Open Constitution Based Knowledge Communities in the Semantic Web

Chide Groenouwe, Jan Top

Vrije Universiteit Amsterdam
{chide, jan}@few.vu.nl

Abstract. This paper introduces the "Open Constitution Based Knowledge Community (OCBKC) approach" and explains what role it could play in accelerating the evolution of the small community end of the Semantic Web spectrum. We defend why it is more true to the idea of "regenerative cycles" of Engelbart and of Berners Lee's vision on the Web as a decentralised *social*-technical entity, than approaching the Semantic Web as a technical entity to be adopted by a large audience, which can be designed as if being external to it. We promote the emergence of small knowledge communities that are both constructors as users of the technical as well as the social aspects of their (Semantic Web) environment. We propose to consolidate this through the *Open Constitution*, which is both the set of *tools* as the set of *behavioural rules* used, developed, and shared by a small community during collaborative creation of knowledge.

1 Introduction

The globally spread phenomenon of the fragmentation of knowledge and its negative consequences are and were addressed by many, among which renowned individuals with a considerable overview in the matter, such as Engelbart [1], Visser [2], Bush [3] and Morin [4]. This problem is not only identified by great visionaries, but also confirmed by the daily experience of many people functioning within society, such as researchers, engineers and educators.

The Semantic Web (SW), as envisioned by Berners Lee [5], holds the promise of improving this aspect of human collaboration, by increasing the transparency of the knowledge produced. The SW however suffers from what circulates within the community of SW developers as "the bootstrap problem".

We start by the taking the challenging position that there is no bootstrap problem of *the* SW. At best, one could contend there is a bootstrap problem of an *aspect* of the SW.

1.1 The Regenerative Cycle

Before elucidating our point, let us first briefly reflect on the work of two noted visionaries: Engelbart and Berners Lee. First, a fundamental message to be derived from Engelbart's approach is not so much the tools he defined (including

hypertext and the mouse), but the "regenerative cycle" that consists of an amplified human intelligence that reflects on itself to improve its own means for intelligence amplification. As he states: "All of this means that a significant improvement in symbol-structure manipulation through better process structuring (initially perhaps through much better artifacts) should enable us to develop improvements in concept and mental-structure manipulations that can in turn enable us to organize and execute symbol-manipulation processes of increased power. To most people who initially consider the possibilities for computer-like devices augmenting the human intellect, it is only the one-pass improvement that comes to mind, which presents a picture that is relatively barren compared to that which emerges when one considers this regenerative interaction." [1] Second, Berners Lee states: "The Web is more a social creation than a technical one. I designed it for a social effect - to help people work together - and not as a technical toy." [5]

We could draw two lessons from these authors. First, we conclude that "the" SW, envisioned as the well-known cake including XML, RDF and OWL layers, only represents a (transitory) aspect of an elusive entity in its becoming, which extends in technological as well as social dimensions. Second, are we to escape a repeating history of overcoming the social resistance to changing from one fixed vision on (collaborative) knowledge acquisition to the next, we should fully respect the "regenerative cycle" of Engelbart by promoting the occurrence of knowledge communities capable of *changing* vision in response to an ever growing level of understanding. Shortly, we promote the knowledge community's *ability to change* instead of *adoption of a certain technique*. We can reach this by lowering the boundaries for knowledge creators to become partakers in shaping their own knowledge environment, including technical and social dimensions.

1.2 OCBKC approach

We propose an approach that is a step in this direction, provisionally coined the *Open Constitution Based Knowledge Community-approach* (OCBKC approach). It is an approach for the smaller *Knowledge Community* (KC) (such as for example, a research team), which, next to making use of tools for collaborative creation of knowledge, do the same for a written set of behavioural rules (or shortly rules). The set of tools and the set of rules is coined the *Knowledge Constitution* (or shortly the *Constitution*). An OCBKC is *Open* in two senses: 1) external: the constitution is open to the public for reuse; 2) internal: the constitution comes into existence in a socially decentralised process within the KC, thus each member of the OCBKC is either designer or supporter of a rule or a tool. Another way to put it is: a technical system is programmed with an open source-code, a socio-technical system with an open source-code and an open behavioural-code.

