Personal Knowledge Elaboration and Sharing: Presentation is Knowledge too

Pierre-Antoine Champin, Yannick Prié, Bertrand Richard

LIRIS UMR 5205 CNRS
Université Claude Bernard Lyon 1
F-69622, Villeurbanne, France
first-name.surname@liris.cnrs.fr

Abstract. In this paper, we propose to consider the construction, elaboration and sharing of "personal knowledge", as it is developed during an activity and at the same time sustains that activity. We distinguish three poles in personal knowledge: specific, generic and presentation knowledge. The elaboration process consists in the building of knowledge of each kind, but also in the circulation of information across them. The sharing of personal knowledge can concern all of only some of the three poles. Although the third pole (presentation) is the less formal, we nevertheless claim that it deserves to be considered equally to the two others in the process. We then illustrate our approach in different kinds of activity involving the creation of personal knowledge, its use and its sharing with others. We finally discuss the consequences and the potential benefits of our approaches in the more general domain of knowledge engineering.

1 Introduction

As the digital world gets more and more connected, information gets both more fragmented and sharable, and computerized devices act more and more as memories and supports to various activities. In that context, we are interested in the means of construction, use and sharing of so-called "personal knowledge": more or less structured data that results from the user's activity and at the same time sustains it. Any system that can be used to define, organize, visualize and share personal knowledge fits in that category. It includes semantic web and semantic desktop [19] tools, but we do not exclude from it plain address books, file systems or a document management systems.

We claim that such systems deserve attention from a knowledge engineering perspective, considering three kinds of knowledge (specific, generic and presentation knowledge) that must be considered together in their *tight integration* and their *co-evolution* during the user's activity. Elaborating one's personal knowledge is a matter of deciding how to dispatch information into those three kinds of knowledge, but also to continuously manage their evolution, maintaining global consistency, in order to satisfy the needs at hand during the user's activity. This is why we enclose in our analysis document descriptions and document generators as "presentation knowledge", while they are usually not considered as knowledge.

The first part of the article deals with personal knowledge management related works, while the following section presents two motivating scenarios regarding personal knowledge elaboration. The third section presents our threefold partition of personal knowledge into specific, generic and presentation knowledge, discussing their co-elaboration and their sharing. Three examples of personal knowledge in action are presented in the next part: in the context of active reading with our functional prototype Advene[1]; some semantic web current practices; and a new web-based prototype we built to demonstrate and study our approach. Finally, we discuss the interest of our proposed approach and the research perspectives it opens, then we conclude.

2 Related Works

Personal knowledge management [1] is a current practice, and lots of work has been done on the different aspects of that kind of knowledge management, from modelling to evolution and sharing.

Applications such as Microsoft Access, Filemaker[2] and Protege [4] allow the user to both design generic knowledge models (schemas, ontologies) and create specific informations accordingly (tables, instances). These integrated applications offer predefined views for visualizing generic and specific knowledge, but also tools for designing means of presenting and interacting with knowledge (reports, forms).

While some use templates to build websites from predefined ontologies [15], tools such as Ontomat [18] or Smore[3], and more recently semantic wikis like SweetWiki [5] or Semantic Mediawiki [13], are intended to allow the co-generation of an ontology, its instances and the web rendering at the same time. Such co-generation helps to keep the three aspects close to the minds of users and without necessarily pre-defined models. Microformats [12] are another way to co-construct instances and web documents as the information is both conceived as semantically structured and rendered as it is produced. Such a principle offers a way to consider the constant evolution of models, instances and rendering within the same activity, as we will discuss later.

There also exists several tools explicitly aimed at *personal* knowledge, such as Personal Information Management (PIM) tools [8] or semantic desktop [19, 17, 9]. These tools integrate different kinds of data, applications and workflows for helping users organize, create and exploit their knowledge. PIM tools are a way to centralize personal information for an easy reuse, possibly organized with a better user interface [10]. User knowledge is thus crystallized in the user workspace and reused at will. In semantic desktops, data from classical desktop applications such as browsers or mail applications are centralized and integrated, while ontologies are used to describe and express links between these data and the applications.

