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Introduction

Since the Middle Ages, public authorities entrusted to persons whom they considered qualified and accredited, the action of issuing an opinion – in a situation of uncertainty – based on technical and/or scientific knowledge, either in the gracious domain or in litigation. In the case of litigation, a judge often calls an expert during a trial. An exceptional archive, preserved in the National Archives of France under the subseries Z1J, which keeps all the minutes of expertise for Parisian building from 1610 to 1792 allows us to launch a large-scale multidisciplinary investigation (legal, economic and architectural) on the question of expertise. This essential source for the history of Paris' buildings is only subject for the moment to punctual use by historians of art. However, the real mechanisms of expertise remain largely unknown.

The project is focussing on the period between 1690 and 1790 because 1690 was a particular turning point; it is the date when experts were divided into two different branches: architects and contractors (entrepreneurs). These two branches have been performed competing, and sometimes complementary activities since the 17th century. It is important to understand that architects became an officially organized profession only in the mid-20th century.

This multidisciplinary research aims to examine, from a major economic sector – that of building in the early modern era – the key mechanism of expertise:

- how and why the technical and regulatory language of experts is essential to society,

- and how and why their technical competence is converted into authority, sometimes even into "abuse of authority".

- we want to adress new questions about the architectural profession at a moment when it wasn't clearly defined yet

An important part of our work is to establish two parallel corpuses. On the one hand, a prosopographic dictionary of the 266 experts (113 architects, from which one became a contractor, and 131 entrepreneurs, from which five became architects ; 23 professions are still unknown) working from 1690 to 1790 drawn from various sources (handwritten and printed); on the other hand, the inventory and the analysis of the minutes of expertise over the same period. Given the immensity of the sources, we plan to work on a group of nearly 10 000 expertises through a sampling of ten years between 1696 and 1786. Each expertise is inventoried, indexed, digitized and analysed in detail. The corpus will be the subject of a serial study on the whole century, with thorough analysis of their contents. This analysis will shed light on the complex networks (or insular positions) woven between the members of these offices in charge of the expertise in the capital, holders of knowledge and power to advocate solutions to technical, economic and legal issues in the field of building construction.

Research Investigation

What are your research questions right now given your work thus far on the project? Have your questions changed since the project launched? If so, how and why?

This study of experts and practices of constructive expertise in Paris from 1690 to 1790 focuses on the practice of knowledge – between judgment and innovation – through a multidisciplinary approach. It aims to identify the key mechanisms of expertise, to work on the language of experts, their skills and authority, but also to look at the history of their original profession, the history of technology, and the economic and legal aspects induced by this procedure. One of the issues underlying our work is to document the evolution of two professional sectors usually considered to be in competition. In particular, we formulate the hypothesis that expertise contributed to the birth of the architectural profession. When bourgeois expert architects were allowed to carry out expertise on the same basis as masons (1690), one might expect, through the establishment of an unofficial professional status, to see a confrontation between contractors and architects emerge. The preliminary results of our research do not reveal any conflicts or confrontations. Contractors are not deprived of their ability to assess, and there does not appear to be a predominance of architects during the century under study who have only acquired additional know-how. On the contrary, the experts seem to form a single body which agrees to carry out its functions.

When one compares its role to that which it has today, one might have thought that expertise was a mainly judicial phenomenon. In reality, we found that it was largely a voluntary or an ex gratia procedure. Expertise operates as an extra-judicial mechanism. The invention of law in the 18th century should be highlighted here in its ability to set up dispute resolution mechanisms outside the classic judicial circuit of the courts, in the face of the difficulties encountered in the field of construction. Expertise takes the form of conciliation or mediation. On reading the minutes, we see a transformation of the decision-making aid, which is the very essence of expertise, into a means of fixing a definitive, peaceful and certain solution to resolve a question in a situation of uncertainty, a priori conflictual. Either the parties agree that the experts (even in the event of disagreement, the third party expert will have the last word) will provide a concrete answer to their concerns, or the judge will decide the dispute, but will he still be free to depart from the content of the experts' statements? In fact, the expert's role is eminently social.

