

# Competency Manifestation Clues within Interactions in Computer Mediated Communication

Hocine Merzouki <sup>1\*</sup>, Nada Matta <sup>1</sup>, Hassan Atifi <sup>1</sup>, Francois Rauscher <sup>2</sup>

<sup>1</sup>University of Technology of Troyes, 12 Rue Marie Curie CS 42060, 10004 Troyes, France

<sup>2</sup>InfoPro-Digital, 92160 Antony, France

\*Corresponding author: Hocine Merzouki, Email: [hocine.merzouki@utt.fr](mailto:hocine.merzouki@utt.fr)

**ABSTRACT:** The notion of competence is multidimensional and polysemic. Several definitions of this notion are present in the literature according to disciplines such as industry, sociology, management, psychology, etc. It often refers to the experience, knowledge, abilities, skills, behaviors, and attitudes that allow valuable action in a workplace. Beyond its intrinsic value for the individual, competence is considered in organizations as an intangible asset whose mere possession often provides very considerable competitive advantages. The manifestation of competence takes several forms and the methods of its evaluation differ, ranging from quantitative approaches to social recognition. The approach that we have developed is based on the hypothesis that interacting individuals emphasize the components of their functional competencies according to the activity they carry out and the context that surrounds it. We chose pragma-linguistic, which permits us a more in-depth analysis in comparison to statistical analysis based on text-mining or data-mining techniques that are insufficient for an accurate detection of competence. For that purpose, we have proposed an interaction analysis methodology based on natural language processing techniques to find language elements that highlight the clues of the manifestation of the competence in computer mediated communications. We have developed and implemented two algorithms for the detection and analysis of competence that we have applied to interactions from the "Ubuntu" corpus of the community of interest of the same name which deal with Ubuntu operating system issues. The results of the application of our approach are presented and discussed in this paper.

**KEYWORDS:** Ability, Behavior, Communication, Competence Detection, Computer Mediated Communication, Interaction

## 1. Introduction

The competence concept covers several disciplinary domains (sociology, industry, psychology, cognitive sciences, Human Resources Management, strategic management, etc.). It is a complex notion that is individual and collective, tacit and explicit, but often reduced to qualifications and sometimes associated exclusively with practices. Moreover, the terms used to designate competence often induce ambiguities according to usage. Thus the words 'skills', 'abilities', 'capabilities' are used almost indiscriminately to designate competence in literature where knowledge and know-how are qualified as "hard competencies" and the other categories related to attitudes, behaviors and personality traits are called "soft competencies" [1]. The methods most used by managers for competence assessment are staff appraisal, evaluation

interviews, tests or references contained in curriculum-vitae [2]. Even if the results of these processes are relevant, they remain biased by the fact that they are based more on the declarations of individuals than on their real or potential capacities to act. Other competence identification systems are proposed such as the "recommender system" [3] where the authors explored the idea that the interests of an individual are strongly linked to their skills. They detect and analyze the traces of online professional activities of an individual to deduce his competencies. The notion of interest is indeed interesting, but it constitutes a simplified representation of competence. There are other automated competence identification methods from documents, based on text-mining such as the method proposed in [4] which extracts keywords from documents associated with personnel. However, these keywords generally refer to vague competence areas rather than to

explicit competencies. In [5], the authors explored an “e-learning” system which makes it possible to integrate the traces of an individual’s training to deduce his competencies. But this way of doing things is flawed by its tendency to confuse competence and training or apprenticeship.

In our hypothesis, we assume that it is more likely to detect competencies by analyzing interactions around previous actions performed by people in the context of decision-making or problem-solving processes or more generally in cooperative activities. Indeed, during cooperative activities, individuals interact and exchange proposals and arguments in order to perform complex tasks. By going through the stages of an interaction, they share and merge their knowledge to create new one [6]. Therefore, the analysis of the interactions underlying a cooperative activity not only allows us to record the links between the parts of the activity, but it is particularly efficient to detect the clues of the manifestation of competence that helped to solve a problem, to make a decision or to deal with a given situation.

Communicative interactions have been the focus of many analytical studies that explored several techniques for different purposes [7]-[15]. In this article, we presented related works dealing with computer mediated communication and we proposed an interaction analysis methodology based on natural language processing techniques using a pragma-linguistics grid to identify language elements that highlight the clues of the manifestation of the competence in computer mediated communications. We chose pragma-linguistics instead of statistical analysis based on text and data mining techniques that are insufficient for an accurate detection of competence.

In this paper, we firstly present different definitions of competence, its characteristics and dimensions. We then report the interaction analysis works and we describe the approach we have developed. Finally, we discuss the results obtained from the application of our approach on a specific corpus.

## 2. Competences

The concept of competence is multidimensional and polysemic because its definition is not consensual [7]. It is also hegemonic and ambiguous due to its widespread use in several domains of human activity, making its meaning plural and problematic [8]. Furthermore, the meaning of the concept of competence depends on the variety of study contexts and uses. Its consensual use refers to its apparent obviousness and to the shifts in meaning, logic and underlying issues that characterize it as stated in [9]. The notion of competence replaces and engulfs the adjacent notions of know-how, behavior and qualification [10]. The relevance of the notion of competence has been an issue

both in the cognitive sciences and in didactics where the concept of knowledge has been broadened in the hope of describing the action without having to refer to other concepts, such as competence [11].

### 2.1. Definition of competence

In [12], the author studied competence from the organizations management point of view and proposed, borrowing from research on education, a three-dimensional representation of competence as illustrated in Figure 1. The three dimensions refer to i) knowledge (data, information, knowing who, what and why, etc), ii) practices (know-how, encompassing techniques, technologies and tricks) and iii) attitudes (behaviors, motivations, identity, etc).