[1] http://advene.org/
[2] http://www.filemaker.com/
[3] http://www.mindswap.org/2005/SMORE/

We see in these various works an increasing trend toward flexibility in the evolution of personal knowledge, and the approach we propose in section 4 is aiming at enhancing that flexibility while keeping a knowledge engineering perspective. As to knowledge sharing, it has largely been studied in the case of ontologies, where a whole model or only a part of it [7] has to be used by others, even if the knowledge has to keep evolving [16]. Sharing is an important aspect of personal knowledge management, not only its generic part but also its specific and presentation part, and we are willing to take this into account in our proposal.

3 Motivating scenarios

In this section we present two example scenarios highlighting different aspects of what we will later define as personal knowledge elaboration. The first scenario deals with Semantic PIM (personal information management), while the second one is about video active reading, inspired by our work on the Advene project [3]. Figure 1 presents the first part of each scenario.

Semantic PIM. John uses a semantic wiki to keep track of his contacts. He first defines a small set of classes and properties to define contacts, reusing parts of the FOAF ontology[4]. He then populates this ontology with instances. Finally, since the default views of the wiki do not fully satisfy him, he builds a custom view named "Address book" (see figure 1-a).

Later on, John realizes that a lot of his contats live abroad. Since his ontology doesn't have a "country" property for addresses, he took the habit of putting the country name in the "city" field, after the city name, which makes the address look nice in the address book. However, it occurs to John that he can not, for example, easily group contacts by country. He decides to fix that, adding the "country" property to his ontology, adapting the address book and the instance descriptions to reflect those changes.

Video active reading. Jane wants to study her favourite motion-picture with her students. She first uses a word-processor to build a table of content of all the sequences with, for each one, its temporal extent (as two timestamps) and a title, followed by the label "indoor" or "outdoor". Then she decides to use Advene and defines a temporal annotation on the film for each sequence, with the title (together with the location label) as its content. Not only can now Advene produce the table of content for her, but it automatically updates it when an annotation is changed, and sequence titles are now hyperlinks to the corresponding moment in the video. She can also have the title of every sequence automatically subtitled while the film is being played. Then she structures the "Sequence" annotations in order to separate the title (an arbitrary text) from the location label (one of the two values "indoor" or "outdoor"). She can now customize the table of content so that sequence titles are colored differently depending on their location.

