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ORIGINAL RESEARCH

Competency Detection from Interactions Within Communities of Practice

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Abstract
The concept of competence generally refers to the knowledge, experiences, skills, attitudes, abilities and behavior that enable effective action in a work environment. Stakeholders interact together using currently social networks and communities support exchanges. Analyzing these interactions can help to identify expertise and skills. The hypothesis in our work is the use of communication analysis and pragmatics techniques from one side, competences studies and definition from another side to detect and emphasize technical competences in a community of practices. We present in this paper, our results towards a support of this hypothesis. Ubuntu community of practices is selected to test algorithms we develop for this aim.

Keywords Knowledge · Competence · Ability · Behavior · Interaction · Mediated communications exchanges · Competence detection

Introduction

The competence is differently approached in the literature according to disciplines (sociology, industry, psychology, management, etc.) [1–9]. It covers several aspects such as knowledge, experiences, skills, attitudes, abilities and behavior that are necessary to deal with particular problem-solving situations or to carry out effective actions in a work environment. Furthermore, the action is driven by the knowledge held by the individual or by the knowledge that results from the exchange, the combination and the sharing of the knowledge of people through interactions between them to perform complex tasks [10]. These knowledge exchanges can take place face to face or through documents, telephone conversations or social media.This is why the interaction content provides a favourable area for detecting and analyzing skills. In this context, communities of practice represent in our opinion an environment where skills can be emphasized during the treatment of a given problem. This led us to take an interest in interactions within these communities to detect and analyze skills. Our contribution via the approach we proposed is based on the analysis of interactions using natural language processing techniques to detect the manifestation of the competence and to analyze it. It is based on the detection of the implicit competence that emerges from the analysis of the context of the interaction. We have opted for pragma-linguistics that allows more in-depth analysis rather than statistical analysis using data mining or text-mining techniques which are not sufficient to detect skills.

In this paper, first communities of practice and competence's components are identified related to literature review. Then, the approach we developed is described linking mediated interactions analysis and competence's elements detection. Finally, the results of the application of our approach on a selected corpus are discussed.

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Communities of Practice

Definition

Community of practice is a concept first introduced in 1991 by Jean Lave and Etienne Wenger [11] who described it as a set of relationships between persons, activities and world as same as, relationships with other organizations based on common interests [12]. This concept stems from the interest for organizational development through the large concept of knowledge management [13]. A community of practice is generally defined as a group of people with a common area of expertise or professional practice, who meet to exchange, share and learn from each other, face-to-face or virtually [13]. It's also defined as a group with an informal structure, where the behavior of members is characterized by voluntary commitment to build and share knowledge in a given area [14]. Such a community can be considered as a coordination device allowing its members to improve their individual skills, through the exchange of a common directory of resources which are developed at the same time as the practice of the community is articulated [14]. Community members are usually linked by a common interest in a field of knowledge, a desire and a need to share experiences, models, tools and best practices [15].

Types of Communities of Practice

Communities of practice have often been related to work teams, but several elements distinguish them. Thus, communities usually do not have a specific result to deliver to the organization, unlike work teams [16]. Likewise, community members are related by knowledge that they share and develop together while those of a work team are linked by the specific objective sought (making a product, improving a process, etc.). Operationally, communities of practice rarely have a defined work plan, unlike work teams [16]. Once their objectives have been reached, the teams should normally disintegrate, whereas the communities of practice are created to last and continue to develop knowledge and skills over several years. In practice, however, the boundaries are much less clear between these two forms of organization [17].

Amin and Roberts [18] have identified four main types of communities: (i) craft, (ii) professional, (iii) expertise and creative communities, (iv) virtual communities. These communities differ totally in their communication and learning dynamics and they are present in numerous and varied contexts (Table 1).

Expertise communities are important for our analysis. The exchanges in this type of communities are related to specific subjects around its stakeholders discuss linked to their knowledge and competences. Interactions on these types of communities can be a good ground to test our hypothesis on the use of communication analysis as a support to identify skills and especially technical ones.

For instance, Ubuntu and Enron communities' exchanges illustrated (Tables 2, 3) reveal information about know-how of stakeholders. The Ubuntu corpus is a set of more than 1 million multi-turn dialogs supported by email, chat and forum where the interlocutors deal with the problems of the Ubuntu operating system used in software engineering [19].

