THE INNER TENSION OF COHESION,

AN INTRODUCTION

"The logos is a link" [Axelos 62:57]

Information has the meaning of 'putting in shape' in addition to the interpretation of data [Lussato 77]. At a time when data are overwhelming us, where set structures are disintegrating, where the work fall into pieces [Friedmann 64], the cohesion that gathers parts into a whole is questioning and has to be explained:

"when history is accelerating, when differences are deepening, when identities are figuring because they are weakening, answers converge toward questions where reigns weak being " [Meyer 10:48]. In this weak being, unity and cohesion are weak, the in question. The question may be formulated as such:

Question 0 "How do various elements hold together?"

This question is especially sharp in the working out of Information Systems, as a project puts in play various elements: actors, trades, knowledge, activities, tools, models. All exchanges are based on information that both describes and puts in shape. Informational cohesion is thus a central factor of Information Systems.

0.1 Field and direction of this research

The problem

1) In 1970, it was foreseen that nuclear fusion would be used fifteen years later. Forty years after, one notes it is far form being the case. What is the reason for this delay? Our mental tools are recurring ceaselessly to analysis, to decomposition, to segmentation and classification, yet to gather ideas, unite points of views - in one word cohesion – are assumed as being granted, and we have few elements in that direction. Thus Mintzberg [90:112] denounces the sophism according which "analysis produces synthesis". This thesis aims to elicit this linking, that which synthesizes, rather that scattered parts.

2) If the problem of cohesion is dating form Antiquity and is strengthened by technical rationality [Heidegger 58], Quantum Mechanics as founded the systemic theory and introduced the interactions between components [Morin 77]. This scientific advance – made by philosopher physicists – has provoked much pondering, yet the movement within the systemic theory remains characterized by jerks, by transitions between states, reproducing thus the paradox of Zeno of Elea: Achilles is overtaking the turtle, yet the reasoning consists in an infinity of iterations, that which illustrates a conceptual poverty.

3) Hegel reintroduced the movement within thought, as the inner logic of concepts [Hegel 94:188], Bergson tried also to develop the movement, and Husserl [76] spotted the suspension or hanging-on link: the expecting attitude which intentionality produces is an opening to the world, when the object is not yet defined. This step forward in thought has been followed by many thinkers: Merleau-Ponty, Heidegger, Ricœur, Patočka, and still nowadays: Renaud Barbaras and Alain Badiou. Suspension enables to show the form in the making, cohesion is being built and we shall model this process for making this gesture more practical. Our goal is to make closer this notion, to make it easier to use and hence to perceive as real.

Outlook

The quality of any form can be described as adaptation, cohesion and dynamism [Chaumette 06]. Adaptation is adequately described by interactions, cohesion relates to the assembly of parts and dynamism to renewal. IN the intentional view –implemented in the Centre de Recherche en Informatique of Paris 1 – form appears resulting from a renewing tension; life begins to be mentioned in lately scientific [Bailly and Longo 06] and philosophic [Barbaras 02] works. Cohesion may be the unfolding of this hanging-on tension and it is this postulate that our work will explore: to perceive the cohesion being born.

Hence we set down two postulates:

P1 It is an inner tension which provokes cohesion

Heidegger [05:41] underlined that, in ancient Greek, the words *being, unity, logos* meant *to rise up, to well up, to blossom up, to appear*, in movement, in the making. They are usually considered as defined, set down, circumscribed facts; yet the movement was inscribed in the saying, s a flow (logos) as a tension. The postulate that a tension is founding being is thus coming back to the origin.

P2 Being is movement

This postulate furthers the advance mad buy the system theory, which considers that a state -coming from the past participate of the infinitive form of the verb to be – is a dynamic equilibrium, a stale and locatable moment in the course of unfolding, as the button, the flower and the fruit are moments of the vegetable, according to the image used by Hegel [97:41]

The requirement to understand

The problem is a conceptual one and we are trying to understand cohesion, we have thus to elicit what means to understand – Deniau [08] resumed it. As said Merleau-Ponty [45:8], the matter is to "come back to the very things ", which are movements. We'll admit that

P3 The uprising of thought rejoins sometimes the assertion of being

For the tension to be, the Logos in the Greek meaning –also mentioned by Louis Lavelle [08] – plays both in the world and in our mind. Yet this junction requires effort and the intelligible rises up then as an inner grasp of the movement of things; these are intelligible in the flow that provokes them. Following the distinction introduced by Martin Muller [74] between directional impulse, formation and formulation, we'll say that the attention unites with the tension to be and – at times – is being formed the meaning which is then formulated. This formulation is being enunciated in language or, in a more synthetic manner, is drawn in graphics; that's why we prefer a diagram to a enunciated formula.

In the move of building form, the active principle becomes action for genesis, and the postulate may thus be enunciated as

P3' Thinking and action may join together

Various authors support this view: thus Lavelle [08:145] wrote: "We know that the distinction between intellect and will is an effect of participation, the nature of the intellect enabling me to grasp being precisely as it overflows me and the nature of will enabling me to grasp it precisely as I am interested in producing it". Merleau-Ponty [45:171] notices: "Consciousness is not originally a "I think so" but a "I can"." A project being a collective activity leads to express this thought. The understanding of a project proceeds thus in three stages.

1) The project expresses – naively – what it is, like the Greek Logos, which is both active principle and discourse.
2) The project gives to itself representations, for negotiating for example, and these representations are partially false view of reality.
3) Information is description but also making form, the project presents itself though representations, yet this presentation - by its making form - can express the very being of the project, the meaning of this collective action. Thus

P3" The project may express what it is

The project can thus – through an effort of lucidity and according to its presentation – be made intelligible.

Our approach departs from a simulation, even predictive, described by René Thom and the most part of actors of Artificial Intelligence [Cardon 04]. We seek to understand, that is to grasp the meaning, the direction, to follow the inner movement of things. It is a similar movement - seeking wisdom without owning it – that Plato has called philosophy. It is in this way that cohesion – central aspect of making form – will be observed, tracked, described.

In the field of pure research

This thesis deals with the science of information as making form; in this regard cohesion is fundamental. The thesis is thus located in the field of pure research. "How

does it happen that various elements hold together?" this is a question which will be dealt with in a pondering between philosophy and mathematics.

For sure, we'll see applications in information technology in a broad sense: in projects and specially in project teams, in deliverables of these projects perceived as self-defined activities, in test campaigns or in the preparation of a talk. Another example of cohesion is offered by diagrams; another example by dashboards that collect observations according to various dimensions.

This thesis is inscribed first of all in the general theory of systems [Le Moigne 77] but this theory – in its usual application – inhibits pondering, as it assumes existing systems without questioning their unity which remains implicit. Mathematics constitute the reasoning on forms in itself, as noticed Plato [510d], they "are the place where thought is stabilized" [Bailly and Longo 06:ii], this also for a practical reason. As in physics the quantum of action is founding the identity of particles that can be created or annihilated, in mathematics the theory of categories describes the identity of elements at the source and goal of the arrows that represent the interactions, these identity are neutral elements for the composition of arrows. The equivalent statement in the system theory would be that systems themselves are neutral interactions regarding the inflows and outflows [Chaumette 08]. Yet this point of view, usual in social systemic [Lugan 93], is not acquired in the general theory of systems.