[4] http://www.foaf-project.org/

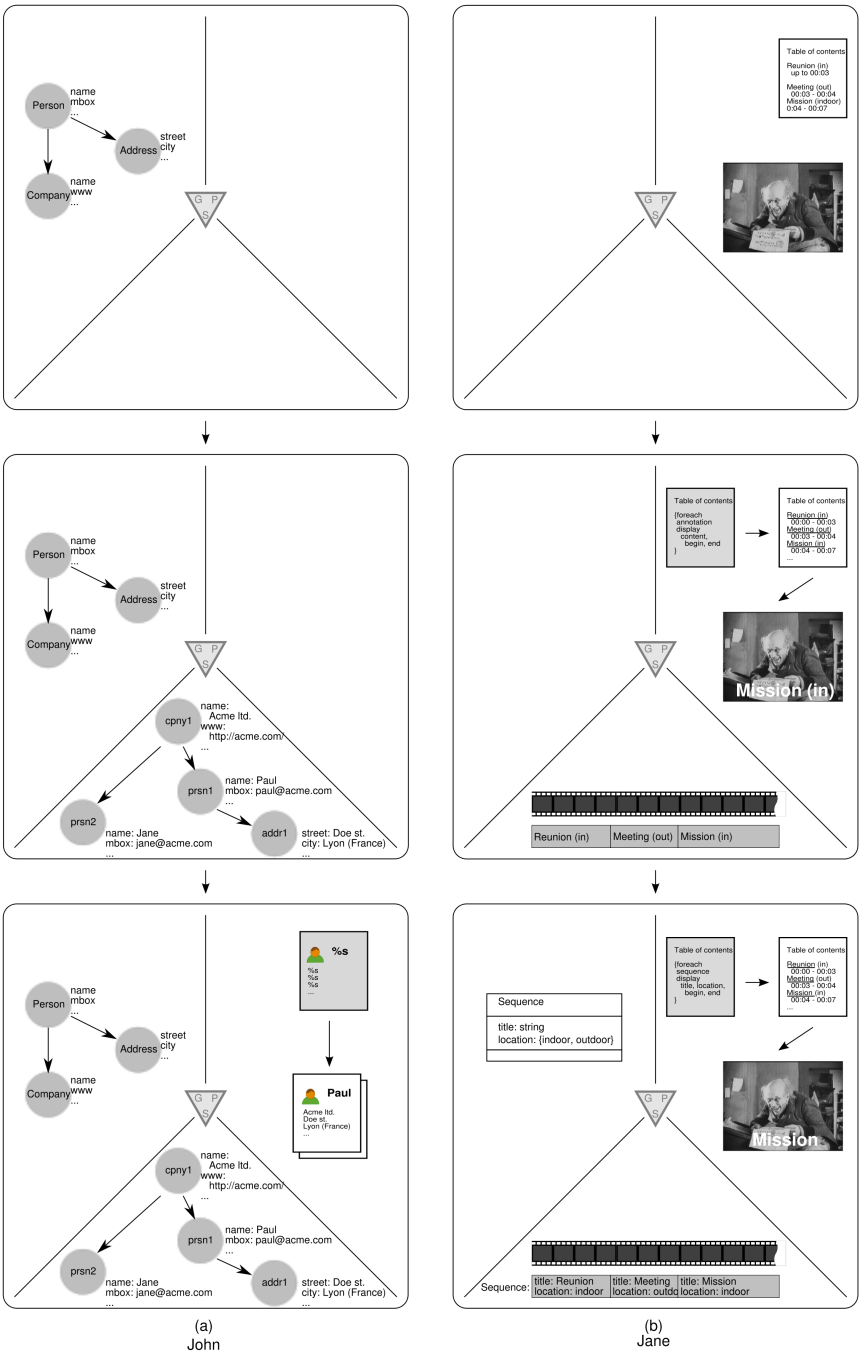

Fig. 1. Illustration of two motivating scenarios of personal knowledge elaboration

She then provides her students with that new generated table of content, as well as the subtitled video (see figure 1-b).

Later on, a student of Jane notices that things are a bit more complicated: some shots are actually both indoor and outdoor, which can not be represented anymore in the annotation structured defined by Jane (the "location" attribute only accepts one value). Jane decides to change the annotation structure, replacing the unique "Sequence" category by two categories of annotations ("Indoor sequence" and "Outdoor sequence"). Now, each sequence is described by an annotation of *at least* one category, but can possibly belong to several ones. The table of content has also to be adapted, of course, to take into account that structural change.

This change gives ideas to Jane: she wants to watch only the outdoor sequences of the film (virtually editing out every non-outdoor sequence). Althought this would already have been possible with the previous structure, it is now made much easier by the fact that outdoor sequences belong to a specific category of annotation.

4 Personal Knowledge

In this paper, we call *personal knowledge* any kind of knowledge which is constructed, refined and used by a person during his or her activity. More specifically, in computer-mediated activities, the system can be used to capture (a part of) that knowledge. That kind of knowledge belongs to individual users, is tighly linked to their practice, and constantly evolves along the activity. However, it can in some situations become stabilized (even if partially and/or temporarily), in order to be shared with others. As stated in the introduction of the paper and illustrated in figure 2, we distinguish three poles in a personal knowledge base (PKB), that we define in the first part of this section. Then we present the process of personal knowledge elaboration. Finally, we discuss how personal knowledge can be shared.

4.1 The three poles of Personal Knowledge

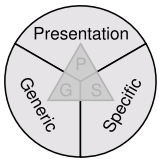

Fig. 2. The three poles of a Personal Knowledge Base

Specific Knowledge The Specific part of personal knowledge consists of formal knowledge that is strongly anchored in the particular activity for which it has been created. It typically includes (but is not limited to) instances of an ontology. In our Semantic PIM example, the instances representing John's contacts information fit in this category. In our Video active reading scenario, temporal annotations on Jane's favourite film are part of the specific knowledge.

Generic Knowledge The Generic part of personal knowledge consists of formal knowledge that is relatively uncoupled from the user's specific activity. It provides additional structure and semantics to the two other parts, in order to enable automatic processing or inferences on the personal knowledge: validity checking, entailment, etc. Schemas, ontologies or rules typically belong to the generic knowledge. In the Semantic PIM scenario, the generic knowledge is the ontology built by John at the beginning of his activity. In the Video active reading example, Jane starts working without any *a priori* personal generic knowledge[5]; she builds it later, when her activity is sufficiently structured.