As was thought, the custom, and that of Paris in particular, regulates the expertise of the building. In principle, the expert should not act in law but only in fact. However, property – and precisely the immovable property at the heart of expert appraisals – is a legal object constrained by the principles of ownership. Although the sources of law are multiple (Roman law, customary law, jurisprudence, doctrine, practice), custom remains a sufficiently flexible and materialistic source to deal in vulgar language with property and its dismemberments. Contractors, architects and scholars have not been mistaken in commenting on it (cf. the carpenter Pussot, the surgeon Louis Savot, King's architect Pierre Bullet, the Royal Academy professor Antoine Desgodets, Jean-François Blondel, etc.). Two subjects are at the heart of this literature: the settlement of

easements (joint ownership) and maintenance repairs and the distribution of their burden.

Another important issue of the expertise lies in the estimation of the value of the properties, mainly at the time of inheritance or partition, because of the consistency of the real estate assets under the Ancien Régime. What are the methods for setting the price? Beyond the market, which was difficult to define at the time, the expert sets both intrinsic criteria (the type of construction, condition, surface area, distribution of space, orientation, etc.) and extrinsic criteria (its location in the town in relation to services, transport, profitability through an evaluation of the rent, etc.) in order to estimate the property concerned. The measurement – an essential notion in the 18th century – via the "toisé" also allows experts to assess the value of the work in order to determine what is owed by the client to the contractor. It is also a means of measuring the appreciation of this value during the expertise between the parties. For example, we can determine the terms and conditions for reducing invoices established to pacify anxiety situations caused by non-payment of debts.

The technical debates in the expertises are capital since our field is is first and foremost a technical field par excellence. How are the men of the art brought to solve the observed defects? The situations are very variable. Should it be consolidated by shoring, underpinning, doubling of walls (or counter-walls) or demolishing and restoring or even rebuilding. In the latter case, should it simply conserve (carry out necessary and urgent works to make the property habitable/houseable and avoid further deterioration) or take advantage of the situation to improve the property by adding value? We see fewer cases of contentious technical innovation than might have been thought, nor great discoveries, but practical solutions, which are the result of serendipity. The experts tend to implement technical solutions that generalise reuse, are inexpensive, favour the pacification of neighbourly relations and always aim for greater solidity, avoid fire and guarantee better hygiene (cesspit, well). Discoveries are made on a case-by-case basis. The experts particularly invest all of their senses to research and propose their technical solutions The question of producing inventiveness through expertise remains open for the time being.

> *What are your current technical/computational tasks? Within the context of this question, please be sure to address the current state of your data, including its completeness and its current organization.*

The research is mainly based on the constitution of two corpuses for which we developed a database and a web application that supports the entire work of the project and was built with free and open XML technologies. Several dynamic forms have been developed with XForms (https://www.w3.org/TR/xforms/) in order to allow the updating of archival analysis or to fill in the prosopography, and to have specific forms for the processing of certain sources such as *post-mortem* inventories or directories. This application allows the team to share data as the work is carried out and soon to share the results before the counts are completed. The use of the database also allows rich queries to be made in the data for statistical purposes, network analysis or to produce dynamic visualizations.

The creation of this tool required in-depth reflection on modeling in order to produce data that are durable and interoperable. Within the framework of a partnership with

the French national Archives, the team wishes to feed finding aids from the analyses carried out, for which it is necessary to use the ISAD-G standard from the International Council on Archives and to communicate the data in the XML-EAD format (https://www.loc.gov/ead). However, the specific questions of our research could not be satisfactorily dealt with this format. We developed a specific schema, compatible with EAD, for the processing which underwent several adjustments based on the work on the sources before it could be implemented in a computerized way. This partnership also suggested from the outset to use the EAC-CPF format (https://eac.staatsbibliothek-berlin.de/) from the archival world (ISAAR-CPF standard) for the description of historical entities because of its consistency with EAD and the opportunities for information exchange possible with archives that currently use these standards for their stakeholder repositories.

