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Using GIS in French Rescue Archaeology. The Choice of Inrap: a Tool for Research at the Scale of Excavation

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In France, Inrap undertakes more than 2000 evaluations and 300 excavations every year. Inrap's Scientific and Technical Direction (DST) is responsible for the national delineation of the policy of the Institute in terms of new technologies. The various examples and trials to use the GIS programs during the last decade showed the need of a national coordination. After having decided on the scope of the application, a process that takes into account the methodological, operational, technical, and human resources constraints was elaborated. This study (in a partnership between the DST and the Laboratoire Archéologie et Territoires, CNRS-University of Tours) showed that the GIS is a strategic choice and not a technical option. On this principle, Inrap chose to use GIS as a tool to support research at the excavation level. This ambitious entrepreneurship led into a deep review of the archaeological data acquisition and data processing. The challenge rests to shift from an illustration, to data processing in order to improve archaeological reasoning. GIS is considered here as a tool that archaeologists must use to treat their data comparable to the shovel they use to dig. The common knowledge appropriation phase will be long but necessary if we are to reach the objective of optimal results. The inclusion of archaeological reasoning in a process of data management has a strong heuristic importance and is an added value of scientific perspective for it improves the robustness of the results. By the renovation of these processes, can propose a reflection on how this new process contributes to the methodological advancement in rescue archaeology.

Keywords: GIS, rescue archaeology, archaeological process.

1. The French National Institute for Preventive Archaeological Research (Inrap) and GIS in rescue archaeology

In France, every year, some 700 square kilometres (435 square miles) of urban and rural landscape are affected by infrastructure and development works. About 20% of this surface is excavated by rescue archeologists. Inrap undertakes more than 2000 evaluations and 300 excavations every year. These activities include fieldwork and subsequent studies, which bring together numerous disciplines and call upon a wide range of analyses and expertise. Nowadays, the concepts and methods employed emerge, spread, and develop simultaneously with rescue archeology. In an attempt to apply these concepts in the fieldwork and under urgent circumstances, Inrap's archeologists propose a real testbed for methods and practices. They also contribute providing their own methodological considerations resulting from many years of experience and a hard, unattended environmental reality.

Inrap, being a national institute, aims at facilitating the harmonization and appropriation of new tools and methods by its crew. The Institute must feed the scientific community back with the data collected throughout the rescue archaeological interventions and expects to share sound analytical results based on a well documented and optimal corpus.

Inrap's Scientific and Technical Direction (DST) is responsible for the national delineation of the Institute´s policies in terms of new technologies, that includes the research process to improve the operational modes (topography, documentation, graphic chain). The extended use of the GIS is a domain requiring particular attention.

The various examples and trials to use GIS programs during the last decade showed the need of a national coordination. The growing use of GIS implies costs, training, expert human resources, personnel allocation, archive management, work organization, etc. The partnership between the DST and the multi-institutional

network of spatialized information in archeology (ISA) (BARGE *et al.,* 2004), created in 2001, allows the monitoring of the discipline´s evolution.

Since 2005, the DST has embodied the careful consideration of the GIS contributions as one of its priorities in order to improve the Institute's scientific production. A partnership between the DST and the Laboratoire Archéologie et Territoires - CNRS-UMR 6173 (a joint lab partnered with CNRS, University of Tours and other research organizations like Inrap) allows the achievement of an outstanding level of knowledge of the application of the GIS in archeology (HODDER *et al.,* 1976; BUCHSENSCHUTZ, 1991; LOCK *et al.,* 1995; WHEATLEY *et al.,* 2002; BERGER *et al.,* 2005; RODIER, 2006; LOSIER *et al.,* 2007; LEFEBVRE *et al.,* 2008; RODIER *et al.,* 2008). It also allows the identification of the key players within the core of the Institute, and the definition of the different scales to be aimed at. After having decided on the scope of the application, a process that takes into account the methodological, operational, technical and human resources constraints (TOMLINSON, 2003; ROCHE *et al.,* 2004) was elaborated.

The first report, written in 2006, concluded that the introduction of GIS in our activity would embrace all the levels of the establishment. This study showed that GIS is a strategic choice and not a technical option. On this principle, Inrap chose to use GIS as a tool to support research at the excavation level. This ambitious entrepreneurship led into a deep review of the archaeological data acquisition and data processing. Then, it was necessary to describe the organizational and operational schemas of this new process, which implied three domains. First, the technical and scientific domain, generating the definition of the process. Next, the domain of the information systems, softwares, networks and computers. Finally, and most important, the human resources allocated for the tasks. In 2009, this process was applied on a number of Inrap's excavating projects. This test not only allowed to validate the process but also showed the helpfulness of GIS as a tool to make decisions regarding rescue archeology. The challenge rests to shift from an illustration to the data processing in order to improve archaeological reasoning.

In fact, despite the development of innovative techniques which contribute with one or another aspect of the archaeological data processing, and in spite of some leading pilot-projects where advanced programs were developed, the current applications of GIS did not succeed so far to become a common practice in archaeological excavations.

