A HELPFUL FRAMEWORK FOR THE ORGANIZATION OF THE HOMECARE.

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Abstract- **We present our contribution to a national project whose ambition is to use new cooperation tools, in the context of homecare, in order to facilitate the coordinated cooperative work of health actors. Homecare is expected to develop in the coming years, but it is still difficult to organize and such care coordination is complex. A study of homecare activity leads us to determine two specific sorts of activity : one concerns the implementation of human and material resources and design of the homecare protocol, and the other concerns the actual coordinated patient care. In this paper we focus on the needs which we have encountered in such a context : a workflow coordination is useful if the care is well protocoled, human decision is crucial in more unusual situations. We propose a model of coordination which is based on the three following concepts : recursive description of action, flexible routing, common share of reference. A prototype is implanted and used to refine the description of the homecare activity.**

Keywords **– Workflow; Cooperation; Homecare; Organization**

I. INTRODUCTION

Cooperation between individuals can be increased and improved if new services are proposed, using the new technologies whose emergence is becoming increasingly important. In the context of care, such new services could be helpful in a lot of domains. Coordination and good exchange of information are crucial for the quality of care [1], communication within the medical space is very important and reveals the great number of direct interactions between clinicians [2]. The HomeCare setting represents an interesting context for testing such new services.

Nowadays, homecare appears as a complementary solution to hospital care, in specific care situations, being able to preserve the patient quality of life and to reduce the cost of care. But even if homecare constitutes undeniably a progress for the patients, it induces complex cooperative health care activities. Care is no longer confined to a well protocoled context of work as in hospitals, actors are distant, work is asynchronous most of the time, and care really requires good cooperation.

The first cognitive studies that we have made on *Coordinated Collective Homecar*e *(THE CC_HC)* activities reveals that it is organized in two different and complementary phases :

- the first one is the implementation process activity. The implementation of the CC_HC process is usually performed by specialized nurses referred to as "coordinators". It deals with the judgement of the feasibility of such an activity and with the organization induced, if it is realizable.
- the second phase deals with the CC_HC running activity. It constitutes the effective care, the participants of the homecare process visit the patient separately, at different moments. They don't meet each other except for some (rare) specific coordination meetings.

But those two phases are not independent and the CC_HC even if well organized, remains complex , in particular due to the encountered processes which are dynamical:

- It is linked to the patient's state of health, which is always evolving.
- It requires a global organization : this organization allows to implement the care context at the beginning. For example, a pathology requires a nurse twice a day, a practician once a day, and so on…But the global organization has to be modified if required when the care is running – for example, the mobility of the patient decreases and he needs a medical bed -.
- It manages the indispensable cooperation of health care actors during actual care.

The CC_HC is specific because cooperation during care depends on the organization previously implemented. And this organization is itself a specific adaptation to a context of care depending on several patient parameters (health state, family, home organization,…) The rules which govern cooperation cannot be represented implicitly but have to be adapted to the existent organization. Moreover, care organization can change during care and can affect the cooperation between all the involved health actors. The role of the human coordinator is essential in the situations of the CC_HC we have examined until now.

We are now studying computerized solutions to create a helpful framework for the organization of Homecare. Our research is built on a rich collaboration between cognitive scientists to know more about the activities induced in the CC_HC and computer scientists to propose new models to represent such activities. In this paper, we first highlight recent research in the field of cooperation, then we present our model, the results we have obtained in the context of the CC_HC, and we conclude.

Report Documentation Page

Report Date	Report Type	Dates Covered (from... to)
25 Oct 2001	N/A	-

Title and Subtitle A Helpful Framework for the Organization of the Homecare	**Contract Number**
	Grant Number
	Program Element Number
Author(s)	**Project Number**
	Task Number
	Work Unit Number
Performing Organization Name(s) and Address(es) Centre d'Etude et de Recherches en Informatique Medicale Universite de Lille2- Faculte de Medecine- LILLE France	**Performing Organization Report Number**
Sponsoring/Monitoring Agency Name(s) and Address(es) US Army Research, Development & Standardization Group (UK) PSC 802 Box 15 FPO AE 09499-1500	**Sponsor/Monitor's Acronym(s)**
	Sponsor/Monitor's Report Number(s)

Distribution/Availability Statement
Approved for public release, distribution unlimited

Supplementary Notes
Papers from 23rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, October 25-28, 2001, held in Istanbul, Turkey. See also ADM001351 for entire conference on cd-rom., The original document contains color images.

