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From Architecturology to Architecturological research

Abstract:

This paper presents a genesis of the French research field of Architecturology, from its creation to the current researches developed from it, at ARIAM-LAREA (National School of Architecture of Paris-la-Villette Laboratory of modeling for computer aids of cognitive activity of conception).

Architecturology has been thought at the creation of French Schools of Architecture that has been initiated with the French movement of 1968 May. Its major aim is to build specific knowledge on architecture for learning architecture. The first book of the beginnings of this scientific field is "Sur l'espace architectural" written by Ph. Boudon and published in 1971.

It's currently constituted with a scientific systemic language and a paradigm that help to explain cognitive activity of design named by it, conception. This scientific language has been published in "*Enseigner la conception architecturale: cours d'architecturologie*" written by Ph. Boudon, Ph. Deshayes, F. Pousin and F. Shatz, and published in 1994 and in 2000, in "*Echelle(s)*" published in 2002 and which gathers different articles of Ph. Boudon and, in different articles of the team of LAREA - Ph. Boudon, Ph. Deshayes, F. Pousin, F. Shatz and C. Lecourtois.

From this scientific language and the paradigm of Architecturology, I develop methods for extending the field of knowledge of this point of view by doing researches in architecture.

These methods are gathered into the concept of *Applied Architecturology*.

In 2005, LAREA has merged with a research team interested in Computer Aided Design, named ARIAM. To create ARIAM-LAREA, we have built a new research program on Computer Aided Conception where we use *Applied Architecturology* for 1) producing new knowledge on implications of Computer in cognitive activity of design and 2) developing new software to Support some operations of conception. This paper exposes my current research work and three theses that I co-lead at ARIAMLAREA on this object.

Keywords: Architecturology, Applied Architecturology, cognitive activity of design, conception, operations of conception.

Introduction

This paper presents a genesis of the French research field of Architecturology, from its creation to the current researches developed from it, at ARIAM-LAREA (Laboratory of modeling for computer aids of cognitive activity of conception, of the National School of Architecture of Paris-la-Villette).

The scientific program of ARIAM-LAREA that I have built with F. Guéna aims to enlighten Computer Aided Conception by using Architecturology as tool of questioning and analyzing implications of Computer in cognitive activity of architectural design. Two kinds of production are expected from our research works: building new knowledge and the developing of new software to assist some operations of conception.

Three parts constitute this paper. The first presents a genesis of the scientific adventure of Architecturology and explains the ways that it has been thought in order to offer knowledge on architectural conception. The second presents some of the important written productions as markers of the construction of architecturology. The third presents the current researches done at ARIAM-LAREA from the methods that I develop from Architecturology under the concept of *Applied Architecturology*.

The genesis of Architecturology

Architecturology is a French scientific field of research that has been initiated by Ph. Boudon and his LAREA¹ research Team from 1975. The starting point of the creation of this scientific field was to identify specific knowledge on architecture in order to constitute new pedagogical program to teach architecture.

The historical context of the creation of the LAREA scientific team of researchers is very important for understanding the cognitive posture of their work. In 1968 May, the student's movement against the government has conducted to distinguish the teaching of architecture from the teaching of Fine Arts. In 1969, French Schools of Architecture were created independently of Fine Arts Schools. Teachers in Architecture asked then themselves what to teach and how to teach architecture differently from Fine Arts.

¹LAREA: Laboratory of Architecturology and Epistemological Researches on Architecture.

In this context, Ph. Boudon and his team have examined, in one hand, the place and the nature of models in architecture and design and, in the other hand, the speeches written on Architecture.

The questioning of models in design proceeds from the place of models in apprenticeship of Fine Arts. In apprenticeship of Fine Arts, the reproduction of models holds a major place.

The question was then to know if, in architecture, models have a similar importance or a particular prominence that permits to specify apprenticeship of architecture.