This thesis is based on Husserl's suspension; he had studied with Weierstrass, a great mathematician whose thesis was entitled "About the concept of number" [Huisman 84:922]. So the same trend of abstract thought leads us to search for the structure as a logical form for itself, as a conceptual scheme according to Kant's expression, as a *mathem* according to this word forged b by Alain Badiou [89:14]. This aim of pure form will be balanced with the general meaning searched for by philosophy; the meaning is closely tightened, experienced and checked as the proof of a well-founded progression, t rather than to sketch merely a formalism, as useful as it could be. Thus we may understand the unity in the making, which institutes cohesion.

This research is thus located in the exchange of philosophy – and its remarkable progress in phenomenology – and mathematics. Physics that introduced the quantum of action will be used as a metaphorical guide, and photons that move forward following a helix have guided the notion of whorls. Biology with its example of cells, of living units, will also be another inspiring place. Yet thought will proceed at the pondering level in the philosophical and mathematical fields.

Progression way

Progression will proceed as a set down intuition. One can't talk of a perception without experiencing it inwardly this psychological fact, yet it is deduction that will show the way. Metaphors in traditions, in ancient writings or in adjunct sciences as physics and biology may guide, but an idea will be proposed only when it receives a logical argument and sometimes the reference of an author.

Notation

According to a usual convention in mathematics, results will be numbered Rn, postulates Pn, hypotheses Hn and questions Qn; this will enable to follow more easily the logical order of arguments. Results will be numbered in the order, preceded by the digit of the chapter, thus R4.2 depicts the second result of the chapter 4. Examples or metaphors are written in italics for distinguishing them from the course of thinking.

0.2 Main results

The thesis brings about results that will be worked out in the course of chapters, but to mention them now will show the perspective. Each of the words will be specified subsequently.

Main result

Tension that provokes a form is welling out of a pole, is unfolding as hanging-on links, which get an interiority and lead to cyclical interactions, which produce the form. Arrows model interactions and whorls model hanging-on links. Logical worlds – fields ruled by a specific logic – are distinguished through their rapport with negation, yet also by their meaning of identity and their specific movement. Hanging-on links – with their limits with other logical worlds - draw three edges, illustrated by three rings of whorls. These rings describe a unit being built and the many worlds of the ring – which may connect with others – explain cohesion.

The model of the Threefold Ring of Whorls implies a threefold tension coming thus from – in the logical world of poles – a threefold pole. BY the way, one may read a shape in three different ways; these ways are related to three dimensions and three colors.

This model of the Threefold Ring of Whorls is then the more factual, the chief result of this thesis, one has then to deduce the consequences.

Cohesion of a form is established in three degrees. At the space degree, form is one and integrates local to global, the model of the threefold ring appears. Then at the time degree, form is recovering from the trace of impacts; it evolves, it is the field of suspension, of gesture, of perception: "what does happen?" describes this enquiry; at this stage everything passes on, and neither object nor subject are constituted. Finally at the reflexive degree, form learns from its experience, it comes back to itself and discovers the poles – intensions, questions and values – of its deeds. Thus truth – criterion of knowledge – appears as a part of the real; this thought rejoins late pondering of philosophers [Meyer 10]. The One, the pole sustaining cohesion, is then a part of a triptych with Being and Persistence.

Contributions

The innovative elements, issued from pondering and furthering the ideas of other authors, seem to be:

1. An hanging-on link, be it a gesture or a perception, is described by a whorl; it is half an edge of graph, of which the ends have been removed. It means that a whorl has no defined extremities. However it has interiority and relational ability as well.
2. Logical worlds are defined in regard of negation and each collects various philosophical notions: (1) action and interaction, knowledge and self-defining notions; (2) gestures and perceptions, quests and hanging-on or suspension links; (3) questions, purposes, values, raisons d'etre, that is poles.
3. These logical worlds have a specific movement and mode of identity. This movement is pulsation for the poles, that is a return to oneself in the Same. It is spirals or progression, in opening outward for the suspension links – whorls. It is rotation or return to oneself in passing through the Other (the outside) for self defining objects - loops which are the identity arrows of categories.
4. The logical world of perception has a spiraling movement and, if there is no equality, there is a return to oneself, this models temporality or being in the way of "Sein und Zeit" of Heidegger. The ring of whorls ensures this progressive continuity and progressive identity.
5. At the border of each logical world, the network of whorls builds a ring, thus the tension must be threefold. This word *ring* depicts a graphic, which turns around a pole; it has two laws of composition: the addition of aims (angle, law of a commutative group) and the partial composition of whorls in the same aim. The word ring thus differs from the usual algebraic structure of a distributive law on addition.

6. The incurving line expresses variance and exploration of the environment; the recovery sketched by the whorl illustrates the interiority, which will define itself in a loop, then will set down in a closed shape. Conversely, the straight line expresses a pulsating ray, meaning a direct link, immediate participation. Thus the line illustrates most closely the trend of thought, the path of consciousness.
7. A two-dimensional figure can be seen according three dimensions, either as a limit, either as an included surface, either as a transversal inscription. These three ways of reading can be linked with three colors of which the general meaning is suggested here: history, evolution for the Green (one dimension); variance, laterality for the Blue (two dimensions); inscription, foundation of existence thus raison d'etre for the Red (three dimensions).
8. A pole has three aspects since it produces a threefold tension: one for the body of form; one for the horizon or sensitivity to the environment; one for the central pulsation, which stimulates direct links. These three aspects are called factors of concretization, of sensitivity and of vitalization.
9. The factor of sensitivity expresses in whorls; the fist quest underlying any perception seems to be "What does happen?" It goes against Badiou's recapitulative formula [06:12]: "There are bodies and languages, save there are truths".

0.3 Genesis, landmarks of this research

Genesis of this thesis

As we have seen, the hope to approach cohesion in a new way comes from the transition of static notions to systemic interactions, that is in Mathematics from the set theory to the theory of categories. This genesis is the underlying gesture to this thesis, be it the genesis of numbers –hence of the multiple – or the genesis of the line, which is parallel. We shall further back this genesis, passing form the quaternary (the space of configurations) to the ternary (arrow of a category) to the binary (whorl) then to the unitary (pole) toward the background. Once this research done, one may then follow the tension unfolding.

Cohesion is in question and one is watching for his appearance, it is thus the movement of its emergence, which is grasped and taken in. The genesis or gestation of a unit appearing on a confuse background is thus the driving thread at the background of this thesis; tis genesis is lying on a philosophical current, which starts with Hegel (Phenomenology of Spirit) going to Husserl, then Heidegger [62:142] with his emphasis on that which rises up, and Merleau-Ponty [45:18]: "By this broadened notion of intentionality … phenomenology can become a phenomenology of gestation". This current is amplified nowadays by the works of Renaud Barbaras and Alain Badiou.

Once the hanging-on link – the whorl – discovered, this phenomenological trend is perceived as an interface and is described in a vaster panorama, as making part of three worlds; one comes back then to a ternary. Color being described by three dimensions, and the study within any space calling forth a ternary – as we shall see at § 5.3 – color enables to tag certain aspects or elements of this space, this helps to spot them more easily. Thus the genesis starts from the ground (0), describes the tension rising up in a pole (1), unfolding with whorls (2), setting down in arrows describing actions (3); they end by forming the set down multitude, at a distance (4): movement has shut down, the given fact is there.

