Assesing the Understandability of Collaborative Systems Requirements Notations: an Empirical Study - Experimental Material

Technical Report # DIAB-11-06-1

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As for single user systems, a proper specification of software requirements is a very important issue to achieve the quality of the collaborative systems. Nevertheless, many of these requirements are from a non-functional nature because are related to the user's need of being aware of other users, that is, the workspace awareness. In order to model these special kind of requirements, CSRML, an extension of i* has been proposed. In this paper, we present a controlled experiment to assess the understandability of this notation compared to i*. The specification of two different systems was used as experimental material and undergraduate students of Computer Science with an average of two years experience in Requirements Engineering were the experimental subjects.
Introduction

In this Technical Report we show the materials given to the experiment’s subjects. First, we gave the students a datasheet to fill with his/her personal data (pages 4 and 5) and we divided them into two groups (G1 and G2). This document also contained the questionnaires to be answered. Also, with this document, we gave a description of Workspace Awareness in order to facilitate the concept comprehension.

Just after giving this documentation, we gave the students, depending of his/her group belonging, the jigsaw domain modeled with i* (pages 7 and 8) or CSRML (pages 11 and 12).

Once all the subjects finished filling the first questionnaire, we remove them the jigsaw model and gave them the conference domain one, once again modeled with i* (pages 9 and 10) or CSRML (pages 13 and 14).
Student Data

Group:
1 □  2 □

D.N.I.¹: __________________

Knowledge about Requirements Engineering:
None □  Less than a year □  Less than two years □  Two or more years □

Experience with Goal-Oriented Requirement Engineering techniques (i*, KAOS or similar):
Yes □  No □

Average mark (approximate): ___

Age: ___

Gender: M □  F □

Jigsaw Questionnaire

Answer the following (T)rue / (F)alse statements:

1. The task “Designate experts coordinator” is a collaborative task ___
2. The task “Expose at team meeting” is a collaborative task ___
3. Two different roles are necessary to perform the task “Give permission to an expert for exposing” ___
4. Two different roles are necessary to perform the task “Attend experts meeting” ___
5. A “Student” actor can play the “Expert” role anytime ___
6. Only a “Expert” is needed to “Make experts report” ___
7. “Participant list with exposition order” is a implementation of “Be aware of expert group member” softgoal ___
8. “Experts report” is an implementation of “Make experts report” ___
9. “See the other users activity” is a softgoal related with awareness ___
10.“Designate experts coordinator” task is more important than “Expose at experts meeting “ task ___

WRITE DOWN DURATION TIME (HH: MM: SS) _____________________________

¹ Student’s DNI will be kept anonymous
Answer the following (T)rue / (F)alse statemens:

1. The task “Paragraph review” is a collaborative task ___
2. The task “Communicate outcome of the review to authors” is a collaborative task ___
3. Two different roles are necessary to perform the task “Paragraph review” ___
4. Two different roles are necessary to perform the task “Communicate outcome of the review to authors” ___
5. A “CP” actor can play the “Reviewer” role anytime ___
6. Only a “Reviewer” is needed to “Paragraph review” ___
7. “Telepointers with reviewer’ name and color” is a implementation of “Be aware of other reviewer activity” softgoal ___
8. “Revision history of each paragraph” is an implementation of “Know who and when reviewed each paragraph” ___
9. “Review outcome” is a resource related with awareness ___
10. “Paragraph review” task is more important than “Communicate outcome of the review to authors” ___

WRITE DOWN DURATION TIME (HH: MM: SS)__________________________
Workspace Awareness

A collaborative system is a distributed software which allows several users to work together and carry out collaboration, communication and coordination tasks. To perform these tasks, the users have to be aware of other user’s actions, usually by means of a set of awareness techniques.

Workspace Awareness (WA) is the up-to-the-moment understanding of another person’s interaction within a shared workspace. Workspace awareness involves knowledge about where others are working, what they are doing now, and what they are going to do next.

The basic the elements is the set of questions “who, what, where, when, and how”. That is, when we work with others in a physical shared space, we know who we are working with, what they are doing, where they are working, when various events happen, and how those events occur.

**Table 1**: Elements of workspace awareness related to the present

<table>
<thead>
<tr>
<th>Category</th>
<th>Element</th>
<th>Specific questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who</td>
<td>Presence</td>
<td>Is anyone in the workspace?</td>
</tr>
<tr>
<td></td>
<td>Identity</td>
<td>Who is participating? Who is that?</td>
</tr>
<tr>
<td></td>
<td>Authorship</td>
<td>Who is doing that?</td>
</tr>
<tr>
<td>What</td>
<td>Action</td>
<td>What are they doing?</td>
</tr>
<tr>
<td></td>
<td>Intention</td>
<td>What goal is that action part of?</td>
</tr>
<tr>
<td></td>
<td>Artifact</td>
<td>What object are they working on?</td>
</tr>
<tr>
<td>Where</td>
<td>Location</td>
<td>Where are they working?</td>
</tr>
<tr>
<td></td>
<td>Gaze</td>
<td>Where are they looking?</td>
</tr>
<tr>
<td></td>
<td>View</td>
<td>Where can they see?</td>
</tr>
<tr>
<td></td>
<td>Reach</td>
<td>Where can they reach?</td>
</tr>
</tbody>
</table>