From this question, The LAREA team has built a categorization of kinds of models in design, relatively to their functions for the design process. From an epistemological point of view, they have distinguished models in design and models of knowledge (Deshayes, Ph., 1986) and for explaining models in design, *substrate models* and *teleological models*.

Architecturology is then posed as a knowledge model on cognitive activity of design, called conception. So it is not a model in design neither a model for designing.

This research on models in design and models of knowledge is the fundamental base of the creation of Architecturology. This allowed the LAREA team to set aside the practice itself and the question of models in design in order to concentrate its efforts on building a scientific model of knowledge on architecture. Architecturology stands today as this scientific model of knowledge on architecture and, it helps to explain the prominences and games of models in architectural conception.

From the question on speeches written on Architecture, the researchers of LAREA have built a categorization of speeches relative to their object. This interest for speeches comes also from the etymology of the suffix *logy* that we find in Architecturology and that comes from “*logos*” which means speech, verb and reason, knowledge or science.

To enlighten what is written on architecture, Ph. Boudon and his team have differentiated object of speech and field of speech. The object of speech is the signification of the field of speech that is to say the way that the field is presented and what is said about it. From this, they have distinguished four genres of speech on architecture: historical, critical, doctrinal and theoretical speeches. Architecturology aims to build a scientific language to produce theoretical speeches on architectural conception. That means that the research work engaged by the LAREA team had aimed to construct an objective knowledge able to explain architecture independently of cases or of kinds of architecture.

They have then studied epistemological works in order to know how to build a new scientific field. From the epistemological cut of Gaston Bachelard (1934), the concept

of paradigm of Thomas Kuhn (Kuhn, 1962) and the distinction between scientific object and natural object of George Canguilhem (1975), the Larea's researchers followed the Kantian apriorism. They have then constructed a scientific object and scientific concepts for explaining it.

So, following the distinction of George Canguilhem, the first work was to find a scientific object which could meet a natural object. The natural object was architecture as a polyssemic activity, difficult to define.

The question of the first epistemological work of architecturologists was then: "What is said on architecture that could identify a common view on it?". To respond, they have chosen to follow the definitions of Architecture of Bruno Zevi (1959), Henri Focillon (1934) and Erwin Panofsky (1967) and have from them, extract postulates of recognition of what is Architecture.

Space, thought and mechanisms for structuring thought would be the elementary principals of Architecture. Architecture is then considered as a cognitive activity of thought of future space. From this postulate, the question was to know what could characterize an architectural thought in opposition with geometrical thought of space. The answer is concrete measurement. Architecturologists have then built a scientific object to work with the question: how conceivers give measurements to architectural space?

To enlighten this scientific object, the LAREA team has worked to create scientific concepts. Each scientific concept is thought as an elementary unit of a language that represents a systemic model of knowledge of conception. Conception is here considered as a cognitive activity of design aiming to give measurements to a future object.

The most famous concept of Architecturology is scale. Scale (or scales) in Architecturology designates (or designate) classes of cognitive operations of conception that link three other architecturological concepts: *space of reference*, *relevance* and *dimension*.

These three scientific concepts are elementary units of the complexity of the activity of giving shapes and measurements. Giving shapes and measurements, that is to say for Architecturology, conception, is a complex cognitive activity that combines these three elements. The ways to combine these elements are various and depend on situations of projects.

Space of reference is a plural concept that designates abstract or concrete knowledge domains and, abilities involved in conception. Empirically, these domains depend on actors or authors of conception and can be diverse. They can be the geometry, the

technique, the culture, the neighborhood, the symbolic, the function, the economy, and so on.

Relevance is another plural concept that designates the ways of using Space of reference in conception. In other words, it designates pragmatic operations of conception of choices, or manners to imply *space of reference* in conception. These pragmatic operations help operations of conception to be implemented in conception. They can be, to apply a rule, to choose a domain of values for a dimension, to not follow a constraint, and so on.

Dimension is the third plural concept that designates elementary units of project that are designated by conceivers and to which measurement is done. It is not a value but the support of measurements. It can be a shape, a length, a bounding, an object, and so on.