The first constitution will be provided by us and is now under development. In the development of this first constitution we take the SW philosophy as point of departure. Specifically, the tool environment will be based on extensions of

the Semantic Wiki *Subleme* which was developed by foundation Network Universalis.[1]

1.3 Related Domains

Next to the SW vision, we would like to mention some challenges emerging from related domains which are strongly related to the proposed OCBKC approach:

- Literacy in Semantic Network Writing. An essential ingredient in the fields related to CSCA (Computer Supported Collaborative Argumentation) is the development of what we will coin a "literacy in semantic network writing", or briefly "semantic writing". Semantic writing is the ability to express one's thoughts in a fine-grained fashion in a semantic network (speaking in SW terms: in RDF triples) instead of natural language text. Several authors have identified the lack of this form of literacy as the reason for the lack of adoption of Semantic Web Tools in face-to-face sense making sessions [6–8]. The problem posed in CSCA underlines the elusiveness of "the" bootstrap of the SW. Even when RDF triples would be used widely, for example for annotating documents and exchanging webservices, this doesn't imply people also being actively involved in explicitising *content knowledge* on a large scale through semantic writing. [2]
- Development of Semantic Desktops and Semantic Wikis. Semantic Desktops [9] and Semantic Wikis are both technologies which aim for allowing people direct access to a SW experience through their personal computers. Within the first envisioned OCBKCs this is exactly what will happen, but additionally, a set of behavioural rules needed to make optimal usage of such an environment during the collaborative creation of knowledge will be subjected to evolution. *Subleme* as part of our first constitution.
- Fostering Learning Communities – as envisioned by Visser [2]. Educational specialists promote the occurrence of highly decentralised communities in the learning environment (also beyond the scope of educational settings, so including all places where learning takes place such as the working floor). Within these communties, learners are not only users, but also the constructors of their own learning experience [10]. These structures are based on the observation that preparation for life in most places of the world is no longer a linear process, but a process of continuous unlearning and relearning. OCBKCs exactly promotes this principle, as has been made clear.
- Reducing fragmentation in science. The most efficient way to produce scientific knowledge is by extending, reusing, and reinterpreting the complete collective body of knowledge produced till so far, and not to proceed by duplicating and neglecting good work that already has been done by others. In the ideal situation this would require any scientist to have an overview

[1] http://www.network-universalis.org Subleme can be downloaded from: http://www.xs4all.nl/ vissermc/Subleme.exe

[2] throughout this article we will use the word "to explicitise" in the sense of "to make explicit"

of this collective body of knowledge. The landscape of scientific research, however, is highly fragmented.
Knowledge technology research and science are mutually highly beneficial for each other. Seen from the perspective of science, knowledge technology, of which our OCBKCs form a part, could help to fight fragmentation within their domain. Vice versa, from the perspective of knowledge technology, science is one of the best case studies imaginable, because of the institutionalised goal of science to make knowledge as transparent and explicit as possible and to extend work of others to the greatest degree possible.

1.4 Overview

In the next section, 2, we will elaborate on the role OCBKCs could play in accelerating the evolution of the knowledge landscape. The subsequent section, 3, is devoted to the first constitution, followed by a description of the approach taken in the first experiments with OCBKCs in Sect. 4. The article concludes with a glance on expected future work in Sect. 5.

2 The Role Of OCBKCs in the Knowledge Landscape

In order to delve into the matter of the role and position of OCBKCs in the complete knowledge landscape in somewhat more detail, we will sketch a view on this landscape and the knowledge communities within it to the extent necessary to do this. We will classify OCBKCs as knowledge communities with a high degree of self-similarity, a notion explained in Sect. 2.1. After that we will develop the notion of Semantic *Micro* Web (2.3), which allows us to establish the focus of our study: at the intersection of OCBKCs and Semantic Micro Webs 2.4. We conclude the section with the consequence of the external meaning of *Open*: an ecology of constitutions.

2.1 The Knowledge Landscape

The complete world knowledge landscape is composed of people and their tools for collecting and sharing knowledge and manipulating representations of knowledge. With some simplifications, it can be thought of as being composed of smaller units, that in their turn consist of smaller units, until we reach the level of smaller knowledge communities and individual knowledge workers. Of course, these units are intensively overlapping and do not only form hierarchies, but also networked structures. On one end of the spectrum (the microscopic level) stands the individual knowledge worker, and on the other end we find the complete world knowledge society. Note a KC doesn't have to be restricted to people working in the same physical space or formal social structure (such as a research group, or a family). We will now clarify why we think a specific kind of KCs, those with a high degree of *knowledge self-similarity* will play an important role in the evolution of the knowledge landscape.