Although in "classical" workflows in knowledge engineering, generic knowledge is a pre-requisite to further knowledge acquisition, we see that in personal activities, generic knowledge evolves jointly with the specific knowledge (*e.g.* John adding a property to his ontology after populating it), or even sometimes emerges from actual uses (*e.g.* Jane deciding, after annotating sequences of the movie, to define an explicit specific annotation type "Sequence").

Presentation Knowledge Any application sustaining human activity involves, at some point, information that is more directed to the user than the machine, *i.e.* that can not be automatically processed beyond being *presented* to the user. We consider this kind of knowledge the Presentation part of personal knowledge. This includes labels, documents, and any kind of templates or document generators that are used to turn formal information into human-legible forms.

Such information is often neglected, deemed "semantically poor". From the point of view of the user, however, it may be just as valuable as the formal knowledge identified as specific and generic knowledge, and deserves equally the status of knowledge.

First, presentation knowledge provides structure to the other kinds of knowledge, even if implicitly, which prescribes uses, and sometimes misuses. An example is John putting the country of an address in the "city" field, just because this is the way he wants it to be displayed in his address book. Another example are novice users of ontology editors modelling a "part-of" hierarchy in the class hierarchy, misguided by the similarity of what they see with what they imagine (even if the semantics of that hierarchy is not the one intended[6]). There is

[5] Some kind of generic knowledge if obviously imposed by the computer applications she uses, but consequently that is not part of the *personal* knowledge.

[6] Protégé (http://protege.stanford.edu/) can display alternative hierarchies based on any property, including a "part-of" property, but this is a rarely-used feature to the best of our knowledge.

also a third, and more subtle example of the influence of presentation on the construction of specific and generic knowledge in ontology editors. Consider a class Person, with subclasses Male, Female, Student and Employee. Obviously, that second level mixes different points of view, since all subclasses are not disjoint. It may be tempting, and is actually done in some professional ontologies, to define an intermediate level of subclasses, namely PersonByGender and PersonByOccupation, serving as "folders" for grouping related subclasses together. Whether this is a misuse or a legitimate use is an open debate; some may argue that these classes should not exist, because they are extensionaly equivalent to Person, and do not correspond to any useful intension; others may argue that, precisely because they are equivalent to Person, they are semantically neutral and nevertheless provide useful (pragmatic) structure to the ontology.

Second, let us notice that documents, although informal from the point of view of the computer, are often the first stage in the process of constructing formal knowledge; this is why a lot of work has been done on the construction of ontologies from a document corpus [6]. It is also becoming more and more acknowledged by the recent work on Semantic Wikis [13, 5], putting an emphasis on free text editing in the process of knowledge construction. We will discuss that further in the following section on personal knowledge elaboration.

4.2 Personal Knowledge Elaboration

Now that we have presented the three poles of a PKB, let us discuss about its elaboration. We deliberately chose this term of "elaboration" because we consider that the process of personal knowledge creation never stops, hence that personal knowledge is necessarily under constant refinement and never reaches a definitive state. To elaborate personal knowledge actually means to distribute new information between the three poles, reorganizing or refactoring these whenever there is a need for the task at hand in the context of the current practice, as we illustrated it through our motivating scenarios. For instance, beginning from a quite stable state of generic knowledge, new elements can appear, that need to change one's point of view and modify it, so as to reflect and adapt to the current state of practice. As generic knowledge evolves, specific knowledge evolves accordingly, while presentation knowledge displaying them has also to be adapted.

Apart from "internal" transformations in the PKB poles (e.g. adding a new instance in the specific knowledge, creating a new concept in an ontology, creating or modifying the presentation of existing information, etc), we are interested in more complicated elaborations that have an impact on multiple knowledge poles, be it refactoring to adapt a PKB at the task at hand, or to integrate new knowledge into it. We see these transformations as *circulations* or *knowledge flows* between poles. We explore in the following the different transformations from one pole to another, and how it impacts the third one.

From specific to generic knowledge: This corresponds to the modification of a generic model, based on its instances. For example in our second scenario, Jane decides to create new categories of annotation (generic knowledge) from

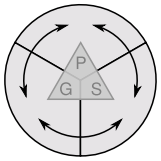

Fig. 3. Circulations in PKB : elements at each pole can be transformed into elements at other poles.

subsets of the existing annotations (specific) based on their "location" attribute. Of course, Jane also has to reflect those changes in the presentation knowledge (the table of content generator). Another example would be the identification of some part of the specific knowledge as reusable in other activities, hence moving it to the generic knowledge.