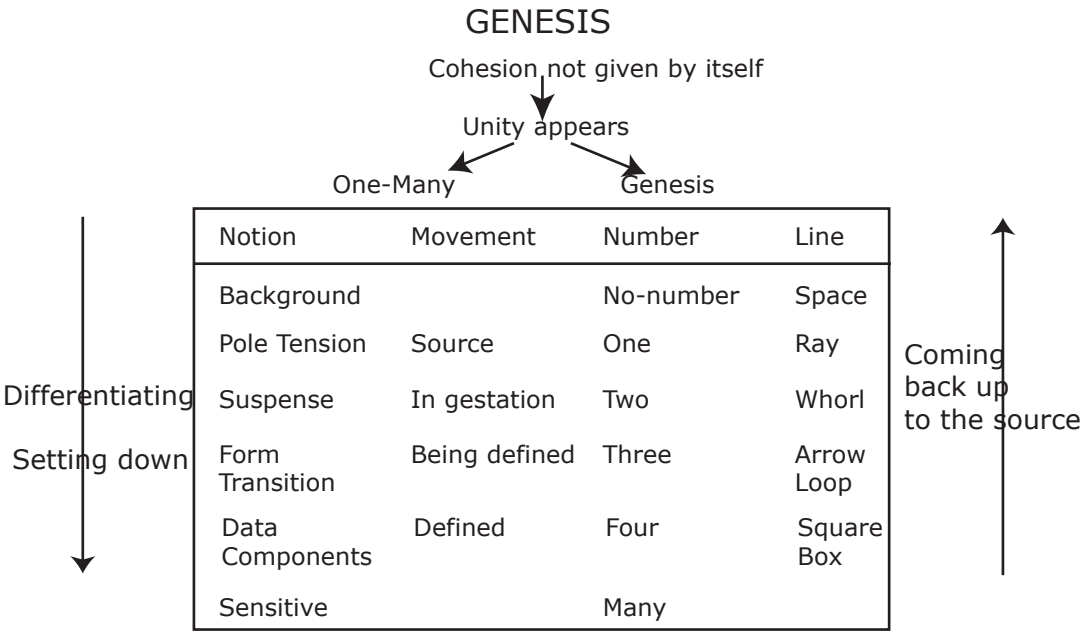

Figure 1. Genesis of numbers and lines

One will find again genesis about the line, how a gesture inscribes itself on a support in, being first space, then line, incurving, rounding or fading away for becoming a circumscribed form, hence enclosed. Genesis underlies also gesture, the appearance of action, from an intent, then a perception before it ends in a perceived form, which will be set down and judged: the object is defining itself. Phenomenology emphasizes movement, which inhabits any search; this movement is seen in the trace it leaves.

These founder choices make appear in hollow hypotheses that have been rejected.

Rejected hypotheses

For sake of clarity, let us remind them.

1. Cohesion is not given, no more than platonic ideas are given, or exist in a world apart. We'll focus, following Heidegger, on the rising up of things, on their genesis.
2. Form is not explained by interactions, which therefore would rhythm the movement in transitions between two states. On the contrary, we'll assert that movement is prime and that states are stable movements, which loop and maintain themselves.

HR1: The explanation of cohesion is not to be searched in interactions.

3. Simulation, if it reproduces phenomena, does not explain them. To understand means to grasp things in the course of action, it is to follow this course from the inside in their logic (logos = dis-course).
4. Analysis does not imply synthesis. Indeed it is the cohesive factor that has to be explained, hence to be developed. In the same order of ideas, judgment is produced on elements presented by perception, and it is the movement of perception that builds its cohesion.
5. Abstraction, since the Sophists, builds a space of representation where various results can be inscribed. But this space is a building "afterwards" and does not describe the process in the making; hence this artifice renounces to grasp things in their movement. We do not claim to reject abstraction, but we'll locate this pondering space among other insights; we hope to relativize it and notably its static aspect, by construction.

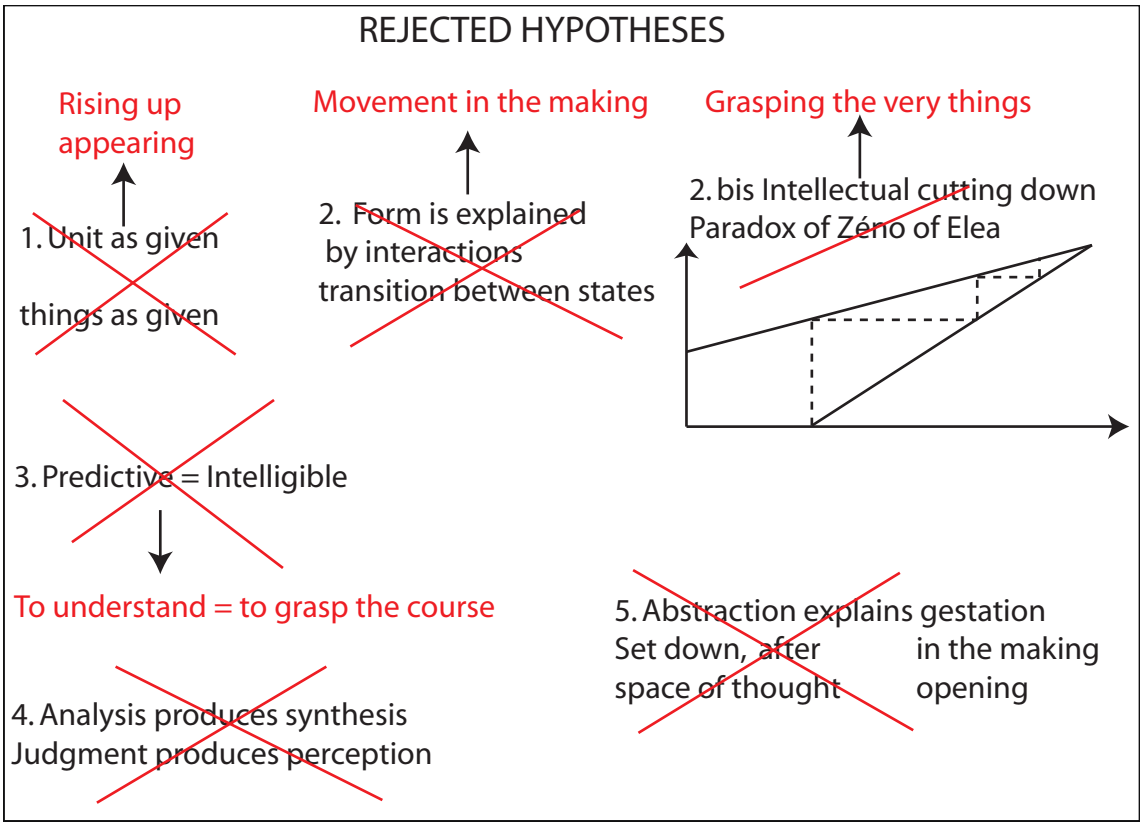

Figure 2. Rejected hypotheses

Mind map

A mind map is a diagram that illustrates thought; it associates cognitive notions and graphics [Buzan 03]; it is used for exploring a domain and it is that sense that we have used it. All this pondering starts with the quantum of action introduced by Planck in 1900, as an ad hoc hypothesis, then furthered by Einstein. It gave birth to quantum mechanics, basis of system theory, showing that all is interacting. This notion of interaction relates to intentionality, a concept introduced by Brentano and developed by Husserl. This word takes various meanings [Searle 85] going from intention, mental state to opening. The laboratory of Paris 1 supports an intentional approach, and cohesion aims to unites rather than distinguish or separate, hence the importance of opening. *By the way, this tension had been illustrated by the creation and annihilation of particles, the identity of quantic systems is itself in question.*

Here below is a mind map illustrating this research on cohesion, and we comment it briefly.