Our goal is to propose a process based on the GIS starting from the preventive archaeological interventions up to the excavation reports carried out by 2 000 agents. The aim is to shift GIS´ status of 'new technology' to the status of an everyday tool. GIS is meant to be an instrument to help decision making regarding the strategies that must be applied before the launching of an intervention, during the operation in order to guide the excavation, and during the study for the exploratory analysis and consolidation of the interpretation. The scientific site directors agree on the primary need of manipulating data for exploratory reasons first, and then, for data analysis. GIS may meet these needs if there is involvement and willingness.

Besides, this exploitation of GIS is not possible unless the first phase of the continuous data acquisition management is also under GIS. We elaborated a global process that starts from the generation of the project and goes up to the delivery of the final report. This process is based on the usual form of dealing with spatial information as it was initially revealed. GIS is considered here as a tool that archaeologists must use to treat their data comparable to the shovel they use to dig.

2. The time of reflection

So far, the workflow of the spatial information processing, from the data collection in the fields up to the map production for the reports, is as follows: identification of features by the archaeologists, acquisition of spatial data by the topographers, transfer from topographic to CAD and illustration tools, CAD processing by illustrators in association with archaeologists to produce the maps for the reports. The switch from topographical tools to those of illustration implies the loss of the structures identification and their georeferencing. Then, the illustrators produce the thematic or chronological maps according to the archaeologist´s instructions.

The reconstruction of this workflow around GIS generates a global scheme in four phases (figure 1): preparation of the archaeological project, fieldwork, post-excavation analysis, and enhancement of data for publication and dissemination. The process lays on the income that the use of GIS tools may bring at each stage of the workflow, in accordance with the objectives. In a GIS, the data integration and their systematic exploitation at each phase of the process allows for the production of both new information, merging from different sources and exploratory analyses, and renewable work papers serving each stage or reasoning and, in some cases, the interpretation or illustration.

So, each stage is marked by one or several documents obtained by the display of the recorded data processed in a GIS. These documents illustrate, at each level, the obtained, produced, digitized, exploited information, and are supposed to provide the archaeologist significant aid in terms of interpretation.

During the project design, data and documents necessary for its preparation are compiled and integrated into the GIS. Based on this documentation, the GIS offers the site directors the possibility to establish a strategic plan of archaeological work to anticipate the fieldwork phase. During fieldwork, the use of GIS, upon data acquisition, is directly useful to conduct the

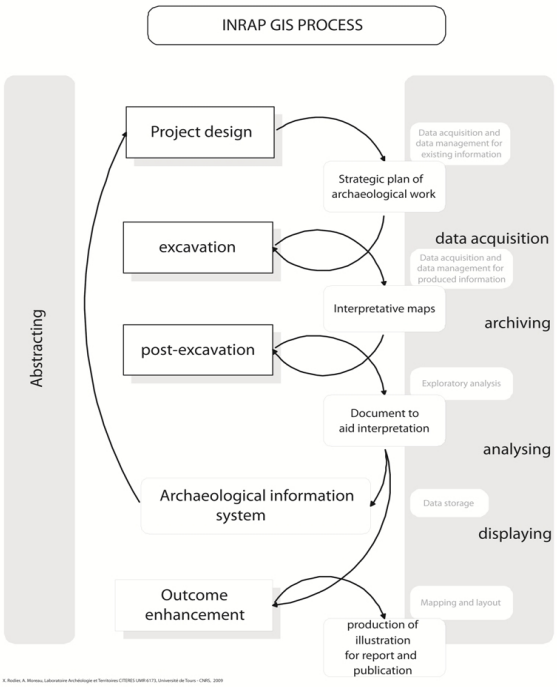

Figure 1: *Global GIS process scheme.*

excavation through interpretative maps. The localized database is available for early use in the post-excavation phase. At this stage, the GIS is applied for data manipulation and exploratory analysis, resulting in papers which aid interpretation. The progressive integration of the data collected, produced or processed at each stage of the process feeds a system of archaeological information usable as a research tool and data processing across the operation, and also as a base for future archaeological operations. The step of enhancement of data closes the process with the production of illustrations which may be dealt with appropriate tools for formatting and publishing. At this point, the documents produced are no longer involved in the processing of data within the information system but are mere illustrations.

3. The time of experience

This general scheme develops into more specific and detailed schemes of the tasks that must be achieved, of the human resources to allocate, and of the necessary means. In 2009, the detailed descriptions of the entire process (figure 2) were applied to seven operations of Inrap's archeological unit in Tours. The chosen operations aimed at sampling the largest possible number of usual cases and at covering different conditions of intervention (three evaluations and four excavations) with a large chronological spectre (ranging from the Palaeolithic to the end of the Middle Ages).

The main purpose of the experiment was to test the process in operational conditions. This evaluation of the endurance of the GIS process provided an opportunity to check the appropriateness of the choices and to record the changes and adaptations to be made. The experience was evaluated under two orientations: the first one being the validation of the transformation of the process and the second one being the scientific contribution of the approach.

