

# An agent based approach to annotate ideas during creativity challenges in an engineering school of innovation

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**Abstract.** This paper presents a multi agent system architecture used to store, annotate and reused knowledge from the ideas created by the students of the University of Lorraine during the creativity workshop called “48 hours to generate ideas”.

**Keywords.** Multi Agent System, Collaborative Creativity Process, Knowledge Annotation

## 1 Introduction

The engineering school of innovation (ENSGSI) of the University of Lorraine organizes every year a creativity workshop called “48 hours to generate ideas<sup>1</sup>” for the students. This challenge is international since there are twelve other universities all over the world, which participate to this event. During forty-eight hours the students will apply creativity method to generate hundreds of ideas in order to solve an industrial problem. The aim of creativity workshops is to develop creativity supported by a collaborative process where students groups generate an eco-system of ideas, evaluate them and make them evolve. The creativity collaborative process involves creativity participants, creativity experts and stakeholders. Creativity experts who are the professors of the engineering school of innovation, animate and lead the creativity process taking into account the skills and evolution of the groups of creativity participants, combining different creativity methods and installing a sequence of divergence/convergence phases helping the growth of the ideas eco-system. However,

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<sup>1</sup> <http://www.48h-innovation-maker.com/>

<sup>2</sup> <http://curbcreativepracticebootcamp.eventbrite.com/>

during these workshops or challenges, ideas are usually written on post-its and then enriched and structured by means of paper forms that are difficult to exploit by both participants and creativity experts.

With the development of information and communication technologies, different innovation platforms are proposed. Several research studies on how to choose a modern interactive tool (or even a collaboration ecology), which simulates the creativity collaborations, have been recently presented in [1][2][3]. Another educational creativity workshop is the annual Creative Practice Bootcamp<sup>2</sup> held in Nashville, TN, where students learn how to apply methods like Brainstorming [4], Brainpurge [5] or Brainwriting [6]. All these systems provide supports for distant and asynchronous innovation. However, even if their main aim is to favor the innovation process, they limit their contribution to feeding participants with information (from other participants, from different content providers, etc.) based on crowdsourcing principles. They are neither installing nor supporting the creativity process itself as creativity experts do during the creativity workshops. Others research works use a multi agent system approach to support the creativity process. In these works we observe two categories; the multi agent systems used to simulate the cognitive mechanism of the creative people like in [7], [8] or the multi agent systems which aim to manage a creativity support system like [9], [10], [11]. The multi agent system approach allows to realize complex tasks like annotate, evaluate ideas and also to take into account of the social features of the creative people like the way they cooperate and the information that they need to fulfill an activity [12].

In this paper we present an agents based approach called CIMAS (Creativity Ideas Managed by Agent System) to support the creativity process all along the challenge “48 hours to generate ideas”. In the next section, we will explain the interest to use a multi agent system approach to support the creativity process. In the following section, we will describe the architecture of CIMAS and the annotation process used by the agents to manage the knowledge inside ideas.

## 2 Overview of CIMAS

In this section we describe the concepts and the architecture of the CIMAS system. There are three types of users; the stakeholders the creativity quizmasters and the creative participants. The aim objectives of the CIMAS system are:

- To help creative participant to annotate and evaluate their ideas and to research others similar ideas;
- To assist stakeholders to search relevant ideas by using different points of views;
- To assist creativity quizmaster by providing indicators and ideas trends from all the creative participant groups.

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<sup>2</sup> <http://curbcreativepracticebootcamp.eventbrite.com/>

### Agents dedicated to the ideas annotation

Doyle explains in [13] that “annotated environments containing explanations of the purpose and uses of spaces and activities allow agents to quickly become intelligent actors in those spaces”. The ideas landscape represents the annotated environment built by the agents. Indeed the CIMAS agents have to annotate each idea, sketch or post-it in order to handle and exploit this information.