As tension is inside, this fact refuses the explanation of cohesion as coming from outside, and this tension must renew the identity, this applies to living systems which are studied in their generality by mathematicians such as Bailly & Longo [06] or by philosophers such as Barbaras [02].

Cohesion has been described as one of the three basic qualities in "La qualité au-delà des mots" [Chaumette 06]. The various logical worlds, issued from negation and associated with numbers, relativize the space of pondering (related to number 4) and the variance for explaining cohesion by suspension (related to number 2) that is a hanging-on gesture – modeled by a whorl – that builds cohesion in the present time. Each of these worlds is linked to a functioning regarding negation, yet also to a number, to a color and to a movement.

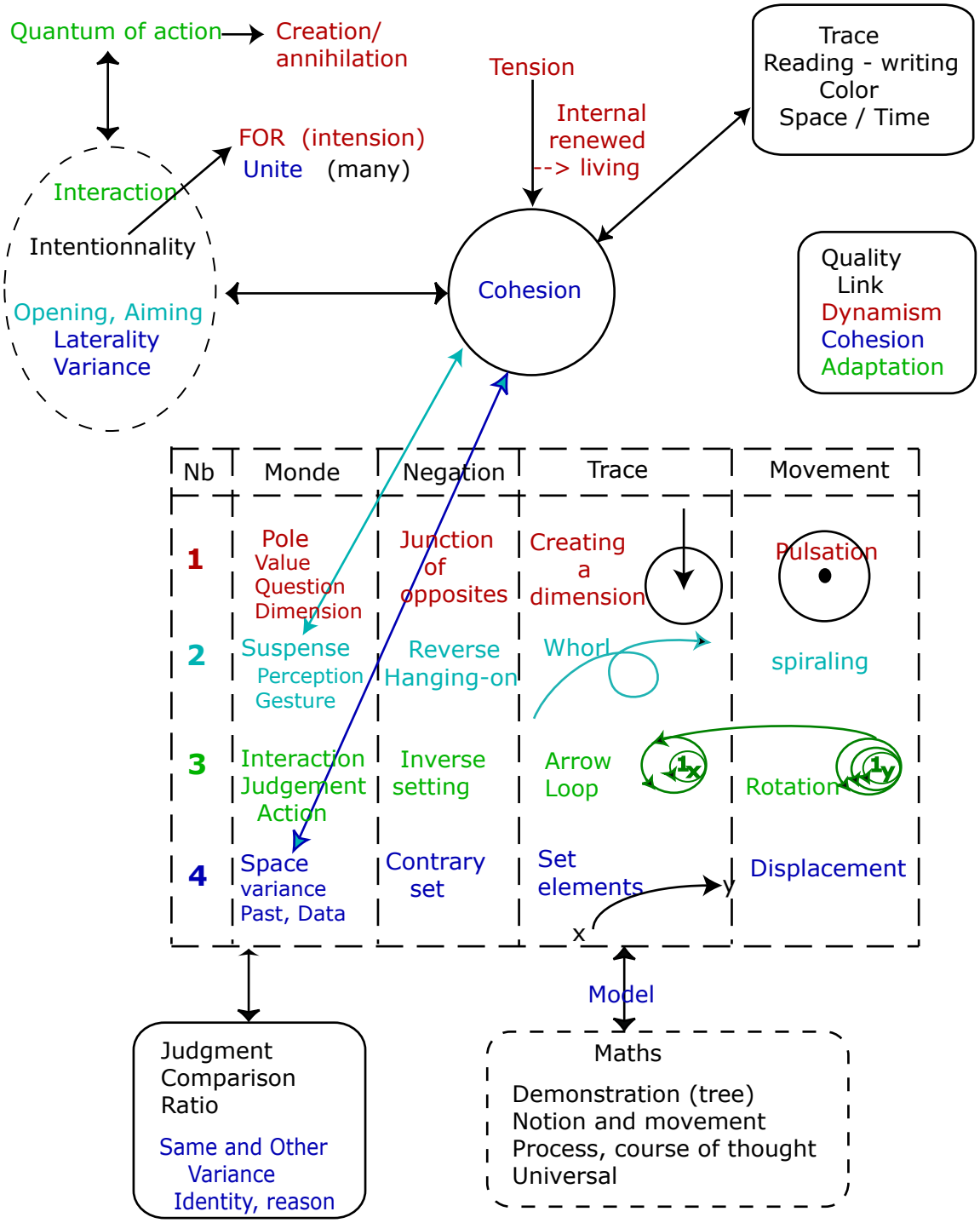

Figure 3. Mind map of this thesis

The world of pondering –at the bottom of the table –is the world of judgment, of a comparative study of the Same and the Other, platonic polarities [Plato 08] [Brisson and Fronterrota 06:159]; they are used to spot the constitutive movement of objects of these worlds. It is also this space of pondering where elements are given and statements set down, that is used by mathematicians [Mac Lane 98] for their demonstrations.

Above on the right, the trace reminds that we are trying to describe cohesion through graphics, and this rejoins the genesis of line.

Meta-model of concepts

On the opposite way of the mind map, the meta-model follows strict rules and represents an achievement: a syntax of notions used in this thesis, far after the exploration.

At the top of the meta-model is found unit, as form is the appearance resulting of this unit. Cohesion refers to the relation of multiple units - the components – to the including unit. Regenerate means that this unit is renewing itself. This fact will be studied in the chapter 1 and the link of the unit to the multiple in chapter 2.

At the right side, trace could have been represented by a package; this would have meant that Line, Shape, Color, Link, would be full concepts. Graphic of modeling begins to be studied, partially thanks to Daniel Moody [08], but this would give another direction to this thesis. These elements are thus gathered in a simple class. Trace and its genesis, its various meanings will be studied in chapter 5.

The approach follows in chapter 3 by a study of the existing, hence by notions located at the bottom of the meta-model. Contrary to the genesis of number, one starts from a multitude of cognitive notions; they are static and associated with the set theory; they are illustrated in the multitude of classes of this model. The systemic view provokes a transition to the world of Three: self-defining objects, which have a structure of arrows, elements of mathematical categories. For underlining the movement and take into account the suspension (Husserl) or trend (Hegel), the chapter 3 introduces and defines whorls, related to the world of Two; this world is the world of suspension, therefore very different from the binary, which shifts between 0 and 1; this binary refers to the static world of Four.

The introduction of this new structure - the whorls – enables to systematize the use of negation in the chapter 4 and leads to distinguish between several logical worlds, each of them has an identity but also a movement. The logical worlds constitute the frame of this thesis. They collect phenomenological notions, appeared in various domains, that we unified through this operation; they are shown in the figure 5.

