Trikonic Analysis-synthesis and *Critical Common Sense* on the Web

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Abstract. The Web is changing the ways we collaborate on projects in virtual communities. There is a need to develop not only tools and ontologies relating to the semantic level of the Web, but pragmatic approaches which consider the roles of the participants in collaborative and other virtual communities. Our approach to this involves Peirce's notion of *critical common sense* taken in connection with his pragmatism and facilitated by |>*k (*trikonic*, Peirce's category theory in diagrammatic form). It is argued that in collaboratories group observation and manipulation of |>*k diagrams could be of value in certain analyses. Six |>*k vectors (showing movement through the categories) are explicated and the potential of |>*k vector analysis for facilitating inquiry directed to collaboratory project development is considered in conjunction with *critical common sense.* A *chiral cycle* involving all six vector patterns in a "melding order" is analyzed. Future research includes the need for the development of a |>*k tool supported by a consensus-seeking and report-authoring element.

1. Introduction

It is difficult to overstate the impact that the World Wide Web has had on the ways we work together and, indeed it "has profoundly changed the way people collaborate" [7]. Through its potential effect on the ways people *will* come to collaborate in the future, the Web may come to significantly impact virtual community development, including those communities associated with the development of the tools & ontologies of the WWW itself. It will certainly do so if it begins to approach the character of a Pragmatic Web [3, 5, 6, 7] which involves the notion that the creative potential of new and evolving approaches to collaboration ought to be fully explicated, and that the most promising of these meta-theories and pragmatic methods of evolving collaborative practice ought to be developed toward completion theoretically and practically. Now, the Semantic Web is concerned with facilitating the interchange of data through the development of useful ontologies and common formats relating data to real world uses, but the proposed Pragmatic Web is directed to contributing as well to the growth of significant purpose and meaning especially in

distributive collaborative settings. The Semantic Web can provide the tools for enhanced collaboration, but only a Pragmatic Web could help provide authentic meaning and purpose to virtual communities and their projects [5, 7] including that of the further development of the Semantic Web itself.

But what can catalyze the Web's further development in these promising semantic and pragmatic directions? Hinting at an approach to an answer, Tim Berners-Lee has commented: "What matters is the connections, and when people see the value of connection and what can be done with that—which is not defined by me, it's defined by the users—we will see the explosion" and suggests that what will probably "break open" the Web will be "a simple but profoundly useful feature or service which becomes possible with the Semantic Web" [1].

It seems to us that the creative potential in certain new approaches to facilitating collaboration would appear to be, if not "simple," yet certainly a "profoundly useful feature" were it fully explicated and developed theoretically, supported by suites of tools seeking to optimize collaborative work. This "value of connections" appears as well in de Moor's method for legitimizing what he calls "user-driven specification of network information systems" [3] needed to facilitate decision making and consensus building at all stages and levels of virtual community development, most notably in testbeds within collaboratories [6]. In short, there is a need for the further development of such pragmatic approaches as take fully into consideration the roles of those using the tools and technologies relating to virtual communities [17].

A promising approach to this for collaboratory development involves Peirce's notion of *critical common sense* taken in connection with his pragmatism and facilitated by the development of new approaches to internet collaboration such as our diagrammatic |>*k (*trikonic*), the applied science of trichotomic, representing Peirce's category theory[1]. It will be argued that in collaboratories group observation and manipulation of |>*k diagrams could be of value in considering those aspects of a project amenable to tricategorial analysis, and that, in particular, it would assist reaching what agreement can be reached, for example, in legitimizing the decision-making processes important to the growth of virtual communities[2]. In Sect. 2 Peirce's Critical Common Sense (CCS) is analyzed in its relation to pragmaticism. Sect. 3 introduces and Sect. 4 further explicates the six |>*k vectors or movement through the categories. Sect. 5 demonstrates how the important *chiral cycle*—involving all six vector patterns—might be employed for collaboratory and virtual community development and points to Sect. 6. future work.