Table 2 An extract from Ubuntu corpus

From	To	Text
A	B	, :S I thought that's what you were doing @.@ ok hang on … how did you start gparted? From the menu on the live cd or did you run the install?
B	A	I'm going to reboot again, but into my root partition and save my files to the ext hdd then start the process. Thanks for your help again. I had to install gparted from synaptic
A	B	On the live cd?
B	A	Yes, on the CD

Table 1 Types of communities of practice [18]

Type of community of practice	Nature of knowledge	Proximity/nature of communication	Nature of social ties
Handcrafted (for example, glass-blowers)	Aesthetic and incorporated	Face to face communication Importance of the demonstration	Interpersonal trust and mutualization by performing shared tasks
Professional (health, education, …)	Specialized knowledge acquired over long periods of education and practice	Co-location required at the start	Institutional trust based on respect of professional standards
Expertise or creation (scientists, artists, …)	Specialized or expert knowledge including standards and codes	Spatial or relational proximity (face-to-face and remote contacts)	Trust based on reputation and expertise Weak social ties
Virtual	Codified and tacit	Social interaction mediated by the technology (face to screen)	Weak social ties Reputation-based trust

Table 3 An extract from Enron corpus

From	To	Text
A	B	Once you make the changes to the release, please fax a copy to Kevin Kolb. I am going to try and meet Pauline Kuo on Tuesday or Wednesday to wrap things up. In addition to the release, I will need the guarantee and a release of lien for the smaller note. I will speak to you on Monday. Hope things are going well with your wife
B	A	Thanks for the info. The changes are alright. I will make the revisions and call you. I am at MD Anderson tomorrow morning, so it will probably be late tomorrow or over the weekend. We will coordinate Monday morning so I can get you everything you need for the closing. Thanks

The Enron corpus contains more than 250,000 email' discussions about the realization of the Enron project exchanged by the employees of Enron Company.

Competence

The literature review identifies many definitions of the concept of competence. Some are more specifically related to the notion of knowledge, others relate to resources and assets. Durand [3] proposed several distinctions of the notion of competence, of which we cite the duality of explicit knowledge/tacit knowledge, individual knowledge/collective knowledge and cognitive versus behavioral knowledge. He borrows from educational research work the three key dimensions of individual learning which are knowledge, practice (know-how) and attitudes. Pestalozzi speaks of head (know), hard (know-how) and heart (attitudes) [20]. According to Paquette [4], competency is based on the relationship between specific knowledge in a given field of application and generic skills. Skills are statements that a person, and more generally a resource, can demonstrate the application of a generic skill to some knowledge, with some degree of performance.

Bourse et al. [5] defined the competence as the "effect of combining and putting into play its resources (knowledge, know-how and behavior) in a given context to achieve a goal or fulfill a specified mission".

Triaa [21] focused on the competence that is most used in industrial enterprises. According to this author, being competent, requires (i) to combine, in a relevant way, the personal resources (knowledge and know-how) and those of the environment (technological, material, …), (ii) to manage varied professional situations in order to achieve an objective according to criteria of realization and (iii) to provide a deliverable (tangible or intangible) for a recipient (customers, service provider, etc.) that makes it possible to evaluate a performance. Bonjour et al. [7] consider the competence as "the mobilization and dynamic organization of a set of heterogeneous cognitive resources that leads to the production of an acknowledged performance in the framework of a finalized activity and a particular class of situations". Thanks to his competence, an actor transforms so a mission, with which he has been entrusted, into a successful flow of actions that will achieve expected results. Belkadi [8] retained this definition also. For Boumane et al. [9], the "Competence is the ability of a person (actor) to act and react with the relevance required to perform an activity in a work situation". The actor is at the heart of a process that consists of selecting, combining and mobilizing knowledge, skills, abilities and behaviors on the one hand, and environmental resources on the other, to 'accomplish a mission defined by the company. Monticolo [1] stated that in the design process, the actors use several skills to carry out the business activities. He borrowed the definition of competence established by Le Bortef [22], who considers it at the individual level as follows: "competence is the capacity for an individual to apply his knowledge and enhance his know-how in a professional setting". Competence is thus considered by Monticolo [1] as an action that the actor is able to achieve using one or more of his knowledge. Thus, he takes into account, in the organizational model, the concept of competence associated with the role.