The Semantic Web [14] represents a set of languages which facilitate the annotation of web resources. By using RDF language of the Semantic Web, we can describe the context and the content of an idea even if the idea is a text, a sketch or a video. Compared to the Web, the ideas have more delimited context. We can easily define who the creators are, the type of content, when the idea was created. Thus an ontological approach is conceivable to describe ideas. There are already several ontologies aimed at the annotation of ideas, such as ideas “ideaontology” [15], or “Idea Management ontology” [16]. Ideaontology is dedicated to the evaluation of the idea and use mono criteria methods to evaluate an idea. The second ontology is based on four groups of concepts; the concepts related to describe the origin of the idea, the concepts relative to describe the idea, the concepts which describe the innovative part of the idea (impact of the idea, target, feasibility, etc.), and the object (evolution of the idea, the process to develop it, etc.). In CIMAS we have built an ontology of concepts relating to description (types, use cases, etc.) and to contexts (creator, trust, evaluation, related project, etc.). The CIMAS ontology is formalized with OWL lite [17] which is related to provide a conceptual model to describe ideas and which the resources are defined separately.

The Figure 1 shows an extract of the CIMAS ontology and an example of annotation with literal and conceptual properties.

The CIMAS system does not lead directly with the web resources but with their annotation to support the ideas information management. Thus the CIMAS ontology represents a conceptual structure used by the agents to annotate ideas, to organize and research them.

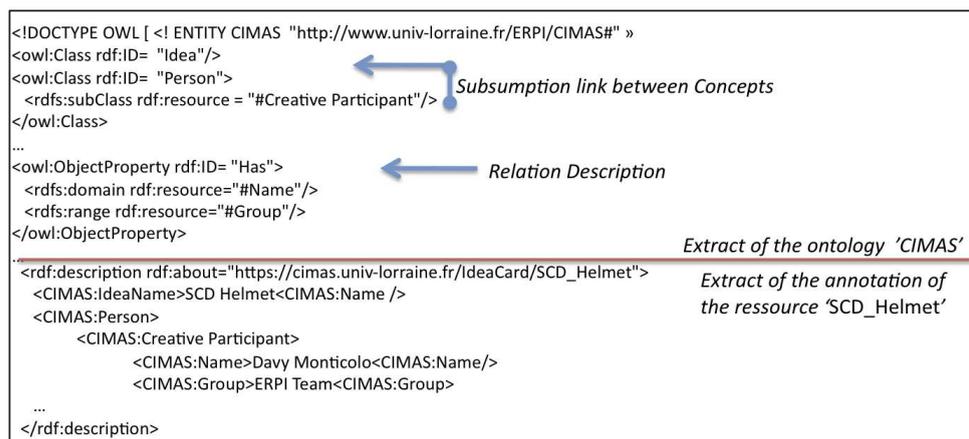


Fig. 1. Extract of the CIMAS ontology and annotation example.

## Architecture

A Multi Agent System is a network of agents that work together in a cooperative way to solve problems that would be generally difficult to solve for any individual agent. Information Agents are a part of intelligent agents [18],[19]. Klusch made a list of the services that a multi-agent system can offer in a information management approach [20]:

- Search, acquire, analyse and classify information coming from various information sources;
- Give information to human and computing networks once usable knowledge is ready to be consulted;
- Negotiate on information integration or exclusion into the system;
- Give explanation to the quality and reliability related to the integrated information;
- Learn progressively all along the information management process;

The proposed approach to design a MAS is based on an organizational approach like the A.G.R model used in AALAADIN [21], Operetta [22] and methodologies like TROPOS [23] or RIOCC [24]. Thus the CIMAS architecture is viewed as a human society in term or role, skill and relationships.