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[1] One can get a sense of |>*k as expressing Peirce's category theory by perusing a |>*k slide show we wrote, prepared in PowerPoint by Ben Udell [11]. Although not constructed as a primer of trichotomic category theory but to support an ICCS04 PORT tutorial, it yet roughly outlines several branches of Peirce's Science of Discovery, that is, *pure theoretical science*. The slides, especially when considered in the light of a paper [10] outlining the system, show individual trichotomic relations, inter-relations of various trichotomic structures and processes, e.g. "trikons of trikons" as in the analysis of semeiotic grammar, strings of them as in the diagram of Peirce's Classification of the Sciences, and analytical or temporal "vectors" which are touched upon in connection with virtual community development.

[2] Used in conjunction with theories, methods and tools for creating *group reports* [4].

2. Implications of Critical Common Sense (CCS) & Peircean pragmatism for Collaboratories

Peirce's conception of CCS has been given relatively little analysis even within specifically Peircean studies. We suggest that considering the role of CCS in socio-technical contexts may prove to be a significant factor supporting the further development of collaboratories and other virtual communities pursuing common inquiry, seeking to share methods and approaches, or pursuing the development of tools to facilitate the virtual work at hand. It can be argued that development in such contexts would tend to increase when principles and practices are legitimized by the community and when, in addition, significant and often subtle cultural differences and other ambiguities are acknowledged and respected [7]. On this pragmatic basis, agreement regarding for example the direction, personnel, and other elements involved in particular collaborative endeavors may *conceivably* be reached. A deeply held "general agreement" in matters of importance to a community suggests what is meant by CCS here. Reaching agreement after critical analysis in matters small and large would tend to significantly positively impact virtual community development. Still, as de Moor comments:

> The need to accept a necessary amount of ambiguity by communities of users assessing the consequences of semantic choices in a particular pragmatic context, implies that there needs to be some user-controlled *selection* process of semantic representations. In such a process, members of the community using the knowledge for a particular purpose themselves are actively involved and aim to reach agreement only on relevant knowledge issues[7].

Peirce begins his argument for CCS by noting that in fact we do hold *some* matters to be, as it were, "indubitable," that we have all come through our life experiences to know certain things in this way. He gives as a familiar example that every rational person does not doubt that if he were to put his hand into a fire then it would be burned. Were one to truly doubt this—say, as a young child could—he might make the experiment, inserting his hand in order to "settle his doubt" in the matter[3]. But Peirce further argues that CCS may be of the greatest importance in the evolution of thought and especially scientific thinking, and that the developed practice of it is essential in a pragmatic approach to inquiry. But how are we to reach such agreement in many subtle & complicated intellectual and organizational issues even when we follow de Moor's helpful suggestion that, in dealing with matters of pragmatic complexity, we "only model constructs that are essential to reach joint objectives"[7]?

And while it may seem clear enough to some of us that that there has been a modicum of success in reaching consensus in such rigorously inductive procedures as those required by the special sciences (which the development of powerful technologies nearly proves and at least demonstrates admirably), yet how—especially as we strive to balance individual and community needs—are we to come to

[3] As learning may be through experience *or* reasoning—external or internal—this example is not sufficiently representative of all the kinds of *indubitable* ideas we might and indeed do have.

significant agreement in socio-technical matters involving decisions relating to the whole complex of roles & social relations of the participants in a given project (say the direction to be taken in an internet research issue, or the selection—or even the *process of selection*—of tools needed to facilitate the efforts of a collaboratory within a given virtual community)?

Peirce holds that perhaps more than anything else *diagram observation and manipulation* can facilitate the group consideration of significant relations and thus facilitate reaching agreement, especially in inquiry and in matters concerning processes, methods, and so forth. Building on such agreement in principle we could further explore ways to best implement that which we together discern to be desirable and potentially valuable for our communities. Peirce's semeiotic[4], pragmatism and critical commonsensism facilitated by |>*k vector analysis may provide one important means to this end, namely, group diagram observation and manipulation of trichotomic relations deemed important to the work of a given collaboratory or virtual community[5]. Peirce maintains that it is "reasonable" despite some appearances to the contrary to imagine that we can reach agreement towards potential solutions to problems which may even have seemed intractable but, given the proper tools and methods, may prove not to be[6].

