* and *explicit* knowledge (von Krogh 1998, Zack 1999a, Dyer and Nobeoka 2000). A KSN is a locus for facilitating knowledge sharing and effective knowledge use, since it makes knowledge permanent, accessible and portable to those who need it, inside and outside.

Knowledge is inherently hard to control as it is *ever expanding* and *unpredictable*. In the VHN these characteristics are more obvious because of the distributed character of their structure and the lack of a staff control. But in this kind of organizations there could appear other barriers in generating and sharing knowledge between the members of the VHN.

We are summarizing here some reasons that make the process of sharing knowledge a complicated task in the VHN:

- Distance – both physical and time – makes sharing of knowledge, and especially its tacit dimension, difficult. It may offer a partial solution, despite the fact that a lot of knowledge is generated and transferred through personal contacts and relationships like physical skill demonstration, body language, conversations etc;
- The individual who possesses knowledge – especially the tacit one – may be discouraged or may refuse to share it with other individuals from the VHN;
- Inequality in status among practitioners is also a strong inhibitor in sharing knowledge, especially when is worsened by differences in accessing information;
- The culture of the organization often blocks sharing, especially in highly competitive environment (such as private hospitals, for example);
- Missing a centralized knowledge basis makes it very difficult to access the complete knowledge of the VHN;
- Differences in the workflow - possible difficulties in coordination of the knowledge transfer;
- Differences in terms - possible misunderstandings can lead to a different interpretation in the knowledge exchange process;
- Difficulties in structuring and classifying the knowledge etc.

Especially in the VHN, knowledge, and therefore also knowledge sharing, plays a significant role, because the care services are based on complex non-standardized solutions, that are patient specific. To ensure an efficient and effective rehabilitation process certain suppositions need to be created, which enable an efficient knowledge sharing (and generally information exchange) between the healthcare practitioners.
In order to solve the problems of the missing centralized knowledge basis as well as the sharing knowledge coordination, some *knowledge models* are developed which describes the organizational knowledge basis of the VHN.

In addition to the requirement of process orientation, the Sharing Knowledge Model (SKM) needs to be readable by computers (because the model is an intrinsic part of an IT-system), and is has to consider the particular knowledge backgrounds of the care practitioners and hospital as an essential requirement for the precise identification of the knowledge needed.

4. Knowledge sharing models in the home rehabilitation VN

We focus in this section on investigating a framework for an *agent-based knowledge sharing model* (AB-KSM). This model includes a number of informative agents who share their results with a just-in-time information presentation agent. The presentation agent does not only suggest its own documents of relevance, but information found by the other agents as well. Agents deposit information for later use by themselves or by other agents. In this way, knowledge sharing between agents is possible, but it is controlled in such a manner that allows modular inclusion of agents within the framework.

The AB-KSM has a tree-layer structure (Figure 1) that makes it possible to abstract over the various techniques that are hidden under its surface. Each layer is focused on one specific part of the activity, and is supported by corresponding types of agents:

- Requester agent (medical staff, patients);
- Provider agent (IT specialists, database administration system); and
- Middle agents (database administrators, MDs).

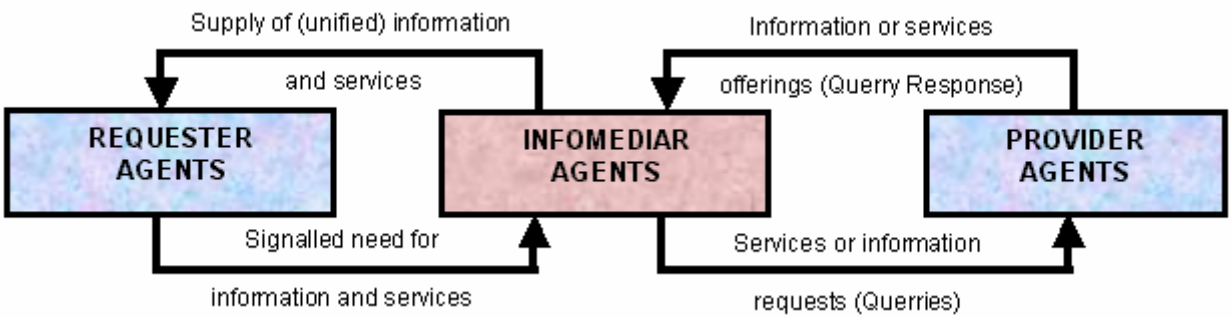

Figure 1: Architecture of an agent-based model

The essential role in this architecture is played by the middle agents (profile agent and infomediaries). They deal with preference or capability information and actively inform the users (Requester agents) when they