**Table 2**: Elements of workspace awareness relating to the past

<table>
<thead>
<tr>
<th>Category</th>
<th>Element</th>
<th>Specific questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>How</td>
<td>Action history</td>
<td>How did that operation happen?</td>
</tr>
<tr>
<td></td>
<td>Artifact history</td>
<td>How did this artifact come to be in this state?</td>
</tr>
<tr>
<td>When</td>
<td>Event history</td>
<td>When did that event happen?</td>
</tr>
<tr>
<td>Who</td>
<td>Presence history</td>
<td>Who was here, and when?</td>
</tr>
<tr>
<td>Where</td>
<td>Location history</td>
<td>Where has a person been?</td>
</tr>
<tr>
<td>What</td>
<td>Action history</td>
<td>What has a person been doing?</td>
</tr>
</tbody>
</table>

Tables 1 and 2 show these elements and list the questions that each element can answer. Table 1 contains those elements that relate to the present, and Table 2 contains those that relate to the past. The elements are all commonsense things that deal with interactions between a person and the environment.
Group 1 – Jigsaw

The following $i^*$ diagram describes a jigsaw learning activity, a cooperative-learning technique in which students individually do some research in a proposed problem and then they teach each other what they have learned by sharing each individual view of the problem.

$i^*$ elements$^2$:

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$^2$ At back page detailed information about the $i^*$ elements can be found
The *i* Framework distinguishes between two kinds of elements: objects and relationships. The objects considered in *i* are:

- **Actor**: An actor is a person or a system that has a relationship to the system to be developed. *i* identifies three kinds of actors:
  - **Agent**: An agent who has a concrete physical representation, e.g., a person or a system.
  - **Role**: Defines the behaviour of an actor within a specific context. An actor can have several roles, and a role can be assigned to multiple actors.
  - **Position**: A set of roles that can be typically played by one agent. An agent can play several positions.

- **Goal**: A goal answers “why?” questions. It describes a certain state in the world that an actor would like to achieve. However, a goal does not prescribe how it should be achieved.

- **Task**: A task specifies a particular way of doing something. Typically a task consists of a number of steps (or sub-tasks) that an actor must perform to execute it.

- **Resource**: A resource is a (physical or informational) entity that the actor needs to achieve a goal or perform a task. The main concern about a resource is whether it is available and from whom.

- **Softgoal**: A softgoal is a condition in the world that the actor would like to achieve, but unlike the concept of (hard) goal, the condition to achieve it is not sharply defined. A softgoal is typically a quality attribute that constrains other element such as a goal, a task, or a resource. A softgoal is considered to be fulfilled if there is sufficient positive evidence for its fulfilment and little evidence against it.

The previous objects are related between them through this set of relationships:

- **Dependency**: A dependency in *i* documents a relationship between a depender and a dependee for a dependum. The depender and the dependee are actors. The depender depends on the dependee for achieving a goal, performing a task, or using a resource. The dependum is the object which the dependee must deliver and which the depender depends on. It can be a goal, a task, a resource, or a softgoal. If the dependee fails to deliver the required dependum, the depender’s ability to achieve its own goals is affected. In other words, it becomes difficult or impossible for the depender to achieve a goal, perform a task, or use a resource. Based on the type if dependum, *i* distinguishes four types of dependencies: (i) **Goal dependency** determines that the depender assumes that the dependee achieves the goal, but does not prescribe how it should achieve the goal; (ii) **Task dependency** defines that the dependee must perform the assigned task to achieve a goal; (iii) **Resource dependency**: expresses that the depender depends on the availability of a physical or informational resource that is provided by the dependee; (iv) **Softgoal dependency** expresses that the depender depends on the dependee to perform a task that leads to the achievement of a softgoal. The criteria to determine how to achieve the softgoal are not clearly defined. Typically, the dependee offers several alternatives for achieving the softgoal, and the judgement of whether the softgoal is achieved or not is up to the depender.

- **Means-end link**: A means-end link documents which softgoals, tasks, and/or resources contribute to achieving a goal. A means-end link also facilitates the documentation and evaluation of alternative ways to satisfy a goal, i.e., different decompositions of goal into subgoals, tasks, and resources.

- **Task decomposition link**: A task decomposition link documents the essential elements of a task. A task decomposition link relates the task to its components, which can be any combination of sub-goals, sub-tasks, resources, or softgoals. The decomposition of a task can thus comprise sub-tasks that must be performed, sub-goals that must be achieved, resources that are needed, and softgoals that typically define quality goals for the task.

- **Contribution link**: A contribution link documents a positive (+) or negative (-) influence on softgoals from tasks or other softgoals. A contribution link describes whether a task or a softgoal contributes to satisfy a softgoal positively or negatively. It does not define precisely which kind of support is offered or the extent of the given support.
The following CSRML diagram describes a conference review system with collaborative aspects. In particular, it is the part of the system related to a process review performed in a collaborative way among various reviewers.