In one important sense, the recognition of critical commonsense represents an aspect of the growth of a shared understanding of what we can finally take to be those principles and practices, especially methodological ones, which have been not only fully examined and criticized *by us*, but some of which are determined to be of considerable value *to us*, that is, to our particular communities of interest. And there is an intrinsic ethics involved in this process, "an ethics of fairness and impartiality" as Peirce puts it [CP 6.3] such that anyone who searches for or tries to persuade us to "arguments for a conclusion which he wishes to believe," say for merely personal benefit, undermines the integrity of the work of any given community. The truth of any matter important to a community—if one can even speak of the fallible, tentative, and asymptotic approach to agreement in any significant matter as "truth"—will certainly be *our* truth, not mine or yours, etc. (a point to which Berners-Lee's above-quoted comments allude). As difficult as it may appear to be to practically achieve this ethic, it would seem of potential value to explore approaches tending toward it. This may involve acknowledging CCS as it factors into pragmatic approaches to inquiry and to project & community development. Indeed Peirce argues that without the developed practice of critical common sense, even his "pragmatism amounts to very little" [EP2, 433].

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[4] In [14] de Souza has shown that in this context the most important communication occurs between the designer and the user with the technology serving as medium. Naturally this impacts decisively and constructively on design philosophy.

Relation of designer to user:
The designer communicates 1/3/2 |> *through* the technology (seem as medium) to the person, the user.

[5] Peirce's semeiotic theory has a very modern concept of virtuality embedded in it [12].

[6] Sowa has in several places [e.g., 15] analyzed how Peirce's pragmatic approach to inquiry represents exactly how "symbols grow" and what is required for knowledge itself to grow.

3. Outline of |>*k vector[7] analysis/synthesis

It is possible now to begin to connect CCS to |>*k analysis-synthesis. This will require especially an explication of six |>*k vectors which analyze trichotomic movement through the three categories as represented in the trikon[8] (or group of trikons composed of trikons, or thread of linked trikons, etc.) diagramming the trichotomic relations involved. In facilitating inquiry directed to collaboratory and virtual community development, |>*k vector analysis can be seen exactly as leading to a moment of applied *critical common sense*.

As noted in [10], *vector analysis* would seem to represent something like the active principle of a vital trichotomic as it might function in collaboratory and related activity. However, vector analysis was not fully developed and, indeed, is barely adumbrated in Peirce's writings, yet the few explicit discussions of categorial paths & "orders" make it clear that there is indeed *significant* movement through these trichotomic relations. In other words, there is an active principle at work which is not merely analytical but reveals an underlying thrust, a *telos*, so to speak.

Peirce's discussion of vectors ("orders") in "The Logic of Mathematics"

In a discussion in "The Logic of Mathematics" Peirce outlines the structure that will hold for all trichotomic vectors, that is, the six possible paths of movement through the three categories. He prefaces this discussion with a comment which was in fact the original impulse for our developing |>*k.

> [T]he triad. . .has not for its principal element merely a certain unanalyzable quality sui generis. It makes [to be sure] a certain feeling in us. [But] the formal rule governing the triad is that it remains equally true for all six permutations of A, B, C; and further, if D is in the same relation at once to A and B and to A and C, it is in the same relation to B and C; etc.[CP 1.471]

From this and other principles discussed in the "The Logic of Mathematics" it is possible to derive pairs of opposite vector which Peirce does explicitly in this one case.

a. Order and analysis vector pair

In a rich and suggestive passage, Peirce pairs the "order of evolution" with an "order of involution" (The evolution is in a Hegelian, i.e., dialectical sense, our *vector of order*. The order of involution is involved in Peirce's own "guess at the riddle," such

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[7] Robert Parmentier [9] first used the term "vector" to refer to Peirce's "orders". Its use in Peirce's category theory and semeiotic is not related to its use in mathematics.

[8] I.e., |>, but more properly looking somewhat like the outline of a forward button on an electronic device, an equilateral triangle on its side pointing to the right—to the future—and representing a genuine trichotomic relationship: 1^{ns} above, 2^{ns} below, 3^{ns} to the right.

that, linking his "Reduction Thesis"[9] to his theory of continuity, Peirce derives his three universal categories). The 'orders' are, for the purposes of the immediately ensuing historical discussion, given the names Peirce first offered in his discussion in "The Logic of Mathematics." However, to be consistent and clear in terminology, in contemporary trikonic the 6 vectors are designated as follows ***1/2/3:*** order (="dialectical quasi-evolution") **&** ***3/2/1:*** analysis**;** ***2/1/3:*** determination **&** ***3/1/2/*** representation**;** ***1/3/2:*** evolution **&** ***2/3/1:*** aspiration.