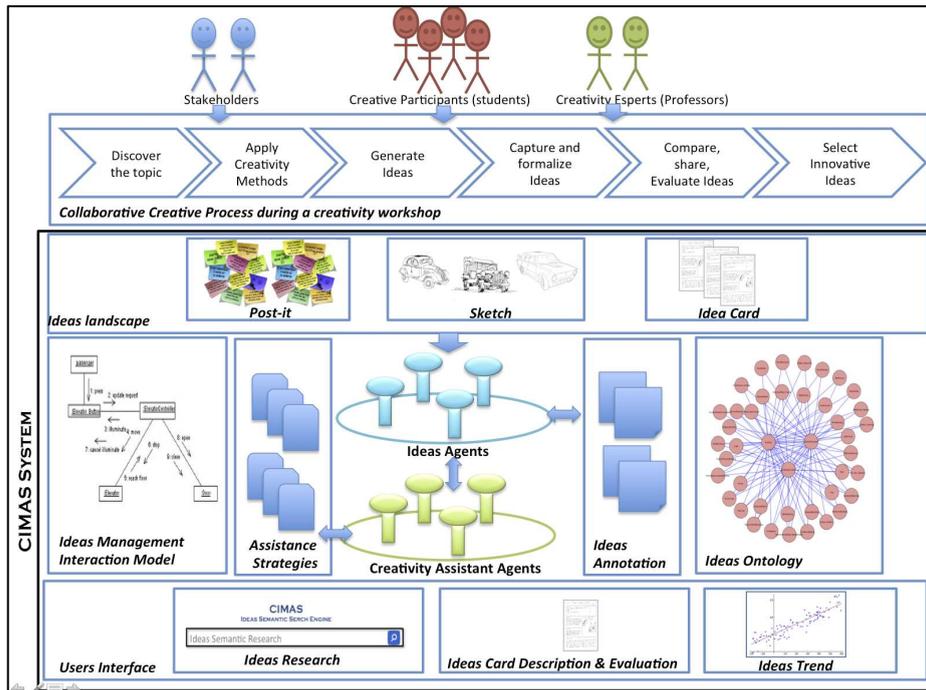


Fig. 2. CIMAS architecture

The main objective of the CIMAS system is to manage ideas coming from different information sources (post-its, texts, sketches). The CIMAS system is based on three layers (Figure 2):

- The ideas landscape where users insert their ideas (text, sketch or post-its) in the system by using forms;
- The agents layer where the management of ideas is executed;
- The Interface layer where users can research an idea, consult an idea card or display the ideas trend inside a creativity workshop.

In this paper we describe the agents layer.

### Ideas Agents Society in CIMAS

From the architecture analysis we can specify the two different agents' societies, the interactions between agents and the mechanisms they use to handle the annotations of ideas.

The Ideas Agents Society is dedicated to annotate the idea according to the ideas ontology. More explicitly, the agents use the structure of the ontology to annotate ideas. There are three Ideas agents, one by type of creativity workshop. There is one agent according to each type of content (post-it, sketch and idea card). The annotation of an idea is composed of a list of tags (Figure 3), which describe its creation (creator, creation date, team, creativity workshop) and its evolution (Number of views, number of “likes”, etc.).

```

<CIMAS:IdeaName>SCD Helmet<CIMAS:Name />
<CIMAS:CreativityWorkshop>Helmet of the future<CIMAS:CreativityWorkshop/>
<CIMAS:IdeaCreationDate>02/01/2013<CIMAS:IdeaCreationDate/>
<CIMAS:IdeaNumberView>31<CIMAS:IdeaNumberView/>
<CIMAS:IdeaNumberLike>18<CIMAS:IdeaNumberLike/>
<CIMAS:IdeaNumberNoLike>6<CIMAS:IdeaNumberNoLike/>
<CIMAS:Person>
  <CIMAS:Creative Participant>
    <CIMAS:Name>Davy Monticolo<CIMAS:Name/>
    <CIMAS:Group>ERPI team <CIMAS:Group/>
  <CIMAS:Creative Participant>
<CIMAS:Person>

```

Fig. 3. Annotation of an idea

The Ideas agents also build the result of the semantic researches when users enter keywords in the CIMAS search engine (Figure 2). They use two mechanisms; the first one is to built SPARQL requests [25] and the second is to calculate the semantic similarity between two ideas.