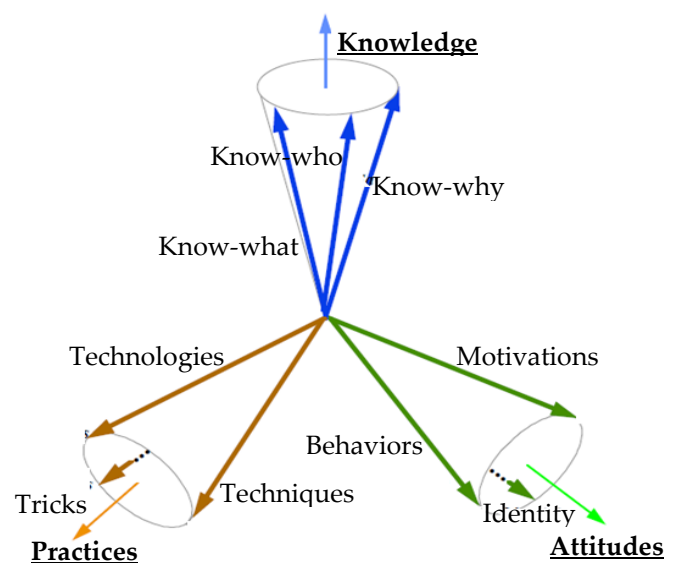


Figure 1: Competence components [12]

Five components of competence are identified in [13], namely, i) motivations, representing the stimuli of action, ii) traits, which are physical characteristics and coherent responses to situations, iii) attitudes and values of the individual, iv) knowledge, referring to the information possessed in a specific area, and v) skill reflected by the ability to perform certain tasks. In [14], the author considers the competence as a process which corresponds to the mobilization, in action, of a certain number of knowledge combined in a specific way. For him, competence is a combination of five components, (i) cognitive (knowledge and skills acquired during trainings), (ii) affective (self-image, investment and motivation), (iii) social (recognition), (iv) cultural (culture of the organization) and (v) praxeological (measurement of performance).

For the authors of [15] “the competence is the effect of combining and putting into play one’s own resources (knowledge, know-how and behavior) in a given context to achieve a goal or fulfill a specified mission”. This vision is close to that presented in [16] where the author considers the competency as “based on the relationship

between specific knowledge in a given domain and generic skills, with certain level of performance". In [17], the authors stated that "competence is the mobilization and dynamic organization of a set of heterogeneous cognitive resources that leads to product an acknowledged performance in the framework of a finalized activity and a particular class of situations".

In [18], the author focused on the most used competences in industrial firms and stated that "being competent requires to combine, in a relevant way, personal resources (knowledge and know-how) and environment resources (technological, material, etc.) in order to manage varied professional situations to achieve an objective and provide deliverables (tangible or intangible) to a recipient (customers, service, etc.) that help to evaluate actions' performance". The authors of [19] and [20] share the same vision and argue that "competence is the ability of a person (actor) to act and react with the relevance required to perform an activity in a work situation".

Based on an organizational approach, the competence is linked to actors' role for the author of [21]. Following the author of [22], he considers that "the competence is the ability for a person to apply his knowledge and improve his know-how in a professional situation". Thus, depending on different analysis visions, several components of the competence are to be considered.

Competence is "The combination and implementation of knowledge, know-how and know to behave to achieve a recognized performance, in relation to a given environment and as part of a finalized activity" [23], where (i) knowledge designates the mastery of varied concepts linked to a given activity domain like protocols, procedures, and standards. (ii) Know-how indicates the efficiency in executing tasks in a specific field of activity and (iii) know to behave reveals the aptitude to work on a variety of situations. Our approach is centered on detecting the manifestation of one or all of these three components.

2.2. Characterization of competence

The competence can be identified by three viewpoints; Organizational, Industrial and Individual, as depicted in Figure 2 [23].

The use of the concept of competence in human resources management derived from the reflection on the management of resources is based on the work of cognitive ergonomics [24] and its characteristics are repeated identically in [25] as shown in table 1.

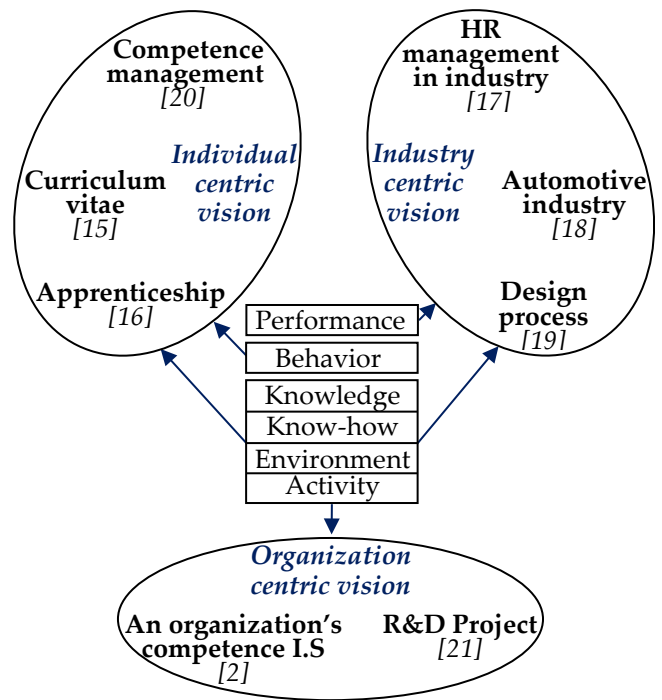


Figure 2: Different visions of the competence components use [23]

Table 1: Characteristics of competence [25]

| Characteristics | Implication   |
|-----------------|---|
| Individual      | It is possible to focus interest on the person competence independently of the organizational [26].   |
| Heterogeneous   | The competence is a combination of knowledge, technical know-how, behaviors, attitudes, interpersonal skills, etc. [27]. It combines diverse resources to surpass their mere possession [28].   |
| Contextualized  | Competence is inseparable from the activity through which it manifests itself [29] [30]   |
| Dynamic         | The competence is constantly developed, enriched and improved to adapt to the changing situation without departing from its associated category, in which case a new competence may emerge [28] |
| Objectified     | Based on competency frameworks which are considered to provide an objective definition of work [31]   |

In the proposed work, individual, heterogeneous, and contextualized characteristics are focused. This choice is motivated by our hypothesis stating that interacting individuals emphasize the components of their own functional competencies according to the activity they carry out and its context.

Indeed, in our approach, competence encompasses three components, namely knowledge, know-to-behave and know-how, that are intrinsic to the individual and inseparable since put together they constitute the competence.

### 3. Interactions

Traditional vision of communication is based on the mathematical theory of communication proposed in [32], where communication is perceived as the propagation of a message from a source which encodes and sends it, as a signal, to a destination which decodes and interprets it. This vision implies that communication takes place in only one direction at a certain time. Since the 1960s, communication theory has evolved from a linear vision, centered solely on the transmission of messages, towards an interactional and contextualized one [33].

#### 3.1. Pragmatic in interactions

Pragmatic researchers study interactions to determine the logics that underlie them [34]. Indeed, the related works to the analysis of communication, as an interactional phenomenon, has not been limited to aspects of the efficiency and precision of transmission and reception, such as those carried out in [32] but they include syntactic, semantic and pragmatic aspects [35], where (i) Syntax covers information transmission issues such as coding, transmission channels, redundancy and other statistical properties of the language; (ii) Semantics deals with the problem of meaning, insofar as the symbols have no meaning if the sender and the receiver do not agree beforehand on their meaning, which supposes a semantic convention; (iii) Pragmatic is concerned with the consequences of the execution of the utterance or its interpretation by the speakers, since communication affects behavior.