Competence can be defined as: "The combination and implementation of knowledge, know-how and know to behave and to achieve a recognized performance, in relation to a given environment and as part of a finalized activity" [23]. In this definition, knowledge indicates the mastery of different elements related to a specific domain of activity, such as standards, procedures and protocols, know-how is determined by the efficiency in carrying out actions in a specific area and the know to behave is reflected by the ability to deal with various situations. Competence can be characterized by three points of views: individual, industrial and organizational (Fig. 1) [23].

Knowledge, know-how and behavior are only studied in our work. Three taxonomies of skills and competences, namely the "European Dictionary of Skills and Competences" (E-DISCO), "Occupational Information Network" (O*Net) and "Taxonomy-DB" [24] are studied (Table 4).

When analyzing these taxonomies (Table 5), E-DISCO (Version 2) has been chosen in our work because it is a comprehensive taxonomy of skills, personal attitudes, values, behavioral patterns and action verbs, available in fourteen European languages. Also, E-DISCO aims to support European transparency tools and it is provided by four comprehensive national skills compilations, namely "Kompeten-zenkatalog" (Germany),

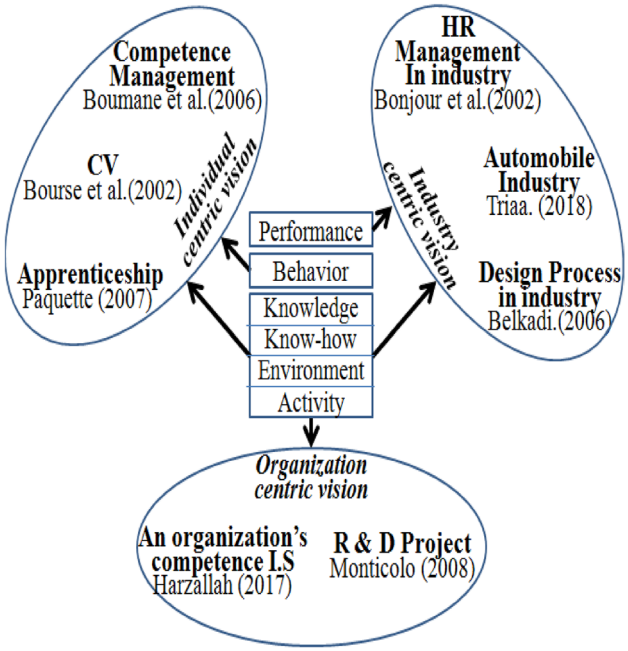

Fig. 1 Use of competence components according to different visions: competence, human resource and organizations management

"AMS-Qualifikations-klassifikation" (Austria), ROME (France), and Taxonomy-DB (Sweden) [24].

We extracted from E-DISCO three lists namely activity domains, action verbs and abilities. The list of domains summarized in Table 6 contains 23 main domains of activity. Each one is subdivided into several sub-domains and sub-sub-domains.

The Table 7 shows an extract from the E-DISCO list containing 167 common action verbs. These verbs applied, within an expression, to an object belonging to a given domain, refer to a potential know-how in that domain.

Communication Analysis

The concept of communication is considered in its interactional sense. Indeed, the traditional definition of the communication developed by Shannon [25] representing it as the transfer of a message from a source to a destination in the form of a signal is replaced from the early 1960s by an interactional vision, where communication is neither a simple one-way transmission of a message, nor simply verbal and informational, nor context free [26]. In the analysis of communications, it is often useful to determine the intentions behind each message exchange [27]. As part of our work, we are particularly interested in computer-mediated communications. The literature review related to this issue revealed a number of works on e-mail, chats, and discussion forums.

Balog and De Rijke [28] developed methods for finding experts and their contact details using e-mail messages. They locate messages on a topic and then find the associated experts. They use an unsupervised approach where both the list of potential experts and their personal details are obtained automatically from e-mail message headers and signatures, respectively.