The desire to produce perennial and interoperable data and the need to create records in XML format naturally guided us towards these technologies for the development of our work platform. The application was therefore developed with XQuery, a language standardized by the W3C (https://www.w3.org/TR/xquery-3/), and the native, free and open source XML database, BaseX. The use of XQuery and the RESTXQ extension allowed us to create a dynamic web application, without using any other programming language. It is a language that can easily be mastered by researchers to express their queries to the database. To complete our XML technology approach, we chose to use XForms for the integration of all our forms.

In the absence of suitable models, we have developed our own schemes for the processing of expert reports and post-mortem inventories. After evaluating the various existing solutions for the prosopographic component, and in particular BioCRM, an extension of CIDOC-CRM developed within the framework of *Reassembling the republic of letters* (https://zenodo.org/record/1040712), we finally chose to use Ric-CM for the structuring of our data, a conceptual model developed by the ICA (International Council on Archives) https://www.ica.org/sites/default/files/ric-cm-0.2_preview.pdf. Despite the appeal of its simplicity, the BioCRM ontology required us to define a vocabulary for the description of social relations while waiting for the completion of the work on SocCRM, the Social Relationship Conceptual Reference model. This model had the advantage of being in line with the four existing international archival standards (ISAD-G, ISAAR-CPF, ISDF, ISDIAH) and of being very close to the XML-EAC-CPF format for the description of historical actors (persons, institutions and groups) and their existing relationships, while being more complete. With a few adjustments, the format allows us to produce semantic data using the XSLTs developed by the National Archives of France.

Over ten years, four complete years of minutes have already been systematically counted, after scheduling, reconciliation and digitization (1696, 1706, 1756, and 1766). The years 1726 and 1776, treated in a preliminary phase of research, are currently being revised according to our new analysis grid. 1716, being in progress, we therefore have three years of records left to digitize and examine (1736, 1746 and 1786). The prosopographic work is now very advanced. Several sub-series from the National Archives, the Paris Archives, or other sources have been systematically examined (V1, Provisions d'offices; Fichier Bossu; DAB6 and D5B6, Faillites d'entreprises; Fichier Laborde, Almanachs royaux). We managed to locate the post-death inventories of half of the experts. The receptions of master craftsmen in the funds of the Chamber of

Buildings have been partly, only partly, stripped, but this source should provide us with a great deal of information on the sponsors. Due to the unavailability of the archives caused by the closure of the Archives nationales de France in the context of COVID-19, we have been forced to modify our work programme to prepare a tool for the conversion and recovery of data from 1726 and 1776.

The three forms for expert examination, prosopographic data entry and post-mortem inventory analysis are now fully operational. The use of a stack of unitary technologies has greatly facilitated their development. Above all, we have complete control over the product, which makes it much easier to adapt it to research needs. XQuery is a language of choice for easily preparing all kinds of data sets for analysis in different formats. We use it to produce the consultation interface but also resources in GEXF (https://gephi.org/gexf/format/) or JSON format that allow us to dynamically build network visualizations from the application with JavaScript libraries such as D3.js (https://d3js.org/) or Sigma.js (http://sigmajs.org/). For some more complex network analyses, we are currently evaluating the use of software such as Gephi (https://gephi.org/) or CitoScape (https://cytoscape.org/) or the NetworkX libraries in Python (https://networkx.github.io/) or JuliaGraph in the Julia programming language (https://juliagraphs.org/).

> *What are your current art historical methodologies? Have these changed since the project launched? If so, how and why?*

Since its conception, the project has been based on a multidisciplinary approach to the history of construction, covering the technical, economic and legal aspects of expertise. This research involved source-centred work and from the outset targeted quantitative analysis and, perhaps to a lesser extent, the use of network analyses. The opportunity of the Workshop organised by the Getty greatly strengthened our commitment in this area and accelerated the team's investment in this direction. In this respect, the focus on the analysis of social structures that this kind of methodology implies renews our approach as historians more profoundly than we first thought.