According to the authors of [36], it is necessary to specify the intended meaning of the messages exchanged. In [37], the author stated that the intention is underpinned by illocutionary acts and for the author of [38], every speech act is illocutionary and corresponds to one of the following five classes of acts : (i) commissive, where the speaker promises to perform an action; (ii) directive, when the sender expects his interlocutor to carry out an action ; (iii) representative, where the speaker commits to the truthfulness of the message; (iv) expressive, in which the speaker communicates an emotional status; (v) declarative when the speaker's message causes an alteration in the status of the referenced object such as the pronouncement of a judgment. Table 2 presents a sample of Searle's classification of illocutionary acts [39].

Table 2: Sample of illocutionary acts classification [39]

| Class          | Speech acts  |
|----------------|--|
| Commissive     | to affirm, to deny, to postulate, to remark, etc.                |
| Directive      | to order, to advise, to forgive, to request, etc                 |
| Representative | to promise, to invite, to guarantee, to bet, to make a vow, etc. |
| Expressive     | to thank, to apologize, to congratulate, to criticize, etc       |
| Declarative    | to decree, to condemn, to acquit, to baptize, etc                |

#### 3.2. Interactions analysis

Our review of the literature is based on interaction analysis especially on emails, discussion forums and chats.

In their works related to knowledge identification from professional e-mails in problem solving context [40], the authors used the speech act theory and the act of request by linking interaction analysis to problem context restitution. In [41], the authors have used the pragmatic to detect criteria that facilitate the analysis of coordination messages during the project design stage. By referring to computer mediated communications, presented in [42], the authors used a pragmatic and action-oriented approach to digital discourse. They demonstrated that the communication medium can modify the construction of speech acts. They thus described and proposed approaches for constructing queries.

To find experts and their contact details in email exchanges, the authors of [43] proposed a message analysis methodology based on unsupervised learning. In [44], the authors developed an activity-centered automatic email classification approach, based on their observation that people are connected in groups around common activities and e-mails dealing with a given activity are often articulated around one or more subjects. Similarly, in [45], the authors focused on grouping e-mails into tasks by identifying relationships between them. To do this, they first measure the textual semantic similarities between the contents of the messages, and then they identify the links between them by exploiting the messages metadata. The results of these two steps are used in an iterative reinforcement process to refine the similarities and classify the emails by activity. Likewise, in [46], the authors focused on the analysis of illocutionary acts [38, 39], augmented with supervised learning techniques, within chat and email discussions to automatically find and classify tasks and detect commitments and their evolution from initiation to finalization or abandonment.

In [47], the authors used a text classification approach to identify “email speech acts”. Their analysis is based on Searle’s act classification [38] applied to multiple corpora in order to characterize a group of “email acts” that are used in the emails classification by means of machine learning techniques. For their part, the authors of [36] used the “n-grams” contained in e-mails to analyze computer mediated communications. They stated that the analysis of communication is biased if only simple words are used as features and the textual context is neglected because the latter represents a very essential linguistic aspect. To illustrate their statement, they made a comparison between the set of words “would”, “you”, “give” and “me” analyzed separately and the entire phrase “would you give me” that is more likely to describe a request.

#### 4. Competency detection method

Our objective is to detect competencies from mediated interactions. The pragma-linguistic approach, illustrated in figure 3, that we developed is based on Searle’s illocutionary acts classification [38, 39]. It aims to identify the communicative intentions as well as the components of the competence mobilized by the actors in their interactions. It follows these steps:

- We select an interaction in a corpus of mediated communication and submit it to our pragma-linguistic analysis grids to identify the interlocutors’ intention.
- By analyzing the intention of the interlocutors, we seek in the content of the interaction for the part which would contain a mutual aid activity which, according to our hypothesis, is the part which is supposed to provide clues of manifestation of the competence.
- We then focus the analysis on the portion of the interaction where the manifestation of competence is detected to spot the verbs and words used by the interlocutors and the class of the speech acts used to deduce the interlocutors’ intention and find who would be the holder of the competence.
- We finally use the action verbs and abilities’ taxonomy and the activity domains’ glossary to identify the interlocutor’s know-how, his behavior and his field of competence.

##### 4.1. E-DISCO taxonomy

To develop our taxonomy of competence, we carried out a comparative study of three main systems providing taxonomies of skills and competences, which are the “European dictionary of skills and competences” (E-DISCO), the “Occupational information network” of the US labour department” (O\*NET) and the Swedish “Taxonomy-DB”. The results of this comparison are summarized in Table 3 [48].

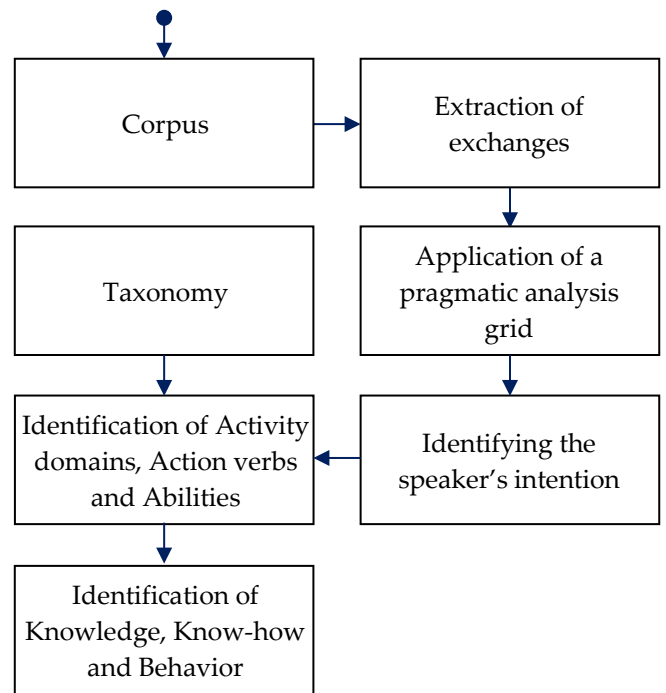


Figure 3: Methodology of competence detection

Table 3: Strengths and weaknesses of competence taxonomies [48]

| Taxonomy    | Strengths  | Weaknesses   |
|-------------|--|--|
| E-DISCO     | Available in 14 languages. Similarities with the language of the job market. Easy definitions of concepts. | Some descriptors are considered as “competences & skills”, even if they are not.                     |
| O*NET       | Easy understanding of competences and skills.  | Technical rather than common terms. Only available in US   |
| DB-Taxonomy | Available in 20 languages. Used for labour market correspondence.  | Blurred border between skills and occupations. Lack of terms explanation. Elementary classification. |

In our approach, we use E-DISCO taxonomy since it is multilingual and compatible with many other nationally recognized compilations such as the French “Operational directory of professions and jobs”, the Swedish “Taxonomy-DB”, the German “Competences catalogue” and Austrian “AMS-Qualification classification” [48]. Its hierarchal structure provides us with a wide-ranging dictionary of skills, abilities and action verbs and it encompasses twenty-five main activity fields, broken down into multiple sub-fields. We present in Table 4 a sample of action verbs from E-DISCO. Table 5 illustrates

the four classes of skills and abilities; personal, physical, cognitive and managerial skills.