Abstract

Subject Terms

Report Classification unclassified	**Classification of this page** unclassified
Classification of Abstract unclassified	**Limitation of Abstract** UU

Number of Pages
4

II. METHODOLOGY

Recent papers have underlined some requirements for cooperation tools :

> Carstensen and Schmidt [3] deal with the complexity of cooperative design, and mention that the requirements for CSCW systems are first about managing task interdependencies, and second managing common information spaces to facilitate mutual awareness among actors. Schmidt and Simone [4] underline that the strategies supporting cooperation depend on normative models of cooperation – regulating interactions – or on the development of 'shared work space' – Mediating interaction - and that it could be useful *to "mind the gap"*.

A. Workflow coordination.

Workflow model is one of the most attractive models for coordination. "Workflow is the automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules"[5]. Workflow describes the transfer of information and transfer of responsibility which occur during a complex activity. Workflow systems decompose the whole activity into different tasks and sub-tasks and empower the description of the work flow with the design of Rules, Routes, Roles (metaphor of the "3R"). In a first approach Rules determine what can be done, Routes indicate how tasks are combined and Roles define some set of actors whose abilities are similar. Guidelines for example, constitute a very interesting application of workflow system in the context of care [6]. The use of a traditional Workflow System to perform a complex and cooperative activity induces some strong constraints : to assume a robust enough system, the Workflow designer has to describe the whole activity, the flow control, and even the exceptions which could occur.

But complex situations call for more flexibility. Two major factors justify adaptive workflow systems : firstly the evolution of workflow management because of changing environment or because of technical advances, secondly the need of ad-hoc derivation during workflow execution[7]. As Jarvis says, the dynamics of a workflow can be improved through the exploitation of IA techniques [8].

B. Specialist's intelligent behavior

Another solution to improve the flexibility of the system is to use human intelligence and to empower the human control if needed. It is pertinent to delegate control to the system when using it in a well protocoled work, but it could be very costly in more undefined situations[9]. We have already focused on the *users'control* while using a workflow for prescription in Intensive Care Units [10].

Referring to the Schmidt's classification of coordination[11], our work deals with integrating cooperation, in which the actors cooperate in a controlled system where individuals know the finality of the whole task so that they adjust their own work better. In a natural situation of human cooperation, each actor performs his task but also controls the system. With a workflow system, actors have to perform the tasks but do not have to assume control : the Workflow notifies the relevant actors of the tasks to be done. It could be efficient to augment self-controlled work for the users, so that they keep control on the way they want to manage the actions to perform. Freedom of action [12] or better presentation of the tasks to perform with refined agendas or personal worklists [13] are some of the possibilities offered to improve user's control.

Human controlled flow of work is sometimes efficient, and, in the field of Artificial Intelligence, Blackboard System defines a representation able to simulate the intelligence of a group of specialists, gathered around a blackboard and able to determine when it is useful and opportunistic to act to reach a global solution. Blackboard System uses opportunistic triggering of actions. BB1[14] is an example of such an architecture, GARDIAN [15] an example of what can be done with such a system in the context of HealthCare.

Our objective is to help the health actors to perform a global task. They are not obliged to reach the most precise description of the tasks. We make the hypothesis that most of the time a "light" coordination is enough to help health care actors improve their work. Each time it is possible, a well protocoled coordination is proposed, if the global work is more complex another type of cooperation could be used. To remain useful, it deals with :

1. a "controlled communication" with some rules which control the constraints for cooperation of the actors and on a description of the Common Frame of Reference [16] to assume a mutual awareness allowing intelligent actor behavior.
2. coordination to assure a good scheduling of some important tasks, a good notification of the actors, using mobile technologies if required.