Dredze et al. [29] dealt with the issue of automatic classification of e-mails according to the activities related to them. Their approach is based on two characteristics of the

Table 4 Characterization of competence

	Knowledge	Know-how	Behavior
Characterization	Principles and facts applying in general areas	Developed capabilities to apply one's experience or knowledge in a given art or job	Attributes/characters of the individual that influence the performance
Modes of acquisition	Learning and/or experience	Experience and development of Capacities	Intuition and Experience
Expression mode	Know + Activity domain	Action Word + Object + Context	Be + Adjective or Have + Ability

Table 5 Comparison of competences taxonomies [24]

Taxonomy	Strength	Weaknesses
E-DISCO	Comprehensive understanding of skills/competences. Structure close to the language of the labor market. Multilingual	No explanation for terms. All descriptors are subsumed under skills and competences, although they are not
O*NET	Comprehensive understanding of skills/competences. Based on empirical data scales for descriptors. Precise definitions	Technical rather than common terms. Not compatible to any European standard. Only available in US English. No synonyms
DB-taxonomy	Available in 20 European languages. International compatibility. In use for labor market matching	No explanation/synonyms for terms. Lacks non-job-specific skills. Blurred border between skills and occupations. Rudimentary classification

Table 6 List of the activity domains from "E-DISCO" [24]

Domains	
Agriculture, forestry and fishery	Law
Architecture and building	Life sciences
Arts	Manufacturing and processing materials
Business and administration	Manufacturing and processing of food
Computing	Mathematics and statistics
Education	Mechanical engineering
Electrical engineering	Personal services
Environmental protection	Physical sciences
Health	Security services
Humanities	Social and behavioural science
Journalism and information	Social services
	Transport services

activities: (i) the observation that activities connect groups of people and (ii) the observation that e-mails related to a given activity tend to focus on one or more topics. They presented several algorithms for automatically recognizing emails as part of ongoing activities by relying on the use of threads to determine the belonging of an email to a given activity.

According to Cohen et al. [30], negotiation and delegation of shared tasks and subtasks are important uses of work-related e-mail. They used text classification methods to detect "email speech acts". Guided by analysis of several email corpora and based on the ideas from Speech Act Theory developed by Searle [31], they defined a set of "email acts" (e.g., request, deliver, propose, commit) and then classified emails as containing or not a specific act by using machine learning algorithms. A taxonomy of speech acts (verbs and nouns) applied to email communication (e-mail acts) is described and motivated Cohen [30]. For Carvalho and Cohen [27], using only simple words as features, will lead to neglect a very important linguistic aspect, namely the textual context. For instance, the specific sequence "would you give me" can be more informative to detect a request act than the words "would", "you", "give" and "me" separately. In this order of ideas, they focused on analyzing the n-grams features extracted from e-mail communications.

Khoussainov and Kushmerick [32] focused on identifying relations between messages for grouping emails into tasks. They used pair-wise message similarity to find potentially related messages, and hierarchical agglomerative clustering to group them into tasks. In addition to the textual similarity between messages, they extended the message similarity function to take into account the structured information available in e-mails, such as send dates, and message subjects. They investigated how (i) features of related messages in the same task can assist with classification of email speech acts, and how (ii) information about message speech acts can assist with finding related messages and grouping them into tasks.

Kalia et al. [33] presented an approach based on techniques from natural language processing and machine learning domains to automatically identify tasks and commitment creation, delegation, completion, and cancellation in email and chat conversations.

Their approach is based on Searle's [31, 34] works in Speech Acts field that classified illocutionary acts into five classes (Table 8). A message is classified as (i) commissive, if the sender of the message promises to take an action in the future, (ii) directive, when the speaker intends the receiver to do something, (iii) representative, if the sender commits to the truthfulness of the message, (iv) expressive, when the sender expresses his or her psychological state, (v) declaration, when the sender of the message brings about a change

Table 7 Common action verbs from "E-DISCO" [24]

Action verbs
Adjust/Advise/Allocate/analyze/Anticipate/Apply/Apply techniques/Approve/Assemble/Assess/Assist/Audit/Blend/Breed/Budget/Build/Buy/Calculate/Calibrate/Care/Care for/Certify/Check/Clean/Collaborate/Collect/Compare/Compile/Conclude/Configure/Contact/Control/Coordinate/Counsel/Create/Cultivate/Cut/Cut up/Deal with/Decide/Define/Delegate/Deliver/Demonstrate/Describe/Design/Detect/Develop/Diagnose/Dig/Direct/Disconnect/Dismantle/Display for sale/Disseminate/Dissolve/Draw something up/Draw up contracts/Drill/Eliminate/Evaluate/Examine [...]