Architecturological scale is the plural concept that designates all possible classes of operations of conception able to be described by combinations between space of reference, relevance and dimension.

AS = SR (-) R (-) D

AS : Architecturological Scale

SR : Space of reference

R : Relevance

D : Dimension

Each *architecturological scale* is implemented in design in order to operate on the project due to elementary cognitive operations of conception that can constitute operating complexities. These elementary cognitive operations of conception are: referring to a field of references, cutting the project into pieces to conceive, dimensioning by giving measurement, orientating the project or one piece of it, positioning the project or one piece of it.

From this modeling, the researchers of LAREA have proposed to think the process of cognitive activity of design, as a game between *Architecturological scales* and *models*.

CP = AS (-) M

CP: Conception process

AS : Architecturological Scale

M : Models in design

In this game, models are what are operated by architecturological scales. They can be models of references or productions of conceivers (models used or produced by a conceiver).

The game proposes to think conception process such as successively, to choose architecturological scales and to produce models of the project.

Process of conception would be to choose an architecturological scale and a substrate model (mental representation of a precedent) then, to apply the architecturological scale to produce a model of the project and, then, to choose others architecturological scales to carry out on the model of the project to produce a new model of the future object and so on.

This scientific modeling of conception process can be better described with two other kinds of scientific concepts called systemic concepts: *properties of scales* and *relationships between scales*. "*Properties of scales*" determines the ways that scales intervene in the process of design. "*Relationships between scales*" determine spatial or temporal relations between scales, relatively to a project. All of these concepts help to describe the operating mechanisms of architectural conception in general, that is to say detached from reality.

All these scientific concepts have been created before 1994, year of the edition of what the community of architecturologists calls The Manual: "Enseigner la conception architecturale: cours d'architecturologie" written by Ph. Boudon, Ph. Deshayes, F. Pousin and F. Shatz. This book is a kind of dictionary that presents what I called Fundamental Architecturology that is to say, all the concepts that form the scientific language of architecturology which allow to explain what we call the design space i.e., the cognitive operations of the design.

Some of the most important Publications of Fundamental Architecturology

Different books and more than one hundred articles have been published on Architecturology.

Books attest of finished cogitations while articles explain works in progress. We can find several articles of Ph. Boudon about Architecturological scales in the book *Echelle(s)* published in 2002 at Anthropos editions. Others articles of all the researches of LAREA team - Ph. Boudon, Ph. Deshayes, F. Pousin, F. Shatz and C. Lecourtois - and, nowadays, of the architecturologits of ARIAM-LAREA - C. Lecourtois, A.S. Delaveau, A. de Boissieu and S. Ben Rajeb - have been published in

different scientific reviews². Those of the LAREA Team concern *Fundamental Architecturology* while those of the architecturologists of ARIAMLAREA concern what I call *Applied Architecturology* that is presented in the last part of this paper.

I only present here some of the most important books in which we can find benchmarks of the genesis of Architecturology.

The first book on Architecturology is *Sur l'espace architectural* written by Ph. Boudon and published in 1971 at Dunod editions (second publication in 2003 at Parenthèses editions).

This book presents a research rapport of an epistemological work concerning written knowledge on architecture. It reports analysis of architects' writings on architecture definitions in order to find elements to characterize the natural object Architecture from which to build a scientific object for Architecturology. Architecture is then considered as space of thought rather than the space itself.

It introduces the thought of leaving aside the architectural practice in order to inquire into its knowledge and, proposes to build an Architecturology as a specific knowledge from architecture different than psychology, sociology, semiotics, history, technology, and so on. It specifies architecture relatively to another space, a space of thinking, geometry and, introduces scale, as giving sizes and measurements, as rise to this difference. Its main architecturological proposal is to regard the building as a representation of its precedent project. In other words it's to think architecture as it proceeds from a cogitation.

The second book is *Richelieu ville nouvelle. Essai d'architecturologie* written by Ph. Boudon and published in 1978, at Dunod editions.