find items (information or knowledge) that match their requirement. Very often, such agents may not understand the knowledge domain directly, but are instead facilitators that can find other people who understand the domain better.

The behavior of middle agents has certain implications for efficiency, privacy, robustness and adaptive power which are related to characteristics of the external environment and of the agents themselves.
In the VHN the *middle agents* have to:

- compare the agents' information in a peer-to-peer, decentralized fashion;
- refer users to others who have similar interests; and
- share the knowledge between the most interested users.

The user agents' behavior is based on the concept of *stereotype*. This means that for a patient and the known information about him, it is possible to generate stereotypes for user groups (different healthcare practitioners that offer care services in the rehabilitation process). Individual users can then be modeled by customizing an instance of their profile from the general class. Each user specifies group preferences when registering within the system.

This process of knowledge sharing has a conflict potential between agents. For example, a situation may arise when a user agent reviews sets of knowledge patterns acquired through an interaction and determines that an identifiable agent is unable to provide quality information, and hence should not be consulted in the future (for example when a "second opinion" system is available within the VHN, both for the patients and the medical staff). In order to solve this issue, the system uses a two-stage-filtering process to improve the performance of the middle agent. The *first stage of filtering* takes place when the middle agent accepts an information request. It examines the user profile encoded in the information request, and uses this information to filter out undesirable agents, or identify favorable agents from whom to acquire quality information. A *second filter* will help the user agent reviews the knowledge that was acquired from the agent community, and decides whether to adopt this knowledge into its dictionary. After that, the filter allows the user agent to review the accepted and rejected knowledge, and then determines if some agents are providing low-quality knowledge. This analysis may prompt the user agent to initiate a change to their profile, in order to avoid undesirable agents, or to favor helpful user agents in future requests.

Different types of middle agents have been proposed in the knowledge sharing, such as *matchmakers, information brokers* and *blackboards* [Decker et al., 1996].

The broker agent-based model contains an information agent (broker agent) who has the capability to accept registration from user agents, which define the user's knowledge capabilities to provide knowledge as well as to accept advertisements from provider agents, which contain the user desired information that can be retrieved by requester agents. All the received information concerning user preferences and advertisements will be stored as meta-data in the broker's external database.

A user agent discovering the lack of sufficient knowledge about a particular patient (domain) can choose to ask the information agent to build an information request containing detailed information about the patient (domain of knowledge) and some of the user's knowledge acquisition preferences. As long as the information agent accepts such requirements, it will be primarily responsible for using previously advertised user agent capabilities to recognize which user agent in the VN can provide the desired information by sharing the knowledge. Figure 2 represents the basic architecture of broker agent-based model of sharing knowledge adapted for the home rehabilitation network.

In general terms, each VN must have a policy for specifying its sharing knowledge strategy, which particular agent within the organization has roles in this activity, and what these roles are. But every AB-KSM can be more or less effective and efficient in the process of operating a VN.

For our VN we use the information broker architecture because it is more efficient and flexible, linking the knowledge about the health problems to the symptoms, the clinical signs and the observations in order to chooses the health care procedures that are most appropriate to be administered to the patient. Of course, the diagnostic hypothesis is a priori reserved to the physicians, but the treatment can sometimes imply therapeutic decisions of the non-medical actors like physiotherapists, occupational and social workers, family members etc.

The knowledge shared between these actors is structured in the internal database on four layers**:**

1. The current symptoms and clinical parameters of the patient (EI);
2. Observations and diagnostics of the physicians (EI);
3. The previous known diseases or health problems of the patient (ID); and
4. Procedures and protocols set up in order to solve the rehabilitation problems of the patient (PK).