Table 4: Sample of action verbs from "E-DISCO" [48]

| Action verbs   |
|--|
| Apply / Assemble / Blend / Calculate / Collect / Create / Disconnect / Disassemble / Dismantle / Display / Draw / Drill / Examine / Exchange / Extract / Find / Fix / Follow / Glue / Identify / Implement / Install / Master / Modify / Measure / Mix / Monitor / Negotiate / Order / Organize / Operate / Prepare / Rectify / Renovate / Repair / Restore / Represent / Select / Store / Solve / Update / Take [ . . ] |

Table 5: Sample of skills and abilities from "E-DISCO" [48]

| Skills and Abilities                           |   |
|--|---|
| Personal skills and abilities                  | Ability to work in a team / Capability to support pressure / Assertiveness / Discretion / Reliability / Carefulness / Politeness / [ . . ]                        |
| Physical attributes and abilities              | Agility / Dexterity / Physical strength / Absence of perception problems and allergies / Stamina / Sense of balance / Responsiveness [ . . ]                      |
| Problem solving abilities and cognitive skills | Concentration and learning abilities / Inventiveness / Analytical mind / Intellectual curiosity / Application of regulations and laws [ . . ]                     |
| Managerial / organizational skills             | Decision-making / Coordination and organizational abilities / Multitasking capabilities / Management techniques / Operative planning / Supervision skills [ . . ] |

4.2. General architecture of the proposed system

To concretize our approach we proposed a system whose general architecture is illustrated in Figure 4. It's based on two algorithms that we developed and implemented using the object-oriented programming language Python. The first algorithm aims to detect the competence manifestation assumption while the second one analyzes the competence manifestation in depth to bring more information such as the competence holder, his how-know, his abilities and his competence domain.

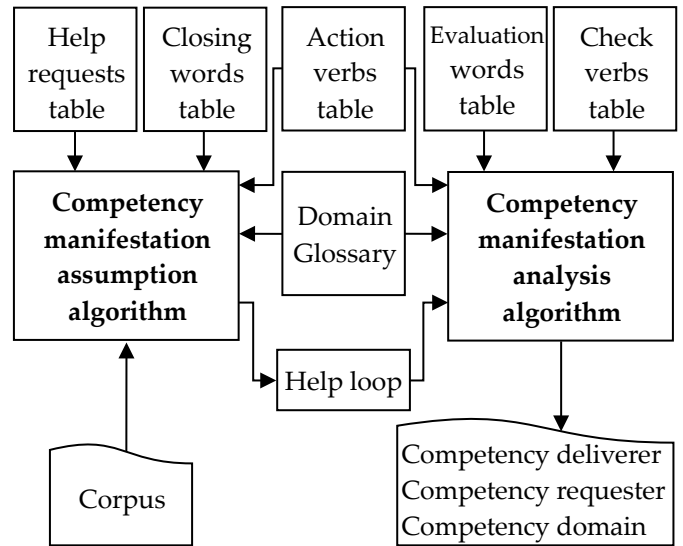


Figure 4: General architecture of the proposed system

4.3. Competency manifestation assumption algorithm

In the aim of detecting the manifestation of competence, we presume that individuals involved in a cooperative activity make proposals, share arguments and seek for explanations through questions and answers in order to make a decision or resolve a problem. We also presume that the competence manifestation is to be found in the part of the interaction between the expression of a request and the end of the response to this request. Moreover, we consider that once the interlocutor, who needs a competence, gets help, he will express an acknowledgment to the person who provided him with the required competence.

The usual expression used to ask for competence is the "help" request. We assume that if such a request exists within an interaction, it implies that there is a potential manifestation of competence that can be selected for further analysis. A request as stated above belongs to the class of directive speech acts where the speaker intends the receiver to perform an action [38]. We make a distinction between direct and indirect requests. Table 6 illustrates these types and gives a variety of expressions using the verb "help" [23].

Table 6: Help request grid [23]

| Request        | Linguistic form         | Examples with Help                            |
|----------------|-------------------------|---|
| Direct request | Performative            | I am asking you to help me.                   |
|                | Imperative              | You have to help me.<br>Help me.              |
|                | Need / Want statements. | I want (need) you to help me.<br>I need help. |

|                  |   |   |
|------------------|---|---|
|                  | Obligation statements   | You have to (must) help me.                   |
| Indirect request | Question about the listener's willingness to perform an action. | Would you like to help me?                    |
|                  | Question about the listener's ability to perform an action.     | Could you help me?<br>Can you help me?        |
|                  | Statement about the speaker's will.                             | I would like (appreciate) if you can help me. |

|                                     |
|-------------------------------------|
| Thank you ever so much for          |
| Thank you very much for             |
| I am really most grateful for your  |
| I am very grateful for your         |
| It was terribly good of you to have |
| I appreciate your help              |
| I am thankful for your help         |
| Thanx                               |
| Thankyou                            |

The algorithm we developed for the competency manifestation assumption is the following:

---

**Algorithm 1: Competency manifestation assumption**


---

```

Result: manifestation of competence
Select an interaction between two interlocutors;
Search for help requests terms for each interlocutor;
Find the words of the associated domain Glossary;
Search interaction closing words;
Search other forms of questions;
Find the words of the associated domain Glossary;
Find answers to questions by interlocutor;
Find action verbs;
Find the forms of speech acts "directive / informative;
Find other forms of speech acts "evaluation ;
Find words in the associated Glossary;
if help requests and closing words exist then
    | A potential competence requester exist;
end
if directive or evaluation forms exist then
    | A potential competence deliverer exist;
end
If words match a domain glossary then
    | A potential competence in the domain exist;
end
If action verbs exist then
    | A competence exists in the associated domain;
end
    
```

---

We use the Table 6 above as an input for the competency manifestation assumption algorithm. However, before being satisfied the interlocutors will exchange to precise the needs and to get more explanation about the subject. We assume that during this exchange they use words that belong to the domain of activity related to the issue they are dealing with. These words are selected and compared to the domain glossary and if they match a specific domain with sufficient proportion, it will be considered as the activity domain. This step is important because as we stated before there is no competence if the context does not exist.