This book presents an empirical study on the French new city of Richelieu. This empirical study has been supported by French state. This book is the second theoretical essay aiming to define an "architecturology". It introduces the scientific object of Architecturology with the question: how does architect measure space?

This study has helped to build the architecturological model of knowledge by confronting theoretical hypothesis with a realistic case. It explores the different meanings of scale for architects as Viollet-le-Duc, A. Choisy and Le Corbusier. Accordingly, it lays the plural scientific concept of *architecturological scale* in term of *relevance* of measurement and, reveals twenty cases of it.

² We can find some of them to www.ariam-larea.archi.fr. I do not speak here of works developed at CRAAL, another laboratory of Architecturology, not because they are not interesting but only because our paradigm is somewhat different of their.

Architecturological scale is posed as a relation between project and *space of reference* by which giving measurement. The *architecturological scale* mainly defined by this study is the *neighboring scale* which gathers all operations of conception that take into account the closeness or the neighbor.

The third important written production for Architecturology is a research rapport that has not been published in its state but through different articles. It takes the form of three volumes written by all the research team directed by Ph. Boudon in 1975: *Architecture et architecturologie, Tome I: Concepts, Tome II: Système, Tome III: analyses et éléments de théorie*.

The first volume of *Architecture et architecturologie* defines the scientific object of Architecturology that takes the form of the question how conceptions give measurements to their project? It presents the work realized on modern architectural writings - of Ch. Alexander, Le Corbusier, W. Gropius, R. Venturi and B. Zevi - in order to understand the architectural mind which presides the project. At last, this volume studies philosophical approaches of the term "concept" - Lacan, Marx, Martinet, Chomsky and Hjelmslev - and suggests building a systemic theory by building oppositional concepts (not isolated from others).

The second volume aims to build theoretical model knowledge in opposition with models in architectural design. It categorizes Models in architectural design due to their functions and the operations they involve: reduction or repetition. Accordingly, it proposes an architecturological model of knowledge to think the architectural design process in terms of interplay between models and scales.

The third volume defines Architecturology as a science of artificial. It exposes scientific propositions for determining an architecturological paradigm and, suggests considering buildings as a representation of their design process.

A fourth volume of *Architecture et architecturologie* was produced by all the team in 1983: *l'idée de l'architecturologie*. It raises the question of a scientific architecturological program. From the phenomenology of Husserl and Merleau-Ponty's, it studies scale as a phenomenon and, examines the possible relationships between architecturologie and phenomenology. Here, scale is a way of questioning architecture.

The main question of this volume is: Can a phenomenology of conception exist? With the difficulty that conception is not a given object. Consequently, it introduces a distinction between conception (scientific object aimed by Architecturology) and perception (possible object of phenomenology).

At last, this fourth volume defines Architecturology in opposition with poietics - which learns the making -, history - which returns on the reality facts -, science of

artificial – which aims the practice-, epistemology – which products knowledge about sciences on art and science -, philosophy - on which it leans- and, sociology - which scientific object is the social. The fifth writing is an article written by Ph. Deshayes in 1986, “Modèles a priori et modèles a posteriori du travail de 'architecte” and published in *La recherche en architecture, un bilan international*, at Parenthèses éditions.

In this article, Ph. Deshayes introduces a distinction between *a priori* and *a posteriori* models.

He queries relationships between reality and models and shows how architecturological scale is an *a priori* model which does not aim to help to do architecture but helps to understand it through a comprehensive system. The colloquium gathered researchers from France, Deutschland, Great Britain, United States, Italy and Austria in order to make the first situation on research in the field of architecture.

The sixth book on architecturologie is *Introduction à l'architecturologie* written by Ph. Boudon and published in 1992 at Dunod editions.

This book aims pedagogy and traces the architecturological intellectual process from the difference between doctrinal and theoretical architectural discourses to the architecturological concept of scale. It gives examples of some architecturological scales in order to communicate the scientific demarche. With the case of the Brittany coast of Mandelbrot, it demonstrates that we need relevance to take or to give measurement and, introduces an architecturological space to explain architect's cognitive work in terms of relevancies operations of conception.