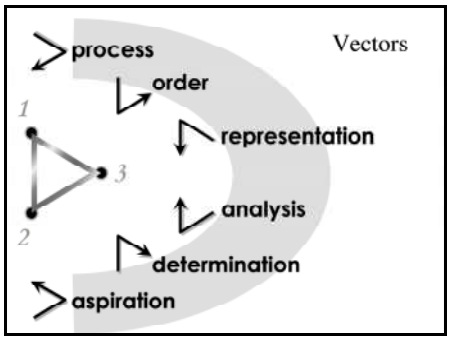

Fig. 1.

Peirce's orders of quasi-evolution and involution are placed in ordinal opposition, *dialectical "evolution"* moving toward synthesis, that is, arriving at 3^{ns}, *analytical involution* representing its mirror, so commencing at 3^{ns} and involving 2^{ns} which in turn involves 1^{ns} (Fig. 1).

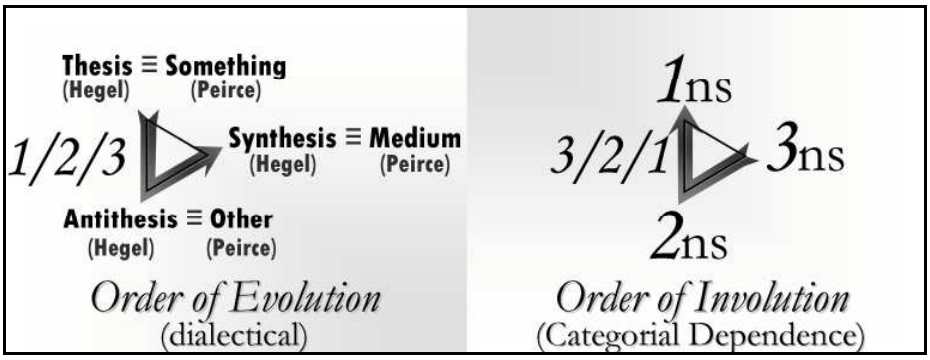

Fig. 2.

> The general law of quality, as distinct from the classificatory system of quality . . . has three clauses, relating respectively to single qualities, to pairs of qualities, and to triads of qualities. The first clause is that every quality is perfect and in itself such as it is. The second more complex law is that two qualities have one or

[9] This holds that all relations may be constructed from triadic relations, but that monadic and dyadic relations alone are insufficient for the construction of triads.

> other of two sorts of relations to one another; namely, they may be, first, independent of one another . . . or secondly, **one of them may be merely a further determination of the other, this latter being essentially the first of the pair in the order of evolution, or synthesis, while it is the second of the pair in the order of involution or analysis**. The third clause relates to the respects, or third qualities, in which two compared qualities agree or differ [CP 1.484, emphasis added].

While one probably can't speak of the primacy of any of the six vectors, yet Peirce makes it clear in this paper that whatever the limitations of the dialectical order (*vector of order*)—and there are several[10]—still even in the derivation of his own three categories he is required to speak *first* of 3^{ns}, next, of 2^{ns}, finally of 1^{ns}. Peirce's category theory, and especially that represented by |>*k vector analysis, develops Hegel's dialectical thinking in a "strange costume" indeed! [8]

b. Determination and representation vector pair

A second vector pair was identified by Robert Parmentier [9]. To the *vector of determination* which in semeiotic Peirce defines as "the object determining[11] the sign for the interpretant," he opposes a *vector of representation* exemplified by the activity of the original artist or scientist, that is, someone who out of the storehouse of his experience creates a complex symbol representing some universe of experience (say, a revolutionary physical theory, e.g., Newton's of gravitation) (Fig. 3).