From generic to specific knowledge: To this category belong the specialisation of a top-level ontology with activity-specific subclasses, or ontology refactoring where a class is changed into an instance of another class. The presentation knowledge usually has to be adapted to reflect these changes. Deciding that something (e.g. a class) we perceive as generic knowledge is specific to our activity is also an example of that kind of transformation.

From specific to presentation knowledge: This corresponds to any kind of standalone document production based on instances. It could be, for example, John sending by e-mail one card of his address book to a friend, or Jane copying the generated table of content back to her word-processor. Note that the resulting document is standalone as it no longer linked to the formal specific knowledge; if the latter is dropped, the generic knowledge can in turn become useless.

From generic to presentation knowledge: This includes, for example, the automatic generation of documentation for an ontology, or of forms useful to populate and browse the ontology. Those kind of tasks are quite common in tools like Protégé. They do not impact the specific knowledge.

From presentation to specific knowledge: This kind of circulation is not new to the field of knowledge engineering: it includes the populating of an ontology from a corpus of documents. In the context of personal knowledge management, however, it also includes much trivial tasks such as copying parts of a static document into the fields of an instance. This is what Jane does when she turns her table of content into formal annotations of the video. It is important to note that it can impact the generic knowledge as well (as when Jane decides to structure annotations with two distinct fields), and that the presentation knowledge itself evolves, but does not disappear (the table of content is changed into a document generator).

From presentation to generic knowledge: Here again, knowledge engineers are familiar with this kind of circulation (ontology generation from corpuses falls into that category). We want to insist on the fact that ontology *evolution* can also be

driven by the presentation knowledge (with an obvious impact on specific knowledge), as is illustrated in the example of John, adding the "country" property to his ontology after circumventing its lack with the presentation knowledge. We also consider that this kind of circumvention is not really a misuse of the formal knowledge, as long as it is satisfying for the user's activity. John feels the need to change his ontology *only* when displaying the country name is not enough, because he wants to group his contacts by country.

4.3 Personal Knowledge Sharing

Knowledge in a PKB is constantly evolving and changing, and circulations are a way to consider its elaboration, but another characteristics of personal knowledge that should be taken into account is its *sharing*. Of course, it is hard to share what is always changing, hence exchanging personal knowledge entails sharing it in a form that keeps its meaning and can be reused. So we consider that what can indeed be shared is an instant view of the user personal practice, a consistent state of a part of the PKB.

From our approach, there are many ways to share such consistent parts. We can easily see from figure 4 that it is possible to share each combination of the three poles. The various possibilities are examined in the remaining of this section.

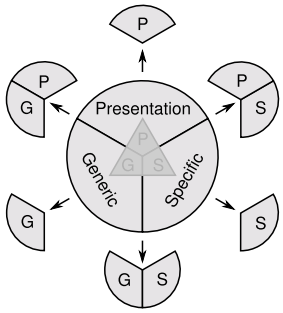

Fig. 4. Sharing the PKB : each corner can be individually shared, as well as each edge and the whole triangle.

Sharing the whole personal knowledge base happens mainly when a work is completed or requires cooperative development. For example, once Jane considers her analysis of the film completed, she can share it with her students to expose her point of view. Since they have access not only to the presentation, but also to the formal generic and specific knowledge, they can then modify or complete this analysis at will.

Sharing only generic knowledge means we want to share our global vision of the activity, our model of thoughts. We share a model, intended to be reused in a later work in the same domain. For example, John could share his ontology built on a subset of FOAF with friends who want to build their own address book.

Sharing only specific knowledge, one assumes that it will be usable by the recipients using their own generic knowledge (to interpret it) and presentation knowledge (to visualize it). For example, John could share its contact specific knowledge with anyone knowing the FOAF ontology – even if they would not grasp all the subtleties of John's own ontology.

Sharing only presentation knowledge happens either on completely self-sufficient or very generic presentation knowledge. For example, John could share his address book, totally unlinked from the formal knowledge used to generate it. On the other hand, Jane could share her table of content generator, suitable to generate a table of content from any set of annotation on any given film.

Sharing both generic and specific knowledge allows a later reuse of the entire formal knowledge defined in a PKB. Not sharing the presentation knowledge lets the receptients free to define their own views to present it acoording to their own interest. For example, Jane can share her annotations together with her model, and let her students define their own presentations.