Initially, for every patient, the first and the second layer are activated. During the process of rehabilitation, the other two layers are activated.

On every layer there are structured different *pieces of knowledge*. For example, on the first layer, there are data and information about the history of the patient's diseases, the current symptoms of the patient and the dynamics of the clinical parameters.

On the second layer there are observations and diagnostics established by different physicians and reactions at different procedures applied to the patient during the evolution of the rehabilitation process.

On the third layer there is registered knowledge about the health problems and diseases of the patient using the terms and relations defined by the medical ontology from the external database.

Finally, the fourth layer is dedicated to the procedures and protocols associated with the different diseases of the patient. These protocols establish the main stages of the treatment applied to every patient.

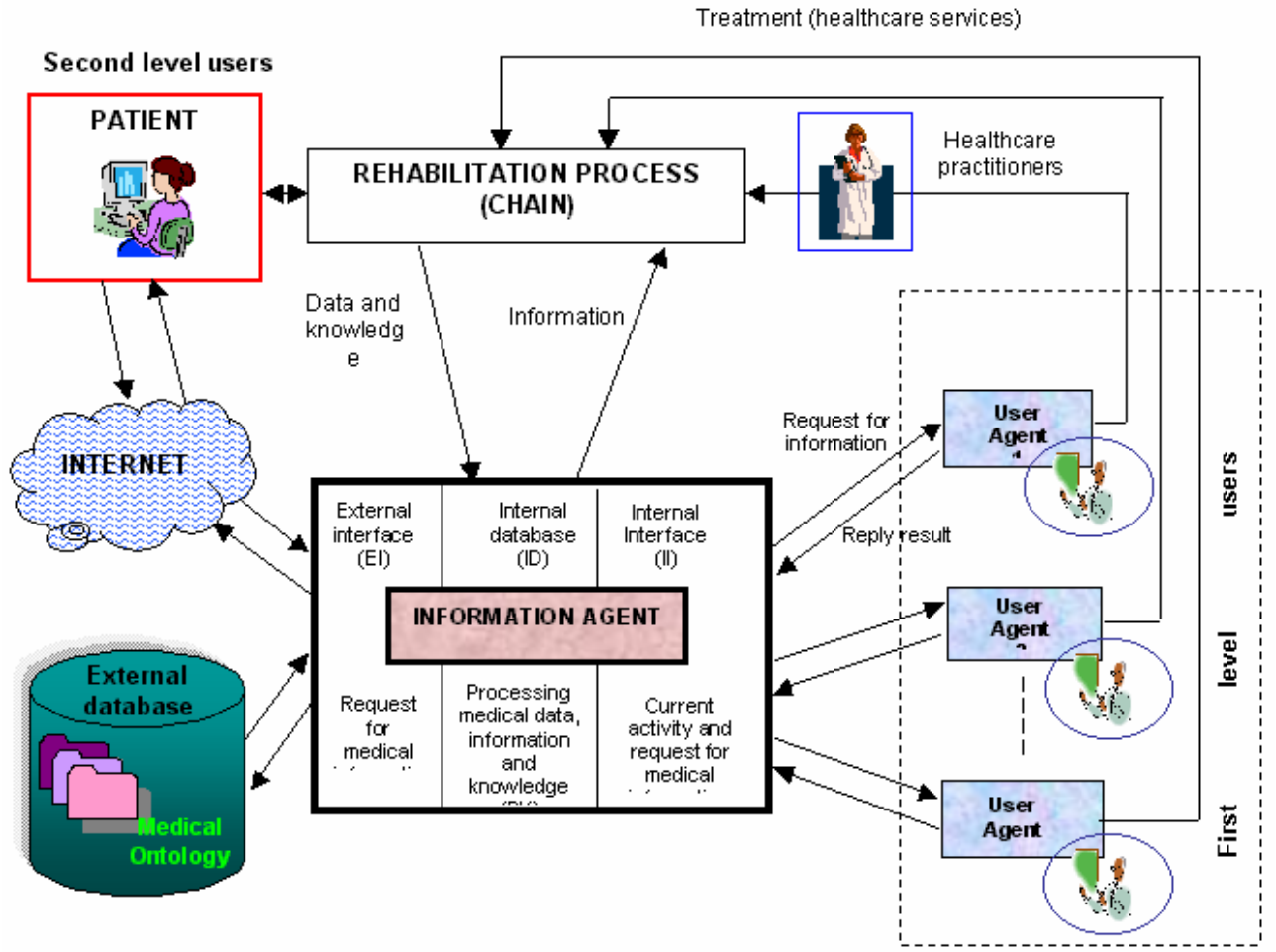

Figure 2: The architecture of the information agent-based model for a rehabilitation VN

Because of the particular nature of the healthcare activity, and especially of the rehabilitation process, designing of a VN for home rehabilitation has to take account of several specific issues:

- The information and knowledge that are shared among the "actors" in the VN must be accessible for the final user – the patient;

- All the medical staff involved in the home rehabilitation process has to ensure a high level of patient' cooperation. This means that they must succeed in convincing the patient that the home care system (based on virtual collaboration) not only preserves all the advantages of an in-patient system, but it also reduces some of the latter's inherent disadvantages: psychical discomfort, other patients' negative influences, long term living into a non-familiar environment, and so on. In this matter, gaining the cooperation of the patient's family members is a key factor;
- The contact with the patient mustn't be interrupted, otherwise it may cause a panic attack to those patients who will feel lost, and, as a result, can lead to loosing their confidence in the system.

Due to the present development stage of healthcare system, all these particularities are more amplified in the Romania's case. And also they are more necessary than ever. The main cause that makes the VHN so necessary is related to the huge existent gap between the demand for medical rehabilitation services and the hospitals' supply of such services in the present type of organization.

5. Pros and cons VN in home rehabilitation. Future works