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### CSRML elements

- **Goal**
- **Softgoal**
- **Task**
- **Resource**
- **Individual Task**
- **Communication Task**
- **Collaboration Task**
- **Coordination Task**
- **Awareness Softgoal**
- **Awareness Resource**

**Dependency Link**

**Means-end Link**

**Task Decomposition Link**

**Contribution Link**

**Playing Link**

**Responsability Link**

**Participation Link**

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3 At back page detailed information about the CSRML elements can be found.
The CSRML elements are:

- **Role:** A role is a designator for a set of related tasks to be carried out. The difference between i* and CSRML is that an actor playing a role can participate in individual or collaborative tasks (through participation links) and can be responsible for the accomplishment of a goal (through responsibility links). In addition, the graphical notation is also different from the i* role (the concept of role/actor boundary is not used in CSRML).

- **Actor:** An actor is a user, program, or entity with certain acquired capabilities (skills, category, and so forth) that can play a role in executing (using devices) or being responsible for actions. An actor has to play a role (specified by means of a playing link) in order to participate in the system.

- **Goal:** A goal answers "why?" questions. It describes a certain state in the world that an actor would like to achieve. However, a goal does not prescribe how it should be achieved.

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  - Abstract task: This kind of task consists in an abstraction of a set of concrete tasks and, possibly, other elements. We are not able to assign participation links directly to this kind of tasks.
  - Concrete task: These are the tasks the participants are involved to. The abstract tasks are refined in these ones. Participants will be assigned to the task through participation links. There are four types of these tasks:
    - **Individual task** is a task that an actor can perform without any kind of interaction with other actors.
    - **Collaboration / Communication / Coordination task** two or more actors are involved in order to perform any kind of collaboration / communication / coordination among them.

- **Resource:** A resource is a (physical or informational) entity that the actor needs to achieve a goal or perform a task. The main concern about a resource is whether it is available and from whom.

- **Awareness resource:** This special kind of resource corresponds to an implementation or a design solution to accomplish an awareness softgoal.

- **Softgoal:** A softgoal is a condition in the world that an actor would like to achieve, but unlike the concept of (hard) goal, the condition to achieve it is not sharply defined. A softgoal is typically a quality attribute that constrains other element such as a goal, a task, or a resource. A softgoal is considered to be fulfilled if there is sufficient positive evidence for its fulfilment and little evidence against it.

- **Awareness softgoal:** CSRML refines the i* concept of softgoal into a new specialization: awareness softgoal, that represents a special need of perception of other user's presence / actions, without which the task the user wants to perform would be affected negatively or even could not be done.

The previous objects are related between them through this set of relationships:

- **Dependency:** A dependency i* documents a relationship between a depender and a dependee for a dependum. The depender and the dependee are actors. The depender depends on the dependee for achieving a goal, performing a task, or using a resource. The dependum is the object which the dependee must deliver and which the depender depends on. It can be a goal, a task, a resource, or a softgoal. If the dependee fails to deliver the required dependum, the dependee’s ability to achieve its own goals is affected. In other words, it becomes difficult or impossible for the dependee to achieve the goal, perform a task, or use a resource. Based on the type if dependum, i* distinguishes four types of dependencies: (i) **Goal dependency** determines that the dependee assumes that the dependee achieves the goal, but does not prescribe how it should achieve the goal; (ii) **Task dependency** defines that the dependee must perform the assigned task to achieve a goal; (iii) **Resource dependency:** expresses that the dependee depends on the availability of a physical or informational resource that is provided by the dependee; (iv) **Softgoal dependency** expresses that the dependee depends on the dependee to perform a task that leads to the achievement of a softgoal. The criteria to determine how to achieve the softgoal are not clearly defined. Typically, the dependee offers several alternatives for achieving the softgoal, and the judgement of whether the softgoal is achieved or not is up to the dependee.

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- **Participation link:** A participation link denotes who are involved in a task. This link has an attribute to specify its cardinality, i.e., the number of users that can be involved in a task.

- **Responsibility link:** A responsibility link assigns a role (played by an actor) to a (soft)goal or task. This link represents who is the stakeholder responsible for a goal/task accomplishment. It is not necessary that this stakeholder is involved in the goal sub-tasks. Nevertheless, if the role is responsible for a goal or task, this role is also responsible for the elements it is divided into, unless a responsibility link reaches one of the elements it is divided into.
Group 2 – Jigsaw

The following CSRML diagram describes a jigsaw learning activity, a cooperative-learning technique in which students individually do some research in a proposed problem and then they teach each other what they have learned by sharing each individual view of the problem.

CSRML elements:

Goal
Softgoal
[!!! / !! / !] Task
Resource
Individual Task
Communication Task
Collaboration Task
Coordination Task
Awareness Softgoal
Awareness Resource
Actor
Role
Dependency Link
Means-end Link
Task Decomposition Link
Contribution Link
[Guard]
Playing Link
Responsability Link
Participation Link

At back page detailed information about the CSRML elements can be found
CSRML language

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