Table 8 Classification of illocutionary acts [31]

Class	Characterization
Commissive	The sender of the message promises to take an action in the future
Directive	The speaker intends the receiver to do something
Representative	The sender commits to the truthfulness of the message
Expressive	The sender expresses his or her psychological state
Declaration	The sender of the message brings about a change in status of the referred object

the in the status of the referred object [33]. Rauscher et al. [35] proposed to use request speech acts to identify problem-solving knowledge from professional e-mails. They link interaction analysis to problem context restitution. Recently, there has been a growing recognition of the importance in using online communication like chats, forums and email, by communities of practice as a model for professional development in a collaborative environment [36]. Therefore, for these communities to be successful, participants need to have a minimum level of technical competence regarding the use of information technologies [37].

Verification of Corpus Identification

To check the richness of exchanges in the community of practices related to competences manifestations, we searched E-DISCO actions verbs in Ubuntu and Enron corpuses. The results obtained are illustrated in Table 9. They show that almost all the action verbs contained in the E-DISCO taxonomy appear in the Enron corpus, comparatively with the Ubuntu corpus where only a few action verbs appear.

Enron's corpus illustrates the activity of an oil company, but even though it is specialized in this specific area, Enron, as a large organization, has other activities such as those related to management, finance and human resources; which involves dialogues covering a wide range of action verbs.

The explanation of the result showing a few action verbs appearing in the Ubuntu corpus is based on the fact that this corpus concerns a community which deals with IT issues. A research in the glossary related to this domain shows that verbs such as analyze, configure and compile belong to the IT glossary. Some messages extracted from the Ubuntu corpus and Enron corpus (Tables 10, 11).

Competency Detection Method

We suppose that an interaction within a professional organization as in the framework of a project is marked by the hierarchical position of the interlocutors and also their competences can be explicitly mentioned or solicited during the exchanges. Conversely, in exchanges within communities of interest, there is no notion of hierarchy; the interlocutors often don't decline even their identity. As a result, identifying competencies in this kind of exchange may be less obvious. Our method is based on E-DISCO taxonomy (activity domains, action verbs). Activity domains list is used to determine the knowledge of the interlocutor. Action verbs list is used to detect the actions done by the interlocutor and these actions refer to his know-how and/or behavior.

Table 9 Apparition frequency of action verbs in Enron and Ubuntu corpuses

Action verbs	Enron corpus	Ubuntucorpus	Action verbs	Enron corpus	Ubuntu corpus
Adjust	319	0	Compare	426	0
Advise	125	0	Compile	266	319
Allocate	163	0	Conclude	223	0
Analyze	250	175	Configure	46	234
Anticipate	277	0	Contact	3413	0
Apply	448	0	Control	1301	0
Approve	1053	0	Coordinate	250	0
Assemble	57	0	Counsel	1931	0
Monitor	504	0	Create	1010	0
Assess	379	0	Cultivate	0	0

Table 10 Set of messages from Ubuntu corpus

Action verbs	Messages
Install	Although the.mpg files are responding to the media software I have installed unlike it did before all of this
	Yeah I'll just do that. Put everything on ext hdd and start from scratch and re-install Ubuntu
Reboot	I'm going to reboot again, but into my root partition and save my files to the ext hdd then start the process. Thanks for your help again
	I'm going to go ahead and put in the installation CD and reboot. And gparted will still be available when I boot from the CD so I can do the partitioning?
Format	If it's going to be used for linux you want to format it as ext3 type
	Can I re-format the exthdd to FAT32 when I reinstall Ubuntu?

Table 11 Set of messages from Enron corpus

Action verbs	Message
Assemble	Assemble the pricing of a transaction from a benchmark price curve
	Patrick, I will assemble a list of ENA contracts that contributed to the financials that were presented in the data room
Monitor	Please monitor local news and weather forecasts and use your judgement to insure a safe commute
	I monitor and I am responsible for representing my company in FERC and state regulatory proceedings
Examine	The court examined the three exceptions to the general rule
	We will examine the foundation stone that underpins the vast majority of credit

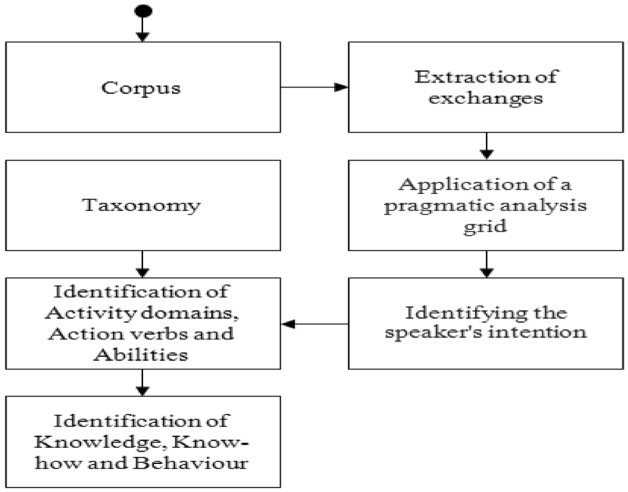

Fig. 2 Methodology of competence identification

Therefore, our method allows us to identify the three essential components of the competence, namely: knowledge, know-how and know to behave.