That which explains the unit of form is the ring of whorls; this structure corresponds to a complete aim around a pole. It is thus the lower element of the model that explains the bedrock of unit at the top of the model.

Tension, first word of the title, appears merely as a dependency of a unit to a logical world; indeed the unit has three edges or three extremities where fades away this tension; this tension is thus threefold. That’s what we’ll see along the modeling in chapter 6, after having defined the tension in chapter 1.

Chapter 7 addresses the unit of the meta-model, its intension, and its link with the reader. The reader is at a distance from the diagram yet interacts with it. How does play the unit – and its tension – in this reading which is exploration, assimilation and rebound? What does underlies the word *interaction* of the object-thesis and the subject-reader? The genesis from the ‘set down’ to ‘in the setting’, the ‘hanging-on’, then to the pole, plays here in our reading within the subject. Another question arises: tension brings about - via hanging-on gestures – to set arguments; yet in the reverse order, how to rise a question? Whence comes the tension of this movement?

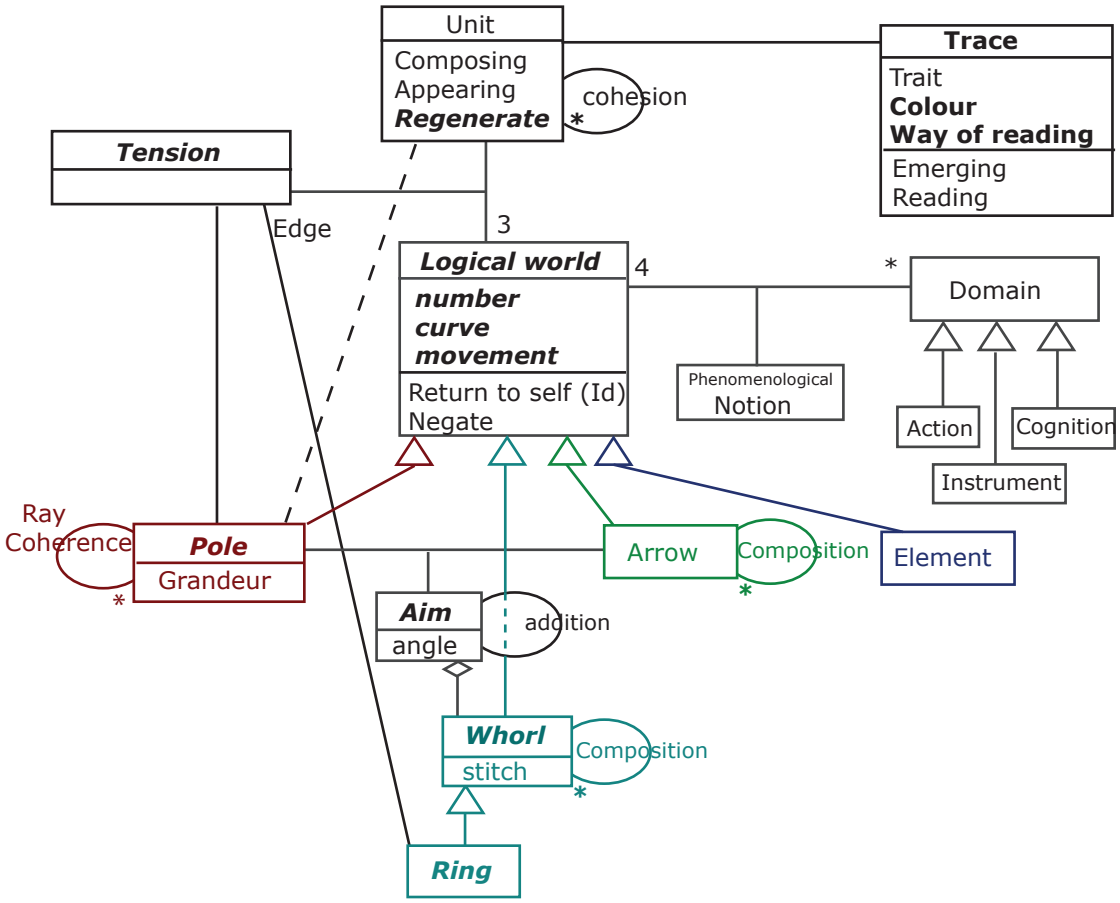

Figure 4. Meta- model of this thesis

Below are the various notions resulting from the crossing of domains and logical worlds; some notions are strictly phenomenological: perception, gesture; others are more classical; finally other notions are introduced in this pondering and are thus innovative.

	Notions			
	Action	Cognition	Instrument	
Pole	**Intension**	Question	Type-grandeur	State of the art
Whorl	Gesture	Perception	**Exploration**	**Innovative**
Arrow	Action	Judgment	Measurement	
Element	Result	Data	Result	

Figure 5. Table of phenomenological notions

0.4 Stages of the approach

The classical approach of a paper is setting the problematic, the state of art, a proposal based on a hypothesis, its development, then and its validation. We'll follow this pattern in softening it, for our hypothesis is based on suspension and does not aim at defined facts. We are also trying to give a meaning to the suggested models, and not to get results, and this changes the validation.

Here are the stages of the approach:

1. Asking the question
2. One and many, the genesis of numbers

3. Orienting toward the Two, in suspension
4. Conceptual structuring
5. Drawing, what does this assume?
6. Modeling cohesion
7. Integrating tension in the reading

Then the approach follows globally a V cycle, starting from the words of the question (chapter 1), philosophical or general thoughts on the subject (chapter 2), the orients toward the phenomenological suspension, which describes finely the cognitive process (chapter 3). The various logical worlds are defined, studied, exemplified in chapter 4. The question of trace and model, unnecessary to the thinking about notions is postponed to chapter 5; then models are elaborated (chapter 6), they may appear objectivist or naturalist, as if the reader was not the source of perception that unites the printed characters. So the thesis will come back to the first question (chapter 7) for reading the perspective.

And here is the figure showing the tension guiding this thesis.