The assessment was quite positive regarding the consequences of the process changes: experience demonstrated that the process was applicable and the agents, including the more reticent ones, smoothly incorporated GIS tool as the centre of the teamwork.

However, some hindrances have to be overcome:

- the shift from theory to practice is very difficult. The change of working behaviours is not easy in the rescue archeological context where pressure is very strong;
- another issue is the unwillingness of topographers and illustrators who feel dispossessed of their tasks and expertise (know-how). It is true that these two positions are directly affected by the implementation of the new processes. However, as it was originally considered, their professional missions are precisely re-focused on their specific required skills;
- in most cases, the site directors do not fully embrace the tool. Their response may be generally confined to requests for a GIS-operator. The success of this project depends strongly on the assimilation of the GIS tools by the responsible agents'.

From a scientific point of view, the experience also revealed the potential of GIS process for archaeological reasoning, and the difficulties implied in its application. The common knowledge appropriation phase will be long but necessary if we are to reach the objective of optimal results. The inclusion of archaeological reasoning in a process of data management has a strong heuristic value and is an added value of scientific perspective, for it improves the robustness of the results. By offering new ways of acquiring, handling, exploring, and exploiting data, GIS tools allow the generation of new documents at every phase of the operation, serving as helpful input for reflection and decision. For the archaeological evaluation, the production of a new synthetic documentation results in a reading aid for archaeological findings.

Conclusion

These protocols must now be validated and applied on concrete actions. Some of them are already engaged and play a part in the success of the collaborative approach between Inrap and the Laboratoire Archéologie et Territoires. The opening of the position of "national geomatic coordinator" at the DST confirms the importance of the domain for the scientific politics of the Institute. The increasing efforts in training, hardware and software updating, and the acquisition of cartographic resources come along with the undertaken

process. The organization of work teams and the consolidation of technical platforms are also aspects to be dealt with in order to assure that archaeologists of the Institute successfully embrace and control spatial analyses tools.

By the renovation of these processes, Inrap consolidates data management, data processing and analysis. The new challenge now is to profit from its advantages. Regarding evaluations, for instance, the whole process provides preliminary papers to the prescribers (Officers of the French Ministry of Culture deciding on rescue archaeology) and goes beyond the mere reading of the analytical results of an operation. Within this perspective, Inrap can propose a reflection on how this new process contributes to the methodological advancement in rescue archaeology.

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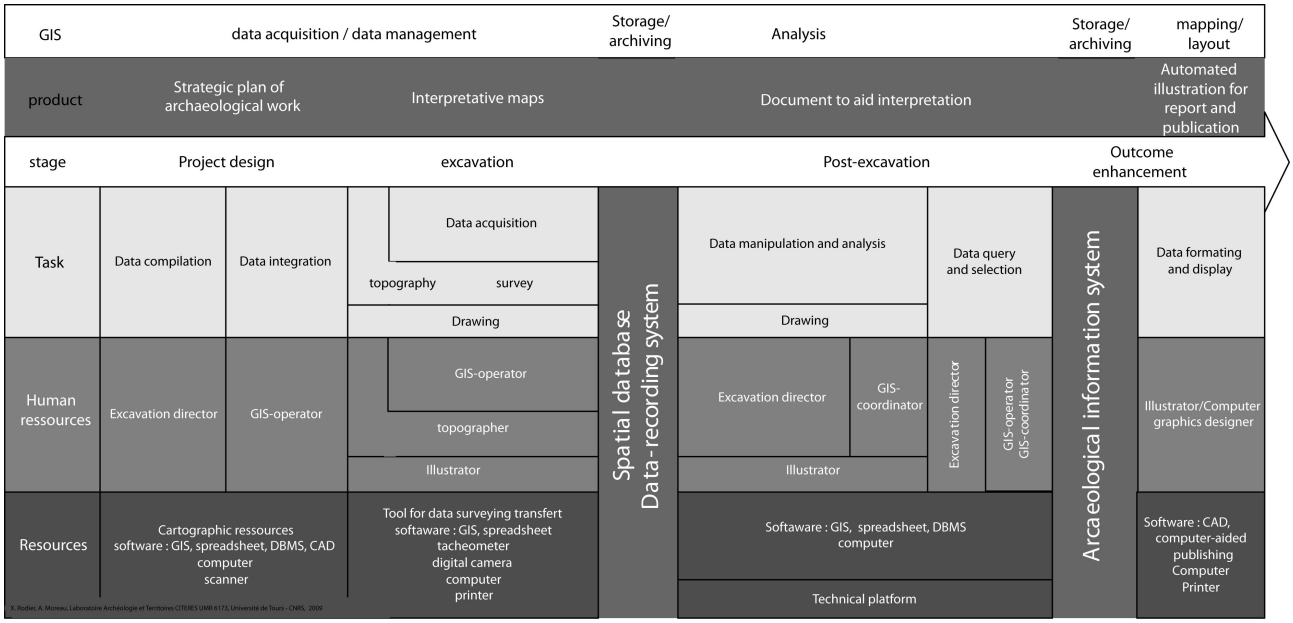

Figure 2: *GIS process.*