These types of interactions are analyzed in our approach to detect technical competences. We propose then a methodology based on several steps (Fig. 2):

(i) Extraction of exchanges from corpus, identification of interlocuters intentions using pragmatic analysis grid based on Searle's [31, 34] illocutionary acts classification.
(ii) E-DISCO Action verbs taxonomy are matched with intention to detect the glossary of activity invoked by the speaker which reflect his/her potential domain of competence. Action verbs underpin the know-how and the behavior of the interlocutor.
(iii) Identification of words belonging to a glossary domain related the E-DISCO activity domains table. The activity domain refers to the knowledge held by the interlocutor

Two algorithms are developed for this aim. The first one is to isolate the competence manifestation and the second one to analyze the competence type.

Competency Manifestation Isolation Algorithm

The very first step in identifying the competency is to find the clues of its expression. Their existence indicates a competence manifestation. These clues can be so located between the beginning of a request and the closing of the interactions related to the request. Furthermore, we consider that a speaker seeking for a competence will ask someone who can help him/her and when he/she gets it he will express an acknowledgment to who that give the solution.

One of the terms which express the need of information or how to do things is the "help" request. Help words and its synonyms (assistance, support, service, advice, look for, …) are firstly detected in discussions. Consequently, if that kind of request is detected, that means there is a beginning of an interaction in which competence manifestation can be isolated. But before getting satisfaction the interlocutors will exchange to precise the need and to get more information about the subject in the one hand, in the other hand the speaker who has the competence will guide the requester by asking him to perform some actions and to evaluate his understanding about that actions in order to lead him to the solution. The terms used and the actions to do will inform about potential competence domain and know-how. A request is a directive speech act which invites the hearer to do something [34]. Two types of requests can be distinguished direct requests and indirect requests (Table 12).

For this purpose, we suggest the following algorithm.

Table 12 Help request grid

Request	Linguistic form	Examples	With HELP
Direct request	Imperative	Do x	Help me
	Performative	I am asking you to do x	I am asking you to help me
	Want or need statements	I need/want you to do x	I need/want you to help me
	Obligation statements	You have to do x	You have to help me
Indirect request	Query questions about ability of the hearer to do X	Can you do x? Could you do x?	Can you help me? Could you help me?
	Query questions about willingness of the hearer to do X	Would you like to do x?	Would you like to help me?
	Statements about the willingness of the speaker	I would like/appreciate if you can do x	I would like/appreciate if you can help me

Begin

- Isolate an interaction between two interlocutors
- Search help requests terms such as "help" for each interlocutor (Cf. Help Request grid—Table 12)
- Find the words of the associated domain Glossary
- Search interaction closing words such as "thanks" for each interlocutor
- Search other forms of questions for each interlocutor (Cf. Request Grid—Table 1)
- Find the words of the associated domain Glossary
- Find answers to questions by interlocutor
- Find action verbs (Cf. Action verbs Grid—Table 7)
- Find the forms of speech acts "directive/informative" (Cf. Speech acts grid—Table 8)
- Find other forms of speech acts "evaluation" (Cf. Speech acts Grid—Table 8)
- Find words in the associated Glossary
- **If** help requests and closing words exist
  Then
  A potential competence requester exist
- **End if**
- **If** Directive or evaluation form of speech exist
  Then
  A potential competency deliverer exists
- **End if**
- **If** words belong to a specific domain glossary
  Then
  The potential competency is related to the glossary domain
- **End if**
- **If** action verbs exist
  Then
  A competency in the related domain exist
- **End if**

End

Example on "Ubuntu" Corpus

Ubuntu corpus contains more than 7 million utterances and 100 million words. In exchanges within such communities of practice, there is no notion of hierarchy; the interlocutors often do not decline even their identities. As a result, identifying competencies in this kind of exchange may be less obvious. Indeed, the absence of identity elements, explicit