Sharing both generic and presentation knowledge can be perceived as sharing a template for an activity, providing both concepts to be instanciated and tools to visualise those instances. For example, after Jane has done her analysis on the film, she might want to perform the same analysis on another film. She will so reuse her model and presentation, and will just have to properly annotate the new film.

Sharing both specific and presentation knowledge consists in sharing a document generator together with the formal knowledge it requires to actually generate a document, without giving the recipient access to the generic model behind it. This assumes that the presentation knowledge does not rely on the generic model. For example, John could share with a friend his address book generator and the instances of his ontology. His friend could then re-generate the address book, and even change data, but not perform inferences on the instances.

To conclude this section, our proposal of a personal knowledge model emphasizes the equal importance of presentation with regards to formal (specific and generic) knowledge. This enabled us to systematically consider the different kinds of circulations between, and sharing of those three poles. Current tools permit in some ways to tackle only some of the circulations and sharing we identified. What we think is lacking is the assumption that personal knowledge cannot but evolve, and taking into account the fact that presentation knowledge is real knowledge that should be manipulated in an integrated way with generic and specific knowledge. What is really needed are means to elaborate *conjointly*, *easily* and *explicitly* the different poles of personal knowledge, by implementing

tools that permit effective circulation of knowledge between them. In the next section, we present some works that constitute advances in that direction.

5 Personal Knowledge in Action

5.1 Active reading with Advene

Active reading is the process of elaborating knowledge about a given document, in order to produce a new document (e.g. an analysis) about the former. The Advene prototype aims at supporting active reading of audiovisual documents [3, 2]. Hence, it qualifies as a tool for managing some kind of personal knowledge.

In Advene, a user elaborates personal knowledge by annotating the audiovisual document, organizing the annotations and building presentations to use them. Specific knowledge is formed by the annotation structure the user sets up during his activity. These annotations are organized in annotation types, which are part of the generic knowledge. For example, the categories Jane used in our introducing scenario ("sequence", "outdoor sequence" and "indoor sequence") are annotation types in Advene. Finally, presentation knowledge consists in three kind of views: dynamic views define ways to play the audiovisual document along with annotations, ad-hoc views are customizable interactive views to display other elements in a pre-defined way (a timeline, a tree, a transcription, etc.) and static views are document templates defined by the user to organize and present information, usually in a web browser (e.g. a table of content, a screenplay, etc.). This great variety of views allows users with different tasks to chose the most appropriate ones.

User input is indeed a major driving factor in the development of Advene. The systematic study of knowledge elaboration and sharing that we presented in section 4.2, was actually first conducted in the particular context of Advene. The result has been the instrumentation in the application of the most commonly observed practices. For example, the transformation made by Jane in our scenario, creating two annotation types from the difference existing between the contents of her "sequence" annotations is a noticed practice of Advene users. Another practice already seen with Advene is the import, as a new view, of the content a word-processor document describing a film. Knowledge relative to "moments" of the film is then extracted from this view and transformed into annotations and eventually types, to support later evolution.

Concerning sharing, all the elements produced by an Advene user are saved in a documentary unit called a package. Once a package is made available to others, each annotation, type and view from that package can be individually imported into another package. On the other hand, one can also decide to only keep in the shared package the element they want to actually share; this is often the case with generic and presentation knowledge, where packages containing only types and related views are shared. The example of Jane sharing her annotation types and views (without the specific annotations on the particular film) is an example of such a generic package, supporting an annotation practice.

5.2 Semantic web practices

The importance of informal knowledge in general, and presentation knowledge in particular, is increasingly acknowledged on the web. The initial rivalry between Web 2.0 and Semantic Web advocates has been replaced by mutual interest and productive synergy. We discuss here some example of such synergy.

The power of tags and folksonomies has been demonstrated by popular websites such as flickr and del.icio.us. The structure of a folksonomy is deliberately poor in order to keep it simple to use, extend and share with others (alone, or aggregated with their own personal knowledge). Hence a set of tagged resources could be considered as purely specific knowledge (i.e. without any generic knowledge to structure it) usable by others through a set of common views: tag lists, tag clouds, tag co-co-occurence graphs, etc. This ease of use as sparked off the creation of many independent and creative viewing tools[7] (presentation knowledge).