2.2 Self-Similar Knowledge Communities

In mathematics, an object is self-similar when the whole object is reflected in each of its constituting parts. An example is the fractal-structure, which is composed of parts that bare a remarkable resemblance with the fractal as a whole, a property that also holds for these parts, ad infinitum. In the context of knowledge communities, we define self-similarity as follows: a knowledge community has a high degree of *downward self-similarity*, when the properties of the complete community are reflected in each sub-group of the members of that community, up to individual members. It has a high degree of *upward self-similarity*, when the property of the community as a whole reflect the property of the knowledge society it is part of. When it is both, we will state that it has a high degree of self-similarity.

A knowledge community with a high degree of self-similarity has a tremendous potential in accelerating the evolution of the knowledge society, because it allows the convergence of normally fragmented aspects of the knowledge landscape to such an extent that the conditions are created for transcending them. Engelbart's laboratory was an example of such an environment with a extraordinary high degree of self-similarity: *one* community within which, among others things, the roles of being *user*, *knowledge worker*, and *knowledge environment developer* converged into one small single community, and in the case of Engelbart himself in one single person.

On the other end of the spectrum of self-similarity we find the knowledge community composed of highly *mono-specialised* parts, for example, an organisation which consists of a specialised group of people involved in choosing and developing the tools for knowledge exchange, and people largely subdued to these choices, the knowledge workers. In that world much more notions are fixed where they are fluent in the community with a higher degree of self-similarity. These hardly self-similar communities are trapped in a continuous cycle of overcoming social resistances in the evolution process of the knowledge landscape.

It is important to note that we do not envision an ideal of a "self-similar knowledge society". Among other things, not everyone has the specific talents needed to partake in such a community and some elements may require hyper-specialisation. Closer to our vision is the view that it is beneficial to foster the occurrence of a sufficiently high frequency of those forerunner communities, acting as breeding places where parts of the knowledge landscape's evolution can take place in an accelerated fashion. Some of these aspects will find their way to a larger audience, perhaps in a simplified, weakened, but still very beneficial form. Also, OCBKCs with a lesser degree of self-similarity can be fostered within existing communities, for example, to act as local forerunner subcommunities of the community they are part of. This is, for example, what we have planned to do within Wageningen Center for Food Sciences (see 4.3) with a selection of employees who show interest in participating in such a community.

2.3 From Semantic Micro Webs to Semantic (Macro) Web

Berners Lee stated that the time has come to make the SW accessible to the end-user, and encourages developing "end-user applications", such as Semantic Desktops and Semantic Wikis. We very much agree with this goal, however, we propose another view on these "end-user" applications. We propose regarding the socio-technical units they form together with their users not as a part of a big socio-technical entity, much like a steer is part of a bicycle, but as self-similar reflections of the (World Wide) Semantic Web into smaller units, much like a solar panel consists of smaller solar cells, which shares many of the functioning of the whole they are part of, and which can also function independently of the whole. High quality solar cells are indispensable for the functioning of the whole solar panel. We have coined the term "Semantic Micro Web" for this, as opposed to the regular Semantic (*Macro*) Web.

A Semantic Micro Web, thus, is a self-similar knowledge community, composed of people who are *exploring* what it means to share the knowledge within the community boundaries in accordance with the SW philosophy, *while* sharing their knowledge in accordance with the SW philosophy. They are both creators as users of the SW philosophy of knowledge exchange within the boundaries of their community.

The motives behind fostering Semantic Micro Webs translate directly from the advantage of self-similar knowledge communities. Some foreseeable as well as unforeseeable dimensions of the SW will most probably first come into existence and maturity within these small units, such as, for example: 1) the ability (and habit) to express and share one's thoughts fine-grained through semantic writing and 2) a highly decentralised coining of terms (decentralised ontology integration, mapping and emergent semantics). In a Semantic Micro Web, the SW philosophy can exist *immediately* on a small scale, as opposed to a Semantic (Macro) Web, which has to be adopted by the huge external party it is intended for ("the world"). It is a fact of history that many already used hypertext intensively on a small scale, including Berners Lee himself to organise personal data [5], before it conquered the world. The hypertext user-community, thus, grew from small, but fully operating, socio-technical units, to a world wide socio-technical unit, while the majority of research and development efforts in the SW area seems to be more focused on conquering the world before their paradigm fully exists on a small scale. We, therefore, ask ourselves the question whether it wouldnt be a better idea to assign a greater part of our attention to fostering Semantic *Micro* Webs!