Table 13 Help loop extracted by applying the competency manifestation isolation algorithm on an interaction between Reighnakj (A) and Edbian (B)

Inter-locutor	Message	Speech acts
A	Can you **help** me *customize* that for me?	Help request
B	Yes	
A	http://www.linuxsa.org.au/pipermail/linuxsa/1999-December/011333.html	
B	Mount -t ext2 -o rw,remount /host/ubuntu/disks/root.disk/ Very good! You could probably leave -t ext2 out but it's just as good this how to is very old. 1999!!!	Evaluation (very good!) positive evaluation
A	I think that did it	Expressive
B	Horray. *Try* to *edit*/etc./fstab nano/etc./fstab	Directive (do something)
A	I just did mkdir test and it worked. Before it says filesystem read only	Informative: to explain
B	AWESOME http://pastebin.com/wYTxwAL3 < – do this BTW, I'm impressed	Expressive (I'm impressed)
A	alt + ctrl + deleted to *restart*	Informative: to explain
B	You *editing* the file? that was fast son	
A	:-D	
B	That looks like a good smiley face	Informative: to describe
A	Alright, now it is D-:	
B	So what happened?	Information Request
A	I got to the login for ubuntu where I *log* in as admin	Informative: response
B	Sure	?
A	In the top right cornor now, it says *Install* problem! The configuration defaults for GNOME Power Manager have not been *installed* correctly. Please *contact* your computer administrator." Is there a way to *reinstall* GNOME Power Manager?	Informative and information request
B	I don't think that's the root of the problem. But yes if you use *recovery* mode (which should work better now)	Informative: explain
A	I am going to do that	
B	it's just sudo apt-get *purge* gnome-power-manager and then sudo apt-get *install* gnome-power-manager Ok. I *suggest* going to the recovery console (as root) and *watching* for any errors. Then if you don't *find* any errors while on the way, *run* dmesg to *find* some errors. But why!?!? :(	Directive: what to do
A	So in the GNU GRUB, should I do normal mode or recovery mode?	Request for action
B	Recovery	Informative: response
A	Ooooh, ok. You want me to use the last option again I will run dpkg through the recovery menu, actually	Informative: describe
B	dpkg? use apt-get please *use* aptitude if you can! It has a reinstall but I don't think this will *solve* the problem	Directive
A	So, what?	Information Request
B	… what does that mean?	Information Request
A	I am *restarting* and *trying* what you said, my method did not work I just *entered* recovery mode again Should I go to root?	Informative: explain Request for action
B	Any errors?	Request
A	Should I *select* "root Drop to root shell prompt"?	Request for action
B	Oh, yes	
A	Then *run* what command?	Information Request
B	I'm not sure what the real problem is here	Informative; explain
A	The GNOME Power Manager is not *installed* correctly. SO, it will not allow me to *login* to my desktop for some reason. http://forums.fedoraforum.org/showthread.php?t=226569. I will *try* that	Commissive
B	Yeah I'm totally clueless at this point	

Table 13 (continued)

Inter-locutor	Message	Speech acts
A	I will be back if I have more trouble. But, at this point I think I am good to go. **Thank you** so much for dealing with me	Cloture

signatures, assigned roles or contextual elements makes it difficult to identify competencies without a detailed analysis of the exchanges between the interlocutors.

Results

We applied the competency manifestation isolation algorithm on an interaction containing 300 exchanges between two interlocutors. As result, we got the help-loop containing 35 exchanges illustrated in Table 13.

This help-loop starts with a help request "can you help me" and finishes with "thank you" (bold). It contains action verbs highlighted, terms of IT glossary underlined and requests. Consequently, we suspect a competence manifestation.

Competency Manifestation Analysis Algorithm

Once an assumption of competence manifestation established, we have to analyze it in order to detect who possesses the competence and in what domain. For this purpose, we assume that the interlocutor who is asking for competence will use help request terms to start his request and he will express acknowledgment terms to end it. Meanwhile, the competent will use speech acts that are proposed to be associated with manifestations of his competence. He will use directives by giving orders (saying what to do), suggestions (instructions) using various statements, name the problem (informative act), make diagnoses (descriptive act), explain the procedure to follow (explanatory act), evaluate positively or negatively what is done (evaluative act) by using expressive to congratulate the interlocutor to have succeeded or criticize him for having done wrong. To determine his/her competence domain we have to find the domain glossary to which belong the terms and action verbs detected. For this aim, we propose the following algorithm.