Another emblematic example is the notion of microformat [11]: a pure presentation medium (HTML) is circumvented to convey more formal specific knowledge. The interesting point in this trend is the microformat motto "DRY: don't repeat yourself": microformat users do *not* want to maintain duplicate information. We see that as an asserted requirement to keep knowledge circulation easy between the presentation and the specific pole.

Semantic Wikis, as described for example in [14] are probably the most interesting applications with regard to our approach: they support quick evolution of the formal knowledge, and put a strong emphasis on presentation —even if their focus is still on the formal part. It is quite easy to elaborate the three poles of one's personal knowledge using a semantic wiki. Circulation from presentation to formal knowledge is supported (by adding semantic link inside textual content), as well as from formal to presentation (using queries and dynamic pages). What could still be added to those tools include: better support for circulation between specific and generic knowledge, means to select a subset of the knowledge for sharing, and more generally the consideration of presentation structures as real knowledge, reusable and sharable as such.

5.3 Personal RDF graph management

Beside our experiment with the Advene platform, described above (5.1), we have been willing to experiment our approach on semantic web technologies. For this purpose, we have proposed PKME, a personal knowledge minimal editor, that can be tested at http://liris.cnrs.fr/~pchampin/wsgi/pkme?intro. That URL actually points to a PKB explaining the basics of the prototype.

In PKME, generic and specific knowledge is expressed in RDF, using the N3 syntax (which is easier to read and write than the XML syntax). For the presentation knowledge we use TAL, an HTML-based template language that

[7] http://www.solutionwatch.com/252/visualizing-delicious-roundup/
http://www.diigo.com/tag/flicker+visualization

we also use in Advene. The three poles are present in the interface (see figure 5.3) and can be conjointly edited, while the rendering of the presentation knowledge is also displayed on the top-left area of the page.

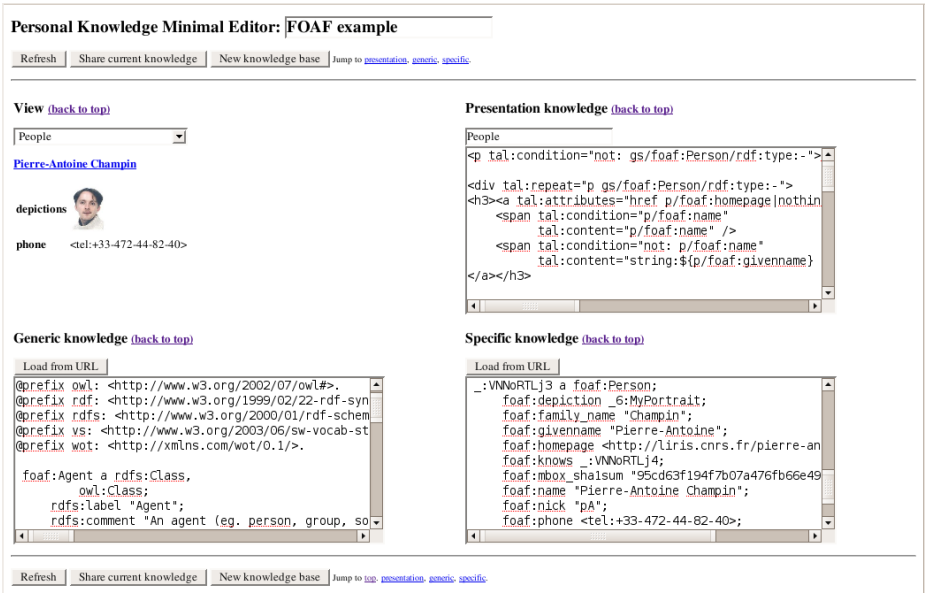

Fig. 5. A FOAF oriented personal knowledge base in the PKME prototype

This prototype is in no way as sophisticated as a full-fledged semantic wiki. It has rather been designed to be quick to learn and easy to use, exhibiting as a proof of concept some interesting features that are complementary to those of existing tools.

First, the visible structure of the presentation knowledge makes it just as valuable as the two other parts for understanding the whole personal knowledge base. One could, for example, learn how to use the FOAF classes and properties by looking at the presentation knowledge used to display them.

