Enabling Communication Rationale via Annotations: A Document-Based Cooperation

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Abstract. This paper describes a cooperative tool used by a mechanical engineering team carrying out an asynchronous and distributed work. The tool supports communication phases as well as document and product creation phases by means of annotations. Memorizing all the annotations and creating documents from these annotations enable capturing the "communication rationale" of the team. Annotation is here defined as a continuum fulfilling several purposes from communication to indexation.

Keywords. Annotation, document, indexation, cooperation,

Introduction

Distributed collective practices involve multiple actors sharing multiple documents. The actors exchange comments, modify documents and can negotiate some parts of new documents being created. Supporting these activities means supporting communication around documents and creation of new documents. We assume that annotating is helpful in this context. In fact, annotation is a means to communicate, to express arguments, and if a set of annotations is correctly stored, it can represent the "communication rationale".

In this article, we follow the objective of suggesting a broad definition of annotation, from the mark-up indexing content, to a discursive annotation enabling arguing. We confront this definition with a real situation: a mechanical engineering team carrying out an asynchronous and distributed work, from preliminary design phase to production phase. Members of this team face design discussions based on project documents such as description and plans, and they send newly created documents to the others. We discuss in this article the lacks of existing annotation tools for these purposes, and, on the basis of the analysis of the distributed collective practices that we have observed, we describe scenarios to design a computer-based annotation tool. This tool, which is capturing the communication rationale, enables activity awareness [1] and collective sensemaking [2].

1. Annotation: a Polymorphic Object

Observing evolution of interpretation techniques in hermeneutics [3] enables us to define annotations as active elements of document creation and as parts of a written document. From De Libera [3], we can define several types of interpretation techniques through text creation: (1) The gloss which is a fragment of text explaining a part of a document, (2) the underlining mark pointing parts of a document, (3) the note paraphrasing the main point of a document, (4) the comment bringing new ideas out, and (5) the discursive comment which is an arguing and organised comment built cooperatively by exchanges among authors. These types show us different steps of text elaboration (from an underlining mark on a text to some explaining words or a structured arguing text). All these texts are *fragments of document* and are bound to a document or to other document fragments, so that we consider them as annotation.

Fragments of a text can also be seen as fragments of a discussion in a newsgroup, since posts are bound to a discussion thread, which structures the document. Researches in Computer Mediated Communication could be helpful for defining the relationship between annotation and text; In fact, we follow [4], who defines a newsgroup as a "dynamic document produced collectively and interactively and which content coherence and form come from a collective and cooperative management" (p.5 personal translation). [5] defines a newsgroup as a dynamic document, as well as polylogal conversation since several participants are involved in a discussion thread. The production of a textual fragment could be seen as an individual process, but also as a collaborative one since the text is created from appended fragments enclosing participants' arguments. Following these features, we consider annotation as a *fragment of a conversation*.

These fragments are also firmly bound to a document or to a topic; we can then consider the relational feature of annotation. [6]'s research carries out a genesis of the mail from the note. This written dialog form is mainly characterized by its brevity and by its informal type as well as its informational, sequential and relational features. Relations are established implicitly by the meaning of the text, or more formally by the actual anchoring of a message stuck on a document or the textual body accompanying an attached document. Annotation is then a tool to link documents, an object anchoring a note, relating different fragments, as in Semantic Web field (SW). Annotation is then *a path to the document*. The relational feature of annotation (as bound to a document) is the one allowing SW [7] to consider annotation as enriching the document in order to improve automatic document indexing and retrieval [8]. Annotation is then used for document content processing, structuring a document, services interoperability, and for some specific types of cooperation (as in [9]'s scenarii of cooperation).

As we aim at favouring communication and memorizing communication rationale, we then propose a seamless definition of annotation as a continuum from the mark-up (computational annotation) to the comment (discursive annotation). Annotation defined as a discourse fragment connected to a text is a cognitive arguing medium which enriches the original document. The discursive annotating activity can be computer-supported in order to assist collective sense-making [2].

2. Annotating purposes

The scenario takes place in a project involving an association committee (AC) (mainly plane pilots), and a mechanical engineering team (divided in a Design Team -DT- and a technical team -TT-). The aim is to reuse a car-engine as an aero-engine. Team members participate to the project during their spare time. So, despite members' co-location, work is asynchronous. Each DT member develops a part of the engine. Mechanical engineering design is a highly collaborative field and consequently, design team needs perpetual feedbacks from TT (technicians and suppliers). DT then relays feedbacks from the AC managing expenses. Drawings and documents represent discussion basis between TT and DT about technical feasibility and about tool or material's availability. TT mainly manages communication with suppliers. Within the DT, communication is widespread even if information should always be forwarded to the group supervisor. The only medium available in this team to mediate this asynchronous written communication is email. We classify activities related to this project in three groups:

1. A member creates a first draft with computer-aided design tools, each member then discusses this draft, asking for complement or verifying calculus. To do so, team members write down their ideas and questions as comments anchored to the draft(s). Each member put his/her annotation on any documents, but a subtle structure of micro-organization within the team entails some ethics rules. After the revision and the updating process, detailed plans are then communicated to the TT in order to begin production phases. TT receives drawing plans and their comments, which explain how the DT made a decision.