2.4 Positioning OCBKCs

Our research is aimed at the intersection of OCBKC and Semantic Micro Webs, thus OCBKCs that have chosen for a representing their knowledge in accordance with the SW-philosophy (see Fig. 1). This is so because we assume that in the current pass through Engelbart's "regenerative cycle", the SW philosophy is among the best candidates which can help us reach an increase of transparency of knowledge.

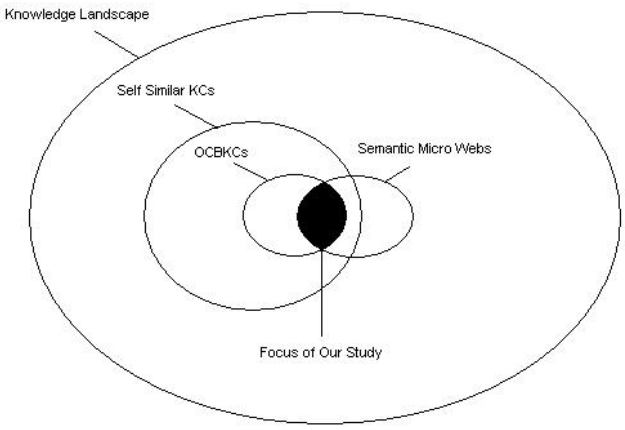

Fig. 1. The focus of our study

2.5 Ecology of Knowledge Constitutions

The second meaning of openness in the phrase "Open Constitution Based Knowledge Communities" is that each OCBKC makes its constitution publicly available for use in other OCBKCs. In other words: it is an *open source constitution*, which allows the behavioural rules to enter an effective and transparent evolution space, as was until now only reserved for the tool dimension (open source *software*). Our hopes are that this will initiate an ecology of knowledge constitutions which will both stimulate the maturation of constitutions as the emergence of a wide variety of constitutions. Self-evidently, maturation is a desirable process, but also the existence of a wider variety of mature constitutions will most probably prove to be important. Constitutions as followed by a specific knowledge community will inescapably demand domain and group specific characteristics, but on the other hand characteristics which will be common to larger communities, or common to all of them.

3 The First Constitution

In this section, we will not develop the constitution which we have currently under development in full detail but provide an important part of the general guidelines it is based on. We remind the reader that we position ourselves as initiators and part of an evolution process, instead of external designers hoping to find a fine-tuned constitution "to be imposed" on a knowledge community. The constitution as developed is, seen from this meta-level perspective, a snapshot of a constitution of an OCBKC at an initial stage, to be developed further by the OCBKC members themselves.

The first constitution, a bundle of the "tools and rules", will be made downloadable from a webpage of our institute (Vrije Universiteit Amsterdam), as soon as it is finished.

3.1 Behavioural Rule Environment

A KC following the first constitution collaborate in a synchronous setting in which all thoughts of participating members are shared *real-time* and in a *fine-grained way* in the SW-compliant knowledge base of the KC. Thus, thoughts are transcribed very accurately in the knowledge base, at the moment they are conceived. The most important guidelines which are worked out in detail in the first knowledge law are the following.

The members of the OCBKC are first exposed to the set of (behavioural) rules, which they have to internalise. When some of them cannot "live" with the rules, they are allowed to leave the OCBKC, or propose to the other members to change them.

SW as Knowledge Representation The knowledge representation chosen takes the knowledge representation of the SW as point of departure. In addition, the rule is to be as exact and pure as possible with regards to the semantics of the entities (= SW resources) used. Additional points to be made about the knowledge representation are provided in the following list.