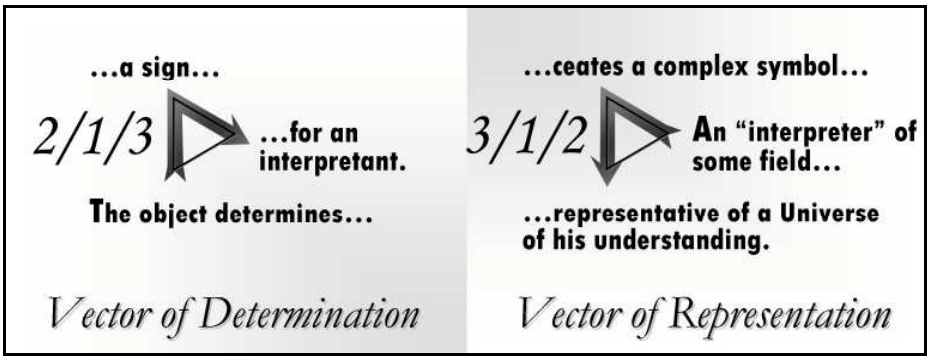

Fig. 3.

Undoubtedly this pair has a fundamental character of its own. The *determination vector* reveals the path of all semeiosis in an objective reality—such as our own three

[10] "[Hegel] reaches each category from the last preceding by virtually calling "next!" [CP 1.453]

[11] Where "determines" may be taken to mean: limits to that which is semeiotically legitimate supposing an objective Reality. This point (regarding semeiotic constraints) is perhaps clarified in considering onomatopoeia where, e.g., one would not find in any language anything like the sign "meow" to refer to the sound a dog makes.

Universes of Experience—since in Peirce's view the "universe is perfused with signs, if it is not composed exclusively of signs."

c. Process and aspiration vector pair

The third vector pair, first noted as such in [10], opposes the *process vector*, the order Peirce employs often both in consideration of the biological process of evolution on the one hand and inquiry on the other, and the *vector of aspiration*, this order moving towards the fulfillment of a goal through hetero- and self-control. This last vector is only alluded to in Peirce's writings. In physical evolution the initial pattern is associated with the categories in *process order* (Fig. 4).

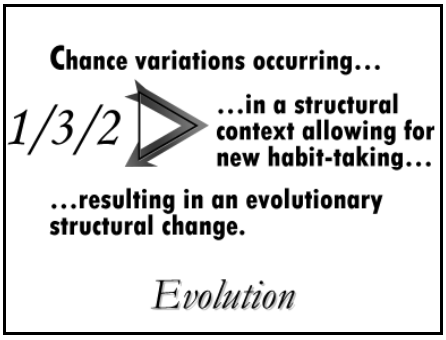

Fig. 4.

And in the analogous case of inquiry (Fig. 5).

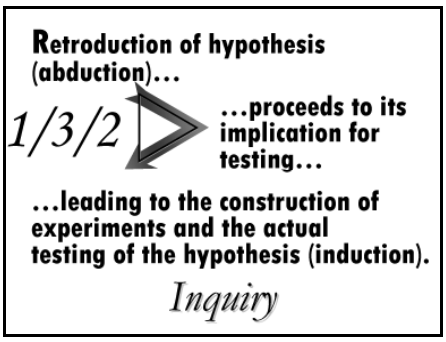

Fig. 5.

We would suggest that Peirce's arguments in normative science which led him to the consideration of a pure esthetic *summum bonum* can be seen as implying a *vector of aspiration* (Fig. 6).

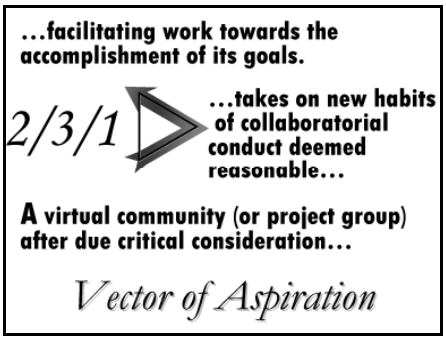

Fig. 6.

4. The *chiral cycle* (vectorial melding)

Besides being arranged as three pairs of opposites, the six vectors can themselves be related trikonically to suggest possible relations of inter-penetrations of vectorial-categorial movement through rather many dimensions of triadic (and higher –adic) relationships. The most important of these is the *chiral cycle* involving all six vector patterns in a "melding order" which may prove to be the most promising for the proposed analysis-synthesis here being considered.[12]

This perhaps more than any other pattern is suggestive of the potential of |>*k vector analysis for facilitating inquiry within especially knowledge representation communities. Here, in moving from one vectorial pattern to the next, the last category of a given vector becomes the first of the following, so this can be seen as a kind *melding* of the six vectors continuously one into the other. The last of the six itself melds into the first so that the pattern may be repeated[13]. The *chiral cycle* involves a pair of three vectorial patterns, the second following directly upon the first, reversing its pattern and providing the basis for intellectual growth and possible creative evolution (Figs. 7 & 8).