2. To share and manage documents, an adapted classification should be set up, based on several pieces of information: author, date, content, aim, recipient, which part of the document/plan it comments, etc. Since it is an innovative project, they can only partly define an a priori classification for documents to be produced. Their classification is possibly extended as work progresses.

These comments are often merged in newly created documents following an explaining purpose (for example by listing and explaining in an email all the modifications which are visible in the document). This situation description shows us that indexation and communication functionalities are crucial for understanding on which basis a solution has been adopted. Annotation is used for communication, indexation and is a part of the project's "communication rationale". We are then going to look at existing annotation tools which could support this complex activity.

2.1. Supporting Communication

Annotation for communication is partly supported by the SoW (Social Web) approach [10], enabling mediated communication by comments. Newsgroup, blog, or wiki [11] enable on-line "polylogue" [5] (dialogue among more than two speakers) by publishing messages related to a discussion thread. Conversation fragments are yet not structured, which leads to topic digression [5] and decay phenomena [12]. Annotation as a comment is supported by annotation clients ([13], [14], [15]) which sort annotation on rudimentary metadata (creation date, author). Annotation could be stored apart on annotation servers, so, differentiated from the document [16] or not [17]. However,

these tools do not allow connecting annotations nor structuring exchanges between users about a document. D3E [18] also considers documents as discourse medium but does not allow a rich indexation of annotations. These tools do not focus on tracing the design rationale underlying the discussion enabling an *a posteriori* understanding of exchanges which took place.

2.2.   Supporting Indexation

Several annotation clients [19] are available from Semantic Web initiatives (SW). "Semantic annotation" of the SW is a "computational annotation". An objective of SW is to index Web pages, and allow search engines a better information recall structuring annotation by underlying ontologies ([20], [21], [22]). These annotations lightly support readers of a page to cooperate or to interact. Magpie [23] uses annotations to support human interpretation and enables multiple viewpoints indexation. These tools enable to add annotation to a document, which permits the DT to explain the TT when and on which document a decision was made. But these annotations only help a user structuring or sharing her/his understanding of the text. As we have already claimed, we not only need annotations to index but also to negotiate. Our purpose is to support document interpretation or recall of an existing interpretation but also to support the creation of new ideas (from collective interpretation). So, annotation is crucial to index and then to capture communication rationale, but we also need a tool enabling exchanges via annotations i.e. enabling discourse around a document.

2.3.   Supporting Communication Rationale

DT needs to collaboratively create documents i.e. to re-use, re-structure and rewrite existing comments to build a draft on which members can work or a *final* document. As we have shown above, two families of annotation tools are available: one focuses on Web pages indexation, while the other focuses on human communication through comments. We can deplore the lack of annotations' management or the poverty of cooperative functions in these two families. [18], [23] are the first steps in linking these two points of view. We thus propose to design a tool combining functions supporting SoW and SW activities (comment, answer, organize). As we claim that annotation is a document-based activity, a critical reading-writing activity, we need to understand and to analyse this reading-writing phenomenon.

3.   A Comprehension Model for Communication Rationale

3.1.   Which Theoretical Background?

In a design team, writing while designing is a cooperative process which could be achieved by means of annotations. Annotating could then be seen as a trace of a comprehension process along a reading. In order to be able to analyse this kind of activity, we need to choose a theory which will permit us to model one unique process of comprehension-expression. We studied some reading [24] and some writing models [25] [26] mainly stemming from Cognitive Sciences. In fact, these models separate

cooperation processes from production process; They focus on a cognitive process, an individual production process. Another one, the "social interaction model" from [27] fits cooperative purposes and represents the whole interaction between a writer and her/his readers around a text but it does not fit our purpose because it cannot explain the annotating process taking place during the production of the whole text. In our annotation scenario, the document is not produced at once and addressed from a writer to its reader as a novel; it can be seen more as a conversation from readers to writers. In [27]'s model, we miss the dynamic facet of the annotation, the discourse fragment giving rise to action (the DOfA, [28]). We are now going to present a discourse production model which better fits annotating activity as we have described above.

3.2. A Discourse Production Model

In his rhetoric description, [29] proposes a discourse production model that has been reviewed in the Middle Ages to stress the importance of links between ideas when reading and ideas already in memory. In order to assist users in annotation creation, we adapt this model of medieval rhetoric [30] representing discourse creation to our aim of textual fragment creation. As recommended in this context of medieval rhetoric, discourse production process is made up of two phases divided into stages: "Divisio" and "Compositio". Divisio is done while reading and consists in dividing a text into memorizable short segments. Compositio is the ordered combination, the suitable arrangement of concepts and objects contained in the memorized segments.