- *Disambiguation of a "document about the thing" from "the thing" itself.* The current SW knowledge representation does not seem to explicitly disencourage a peculiar ambiguity to occur, which we will elucidate with an example. The URI `http://www.china.cn/hujintao` can end in a webpage, but at the same time be used to refer to another entity, that in this case is even external to the web: the president of China. Related to this problem is a thing we encountered several times in the Semantic Wiki community, in which the identifier for an *explanation of a thing* is not disambiguated from the identifier of *the thing* described (such as for example in Semperwiki [11]). This ambiguity can easily be solved by separating the URI which identifies a *file about the thing* from the URI that identifies *the thing* itself. For example: using, `http://www.china.cn/webpageabouthujintao` to denote a webpage about Hu Jintao and `uri://www.china.cn/hujintao` which is a pure identifier of the president Hu Jintao in flesh and blood.
- *No use of the term metadata.* The term "metadata" is a term that can give rise to quite some confusion. Since the SW was formulated as an extension on top of the current web, it suggests a view in which text documents in natural language contain the content information, and a layer on top contains "additional" information which makes it easier to find the "content information". This also seems to be reflected in the term "Resource" being used in RDF, which is a bit of a misnomer because it seems to implicitly suggest that it is only used to describe resources of information. (However,

note that Berners Lee explicitly declared that it could also be used for entities which are "not retrievable" [12].) When considering semantic writing, as defined earlier, as a first class means for expressing knowledge (as also suggested by [13, 7]), content information is directly expressed in RDF triples, rendering RDF triple data from metadata to also being used for expressing content-level knowledge. At the heart of the problem lies the fact that classifying information as "metadata" is a matter of *perspective*. The annotation `author = [Agatha Christie]` of a document on the web could be considered as metadata, but exactly the same information in the context of a biography of the same author, is suddenly considered as content-data. For this reason, in the first constitution, we do not use the term metadata, but make only a distinction between knowledge provided in semantic network representation, or in another form (for example documents in natural language).

– *RDF representation for all data.* All knowledge and data is stored in the same knowledge representation system: RDF. This includes all data produced by the tools and process knowledge. For example: this constitution will also be stored in a RDF representation in the knowledge base of the OCBKC, and judgments made *about* knowledge in the knowledge base, are also stored as RDF triples.

Socially Decentralised Introduction Policy for New Entities (Resources). Members have to make use of a highly socially decentralised entity (note, we use the word instead of SW resource) introduction policy. While expressing a thought, new entities might be needed to be defined. Each member can propose a new entity. It must first go through an acceptance procedure, until all others member agree that it 1) it isn't an entity defined earlier 2) it has an unambiguous meaning.
Motivation: In accordance with high degree of self-similarity.

The OCBKC is Initialised with Predefined Entities by Means of the Introduction Policy for New Entities. Some entities are predefined in the constitution (such as for example, to express judgments about knowledge). All members of a new OCBKC first have to make a "mental copy" of these entities defined, through much the same acceptance procedure as they use when proposing their own entities.
Motivation: Using the same introduction policy for the predefined entities as for the member's own defined entities is in accordance with the high degree of self-similarity of the OCBKC: the members being their own constructors of their environment. In a sense, the designers of the first constitution position themselves as the first members of that OCBKC, who have done some prework. Note that in this we clearly depart from another approach taken often, in which one positions oneself as an external designer of a fixed ontology to be used by a community (as for example in ClaiMaker [14]).

Socially Decentralised Introduction Policy for Propositions. Every member can create a proposition (in the form of a set of RDF triples or a natural language text resource) in the knowledge base, which has to be evaluated by all the other members as soon as possible. The evaluations are also stored in the knowledge base as triples, for example: `[Pete] --agrees with--> [Proposition A]`. Conflicting opinions may exist next to each other. There is an initial set of entities developed for doing this, which may be expanded during the session.
Motivation: In accordance with principle of self-similarity.

Maximising Enrichment Of Explicitised Knowledge and Expressing Knowledge as Context-Independent as Possible. While explicitising knowledge it is put in the knowledge base 1) as context-independently as possible, and, for the same reason, 2) enriched as much as possible with links to other entities. Both actions improve the reusability of the same knowledge across contexts.

Maximise Knowledge Self-Similarity. All propositions in the knowledge base have to be evaluated by every member as soon as possible, to maximise so called "knowledge self-similarity": all members covering the same knowledge. The systems keeps a record of who has evaluated a proposition at which moment, and automatically prompts a member to evaluate new propositions. When a member agreed with a certain proposition being true, it is put on some sort of rehearsal scheme to ensure a regular refreshing of the mind of that member. A number representing the degree of knowledge self-similarity of the KC is fed back to each of the members, and the basic rule is that everyone is actively engaged in maximising this number.