In the context of Homecare, we aim at proposing new services to facilitate the organization and the coordination of homecare. It seems to be obvious that some of the information like administrative information should be shared between the different participants and automatically completed if possible. But having a complete description of the different processes to perform is infeasible. Homecare, for example, always needs nurse care. While organizing homecare, a nurse has to be found. It is sometimes very easy and refers to a list of well-known nurses, but sometimes a free nurse has been found by chance, while discussing with the neighbor in the grocer's shop.

Three major difficulties guide us in defining our model:

1) A system which describes precisely the different processes will suffer from exceptions, an overly generic system will be uninteresting. To solve this difficult problem, we propose to have a system with a recursive description of actions. We are making the hypothesis that at a low level of granularity the system will not be very useful but usable without exceptions, at a high level of granularity the system will be very interesting but will not reach all the possible processes. For example, when using a global description of the work, the system indicates that a nurse has to be found and which parameters have to be recorded (name of the nurse, address, availability …) and covers all the

situations used to find a nurse. But if a refined description of this action is implemented in the system and if the context corresponds to a well protocoled situation in which such a description is useful, the user would be helped if he chooses to use the refined action. For example, he obtains information about how to find a nurse.

2) Sometimes, activities are well-known and easy to describe in a refined manner, and sometimes activities are more complex or unusual and difficult to anticipate. The processes are by nature dynamical. For example it is easy to describe the global organization of THE CC_HC (ask for THE CC_HC then evaluation of the feasibility…) in an ordered and static way, but the organization of the care depends on the dynamics of the care (a nurse is always needed, but what about the physiotherapist)
3) Individuals require a lot of information to build their common frame of reference.

We aim at taking these requirements into account to propose our model.

III. MODEL

We propose a "workflow inspired" model with task decomposition, routes, rules and roles. Those last two points (rules and roles) are not presented in this paper.

A. Recursive Task decomposition

A workflow defines some processes. A process is " a formalized view of a business process, represented as a co-ordinated set of process activities that are connected in order to achieve a common goal" [5]. A process activity is "the smallest unit of work which is scheduled by a workflow engine during process enactment" [5]. As stated before, we have chosen to use a recursive representation of the tasks :

Let us call the recursive representation of the tasks Action Elements (AE). An AE can be recursively decomposed into different AE.

For example we describe *Homecare_AE* as composed of *homecare_demand_AE*, *homecare_Evaluation_AE*, *Homecare_organization _AE*, *actual_care_AE* and *Homecare_exit_AE*. *HomeCare_Evaluation_AE* is composed of *administrative_evaluation_AE*, *medical_evaluation_AE*, *environment_evaluation_AE* (family, home,…). *Environment_ evaluation_AE* is no more decomposed.

Each time no decomposition is defined for an AE, it is like **an activity** in the workflow concept.

Each time AE has a decomposition it could be viewed **as a process or as an activity**.

- If viewed as a process, the actor can refine the AE and uses the knowledge of what can be done to perform his task in an efficient manner (for example an evaluation is composed of medical, administrative and environment evaluations).
- If viewed as an activity, the actor only uses the description of information that this activity has to return and completes the useful data before jumping to another task. For example, the user says that the evaluation is not OK, without giving some details on this decision.

An AE has pre and post condition, transition rules, AE components, …

All the AE are described in a declarative form so that it is very easy to modify the description of the activities. It is very important because we are now evaluating the representations of activities that the cognitive scientists are elaborating.