After having obtained satisfaction or not, the interlocutor who asked for help generally thanks the one who guided him. We therefore consider the detection of a "thanks" word as being synonymous with the end of a help sequence. However, other words can signal the closing of a help sequence. We assembled the closing words in Table 7.

The aim expected from the competency manifestation assumption algorithm is to delimit the part of the interaction where the manifestation of competence is found. This part is isolated to be the input for the competence manifestation analysis.

Table 7: Closing words table [23]

| Closing words       |
|---------------------|
| Ta                  |
| Thanks              |
| Thanks a lot        |
| Thank you very much |
| Thank you           |
| Thank you so much   |
| Thank you for       |

#### 4.4. Competency manifestation analysis algorithm

After detecting a potential manifestation of competence within a portion of an interaction, we perform a more depth analyse of this isolated part to detect who is the owner of the competence, his domain of knowledge and his know-how. To do this we rely on the supposition that the competent person will help the applicant by asking him to perform certain actions. He will then use action verbs (Table 5) in a directive form according to sealers classification (Table 2). For example, he can make suggestions in the form of instructions to follow, identify and name the problem to be solved, make a diagnosis by describing the situation or explaining the approach or solution adopted. Besides giving instructions to guide the

requester, as things progress, the competence holder will tend to control and evaluate the actions performed then he will ask to perform checking on the one hand and on the other he will assess the results of the actions by using evaluation words (evaluative act). To do this we selected from the action verbs taxonomy those generally used to perform checks (Table 8) and we constituted a bag of words that express evaluations (Table 9).

Table 8: Check verbs [23]

| Check verbs                                 |
|---|
| Try / check / see / look / verify/ control. |

Table 9: Evaluation words [23]

| Evaluation words  |
|---|
| Good / great / right / Fine / Wonderful / Super / Nice / Success / It's working / It works / It worked. |

During the part of the interaction containing the assumption of competence manifestation, the competence holder will use words in relation with his competence domain and verbs that express his know-how and how to behave. For this is, we use the domain glossary and action verbs taxonomy. The input of the competency manifestation analysis algorithm is the help-loop previously isolated and the output expected is the competent interlocutor, his how-know and his competence domain. Moreover, an annotated text file is delivered. It contains the portion of interaction represented by the help-loop with highlighted words, action verbs and check verbs and their corresponding class in Searls' speech acts classification. Based on the above, we have proposed the competency manifestation analysis algorithm as follows.

---

**Algorithm 2: Competency manifestation analysis**


---

```

Result: Competency requester, Competency deliverer,
Competency domain
For each help request;
Determine interlocutor;
Set interlocutor_1= interlocutor;
Find in the thread of interaction the first next apparition
of closing words;
Determine the interlocutor;
Set interlocutor_2= interlocutor;
if interlocutor_1 = interlocutor_2 then
    Set help requester = interlocutor_1;
    Set help deliverer = the interlocutor who answer
    interlocutor_1;
    
```

```

Set Help-loop = the part of interaction between
the help request and the closure of help;
Isolate the Help-loop;
Count the number of directive and evaluation
answers for each interlocutor;
Set A = the number of directive and evaluation
answers of the Help deliverer;
Set B = the number of directive and evaluation
answers of the Help requester;
Detect action verbs and words used within answers;
if A > B then
    Set Competency requester = Help requester;
    Set Competency deliverer = Help deliverer ;
    Set Competency domain = domain Glossary
    related to words ;
else
    Exit Help-loop ;
end
    
```

end

Find the next help request within the interaction;

---

## 5. Results

To apply our approach, we used the Ubuntu corpus, which is made up of more than seven million statements exchanged within an interest-based community around the Ubuntu operating system technical issues. We chose this corpus because the communities of interest are characterized by the absence of hierarchy, roles, signatures and identity elements that could explicitly indicate the competences of its members. All of this renders the identification of competence difficult without operating a detailed and in depth analysis of the interaction.

### 5.1. First application

Our competency manifestation assumption algorithm has been applied to a selection of nearly 400 exchanges involving two participants in an interaction. The result obtained consists of 6 help-loops, one of which is presented in Table 10.

Table 10: Help loop extracted from an interaction between "Kartagis" (A) and "Ikonia" (B)

|   | Message   | Speech acts  |
|---|---|--------------|
| A | Can you help me with my <u>problem</u> ?<br><u>Ubuntu</u> dims the <u>display</u> every time.<br>I start a <u>GUI program</u> with dare<br><u>background</u> , like <u>terminal</u> | help request |
| B | are the <u>video cards</u> different  | request      |
| A | It could be, I'm not sure. can't <u>check</u><br>now because the one at work is off   | Check        |
| B | Worth checking,   | informative  |
| A | and if they are?  | informative  |
| B | well, that is where I'd <u>start</u><br>investigating   | commissive   |
| A | What <u>codecs</u> can I <u>install</u> here?   | request      |



|   |  |                 |
|---|--|-----------------|
| B | is that the one that's working (I bet not)   | request         |
| A | that's the one failing   |                 |
| B | SIS <u>videocard</u> , terrible, lots of <u>problems</u> . Not surprised it's failing <u>grep \$ username/etc/passwd</u> and let's <u>see</u> the result (it contains no <u>password information</u> ) | informative     |
| A | vetibbc.com: x: 1000: 100: BBC Vetereiner Klingi,: /srv/ www/vetibbc.com: bin/bash   | informative     |
| B | ok, so that's all. <u>Look</u> at the <u>permissions</u> on the <u>home-dir</u> as I suspect that's the <u>issue</u> . <u>Set</u> spot on,   | directive chek  |
| A | 600, maybe that i's why?   |                 |
| B | is the <u>user</u> the <u>owner</u> ? and <u>look</u> at the <u>permissions</u> on /sry and srv/www as the <u>user</u> needs to be able to get into them to see his home dir                           | directive check |
| A | Yes  |                 |
| B | if you su - \$ <u>user</u> can you then <u>put cd</u> into the <u>home-dir</u> ?   | directive       |
| A | <u>permission</u> denied   | informative     |
| B | we have a <u>winner</u> !  |                 |
| A | http://pastebin .com/QbNcKSrE  | informative     |
| B | ls -la /srv/www  |                 |
| A | drwx----- 3 vetbbc.com <u>users</u> 4096 Sep 28 23:57 vetbbc.com   |                 |
| B | No, can you <u>run "id"</u> on the <u>user</u> vetibbc.com. 600 is a good <u>permission</u>  | directive       |
| A | uid. =.1000 (vetbbc.com) gid. =.100 (users) <u>groups=100(users)</u>   |                 |
| B | that should be <u>fine</u> . can the user get into /sry ?  | evaluation      |
| A | yes, and / srv/ www too. 700 <u>fixed</u> it though  |                 |
| B | Why do you need <u>write-access</u> ? most odd glad your <u>fixed</u>  | informative     |
| A | <u>Thanks</u> .  | Cloture         |

The present help-loop begins with a help request "can you help me" and ends with "thanks" (in green). It contains requests, action verbs (in blue), check verbs (in red) and terms (underlined) that belongs to the glossary of information technology (IT). All these elements suggest a manifestation of competence that we analyzed by applying the competency manifestation analysis algorithm. We got the results shown in Table 11.