The seventh and last important book of architecturologie for me is what we call The Manual of architecturologie, *Enseigner la conception architecturale, cours d'architecturologie*, written by Ph. Boudon, Ph. Deshayes, F. Pousin and F.Schatz edited in 1994 and 2002 at la Villette Editions.

This book is the result of all the scientific cogitation since 1970. It presents the model of the *architecturological space* and exemplifies its concepts. It takes the form of a dictionary and presents the architecturological language. That is to say that it builds scientific knowledge on architectural conception for students, teachers and researchers.

I arrived at LAREA in 1998, after the publication of The Manual. My scientific work is to pursue the scientific language of Fundamental Architecturology by developing research methods for using it by confronting it to realities. I have so created a field of architecturological research, called *Applied Architecturology*.

Architecturological research: Applied Architecturology

From *Fundamental Architecturology*, I have developed new empirical methods in order to explore architectural design. These methods are called *Applied Architecturology* and use concepts of Architecturology as analysis tools.

The principle of *Applied Architecturology* is to confront the theoretical model of knowledge with empirical reality. It proceeds from a scientific method aiming to validate or not, theoretical propositions. The theoretical propositions in this case are architecturological concepts which can be posed as, what E. Kant calls empty concepts that take values by experiences (Kant, 1781).

The confrontation between architecturological concepts and realities can be diverse. *Applied Architecturology* regroups therefore different methods of confrontation depending on empirical case explored corpus and aims of analysis. These corpus of projects can be composed with verbal descriptions, press papers, physical or virtual models, sketches or different kinds of texts (critical, historical, technical, theoretical,...). Aims of analysis are to describe the conceived part of an object.

This object able to be explained through conception can be: conception itself (Lecourtois, 2006), perception (Lecourtois, 2007), architectural style (Delaveau and al., 2009), aided modeling operations of conception (de Boissieu and al., 2010), collaborative operations of conception (Ben Rajeb and al., 2010), and so on.

So, for architecturologie, perception, architectural style, helpdesk and collaboration are conceived objects or mental mechanisms that can be described in terms of operations of conception.

For each, *Applied Architecturology* gives tools to analyze cases from the same postulate that corpus of cases can be read as composed with "indicial signs" of operations of conception. The term of "indicial signs" comes from Ch. S. Peirce. It designates the kind of signs that having meanings depending to a precedent object. It's the case of footprints in the snow which designates that someone has gone (Peirce, 1978).

Ch. S. Peirce distinguishes different kinds of signs from a triadic semiotic model that links three elements of the sign: object, representamen and interpretant (context). From the relationships between these three elements, he has built a typology of signs in which there are "indicial signs".

Applied Architecturology is based on this semiotics' paradigm. It consists in reading elements of corpus in order to explicit operations of conception. It aims to build methods for a graphical semiotics or semiology, able to explain conception through physical representations.

The first method built to use Architecturology proceeds from the determinant usage of sketches in architectural activity. Sketches are for us tools by the way conceiving architecture (Boudon and Decq, 1976; Lebahar, 1883; Boudon and Pousin, 1988; Conan, 2000). They are manifestations of cognitive activity helping to express new objects in their shapes and measurements.

From this point of view, each sketch as each model of a future referent object being conceived can be taken as a composition of "indicial signs" of cognitive operations of conception. The cognitive operations of conception implementing through sketches or models, consist in giving shapes and measurements by linking the new conceived object or space with own references. These own references are various and constitute, for the conceiver, fields of references to use. Applied Architecturology aims to describe the implicit fields of references being used in design and, operations of conception that are characterized by them.

For example, when conceiver thinks the structure of his project, we can say that he refers that he uses a culture field of references. When he takes care about prices, his field of references is economics and so on.