[12] Peirce notes that his categories offer only "hints" and are not to be taken as true or false as such, but are only suggestive of possible relationships. All of the vector groups should be seen as mere abductions concerning categorial relations of possible interest. After exploration of all possible vectorial relations and possible groupings, patterns & cycles of these, the process oriented chiral would seem to offer the greatest promise for what is here termed *analysis-synthesis* (towards the resolution of problems and the evolution of systems). But other groupings, such as the logical/temporal, may also prove effective in certain types of analyses.

[13] It is the progress through each vectorial pattern of three categories—not through the six vectors themselves—which is clockwise/counter-clockwise.

Right skewed (clockwise) pattern:

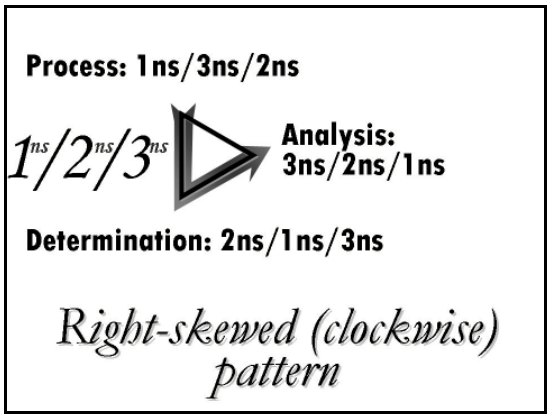

Fig. 7.

1st *Process* commences the potentially evolutionary gesture (see comments above relating this vector both to evolution and inquiry) and so **2nd** eventually there actually occur situations determining events, the facts regarding these factoring, for example, as the *constraints* on any given project or process (and even such natural processes as the evolution of a biological structure) then **3rd** moving in the direction of an important phenomenological analysis in consideration of all significant relations from the standpoint of *categoriality*. This is followed by a path suggesting the importance of an intelligent *ordering* of the elements in any enterprise (Fig. 8).

Left-skewed (reflexive or counter-clockwise) pattern:

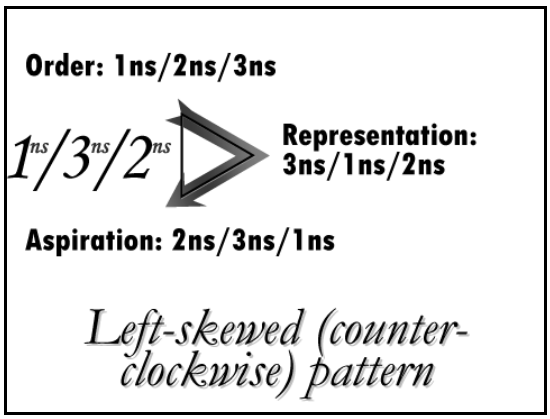

Fig. 8.

4th Finding & agreeing upon an acceptable and even potentially optimal *ordering* of the various elements, tools, time frames, etc. in a virtual collaboration proceeds to **5th**

clarify the representation of the important relations, tasks, etc. as well as to introduce additional abductions & other creative contributions by the individuals actively involved in the project, leading to **6th** the community directing itself to the achievement of its goals and thus completing a complex and iterative cycle (note: the pattern may hold not only for the enterprise as a whole, but for many of its internal cycles and processes). As noted earlier, at this point the entire pattern may be repeated in a new direction or dimension.

5. The *chiral cycle* in the context of collaboratory and virtual community development

In collaboratorial context, the entire movement from conception to the realization & completion of a project will tend toward *the chiral pattern* and may be analyzed trikonically.