Table 11: Results of the application of the competency manifestation analysis on a thread of discussion between "Kartagis" and "Ikonia"

|                     |    | interlocutors |        |
|---------------------|----|---------------|--------|
|                     |    | Kartagis      | Ikonia |
| Number of exchanges | 27 | 14            | 13     |
| Help requests       | 1  | 1             | 0      |

|                            |  |   |   |
|----------------------------|--|---|---|
| Cloture terms              | 1  | 1 | 0 |
| Requests                   | 3  | 1 | 2 |
| Directives                 | 4  | 0 | 4 |
| Directive with check verbs | 2  | 0 | 2 |
| commisive                  | 1  | 0 | 1 |
| Commisive with check verbs | 1  | 1 | 0 |
| Informative acts           | 7  | 4 | 3 |
| Evaluation acts            | 1  | 0 | 1 |
| Competency requester       | Kartagis   |   |   |
| Competency deliver         | Ikonia   |   |   |
| IT domains associated :    | Software terms: 75%<br>Computer security: 10%<br>Apple terms: 5% |   |   |

These the results show that the help-request and the cloture term (Thanks) are exclusively formulated by "Kartagis", thus, we consider him as the competency requester. All directive acts are expressed by "Ikonia", therefore, he is the competency-deliverer. These results show, as we stated in our hypothesis, that the competency-deliverer formulates language acts attesting to his competence like orders by asking his interlocutor to perform some actions (ie. "set spot on"), or propositions by reformulating the expressions of his correspondent to make a diagnosis (ie. "Not surprised...it contains no password..."), by detailing the tasks to be executed in order to tackle an issue (ie. "If you....then put cd.."), or by assessing the actions carried out (ie. "that should be fine").

## 5.2. Second application

To reinforce the results obtained in the first application of our approach we selected another interaction where the interlocutor "Ikonia" who was declared competent is involved. The help loop obtained after the application of the competency manifestation assumption algorithm is presented in Table 12 bellow. Due to the duration (length) of the interaction, we only selected the top and the end of the help loop.

Table 12: Help loop extracted by applying the competency manifestation isolation algorithm on an interaction between Roasted (A) and Ikonia (B)

|   | Interaction  | Speech act      |
|---|--|-----------------|
| A | <u>Appreciate the help</u> .   | help request    |
| B | arp will show you the <u>mac</u> 's currently connected  | Information     |
| A | meaning it'll show me the <u>MAC</u> of the wireless adapter in my laptop - not the actual access point? | Request         |
| B | <u>try</u> it with a different user account, <u>see</u> if it's your personal settings or a <u>bug</u>   | Directive check |
| A | I'm almost positive it's a personal <u>setting</u> in the  | Informative     |

|     |   |                 |
|-----|---|-----------------|
|     | .thunderbird <b>directory</b> that KDE's existence changed.   |                 |
| B   | ok, well <b>finding</b> out for certain if it's a personal settings thing is the way to go  | Informative     |
| ... | ...   | ...             |
| A   | I've had this happen before, so I'm pretty certain that's what it is.   | Commissive      |
| B   | then <b>fix</b> it how you <b>fixed</b> it before instead of asking for help  | Directive       |
| A   | if I knew how to <b>fix</b> it, I would have <b>fixed</b> it instead of asking.   | Information     |
| B   | if you want help - <b>follow</b> the advice to get the information spot on to get help, if you know the problem then <b>work</b> out how to <b>fix</b> it | Informative     |
| B   | <b>check</b> for certain with a different user  | Directive Check |
| A   | I'll continue asking for help since I am unsure of how to fix it.   | Commissive      |
| B   | please don't be so rude as to post links to it when I've just ( we don't deal with unsupported packages in here   | Directive       |
| A   | I got it <b>fixed</b> . <b>thanks</b> anyway.   | Cloture         |

In order to analyze this isolated part of the interaction, we submitted it to the competency manifestation analysis algorithm and obtained the results presented in Table 13.

Table 13: Results of the application of the competency manifestation analysis on a thread of discussion between Roasted (A) and Ikonja (B)

|                             |     | Interlocutors |     |
|-----------------------------|-----|---------------|-----|
|                             |     | A             | B   |
| Number of exchanges         | 240 | 140           | 100 |
| Help request                | 1   | 1             | 0   |
| Cloture terms               | 3   | 3             | 0   |
| Requests                    | 28  | 23            | 5   |
| Directives                  | 22  | 7             | 15  |
| Directive with check verbs  | 8   | 0             | 8   |
| Commissive                  | 25  | 22            | 3   |
| Commissive with check verbs | 3   | 2             | 1   |
| Informative acts            | 150 | 82            | 68  |
| Evaluation acts             | 0   | 0             | 0   |

|                       |   |
|-----------------------|---|
| Competency requester  | Roasted   |
| Competency deliver    | Ikonja  |
| IT domains associated | Software terms: 40.2%<br>Business terms: 35.4%<br>Computer security: 3.9% |

This table shows that the help request sentence (Appreciate the help) and the closing words (Thank you) are expressed by the same speaker "A" who also formulated the majority (24/28) of commissive acts, so he is the requester of competency according to our hypothesis. Moreover, the majority (23/30) of the directive acts are formulated by the speaker "B" who is consequently the competency-deliverer. Through these results we notice that the deliverer of competence performs language acts to guide his interlocutor in order to help him in performing tasks (ie. "fix it") or to control his activities by directives with "check verbs" (ie. "try it with ..., see if it's your personal settings or a bug ") or to lead him to explore different paths of a process (ie. "if you want help - follow the advice ..., if you know the problem then ..."). The results gave the interlocutor named "Ikonja" as the holder of competence in software domain. These results were confirmed by an expert who analyzed the interaction.

## 6. Discussion

The results obtained by applying our method on two different interactions in which we kept one of the interlocutors unchanged showed that the latter had competence in both cases and in the same field. These results, which are confirmed by an IT expert, show that the method we proposed enables us to detect a potential manifestation of competence and to discover the competent and his field of competence. Moreover, the file obtained is annotated and makes it easy to identify the action verbs, the glossary words used and the classification of the speech acts contained in the interaction. This deliverable can be used as needed by an expert for a possible in-depth analysis. Indeed, unlike CV analysis methods, where the skills are declared by the author of the CV, our method detects the acts and the words then link them to a glossary.