TENSION OF THIS THESIS AND ITS APPROACH

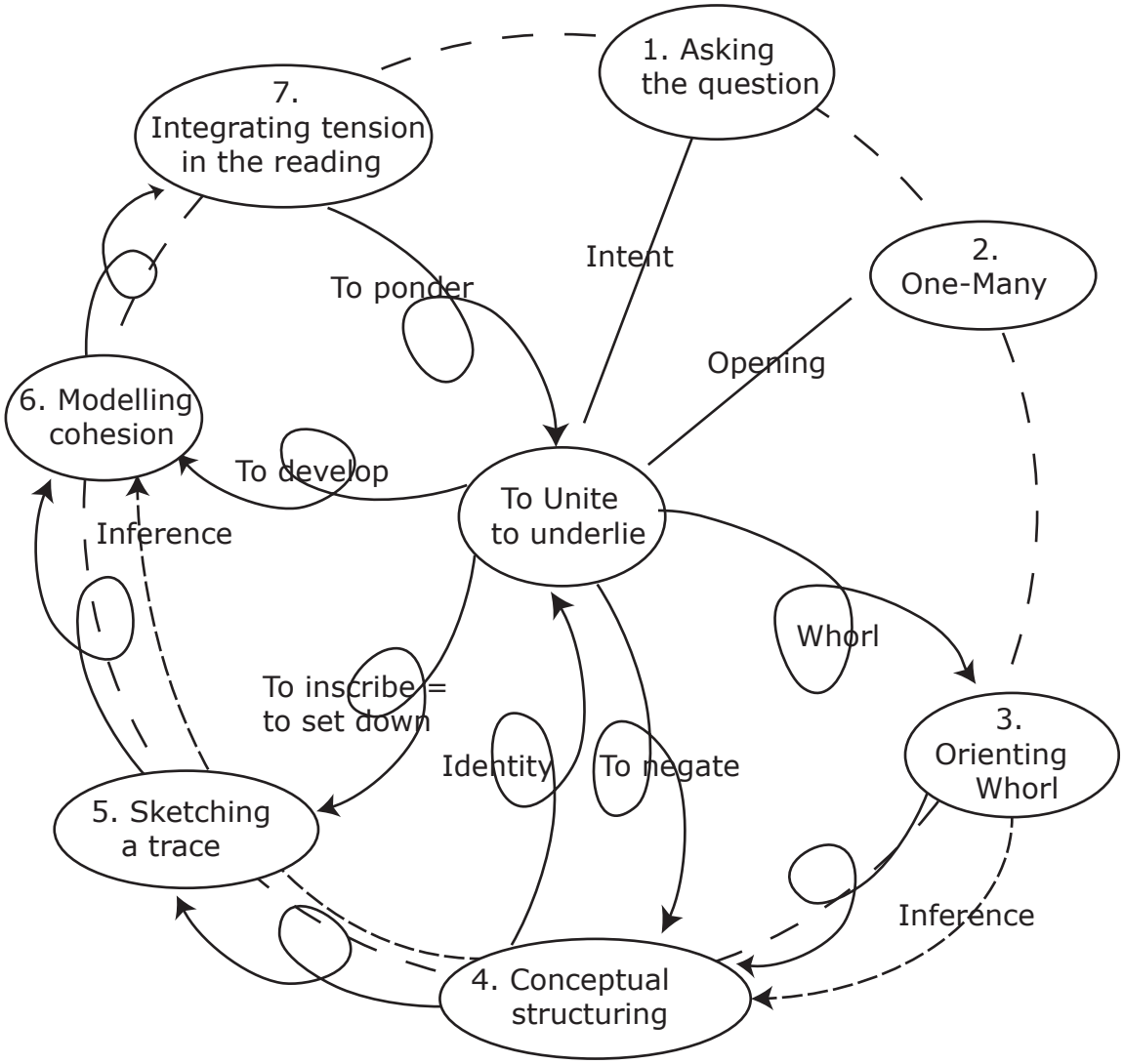

Figure 6. Model of the approach of this thesis

Here is more in details the path of thinking that will be developed in the following chapters; references will be given in the course of the chapters.

1. Asking the question

1. The first gesture is to take back the words of the title of the thesis, hence to analyze the meaning of *cohesion, tension* and *inner*. Cohesion gathers units in a form that constitutes the appearance of this greater unity. The word *form* is translated in Greek by two words *morphé* (external form) and *eidos*, idea. A platonic idea may be considered as an inner tension. Schopenhauer's de-subjectivated will is a facet of this tension underlying things.

2. Some empirical observations remind us of: (1) the distinction substance-form coming back to Aristotle, (2) the necessity of renewal for describing an inner factor and (3) the fact that cohesion concerns only two levels: the form and its components; besides other levels would be deduced by iteration.

3. Thus the question is subdivided in three facets: a renewed identity of the unit, an assembly of components and an interaction with the environment, as the system theory is an unavoidable basis of pondering.

2. One and many, the genesis of numbers

1. The first approach is to build a space where answers are inscribed and can be compared. This approach is as old as Greek sophists and we call it the world of Four; it means to go up a grade in abstraction and also to stop the movement. If there is cohesion, the question is then how to articulate the one and the many. They are articulated in several trees or ordered links and one may make three observations. 1) The one at the top is disturbing at this time, for it evokes a dogma or a supreme authority, when only one energy does not threaten the freedom of the thinker. There does exist then a sense Top and Bottom in the relation One-Many. 2) The subject is lived as intimate, living, whereas the object is opposed in front of him, as a structure. 3) The observation begins by the fixed, the set-down, it induces the intention that has guided this creation.

2. Some philosophers have neatly emphasized the One and their contribution on that point will be resumed; they are Plotinus, Leibniz, Hegel. During a long time, with Plotinus in particular, unity has seemed more fundamental than being since, in every becoming, appears a non-being. For this author, the One is, yet does not exist, that avoids to the One to be set in front of its opposite.

3. Late philosophers emphasize the multiple. Deleuze, basing his thought on the Desire analyzed by Lacan, underlines the One-Two; that shows the usefulness of movement and points out the genesis of numbers. Alain Badiou postulates that being is multiple whereas unification is implicit for making "compossible" some conditions of philosophy [Badiou 89:41].

4. The One then does exist merely in tension, in movement. It emerges from the no-number as some traditions have mentioned and its gives birth to multitude. The Two is unstable as a relation or as a trend, and it settles in the Three. It is this genesis that will be followed backward in this thesis, starting from multiple notions for going to the self-defining Three, the hanging-on gesture of the Two, and the One or pole, motivating tension.

3. Orienting toward the Two, the hanging-on link

1. We have just seen that cohesion is inscribed necessarily in the spectrum of the One and the Many, precisely in the One-Two. Then one has to settle in this dimension and to search for, according to our hypothesis, the interface between tension and substance. This interface makes an echo to the system theory that finds its blueprint in the mathematical theory of categories. This theory makes a correspondence between inner properties of objects and interactions with the outside; identity itself is a relation - an arrow - and objects are then perceived as self-defining.

That's why our first step will be to search for a categorical structure: it is a cone. For describing meaning – which exceeds coding as cohesion exceeds components - Andrée Ehresman combines cones. Sources of forms and their interactions are naturally described in our time in the language of categories, a language of arrows.

2. Yet we are lead to refuse this language, based on the Three, predicate subject – verb – object or source- arrow- goal or state – transition - state. If interactions explain adaptation, cohesion that assembles requires the link, the Two, and the suspension conceptualized by Husserl shows this Two. Another reason for refusing interactions is that they imply the division in parts of time, as points the paradox of Zeno of Elea; our intellectual tool workshop wants to define all when all is moving.

So we have to search for a mathematical structure based on the Two; it will model perception and not judgment. Judgment operates in topos, some special categories where demonstrations can be generalized; well any category is based on an underlying graph. One has to start from the graph – made of edges between two nodes, thus related to Three - to pass to the Two. In cutting an edge in two and in removing the nodes, one gets a whorl, a link that curves without defined extremities. Whorl depicts then a hanging-on link, such as a perception.

3. Whorls have various properties inherited from arrows of categories, among them the associative composition. Whorls project upon arrows since they are issued for the underlying graph of a category; above an arrow, they make fibers with a relation of partial order. Similarly to arrows, whorls may constitute cones for describing universal solutions, modeling stable perceptions.

Whorls can be discovered in oriental traditions and in biology. Whorls describe photons perceptions, gestures; that shows the large extent of possible applications. These applications constitute a kind of validation of this structure. *Physics uses clouds of virtual interactions, but a whorl describes more simply these virtual couples of interactions.*

4. As whorls model suspension before any judgment, one can't speak of equality nor identity; for these relations assume a ratio. Plato in his dialog Parmenides is using quite a lot the word *similar*, and this similarity may apply to whorls. This similarity is made in fibers, for example with the same projection on an arrow.