Second, circulation between the poles is made easy by making the three of them visible at the same time. Furthermore, the generic and specific knowledge are syntactically homogeneous, making circulation possible by simple cut-and-paste. This is obviously the crudest form of circulation. As it has been done in Advene, more specific assistants and wizards should be provided to enable, for example, the mutation between classes and instances, between properties and reified relations, etc. We nevertheless consider an important feature the homogeneity, in the interface, between the two kinds of formal knowledge, and a necessary first step in the direction of more elaborate circulation tools.

Finally, PKME makes the sharing of PKB very easy: by clicking on the “Share current knowledge” button, one generates a permanent URL to the current state

of their PKB. This permalink can then be shared with others, who can in turn elaborate their own personal knowledge on this basis. The example provided with PKME (as the FOAF example in figure 5.3) have been built that way, encouraging users to fill some slots with their own data (FOAF profile in that case). Note that it is easy to prune the current PKB by emptying one or several of the parts before actually sharing it, making the selection of the shared parts an immediate feature of the prototype.

Let us note that support for the SPARQL[8] query language in the Presentation Knowledge would be a very interesting addition to PKME. Indeed, it would be more readable to most users (it is more widely used than TAL), would allow more circulation since it is very homogeneous to the N3 syntax, and would be easier to share as standalone presentation knowledge (since more applications support it). However, it could not completely replace TAL since it can not generate HTML documents, and having two languages to deal with seemed too complicated for our design purposes. Its nevertheless an addition that we plan for future versions.

6 Discussion

Although in Advene and PKME the *boundaries* between the three parts of a PKB are quite well defined, we acknowledge the fact that it is not the case in all knowledge management applications. Indeed, the difference between specific and generic knowledge is often a matter of subjective judgement, which is why we identified the re-qualifications between specific and generic as a kind of knowledge circulation. A consequence is that it is important for personal knowledge management tool to make apparent the three parts of personal knowledge and let the user know which kind of knowledge they are handling, and how they can actually circulate.

Furthermore, even when one clearly distinguishes the three poles, it may not always be easy to identify the structural *dependencies* between them, and hence the possibility to share them individually or not. It strongly depends on the languages used to describe each kind of personal knowledge, but is usually more difficult for presentation knowledge, for this is the less formal one. A current research direction in Advene is to determine all the annotations, types and other views which are necessary to the use of a given view. The goal is to assist both users exporting views, in selecting the appropriate elements to package with it, and users importing the view, in connecting it with elements in their own personal knowledge.

We already insisted on the role of presentation knowledge as documenting or prescribing uses (or misuses) of formal structures in the generic knowledge. From this point of view, we argue that it can play a key role in the discovery, validation and documentation of *knowledge patterns*. Indeed, such patterns are generally useful with regard to some practice which are in turn captured by the

[8] http://www.w3.org/TR/rdf-sparql-query/

presentation knowledge. On the other hand, such practices themselves also constitute patterns —that we claim to be knowledge patterns since we do consider presentation as knowledge. From the point of view of the documents generated by presentation knowledge, such presentation knowledge patterns may very well be related to document genres [20].

Finally, it would be interesting to evaluate our proposed perspective on personal knowledge in the context of organisational knowledge: when does personal knowledge, through iterative sharing and individual refinement, becomes consensual, organisational knowledge? To what extent do the three parts transpose to more constructed knowledge? What are the constraints imposed on knowledge circulation when several actors are implied in the evolution of that knowledge? In a wider context where multiple organisations are involved, can organisational knowledge be considered as "personal to a group"?

7 Conclusion

In this paper, we have proposed to consider personal knowledge as composed of three parts: specific, generic and presentation. We have insisted in particular on the presentation part (as document and document generators), which we claim must also be seriously considered as knowledge. That tri-partition of personal knowledge allowed us to propose a systematic analysis of elaboration (as circulation of knowledge) and sharing processes. Through examples of actual practices in existing applications and prototypes, we have illustrated the interest of that analysis by highlighting the strengths and lacks in those applications.

Since supporting flexibility is a strong trend in knowledge engineering, we believe that our approach will prove valuable in the design of new knowledge management tools, as well as in the evolution and integration of existing such tools. We are currently improving both Advene and PKME in order to improve their circulation and sharing functionalities.

Besides the sharing of personal knowledge as a static (if temporary) result of the user's activity, we are also studying how the elaboration process *itself* can be represented (as traces of the user's interaction with the system), reused and even shared with others.

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