Within rehabilitation VN, individuals with loco-motor disabilities can communicate, participate and learn by means of VR as to obtain social reintegration. The network also comprises the possibility for a virtual therapist to intervene in order to drive the complex process of rehabilitation and to launch new activities favoring processes of physical and mental reintegration. Moreover, it also includes a management and evaluation layer, enabling system feedback and corrections, therapeutic knowledge and management functions (configuration, updating, storage, sharing etc.).

Having a flexible architecture, the VN uses intensive methods of KM to implement virtual reality applications capable to emulate real participation scenarios concerning representation of "real world" metaphors, spatial and multi-dimensional representation of contextual situations, manipulation and navigation possibilities, dynamism and realism.

Also, from the economic point of view, on the long term, the existence of such a virtual network system will bring important savings/profits and possibilities for reconsidering the way of organizing healthcare services. In this field, we hope that our team's future work will result in more quantitative arguments (cost/benefits arguments) that can sustain the opportunity of a VN designing in home rehabilitation process.

We already have a real interest and precise short term objectives for analyzing and decomposing this process using the Supply Chain approach.

In the Romanian medical rehabilitation context, as we had showed in section 2, using the advantages of a VN is more than a necessity, it is a must. Benefit from different specialists' experiences in similar clinical conjuncture (elements of the Data Base of an AB-KSM), without the necessity of an in-patient system could make the difference between life and death for many individuals with disabilities leaving miles away from the rehabilitation centers.

Still, designing a VN with all its above mentioned advantages, at the beginning could seem to be an "expensive" method to support the necessary medical procedures in rehabilitation: to many IT and modeling specialists involved, different gaps between the way of viewing things from the medical and non-medical point of view, a (partially justified) reticent attitude of medical teams in learning to use even a very friendly IT product, the insufficient number of computers in the Romanian healthcare system, the necessity to adopt robotics structures and dedicated soft for rehabilitation, and so on.

In fact, the most important element that makes the difference between YES or NO for VN in Romania's healthcare system consists in the ability to identify and to turn in the strengths and weaknesses for each organizational manner: in-patient rehabilitation and/or home rehabilitation within a VN. We believe that this is the corner stone in changing both the mentalities of the involved people, and of course the way things are done now in Romania in this important medical field.

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