Due to a lack of sources, historical research does not always allow an analysis of the individual attributes of the expert population to be conducted. Specialists in network analysis, on the other hand, avoid paying too much attention to it when the study of social structure seems relevant. In this regard, in a seminal article for the field of network analysis, Harrison, White and their co-authors warned of the risk of classification in envisaging social organization.

> « [...]largely categorical descriptions of social structure have no solid theoretical grounding; [...] network concepts may provide the only way to construct a theory of social structure » (White et al., 1976, p.732)

Thus, network analysis approaches make it possible to identify by formal means the structuring of a community of actors and practices. This involves characterizing its functioning, its morphology, etc. Working on network analysis has led us to take a more structural approach to the study of the Parisian expertise environment by reformulating a certain number of questions that we had been asking ourselves.

With the network analysis, our ambition was to be able to identify the complex network woven between the members of these offices in charge of expertise in the capital or isolated positions of experts. It was also a question of shedding light on the differentiated professional trajectories of the two branches of expertise (architects and entrepreneurs) in order to better understand the relationships between these two professions (genealogical, collaborative, etc.). We also formulated the hypothesis that network analysis would allow us to explain the operations of certain experts according to the type of expertise requested or the position of the actors within the professional field according to the intensity of their activity, their personal or professional links or their places of intervention in the Parisian space.

Between now and this summer, we will first focus on analyzing the collaborations of experts and the genealogy of offices in order to familiarize ourselves with metrics, before moving on to the use of bi-modal networks, which we feel are essential to answer a number of the questions we are asking ourselves. The Edict of 1690 mentions the designation of expert "according to the order of the table" in the context of police visits. However, the sources show that this rule is clearly not applied for expert reports. On the one hand, the applicants choose the experts, and on the other hand, where appropriate, the judges do not always seem to follow this rule of the table. Some important cases seem to be entrusted to a particular choice of experts of high repute. We would therefore like to be able to identify the principles governing the appointment of experts and in particular whether the nature of the cases is taken into account.

The bi-modal network we are considering includes two distinct groups of nodes, in this case the actors and the businesses, which are linked to each other. Several approaches can then be envisaged for the study of this bi-modal network. The use of a projection is most often preferred because most metrics, such as centrality or density measures for example, are only applicable to uni-modal networks. However, these sometimes pose problems of interpretation. In our case, the relations between actors being effective they do not pose too many difficulties but the analysis requires the application of normalizations according to the frequency of expert interventions. The direct study of the bi-modal network can allow the identification of bi-cliques or sub-graphs.

What preliminary conclusions have you drawn, what results have you found, or do you have anything otherwise surprising or interesting to report about your research?

New ways of asking questions have emerged as we have progressed in understanding the fundamentals of network analysis. But fundamentally, our questions remain the same. We would like to determine how the network of 266 experts between architects and contractors is structured, according to their qualifications, their level of wealth or their family ties. In particular, we want to clarify how business is distributed among experts and how this distribution structures the community. Are there frequent specialisations, associations or collaborations in particular situations or according to the type of business (estimation of the value of goods, reception of works, registration and drawing up of an inventory of properties, sharing, etc.)?

At the beginning, we asked ourselves some of these questions globally, without taking into account the fact that we only have a review of ten years of archives of expertise, at the rate of one year every ten years starting in 1696. Thus our questions must be reformulated on the basis of this information. Currently we have gathered little immediately usable information on direct relations between experts (we are, for example, waiting for access to the archives for the analysis of the craftmen master's degrees). Only offices genealogy allows us to envisage analysing the network of experts over the entire period.

Nevertheless, there are several possible conceptualizations of the network that allow us to account for spatial or temporal dynamics. In our research, it is clear that the expertise cases plays a fundamental role in structuring the community we are studying. On the other hand, the community of experts is distributed through offices that are transmitted between individuals. This arise new questions: for instance, are there specificities associated with certain offices? The network analysis will allow us to identify the rules of cases distribution, the specialization of the experts or their offices.