B. Flexible routing

The concept of route is very important for the Workflow Systems and organizes the different tasks. Our objective is to have a flexible model: when parameted as very strict, its behavior looks like a workflow system ; when parameted in a more lax manner, the system gives advice to perform the tasks.
Routes are expressed into declarative scenarii. For example when using the knowledge associated with the homecare organization, a user will not only find some information about task decomposition (*lookingForHealthCareActors* is composed of *LookingForNurse* and *LookingForPhysician* and *LookingForPhysiotherapist*) but will also mention in an attached scenario that *lookingForNurse* is always triggered while *lookingForPhysiotherapist* is optional) For the moment, the scenarii express the sequentially of action or indicate that some actions are optional. We are now working on the expressiveness of scenario, to improve the flexibility of the routes : more or less strict behavior.

C. Shared information

Two spaces of information are used : one is about the progress of the activity and presents the actual state of the global job, the other space is about all the information already known by the system about the patient. An easy access to these two spaces of information found the mutual awareness. We will work on the rules which control the information access and try to know more about which information are pertinent in a given context.

IV. RESULTS

The project is implemented in JAVA. AE are described in an XML formalism (Fig. 1) and generate JAVA objects.

```
<ACTION>
    <NOM_ACTION>Evaluation</NOM_ACTION>
    <SCENARIO>/Eval. soins,/Eval. entourage,/Eval. ressources humaines,/Eval. matériel,&Eval. sociale,</SCENARIO>
    <COMPOSITION>
      <NOM>Eval. soins</NOM>
      <NOM>Eval. entourage</NOM>
      <NOM>Eval. ressources humaines</NOM>
      <NOM>Eval. matériel</NOM>
      <NOM>Eval. sociale</NOM>
    </COMPOSITION>
    <FILSDE>HAD</FILSDE>
    <ATTRIBUT>
      <NOM_ATTRIBUT>Nom</NOM_ATTRIBUT>
      <NOM_ATTRIBUT>Age patient</NOM_ATTRIBUT>
      <NOM_ATTRIBUT>Adresse</NOM_ATTRIBUT>
      <NOM_ATTRIBUT>Pathologie</NOM_ATTRIBUT>
      <NOM_ATTRIBUT>Téléphone</NOM_ATTRIBUT>
      <NOM_ATTRIBUT>N° SS</NOM_ATTRIBUT>
      <NOM_ATTRIBUT>Nom demandeur</NOM_ATTRIBUT>
      <NOM_ATTRIBUT>Adresse demandeur</NOM_ATTRIBUT>
      <NOM_ATTRIBUT>Téléphone demandeur</NOM_ATTRIBUT>
      <NOM_ATTRIBUT>Qualité demandeur</NOM_ATTRIBUT>
    </ATTRIBUT> …..
```

Fig.1 :Part of a description of an Action Element.

We are now able to underline two positive results :

The model is useful because it allows to represent the knowledge about this activity in an explicit and declarative way. It improves the exchange between the scientists and the users, especially the coordinators in actual health care organization. We now have to refine our description of activities and information exchange.

Fig 1 : The CC_HC interface.

Even if the proposed interface has to be improved, the actual proposed interface seems to be well adopted and usable, recursive description of the tasks matches the user's representation, users seems to agree with the two area of visualization (processes and information).

V. Discussion

A lot of perspectives and very interesting researches are to mention :

1. Improvement of the system itself : firstly to integrate the notion of roles and rules in a more explicit way, secondly to use the model for the CC_HC running activity,
2. Knowledge of the homecare activities. Is it possible to generalize part of the model of health care activities ? What functions are essential for managing healthcare ?…
3. Connection of this system to the global environment of THE CC_HC by improving the interface between this system and the existing software, and use of mobile technologies.

VI. Conclusion

Cooperative tools in complex and dynamical context are known as difficult to model. Workflow systems propose an answer to the coordination of actors, especially well adapted in well-protocoled situations. In the context of homecare organization advices are often as useful as protocols. That is why we propose a solution to combine intelligent human behavior and power of coordination systems in the context of homecare. The use of declarative descriptions of activity processes is crucial, so that the system can be easily adaptable to the improvement of the knowledge of the homecare activity.

Acknowledgment

Thanks to L. Watbled, S. Fremy , theSantelys association and Omolade Alao. This project is granted by Région Nord/Pas De Calais and the French Ministry of research.

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