## 7. Conclusion

In this work, we started by studying the notion of competence to adopt its definition and determine its components. We then presented the notion of interaction and elements of pragma-linguistics and led a literature review on related works on the interaction analysis. The approach we proposed in response to our hypothesis was then presented. It consists of a methodology to detect and analyze competencies in the interactions. We used pragma-linguistic concepts applied to computer-mediated communication to determine the intention of participants

in an interaction in order to detect a potential manifestation of competence and then analyze it. Two algorithms have been developed for this purpose and implemented. We applied them to interactions from the Ubuntu corpus. The application made it possible to detect the manifestation of the competence, the interlocutor who is competent and his competence field. To confirm the obtained results, we applied our method on two distinct interactions where one of the interlocutors is involved in both. For the two interactions the results gave this same interlocutor as competent and in the same field. These interactions are also analyzed by an IT expert who confirmed the results. The limit of our approach lies in the type of the interaction we selected. Indeed in our work we focused on a specialized discussion corpus, which limits the topics of discussion, whereas if the corpus deals with several topics it would be considered essential to enrich our methodology with new algorithms. Moreover, our work could be extended to analyze "soft competencies" such as attitudes which remain difficult to detect.

### Conflict of Interest

The authors declare no conflict of interest.

### Acknowledgment

Authors would like to thank all the members of Tech-CICO research group/LIST3N (Computer Science and Digital Society Laboratory) of the University of Technology of Troyes that made this research and development possible.

### References

- [1] M. Tremblay, B. Sire, *Rémunérer les compétences plutôt que l'activité?*. Revue française de gestion, (126), pp. 129-139 (1999).
- [2] G. Berio, M. Harzallah, "De l'ingénierie des connaissances à la gestion des compétences." *IC-16èmes Journées francophones d'Ingénierie des Connaissances*. Presses universitaires de Grenoble, 2005.
- [3] R. Lindgren, S. Dick, J. Ljungberg, "Rethinking competence systems for knowledge-based organizations." *European Journal of Information Systems*, vol. 12, no 1, p. 18, 2003, doi: 10.1057/palgrave.ejis.3000442.
- [4] I. Becerra-Fernandez, J. Rodriguez, "Web Data Mining Techniques for Expertise-Locator Knowledge Management Systems". In : *FLAIRS Conference*, pp. 280-285, 2001.
- [5] A. Garro, L. Palopoli, F. Ricca, "Exploiting agents in e-learning and skills management context". *Ai Communications*, vol. 19, no 2, pp. 137-154, 2006.
- [6] M. Grundstein. "From capitalizing on company knowledge to knowledge management", *Knowledge management, classic and contemporary works*, vol. 12, pp. 261-287, 2000, doi:10.7551/mitpress/4075.003.0022.
- [7] M. J. Sá, S. SERPA, "Transversal competences: Their importance and learning processes by higher education student". *Education Sciences*, vol. 8, no 3, pp. 126, 2018, doi:10.3390/educsci803012.
- [8] T. PIOT, "La construction des compétences pour enseigner". *McGill Journal of Education/Revue des sciences de l'éducation de McGill*, vol. 43, no 2, pp. 95-110, 2008, doi:10.7202/019577ar.
- [9] F. Ropé, *Savoirs et compétences*, L'Harmattan, 1994.
- [10] C. Dubar, *La Crise des identités, l'interprétation d'une mutation*. Puf, Paris, 2001, doi:10.4000/osp.5231.
- [11] P. Perrenoud, *Construire des compétences dès l'école*. ESF Sciences Humaines, 2018.
- [12] T. Durand, "L'alchimie de la compétence", *Revue française de gestion*, vol. 41, no 253, pp. 267-295, 2015, doi:10.3166/RFG.160.261-292.
- [13] L. M. Spencer, P.S.M. Spencer, *Competence at Work models for superior performance*. John Wiley & Sons, 2008.
- [14] R. Wittorski, De la fabrication des compétences. "Éducation permanente", vol. 135, pp. 57-69, 1998.
- [15] M. Harzallah, M. Leclère, F. Trichet, "CommOnCV: modeling the competencies underlying a Curriculum Vitae". In *Proceedings of the 14th international conference on Software Engineering and Knowledge Engineering*, pp. 65-71, 2002, doi:10.1145/568760.568773.
- [16] G. Paquette, "An ontology and a software framework for competency modeling and management". *Journal of Educational Technology & Society*, vol 10, no 3, pp. 1-21, 2007.
- [17] E. Bonjour, M. Dulmet, F. Lhote, "An internal modeling of competency, based on a systemic approach, with socio-technical systems management in view". In *Proc. of IEEE International Conference on Systems, Man and Cybernetics SMC*. pp.6-9 2002, doi:10.1109/ICSMC.2002.1173302.
- [18] W. Triaa, "Gestion agile de processus métier: proposition d'une approche tirée par les compétences", (Ph. D Thesis, University of grenoble alpes, France, 2018), NNT:2018GREAI065. tel-01968687.
- [19] F. Belkadi, "Contribution au pilotage des compétences dans les activités de conception : de la modélisation des situations à la caractérisation des compétences", (Ph. D Thesis, University of Franche-Compté, France, 2006).
- [20] A. Boumane, A. Talbi, A. Tahon, D. Bouami, "Contribution à la modélisation de la compétence". In *MOSIM Conference*, 2006.
- [21] D. Monticolo, "Une approche organisationnelle pour la conception d'un système de gestion des connaissances fondé sur le paradigme agent". (Ph. D Thesis, University of Belfort-Montbeliard, France, 2008).
- [22] G. Le Boterf, *Construire les compétences individuelles et collectives: Le modèle: agir avec compétence en situation*, Eyrolles 2013.
- [23] H. Merzouki, N. Matta, H. Atifi. "How to identify competence from interactions". *The 15th International Conference on Signal Image Technology & Internet based Systems, 2019*, doi:10.1109/SITIS.2019.00101.
- [24] C.K. Prahalad, G. Hamel, "The core competence of the corporation". In: *Strategische Unternehmensplanung/ Strategische Unternehmensführung*. Physica, Heidelberg, pp. 969-987, 1997, doi: 10.1007/978-3-662-41482-8\_46.
- [25] E. Oiry, Qualification et compétence: deux sœurs jumelles? *Revue française de gestion*, no 5, pp. 13-34, 2005, doi:10.3166/rfg.158.13-34.
- [26] M. Parlier, *La compétence au service d'objectifs de gestion. La compétence. Mythe, construction ou réalité*, L'Harmattan, Paris, pp. 94-108, 1994.
- [27] S. Bellier, *Le savoir-être dans l'entreprise*, Vuibert, Paris, 1999.
- [28] F. Belkadi, E. Bonjour, M. Dulmet, "Competency characterisation by means of work situation modelling". *Computers in industry*, vol. 58, no 2, pp. 164-178, 2007, doi: 10.1016/j.compind.2006.09.005.
- [29] G. Le Boterf, *De la Compétence. Essai sur un attracteur étrange*, Les Éditions d'organisation, Paris, 1994.
- [30] J. Bernabé-Moreno, A. Tejada-Lorente, J. Herce-Zelaya, C. Porcel, E. Herrera-Viedma. "An automatic skills standardization method based on subject expert knowledge extraction and semantic matching". *Procedia Computer Science*, vol. 162, pp. 857-864, 2019, doi: 10.1016/j.procs.2019.12.060.
- [31] A. Wolf, "La mesure des compétences : l'expérience du Royaume-Uni", *Formation professionnelle-Revue européenne*, no 1, pp. 31-38, 1994.
- [32] C. E. Shannon, W. Weaver, *The mathematical theory of communication*. Illinois press, 1950, doi: 10.1063/1.3067010.
- [33] H. Atifi, *Communication, CMC and E-mail: A Brief Survey. Daily Knowledge Valuation in Organizations: Traceability and Capitalization*, John Wiley & Sons, pp. 123-151 2016, doi: 10.1002/9781119292142.ch6.
- [34] N. Matta, K. Sidoumou, G. Ninova, H. Atifi. "Modélisation d'une analyse pragma-linguistique d'un forum de discussion". *arXiv*