- Divisio originally structures individual memory, but in our context, this phase could be seen as a collective one. It consists of two phases:
  1. Cogitatio: associating sections of a chronologically divided content of a document in various memory locations. Textual fragments that form the text are then structured and become easily memorizable;
  2. Collatio: storing textual fragments in distinct places in memory and combining in a structure. In this phase, connections between the various fragments are created. A co-text is then formed by semantically binding new memorized fragments and fragments previously memorized.
- Compositio consists of four phases:
  1. Inventio: focuses on creating semantic links between various memorized elements, on a conceptual level, not on the word level. An outline is formed, i.e. a set of ideas hierarchically organised (for example, an argument structure);
  2. Dictamen: consists in a word-level formatting of the conceptual outline. It is a traditional phase of drafting. This stage creates a physical discourse, classically done on an adjustable support (a draft), where the style, the choice of the terms, therefore only the textual shape of the discourse can be modified;
  3. Exemplar: consists in transforming the draft support of the discourse in a perennial support. The discourse remains strictly identical to the one found in output of the process of Dictamen;
  4. Emendare: consists of open comments by the addition of public comments, arguments or annotations of an author to the original text after the final copy of the discourse is diffused. The text becomes a reference text, a written document being an authority on the field.

This model presents an interactive text elaboration during the whole discourse elaboration, which is adapted to our specific study case. We are dealing with a continuous text production, stamped with context interaction. While reading and working on documents, readers/authors "commit" a new version of a document. The document in progress is also bringing into action other fragments; the document is used to think ("writing for thinking" [31]) or to bring on action (DOfA) [28]. In mediated work, we should track down fragments' elaboration and store clues of collaboration, i.e. annotation that enabled discourse production. These annotations are marks of versioning on a DOfA, an amendment of a document in a collective work. This model shows us how to generate a document and enables us analyzing the design situation described above.

4. Scenario-Based Requirements

Having described our annotations purposes (section 2), we can identify functions of a groupware supporting collective annotations. We can consider three main functionality families: communicating, browsing, and interpreting:

1. Communicating: Supporting interpretation means handling annotations as creating fragments of discourse and enabling discourse by creating threads of annotations. Functions as selection of document fragments (highlighting, circling…), anchoring discourse fragments to documents or other annotations (answering, multi-anchoring…), are then necessary.
2. Browsing: Once created, an annotation should be indexed to be easily retrieved. Browsing is based on annotation indexing. Indexation allows structuring annotations in browsable knowledge map as Topic Maps formalism allows [32]. To index subtly these fragments, the user should be involved. But to support the user in this time-expensive task, we suggest using Natural Language Processing tools to propose user domain specific terms and the annotation arguing type.
3. Interpreting: Thirdly, users should be able to create new documents which gather ideas emerging from collective brainstorming and exchanges around a document. Our tool should contain a gathering functionality allowing creation of a new document to work on.

AnT&CoW [19], an annotation tool which is still under development, roughly implements these functionalities. We are now focusing on implementing the visualization of the communication rationale. AnT&CoW re-uses Annozilla [33], an open-source annotation plug-in for Mozilla-Firefox browser, which follows W3C Annotea protocol [34]. When the user launches Annozilla, it appears as a frame on the left of the screen. We improved Annozilla in order to facilitate communication. We consider that, in so doing, we are improving activity awareness. Annotations posted by several members are stored on a server and can be classified according to several viewpoints defined by the group. Annotations can be anchored by user on a document, creating links between several fragments. The link is explained by the argument written by the annotation's author in the annotation body. This body could also be annotated and then anchor an annotation. Multi-anchoring and replying is part of the genesis of a new document. Now, our tool enables multi-anchoring only on one document, but we

will go beyond technical limits in order to enable multi-anchoring among several documents. From the note paraphrasing an external document, new ideas are brought out and form a discursive comment. The cooperative structuring of a discursive comment during discussion around a document can be merged into a new document. AnT&CoW allows also the composition of a document representing a collective interpretation. The new document built is a gathering of linked fragments. Gathering these fragments is done manually by choosing fragments or automatically after a keyword selection. Gathering different fragments written by different authors means gathering members' viewpoints in one document. This new document is chronologically arranged and enables visualization of communication rationale by showing annotations, their indexes, and their links.

AnT&CoW is still under development but already implement basic collaborative functionalities allowing collective activity awareness and collective sensemaking through communication and indexation means.

5.   Conclusion

We have defined an annotation as a continuum from Semantic Web mark-up to Social Web discourse fragment. In this broad definition, supporting annotation activity means tracing communication rationale. To understand this activity in order to design a tool supporting annotation activity, we use a comprehension model stemming from a medieval rhetoric model of discourse production. In that way, we bring to light three main families of functionalities, communicating, browsing and interpreting. Interpreting enables to gather annotations in order to create a new document representing an interpretation, or in other words a discussion with its arguments. Annotation is then a central element to trace the "communication rationale" in asynchronous or distributed projects. In order to support this activity, an annotation tool is being developped. It enables users to annotate existing documents and to produce new documents based on annotations which have been correctly indexed.

Acknowledgements

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