Operations of conception for themselves connect pieces of project (*dimension*) with fields of references (*space of reference*). The created link gives measurement to the pieces or determines them. The operations of conception can be one or several elementary cognitive operation(s) of conception.

To understand what have happened during the conception of the sketch of a project (that is to say to discover the cognitive operations of conception behind each indicial signs of conception), I use the Architecturological model of conception process:

CP = AS(-)M.

This model suggests that cognitive operations of conception constitute the in-between of two consecutive sketches or models. So, by comparing two consecutive sketches or models, we can identify graphical or models entities that can be read as "indicial signs" of cognitive operations of conception.

The second method built with the use of Architecturology for analyzing cases proceeded from the point of view that architectural perception is an individual conceived cognitive activity (Lecourtois, 2007). From theories on perception of M. Reuchlin (1998), J. L. Austin (1971), J. Bouveresse (1995), J. P. Cléro (2000) and using the words of P. Sansot (1973), I propose to think architectural perception as an activity that aims to "qualify the reality" (Lecourtois, 2007). Architectural perception is made by users that express their opinion about the ways that architecture has been conceived, relatively to their horizon of expectation (Jauss, 1978). Studying architectural perception with *Applied Architecturology* consists in describing

operations of conception implemented by users for expressing their opinion on architecture. It is possible to do so by analyzing verbal or textual expression of perception.

The third method of *Applied Architecturology* has been developed in the context of a thesis that I co-lead and which deals with the question of a digital architectural style (thesis of A. S., Delaveau). It uses the first method on doctrinal discourses and models of projects in order to enlighten the recurrent operations of conception. This method helps to explicit the ways that conceivers develop their own architectural styles, which are usually not perceptible. This thesis suggests approaching architectural style through the concept of act of style built in opposition of the concept of fact of style (Delaveau et al. 2009).

The fourth method is used to question IT support and helpdesk in cognitive activity of conception. It consists in studying projects by the means of *Applied Architecturology* (presented above) to compare “cognitive architectural operations of conception” and “modeling operations”. The comparison is based on the description of these two kinds of operations - of conception and of modeling - and aims to understand the manners that “modeling operations” influence the cognitive activity of architectural conception (Boissieu et al., 2010). A thesis - that I equally co-lead - concerning the relationships between parametric modeling and architectural conception, is currently developed from this paradigm by A. de Boissieu at ARIAM-LAREA.

The fifth method of *Applied Architecturology* aims to describe collaborative conception in architecture. On the postulate that architecture is a cooperative work, *Applied Architecturology* on collaborative conception helps for questioning the ways that conception is concerned by the cooperation and the multiplicity of actors. The main question of this research work is to enlighten the possibility of architectural conception to have a multiple author or a not individual conceiver (Lecourtois et al. 2010), (Rajeb et al. 2010).

This research examines the nature of the architectural conceiver and the possibility for it to be multiple. So, I have built an analysis method in posing Architectural collaborative conception as a new research field for Architecturology that is to say concerned by two questions: 1) What can Architecturology ask as evidence of collaborative work in architectural conception? 2) What can Architecturology afford to say on collaboration in architectural conception? From these two questions, two objects were distinguished to be analyzed through *Applied Architecturology*: Collaboration and collaborative conception.

So collaboration is considered as a conceived mechanism that can be enlightened in terms of operations of conception. To really collaborate, conceivers have to build a

common abstract or concrete space to work together in order to understand each other. Elsewhere, new collaborate tools inevitably proceed from a certain conception of collaborative work.

Mechanisms or tools of collaboration can be questioned through their conception in order to better understand the ways that they intervene in architectural conception.

Collaborative conception is another object of *Applied Architecturology*. The aim relatively to this object is to know if the cognitive activity of architectural conception is or can really be collaborative or shared. The main postulate of Applied Architecturology is that, if collaborative conception in architecture exists then it is possible to find shared cognitive operations of conception. So the existence of the sharing of the cognitive activity in architecture depends on the possibility of explaining the sharing of some operations of conception. That supposes to define what I call shared operations of conception and the ways that we can say that there is sharing of an operation of conception.