After having tried simple network analysis on the associations of experts and the genealogy of offices, we will focus on bi-partite network analysis to take into account the categorization of cases. But it is also clear that it will be necessary to cross-tabulate network analyses with traditional statistical approaches: cross-tabulation, study of distributions, correlations, distributions, standard deviations, correspondence factor analysis, matrix sorting, etc.

Project Management

What has been going well for you?

We set up regular project committees from the outset. These meetings, which bring together the seven members of the team, take place at least once a month, sometimes more often when the need arises. They are an opportunity to share the progress of the work, and all questions relating to the project are discussed jointly, with everyone being free to express their point of view. These frequent meetings seem important to us because they guarantee the quality of the project follow-up, by setting short-term deadlines while allowing us to be reactive and flexible in finding solutions or revising certain choices. They also ensure team cohesion. Beyond these project committees, communication between members is frequent, exchanges are numerous and daily, and work in pairs or trinomials is frequent. Although the team is relatively small, it has a strong coherence and the disciplinary specialties or responsibilities are very complementary. The team includes a legal historian, art and technical historians, an economic historian and specialists in digital technologies.

The technological choices we made have proven to be relevant. Developing the application ourselves obviously took time, but we now have a tool that is particularly well adapted to our needs and over which we have total control. XML technologies also ensure the documentation and durability of our data. They facilitate the querying of data and the production of content in different formats, while simplifying the sharing and alignment of our information.

From the point of view of network analysis, we are fortunate to be able to work with relatively complete information. We have been able to identify all the experts active

during the period under study and the information is the result of systematic processing, which should greatly facilitate the analysis. On the other hand, the choice of sampling the counts every ten years may pose difficulties for comparisons. Moreover, direct relations between actors are relatively few, which makes it necessary to work with more complex networks.

Perhaps more importantly, what has not been going so smoothly for you and/or what victories have you snatched from the jaws of defeat?

The mastery of our application tool also led us to carry out non-priority IT developments, in particular for the addition of advanced functionalities and data entry assistance for certain forms. It is difficult to evaluate the real benefit of these improvements in terms according to the time cost for their integration. On the other hand, they did provide an opportunity to deepen our knowledge of the technologies used.

Above all, the Covid-19 crisis required us to change some of our priorities. Indeed, the closure of the archives prevents us from having access to the sources necessary for the continuation of the examination (compilation and digitization). We have therefore worked on resuming the two years of expertise that had previously been processed according to another analysis grid, in order to ensure the quality and homogeneity of our data.

The choice of technologies to be used to conduct our network analysis still raises questions, both in terms of data visualization and the languages to be used to perform the mathematical calculations required to study our entities.

> *Have there been any team changes since our meeting last summer? If so, what have they been, how have you addressed them, and what benefits or disadvantages have accrued from them?*

> *Even if your team has not changed over the last year, what have you learned about the way that your team works together, both in the face-to-face and virtual environments? What could be improved, if anything?*

Our team remained stable until the beginning of the project. It is characterized by regular communication and allows us to ensure a good follow-up of the project and the organization of tasks. Virtual environments were already very important for our exchanges, as we are an international team. However, for the second consecutive year, we set up a seminar to mobilize and exchange with colleagues and professionals working on similar subjects or issues. They were the occasion to meet us "physically" but the Covid-19 crisis has slowed down these meetings.

Looking Ahead

What questions or topics would you like to put to the community for discussion at our virtual convening this coming summer?

At this stage of the work, we ask ourselves whether the questions most often asked in art history do not most often consist of bipartite networks in the sense that they often

bring actors into contact with objects. Without ignoring their difficulty of interpretation, it seems to us that this path deserves to be explored. Our sampling choices of one year stripped every ten years, pose difficulties to be able to carry out comparisons, we will undoubtedly need to explore specific methods to solve the difficulties related to sampling in order to generalize our conclusions. Finally, the expert reports that we are studying concern physical assets that can be located in space. We would like to be able to find solutions to jointly consider the network studied with geography based on the cases and addresses of the experts.