Begin

- **For** each help request determine the interlocutor ← interlocutor-1
  - Find in the thread of interaction the first next apparition of closing words and determine the interlocutor ← interlocutor-2
  - **If** interlocutor-1 = interlocutor-2
    Then
    - help requester ← interlocutor-1
    - help deliverer ← the interlocutor who answer interlocutor-1
    - Set the 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
    - Detect action verbs and words used within answers
    - **If** the number of directives and evaluation answers of Help deliverer > the number of directives and evaluation answers of the Help requester
      Then
      - Competency requester ← Help requester
      - Competency deliverer ← Help deliverer
      - Competency domain ← Domain Glossary related to words

      Else
      - Exit Help-loop
    - **End if**
  - **End if**
  - Find the next help request within the interaction
- **End For**

End

Table 14 Results of the application of the competency manifestation analysis on a thread of discussion between Reighnakj (A) and Edbian (b)

		Interlocutors	
		A	B
Number of exchanges	35	18	17
Help requests	**1**	**1**	**0**
Cloture terms (Thanks)	**1**	**1**	**0**
Requests	7	3	5
Directive acts	**3**	**0**	**3**
Informative acts	9	6	4
Evaluation acts (good, well, fine…)	**1**	**0**	**1**

Bold numbers show important sentences form that help to isolate competencies manifestations

To analyze this isolated Ubuntu competence exchanges, we applied the competency manifestation analysis algorithm Table 14. Illustrates these results.

The analysis of the results chows that the help request as well as the cloture term (Thank you) come from the interlocutor "A", which leads to consider him as the competency-requester. Directive acts come exclusively from the interlocutor "B". This leads us to conclude that "B" is the competency-deliverer. Indeed, these first results show that the competency-deliverer performs acts of language that attest to its competence such as directives by giving orders to follow (i.e., "use apt-get please"), or suggestions to try by explaining the tasks to be done to solve the problem (i.e., "if you don't find …, run dmesg to …"), by reformulating the statements of the competence requester by making a diagnosis (i.e., "it's just sudo… and then…"), by evaluating the activities of the competence requester (i.e., "Very good").

To reinforce the results obtained, we selected another exchange in which participates the interlocutor named "B" considered as competent according to the application of our method on the first interaction and we have obtained the results showing "B" as the competency-deliverer and the other interlocutor as the competence requester.

To evaluate the efficiency of our method and the relevance of the results obtained by applying the two algorithms, we submitted the exchanges to a group of IT experts that we asked to analyze this multi-turn dialog to determine, according to their expertise, if there is a manifestation of a competence and who is the interlocutor that has this competence (know-how end behavior) and his domain of competence (knowledge). After analyzing the interaction, the experts confirmed that the part of the interaction considered in our application highlights a paten of problem-solving situation that contains clues of manifestation of competence as detected by the first algorithm. Also, they confirmed that the holder of the competence is indeed the one obtained by the application of second algorithms. Our method allows us to detect an assumption of competence manifestation and to find the competent and its domain of competence.

To reinforce these results, we need to analyze other interactions where the person detected as competent in the first results is involved and if this same result appears, we can deduce that his competence is confirmed.

Conclusion

Three main questions are treated in this paper

1. Which elements can characterize competences, especially in exchanges? Three dimensions of competences (individual, industrial and organizational) are shown in this study. Taxonomy of actions verbs related to know-how and ability is also identified that help to detect the manifestation of competences.
2. Is it possible to detect competences from community of practices? The detection of know-how and ability actions verbs in two type of community of practices (Ubuntu technical one and Enron related to project exchanges) show first results to confirm this hypothesis.
3. How can isolate competences manifestation in community of practices and interactions? Two algorithms have been developed using pragma-linguistics techniques, based on the form of interactions. The application of these algorithms on Ubuntu exchanges give a first prove of our hypothesis.

We aim at short time to apply algorithms on Enron corpus in which exchanges are related to other types of organizations, a project one which is different from a technical one illustrated in Ubuntu. Abilities and organizational competences will be detected.

Techniques that help to analyze the pertinence and effectiveness of know-how exchanged will be also developed. Algorithms to identify the nature of the exchanges' sequence will be defined. They may rely upon context analysis of exchanges and speech acts manifestation and their links in interactions [38–46].

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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