preprint arXiv: 1008.4310, 2010, doi:10.48550/arXiv.1008.4310.

- [35] P. Watzlawick, J. H. Beavin, D.D. Jackson, J. Morche, *Une logique de la communication*, Seuil, Paris, 1972.
- [36] V. R. Carvalho and W. Cohen. "Improving Email Speech Acts Analysis via N-gram Selection". *Carnegie Mellon University*, 2006, doi: 10.3115/1564535.1564541.
- [37] J. L. Austin, *How to do things with words*. Harvard University Press, Boston, MA 1975, doi: 10.1093/acprof:oso/9780198245537.001.0001.
- [38] J. R. Searle, "Meaning and speech acts". *The philosophical review*, vol. 71, no 4, pp. 423-432, 1962, doi: 10.2307/2183455.
- [39] J. R Searl, "A classification of illocutionary acts". *Language and Society* n 5, pp. 1-24, 1976, doi: 10.1017/S004740450006837.
- [40] F. Rauscher, N. Matta, H. Atifi, "KTR: an approach that supports Knowledge extraction from design interactions". *IFAC - PapersOn - Line*. 49 (12): 473-8, 2016, doi:10.1016/j.ifacol.2016.07.658.
- [41] N. Matta, H. Atifi, M. Sediri, M. Sagdal. "Analysis of interactions on coordination for design projects". In *Sixth International Conference on Signal-Image Technology and Internet Based Systems*, pp. 344-347. IEEE, 2010, doi:10.1109/SITIS.2010.62.
- [42] H. Atifi, M. Marcoccia, 2020, "Indirectness and effectiveness of requests in professional emails: A case study, in indirectness and effectiveness of requests in professional emails". *The Discourse of Indirectness: Cues, voices and functions*, vol. 316, p p. 145, 2020, doi: 10.1075/pbns.316.07ati.
- [43] K. Balog, M. De Rijke. "Finding Experts and their Details in Email Corpus". *Proceedings of the 15th international conference on World Wide Web*. 2006, doi:10.1145/1135777.1136002.
- [44] T. Dredze, N. Lau and N. Kushmerick. "Automatically classifying emails into activities". In *Proceedings of the 11th international conference on Intelligent user interfaces* pp. 70-77. ACM, 2006, doi: 10.1145/1111449.1111471.
- [45] R. Khossainov, N. Kushmerick. "Email task management: An iterative relational learning approach". *CEAS*, 2005.
- [46] A. Kalia, N. Motahari, C. Bartolini, M. Singh. "Identifying Business Tasks and Commitments from Email and Chat Conversations". In *HP Labs Technical Report*, 2013, doi:10.1.1.643.5660&rep=rep1&type=pdf.
- [47] W. Cohen, V. R. Carvalho, T. M. Mitchell. "Learning to Classify Email into Speech Acts". In *Proceedings of the Conference on Empirical Methods in NLP*, pp. 309-316, Barcelona, Spain, 2004.
- [48] J. Markowitsch, C. Plaimauer, "Descriptors for competence: towards an international standard classification for skills and competences". *Journal of European Industrial Training*, vol 33 n 8/9, pp. 817-837, 2009, doi: 10.1108/03090590910993652.

and workshops on COOP, ISCRAM, KMIS, IJCAI, ECAI, CTS conferences. She wrote several books on Knowledge Management. She is involved in scientific committees of several conferences, journals and research groups. She manages several projects on the application of Knowledge Management in several domains (consulting, design, safety, security). She completed her PhD in KE and AI at University of Paul Sabatier (France) in collaboration with ARTEMIS. She worked for 4 years at INRIA in projects with Airbus Industry and Dassault-Aviation. E-mail: nada.matta@utt.fr. <http://matta.tech-cico.fr/en>.

**Hassan Atifi** is Assistant Professor in Communication Studies at the Troyes University of Technology (France) and researcher in the Tech-CICO research group/LIST3N (Computer Science and Digital Society Laboratory). He has published several papers in the field of digital ethnography about different aspects of computer-mediated communication: Knowledge pragmatic extraction from professional e-mails, Maker's Tutorials, ordinary political discourse and online participatory communication.

**François Rauscher** has completed his PhD degree in knowledge management from the University of technology of Troyes in France.

**Copyright:** This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY-SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>).



**Hocine Merzouki**, Phd candidate at the University of Technology of Troyes in France. He has done his Master degree in Information system management at University of Pau and Pays de l'Adour (France) in 2011.



**Nada Matta**, Full Professor at the University of Technology of Troyes. She studies techniques in knowledge engineering and management specially to handle cooperative activities as product design, crisis management, etc. She is Director of department of "Human, Environment and ICT".

She assumed several responsibilities as: Director of department of "Human, Environment and ICT" for four years, Director of "Scientific group of supervision, and security of complex systems" for five years and Director of department of "Information Systems and Telecom" during two years. She is involved in the organization of several tutorials