Whorls project on arrows but this projection is itself ternary; hanging-on links would be then fugitive appearances between well-set objects. Conversely, one may describe a judgment as a combination of perceptions, as did Merleau-Ponty. Judgment will be thus modeled by three whorls. More generally, one may support the view that objects, actions are engendered by hanging-on links.

5. Arrows may compose cycles and whorls too: this produces a ring of whorls. The word *ring* evokes both its graphic appearance and a mathematical structure. A ring of whorls is a composed unit opened to the environment. Thus the structure of the link that constitutes cohesion is discovered; the world of Two is modeled with whorls.

4. Conceptual structuring

1. Parmenides stating that "Being is" underlines that propositions must be set down and sustained as in a trial. Plato's dialogs use contradictions and disjunctions for showing the dead-ends of thought, but Aristotle set down the bases of syllogism and the argument of excluded middle has persisted for centuries. Thus the abstract pondering of Antiquity sets a valuable discourse where contradiction is excluded and the movement is applied on data from the outside.

It is Hegel who used contradiction as a fruitful tension; he reintroduced movement within thought; a double negation - negating the antithesis - does not come back to the starting position but questions the link thesis – antithesis; synthesis is thus more powerful that the original thesis. Thus negation appears inside the discourse. More recently, Alain Badiou underlines that perception has a reverse side – presence or absence of something – without being negated itself: one can't suppress a perception; this introduces another status regarding negation. Finally, various currents of thought told about the junction of opposites. Thus negation applies differently in various domains that we'll call logical worlds.

These worlds have each a specific behavior with negation, hence a specific sense of identity; as being is movement (P2) they have an associated kind of movement.

2. Evolution of thought and reintegration of movement in cognitive notions have sketched a retro genesis of numbers.

We'll begin by the world of Four, a space of configuration where are compared static elements; it is described in mathematics by the set theory and movement is left outside.

The following world (of Three) is the world of systems, described by the theory of categories: everything is an arrow, including identity that becomes a loop. Movement is within things, yet they pass from one state to another in a jerky way; things are setting down or defining themselves in this movement of coming back to self.

The world of Two is the world of suspension; things are being made without yet being defined, movement is progressive, negation becomes a reverse side and the similar replaces the equal or identical as things do not come back to their starting point.

The world of One has been sketched by Leibniz who distinguished causes, which produces mechanisms, and ends, the realm of liberty. This world of poles represents questions, dimensions and values. Here negation fuses opposites, for a new dimension is not unfolded nor outspread. Poles are pulsating.

When it sets down in front of a judgment (world of Three), the One does not remain one but divides in two in a false symmetry; the pole sends back to its shadow, to effects that are judged negative regarding the expectation; thus the true sends back to the false, the beautiful to the ugly, etc. However these two values are not symmetrical, the origin and end are not symmetrical, subject and object neither, for the flow of attention implies an origin and consistency contrary to its achievement.

Genesis goes to an end with the no-number or zero. The ground from which everything rises up, the undetermined whence flows up the unit then the many, any value or dimension that becomes afterwards observable and perceptible.

3. Worlds being defined, they are not isolated but follow their own logic. Notions define themselves, set down and appear as contents; hanging-on gestures become actions that define themselves; poles instituting dimensions provoke gestures and perceptions. One may thus describe a V cycle based on perception and going to inert notions or abstractions. Yet this V cycle uses projections that are transitions from one world to another and have a ternary structure.

Other interactions between worlds are possible. One of them is a whorl that has interiority and no defined extremities; it uses the undetermined world of no-number. Tension can be seen as the passage of the undetermined to the world of One.

4. These worlds being set down, the meta-model of this thesis is built. Arrows, whorls and poles are modeling notions in the domains of knowledge, action and instrumentation. An aim is the interface between a pole and an arrow; it collects various whorls - perceptions or gestures. According to the arrow, an aim has an angle and some aims are complete, that means that they are making a turn around a pole; they describe then a ring that obeys to two laws of composition. These rings correspond to cycles of arrows in categories and institute stability in the hanging-on links that are the whorls; they establish unity from multiplicity. Therefore this notion is central for taking into account cohesion.

5. Logical worlds are used to present a first example: a project. This description is contrasted with a more classical reading in terms of stakes, existing objects, etc. Genesis, choices are thus taken into account in this example, which shows the usefulness of the meta-model.

5. Drawing, what does it assume?

1. To write means to let down a trace, it is stopping the movement but –civilization shows it – a written sign brings along pondering, recoil, broadening, rebound. Thought expresses through the senses, either by some discourse either by some graphic. Graphic offers, in addition to a relative permanence in time, a laterality; the latter expresses variance i.e. various possibilities; graphic evokes a synthetic vision added to an analytical or linear vision (as with a text). That's why trace becomes a philosophic notion of the first order (Alain Badiou) as inscription on the body and that's why information technology uses so many models.

2. Trace leads us to a genesis of line and to the examination of its codes – the most often implicit. A strait line curves, rounds up and results in a closed static figure, of which the archetype is the square. Thus the lateral, which illustrates variance, completes the

longitudinal that is traveled along the line. Left side completes the right side, the top completes the bottom; each of these directions acquires a meaning that is implicit in the gesture of drawing as well as in the reading. An example of diagram comes for illustrating these rules of reading as well as the logical worlds. These rules apply also to the meta-model of this thesis.

3. When the gesture sets down, it passes from the Two (origin and move) to the Three; color, with its three dimensions, can tag this space. The three basic colors are assigned to three general characteristics: type, variance and effectuation. Logical worlds and their objects may then be tagged with colors: arrows denoting action are green, whorls being an addition of longitudinal and lateral are cyan (addition of blue and green), pulsating rays take a red color.

4. Some whorls could become multicolored and various alternatives will be studied. Color offers also a qualitative frame for poles, if one admits a frame based on three dimensions. Such an approach has been sketched for values, managerial values as well as human values. A similar spotting of questions is also possible.

6. Modeling cohesion

1. The implications of graphic have been studied, its meaning described, one can now model a form on the basis of the logical worlds distinguished in the chapter 4. According the result R3, cohesion addresses two levels: the including unit and the components. A tissue of whorls issuing from the pole will model a form, provoked by the unfolding tension. Three edges of this tissue appear, they are the limits of this tissue with 1) the interactive circumference of form, it is the edge of concretion; 2) the environment, it is the external edge of the whorl tissue, the edge of sensitivity; 3) the pulsation of the central pole, where whorls do not yet appear, it is the edge of renewal.

2. Tension is unfolding through whorls, then fades away unto an edge; these three edges come from three distinct tensions, yet it is rather a threefold tension as a tension producing an edge does not exist alone. Each aspect – concretion, sensitivity and renewal – is necessary to an intelligent renewing form according to the three goals of cohesion enunciated in chapter 1. These three tensions may be tagged with the three colors according to the meaning defined in chapter 5.

3. The structure of the form is thus modeled, then one can describe the play of this form with the elements of the environment according to three logical worlds: first of all, the importation of whorls describing the sensitivity of the form and ensuring its assembly. Then one describes the importation of interactions or arrows, their link with whorls is studied. Finally the importation of poles and the influence of pulsating rays are described: the making of coherency of internal components is also sketched in its various stages.