1st One imagines that, say, a collaboratory within a virtual community analyzes and evaluates the methods, tools, and processes being considered in relation to **2nd** the constraints involved (finances, personnel, choice of tools available, etc.) regarding the contemplated project, followed by **3rd** a reflection on the (possibly many) significant categorial relations involved through |>*k group diagram observation so that intelligent consensus can be reached at each stage. This analysis is followed **4th** by a consideration of a possibly optimal ordering of the relationships of elements of the project which implies that **5th** the various individual and collaborative creative products of the participants in the process will eventually be integrated into **6th** the organizational effort, the patterns and structures constituting the various elements bringing about the desired result: the realization and completion (or quasi-completion) of the particular project. Thus, the *chiral cycle* may be seen to have potentially significant implications for collaboratory and virtual community development.

6. Future work

It will certainly be necessary to develop a sophisticated |>*k tool for diagram observation and manipulation if Peirce's trichotomic is to be employed in facilitating actual projects of any size and complexity. Such a tool would seem to be the *sine qua non* of |>*k being tested in a collaboratory. It ought to be possible for some actual collaborator (or working group) to posit something like the following (Fig. 9) so that others in the community might observe the diagram, manipulate its elements, agree/disagree (with reasons) on the implications of the research, etc.[14]

[14] The following is a mere scenario so that actual empirical investigations are certainly needed. In consideration of its possible value to the software engineering process, (16) takes a step forward in this more empirical direction.

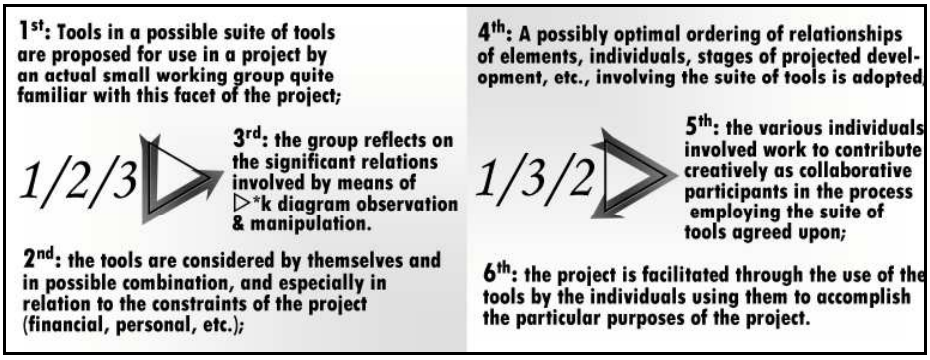

Fig. 9.

As earlier noted, the above six stage process may then be taken up again in different—perhaps related—contexts. One should note, however, that each of the six vectors is in itself vitally important in virtual community development. Consider for a moment by way of example the importance of *process*, *order*, and *representation* in all facets of the development of knowledge representation projects. It could be argued that each of the vectors[15] are highly significant in structuring collaborative projects to the extent that there are places & moments where any one of them might be considered apart from the larger *chiral* pattern.

Tools for creating *group reports* of the progress of the observation-manipulation of diagrams will need to be highly developed in line with such principles as those underlying de Moor's GRASS [4] and no doubt such a consensus seeking & group reporting tool will need to be integrated into the mechanism allowing for group |>*k diagram manipulation to permit reflection on the argumentation involved in the discussion. Especially the progress of and extent of agreement & disagreement on the substantive issues being considered leading to decisions of significance to a community needs to be charted. Diagram observation-manipulation ought to be strongly supported by adjunct tools facilitating reaching consensus.

The Peircean de Regt recently paraphrased the famous pragmatic maxim as follows: "If you want to know what our idea of anything is look for our idea of its sensible effects" [2]. This formulation seems to us to miss an essential characteristic of Peirce's maxim, namely, that these are *conceivable* effects, effects which may *possibly* come into being, and would so *necessarily* if we were to agree to create the *conditions for their realization.* As pragmatic semeiotic and trichotomic category theory would seem to have some potential for facilitating the work of organizing, representing and communicating knowledge [13, 14, 17, 18], future work will be directed toward actualizing and applying the theory which has here been merely sketched.

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[15] In addition, other vector patterns—such as an important logical/temporal pairing mentioned above—may prove to be significant.

I am once again indebted to Ben Udell for producing the graphics and for his help in editing the text, as well as valuable discussions related to the Peircean Classification of the Sciences and related matters.

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