From these objects identified above for *Applied Architecturology*, it is possible to enlighten two different kinds of operations of conception: 1) the ones that explain collaboration as a conceived mechanism, operations of conception of the collaboration that have been named pragmatics operations of collaboration (Ben Rajed an al. 2010, Lecourtois et al., 2010), 2) the others that explain collaborative conception in architecture, operations of collaborative conception, shared architectural operations of conception. From real representations of a project (models, sketches, discourses, and so on), *Applied Architecturology* permits to investigate the activity of architectural conception in terms of cognitive operations of conception for giving shapes and measurements to a new object or project (cf. above). With the first method of *Applied Architecturology* analysis, it is possible to identify sketches made with two hands and common fields of references (*space of reference*) discussed by the two conceivers.

So, shared operations of conception are, in data, entities of sketches and entities of discourses that are worked together and that imply new architectural decisions. This fifth method of *Applied Architecturology* is used for a research (project n°ANR-08-CREA-030-02) supported by the French National Agency of Research (ANR) that gathered three different laboratories: LIMSI-CNRS, ARIAM-LAREA and LUCID-ULg. It is also used and adjusted by S. Ben Rajeb in her thesis on remotely collaborative architectural design.

At last, the sixth method of *Applied Architecturology* currently developed at ARIAMLAREA consists in using *Fundamental Architecturology* for developing new

software to support architectural conception (Lecourtois & Guéna, 2009, Guéna & Lecourtois, 2009).

ESQUAAS (Architecturological aids for freehand sketches) is thought to assist architects in computer modeling by using recognition of freehand sketches. Considering architectural conception as a game between freehand strokes and *architecturological scales* (their significations), it consists in building a computer system able to link freehand strokes with *architecturological scales* for understanding the sketch in progress and, to automatically build a 3D model of the project.

To implement this program, architecturology is worked in order to be re-constituted as a multi-agent computer system, able to recognize and to interpret signs and graphical actions.

From dromies (elementary unit of design, relations between strokes) and *architecturological scales*, it consists in creating an intuitive 3D dynamic modeling assistance universe.

In conclusion:

Architecturology has been developed in order to build specific knowledge on Architecture from Architecture. To build its scientific object, architecturologists have chosen to postulate that Architecture is at first a cognitive activity of design before than to be buildings. Calling this cognitive activity of design, conception, Architecturology gives then scientific tools (concepts) to describe and communicate on it through a systemic language that produced a model of knowledge. This systemic language or model of knowledge of conception is currently called *Fundamental Architecturology*.

Fundamental Architecturology can be used in different ways. We have seen in this paper that I have built methods to do researches from *Fundamental Architecturology*. Six methods are currently used in my Laboratory, at ARIAM-LAREA (Laboratory of modeling for computer aids of cognitive activity of conception, of the National School of Architecture of Paris-la-Villette). They conduct to build knowledge on conception and computer aided conception. The sixth one is quite different because of its empirical aim of developing new software.

Others usages of *Fundamental Architecturology* are developed by architecturologists or other researchers interested in architecture, conception, complexity, pedagogy and space. For example, F. Schatz and Ph. Deshayes which work on the architecturological idea since 1975, use it to teach architecture and conception. J. C. Ludi says that he

used architecturological work to explain architecture in his courses. About me, I use it as intuitive tools for correcting the project in project apprenticeship courses.

Architecturology was also used by anthropologists to investigate space and, was epistemologically questioned by D. Raynaud relatively to anthropology in order to understand its specificity.

At last, I know from Ph. Boudon that it is used by some architects - as S. Fiszer - as checklist to not forget relevancies in architectural conception. Some of my students have confirmed this use in their own practice.

We have seen here some possible usages of Architecturology in different practices interested by conception - Architecture, pedagogy and research - but, to imagine possible others usages and implications in practices or in science, is a research question that remains to be investigated.

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