The integration of components coming from the outside, or symmetrically the ejection of internal components, will be modeled in its various stages. Cohesion of a form "in the making" is thus modeled, this answers to the central question of this thesis: "How various elements hold together?"

4. Cohesion has been described in space, time can now be dealt with. Time is often considered as a continuous flow, an abstract support of movement; one can consider it as constituted by cycles that are temporal forms, an idea supported by Pierre Lusson. Therefore one is interested in the creation of intensional iterations that are temporal forms with a reason d'etre or a purpose. This reason d'etre provokes gestures leading to actions and producing results, thus is drawn a standard component of a cycle.

It is then possible to sketch a generic approach for an intensional cycle, to put in evidence an elementary pattern that is reproduced in these cycles and to show the typical interaction between the activity cycles of two stakeholders, for example business and development.

5. The generic approach is applied in particular to a request of a research engine. It applies to the principle of the double path in test and their lifecycle. The approach applies too to the multimedia project presented in chapter 4 and to the building of diagram presented at the end of chapter 5. These examples will put in evidence the three tensions that have been defined before and the interrogations of the Why of an activity.

6. This generic approach will then be validated by an experiment; it is compared with the elaboration of more classical diagrams (diagram of activity for example). This experiment rests upon a bedrock of knowledge (suspension, poles) and concerns a sample of 53 students. The approach is to ask them to use the hanging-on links (whorls) before describing the same subject with a more known model. One measures in the experiment the richness of interrogations which suspension enables, the freedom and easiness of movement of this notation; this is compared with the formalism and the neatness of more ancient approaches.

7. Integrating the tension in the reading

1. Once the cohesion modeled, a generic approach established, a validated graphic, everything goes well on the paper, but this is similar to systemic models, that have not become a true theory for they do not take into account neither the deed neither the author of modeling. A model of cohesion that stays external to the reader falls under the critics of naturalism enunciated by Ricœur: the object is not grasped but remains at a distance. This critic rejoins the critics of the simulation of behavior, dear to artificial intelligence (Alain Cardon). Well, to foretell is not to explain; the intelligible grasps the movement within things, whereas simulation reproduces merely the external behavior.

If one wants to understand – and not only simulate – one has still to assimilate the inner tension of cohesion, to carry it within oneself and to lead it to the reflexive degree. The reflexive degree, after the space degree then time degree, integrates the changes underwent by the form and enables learning. The reflexive as a return to oneself enables consciousness and any flow of attention assumes implicitly a source of tension – origin means to well up – though this source is not defined. The reflexive degree leads then to compare the status of the subject according to our vision of tension to others views, the one of Hindu metaphysics and the one presented nowadays by Alain Badiou.

2. Alain Badiou, after Merleau-Ponty in particular, assumes at the basis a "There is'" whereas the prime question does not seem to us a static ascertainment but, as being is movement (P2), the interrogation: "What does happen?" This question lays at the basis of our opening to the world, hence of consciousness and of scientific enquiry. Two authors at least have mentioned this question in their writings: Jung and Gilles Châtelet.

The pole of knowledge is truth: how to understand this word? Can one talk of truths or of the True? One finds again the opposition one-many seen in chapter 2, at the reflexive degree this time. Judgment that sets down from perception leads to the question of truth. Truth is not some content at a distance, this would mean to fall back in the static Multiple (world of Four); it is neither an operation that would define itself, as suggests Alain Badiou, this refers to the world of Three. We'll sketch an approach of Truth as the pole of True, the true being a pulsating ray; to be true means to take part directly to the thing, before it is defining itself, setting and perceived.

If consciousness is not based on a "There is ", however it assumes a ground – as we called it – a unit or confuse multiplicity, a chaos in the primitive Greek sense of the word. The ground is a logical world – extreme as the void set or the no-number - which is its link with the other worlds? These worlds have been associated to color, which color can be associated with it?

The study of cohesion lead to a threefold tension, can one deduce that there does exist three fundamental poles? They would be tagged by color and would be located at the root of the tree of poles; they could be the Good, the True and the Beautiful according to the western ethical tradition or the logos, ethos and pathos (Meyer) according the Greek tradition. One has thus to come back to the One, supreme value for Plotinus, and to search for a threefold prismatic structure with the One, Being, and Duration. This ternary is parallel to the ternary developed by Louis Lavelle: Being, Existence and Reality.

3. The meta-model shows that two domains where tension expresses are the cognitive domain and the action domain. Louis Lavelle shows that that both correspond each other in the act of knowing. One may add the domain of piloting since it guides decision, therefore the action. Thus these three domains unite and the poles of True, Good and Right converge. Since knowledge is a versant of action, it is right to get out of the

domain of pondering, which intellectual people overvalue since it is the field of their competency, according to the writings of Bourdieu and Barbaras.

It is Reality that unites the worlds and not truth, contrarily to what claims Badiou. Reality is the ground under our feet, whereas one may take part to truth without proving it to others. Since the Greeks, the matter is to prove in a trial when the question is to point out, to guide the other toward his (her) right perception.

The Real includes not only the dimension of action or power, yet also the enjoyment, the joy of philosophical experience; it includes too the hazards of research when one has not yet found, yet this research is being built progressively. So this thesis shows that it is possible to base cohesion upon tension, it does not prove it is the only one possible way to find the origin of forms.

4. The question of cohesion has received an answer with the model of the threefold ring of whorls. Thus form renews itself, assembles elements and is sensitive to its environment. Suspension has been modeled to ease the use of this concept; this has given the whorl, yet this new element fits well in the series of logical worlds that makes a general conceptual frame. Color too has received an abstract meaning that tags these worlds. The model works in three degrees: spatial, temporal and reflexive.

The model of the threefold ring satisfies to the conditions of validity enunciated by Whitehead; theoretical validity first of all and theoretical usefulness in its methodological consequences. Is this model useful? An experiment has shown the easiness of using the model for describing intensional quality. It is still a very partial validation of its usefulness.

This study is based on the genesis of numbers, numbers being the archetypes of thought and genesis the birth of movement; these two points lie in the Husserl's thought. Logical worlds are another result of this research, and it is amazing yet understandable to see logic appear at the basis of cohesion since the Greek word *legein* means to link, to assemble.

Which limits this thesis presents in an obvious manner? It has no quantitative parts; tension is supposed to fade away but nothing is said about this fact. Suspension escapes to any comparison, any measure. It is also difficult to say which are the necessary whorls, in an absolute point of view.

How this research can be furthered? Developed? An aim that collects hanging-on links is based on judgments and thus can be compared, basis of any measure. It will be useful too to deepen the structure of poles, their mutual links and their correspondence with the three dimensions of color.

In brief, an IT (Information Technology) project associates multiple elements, organizational, human, cognitive, and digital ones. Whence comes their cohesion? This thesis aims to contribute to a science of information as making form; it questions the meaning of notions, answers according to thoughts given by some philosophers and relies on the formal rigor provided by mathematics.

Interactions assume some defined and existing systems, thus they describe merely an already existing cohesion; moreover they cut the movement in jerks. Therefore to explain informational cohesion with interactions does not suffice, the matter is to grasp the movement that puts in form.