The first method is used to research the exact name of an idea, a creator or a group. Figure 4 shows the SPARQL request to search an idea which is called “Unbreakable helmet” created by the group “ERPI team”.

```

PREFIX CIMAS: <http://cimas.univ-lorraine.fr/cimas.owl>
SELECT ?Idea
WHERE {
  ?IdeaName CIMAS:IdeaName "Unbreakable Helmet"
}
UNION
{
  ?Group CIMAS:Group "ERPI team"
}

```

Fig. 4. SPARQL request built by the Ideas Agents

The second method consists of calculate the similarity between two concepts in order to identify the similar concepts or the closed concepts. The method is based on the calculus of the semantic distances between two concepts in the RDF models embedded annotations. For example in the CIMAS ontology we have the following property:

$$[Post - it] \rightarrow (Creator) \rightarrow [CreativeParticipant]$$

The method will provide results such as:

$$\begin{aligned}
[Sketch] &\rightarrow (Creator) \rightarrow [Student] \\
[IdeaCard] &\rightarrow (Creator) \rightarrow [Professor]
\end{aligned}$$

To research the concepts, which are close semantically, the agents use the distance of Rada [26] counting the number of arcs on the shorter path between two terms (t1 and t2) (formula 1). By using this distance we can define the distance between two RDF triplets as the sum of the distances between: two relations, two concepts in first argument (domain) and two concepts in second argument (range) (formula 2).

$$dist(t1,t2) = length(t1,lest(t1,t2)) + length(t2,lest(t1,t2)) \quad (1)$$

$$\begin{aligned}
dist(triple1,triple2) &= dist(domain(triple1),domain(triple2)) \\
&+ dist(predicate(triple1),predicate(triple2)) \\
&+ dist(range(triple1),range(triple2))
\end{aligned} \quad (2)$$

The algorithm gives a number between 0 and 1. The closer the number is to 1; the closer are the concepts semantically. A semantic research on all the RDF annotations on the word "Helmet" provides the results shown in Table 1:

<i>Concepts</i>	<i>Similarity index</i>
Headdress	0,632
Hard Hat	0,452
Crash Helmet	0,678
Bandore	0,128
Crown	0,321
Hat Head Protector	0,521
Safety Helmet	0,862

Table1. Research for the word "Helmet" in the Ideas Annotations

The Ideas agents will propose the three best results of the research i.e. the results are “Headdress”, “Had Hat” and “Crash Helmet” for the previous example.

### **The Society of Creative Assistant Agents in CIMAS**

The Creativity Assistant Agents (CAA) interact with the users through the three following interfaces:

- The semantic research engine where they will send the elements of the request to the Ideas agent;
- The Ideas Card visualization and Evaluation. With this interface the CA presents the different idea cards and allow the users to add a comment or a mention “like” or “not like”;
- The Ideas Trend interface. This interface is a scatter chart showing the different ideas themes which are emergent in the workshop.

There are three different CA agents by creativity workshop. Each agent manages one type of interface; the ideas research interface, the ideas cards description & evaluation interface and the ideas trend interface.

### **3 Conclusion**

This paper presents the architecture of a multi agent system dedicated to the ideas management during the creativity workshop “48 hours to generate ideas” organized by the engineering school of innovation of the University of Lorraine. The system uses the semantic web language and an idea ontology to build, research and exploit ideas annotations. The next work of this project will be to make the agents pro active, i.e. to allow the agents to inform the different type of users (Creative participants/students, creativity experts/professors and stakeholders/industrial partners) all along the workshop about the trend of ideas, or if a new idea is similar to another. Another perspective will be to evaluate the whole ideas generated during the creativity workshops and to propose actions to reuse them.

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