Maximise Level of Explicitation of Knowledge. [3] There are different levels on the scale of explicitation of knowledge, varying from knowledge expressed in RDF triples which connect entities with a simple and clear meaning (= very explicit) to knowledge expressed in a resource that contains a text in natural language (= obscure) [13, 8]. The more relevant a member deems the knowledge he expresses to be for solving the problem, the higher the level of explicitation should be.
Motivation: promote collaboration in knowledge creation by increasing transparency and reuse of knowledge

3.2 Tool Environment

Many parts of the tool-environment and the rule-environment are two faces of the same coin. For example, the introduction policy for new terms is supported by the tools. In the written constitution, however, the tools are specified in detail to ensure the right implementation. Important guidelines for the tool environment design are the following.

[3] We define "explicitation" as "the process of making explicit"

The Basic Graph Manipulator. There is a tool, the basic graph manipulator, which allows any member to edit *any* part of the complete RDF graph as it is. This means: introducing new entities (resources), and creating new triples. This manipulator can be enriched with querying services using inference engines. Of course, in many cases, when a member would use the Basic Graph Manipulator freely, he or she would violate the rules.

Extended Services. Other services are provided to make certain tasks *easier*. For example: to support the introduction policy for new propositions, an extended service is created which prompts the member that a new proposition has arrived, and automatically creates the necessary triples when a member agrees with it. But it should in principle *always* be possible to reach the exactly the same using the Basic Graph Manipulator only.

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4 First OCBKCs

4.1 First Family: Tame Problems

The first sub-family of OCBKCs fostered by us are characterised by the following properties: 0) They will take the first constitution as point of departure; 1) Each OCBKC is composed of a group of volunteers of about 2 to 15 persons; 2) They will be confronted with an easy mathematical challenge to be solved collaboratively; 3) They are initiated with the initial constitution, so the set of tools and the set of rules; 4) They are – of course – allowed to change the constitution while they are working, which we don't expect to happen in these first premature and quite artificially formed OCBKCs; 5) Each OCBKC will only exist during a session of a few hours.

The choice for a mathematical problem is based on the fact that it offers us, as experimenters, a much more objective instrument to evaluate to what extent the environment helped the group to solve the problem effectively. That a mathematical problem has been solved can be verified unambiguously, which is much harder with a problem such as "what kind of political structure is likely to arise in Cuba ten years after Fidel Castro".

4.2 Second Family: Wicked Problems in Experimental Research

Depending on the outcomes of our experiments with these first premature OCBKCs, we will investigate OCBKCs that are exposed to problems of a more "wicked"

nature [6], that is problems for which there is no clear way to verify whether a solution has been reached. In our case, we will mainly focus on problems within the domain of experimental research, in specific within Wageningen Center for Food Sciences, which serves as the primary case study.

4.3 Volunteers: Vrije Universiteit Amsterdam, Wageningen Center for Food Sciences and... You?

The first volunteers to populate the OCBKCs will be sought under researchers of our own group within the Vrije Universiteit Amsterdam and Wageningen Center for Food Sciences (WCFS), with which very close relationships exist. However, we warmly welcome readers from a variety of other domains to contact the authors when they would like to participate.

Vrije Universiteit Amsterdam does not need much introduction within the SW community of researchers, for it has a highly active SW research community in particular lead by Schreiber and van Harmelen.

Wageningen Center For Food Sciences (WCFS) is an internationally renowned research institute which performs long-term strategic and fundamental research for the development of new and innovated food with attention to health aspects. Many of its researchers belong to the international top of their field. WCFS embraces new ways to share knowledge, with a special focus on improving the experience of the individual researcher and research teams. Currently they are developing their own Research Management System (RMS) in which all research data, but much more uncommon, also *argumentative and reflective (about the best way to, for example, carry out experiments) knowledge* is translated into an RDF compliant knowledge base. The degree of "self-similarity" within WCFS is above the average, as is witnessed by the fact RMS is developed in house and the relative high degree of researchers both investing time in their research topic, as in improving their organisation as a place for collaborative creation of knowledge.

5 Future Work

Our future work will consist mainly of fine-tuning the OCBKC approach by exposing it to a specific field of knowledge work, that of experimental research. Next to this, we consider it essential for our study that people in other domains apply the same approach, and with this contribute to the "ecology of open constitutions". We will promote this to happen by successive publications, and by founding a webpage from which open constitutions can be downloaded (*"semantic tools and rules, ready for use!"*, it almost rhymes). Moreover, people within the juridical world have shown strong interest in participating in OCBKC experiments as well.

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