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Resources, Opportunities and Limits of Data and Open Source Tools Used in Preventive Archaeology †

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Abstract: Open resources are increasingly used in preventive archaeology, following a more general trend in society, with a useful and effective impact for this task. In fact, on the one hand, we are witnessing the definition of standards increasingly devoted to open source access by the direct decision of the Ministry of Culture, effective both at a central and peripheral level, in order to guarantee standardization and interoperability in data management. On the other hand, in the preliminary archaeological risk assessment phase, the use of contextual data—cartography, remote images, datasets, etc.—which increasingly populate the open source repositories of the web, is necessary, but not always obvious to recover. The use of open source resources in preventive archaeology must be improved, as sometimes they are employed at an insufficient definition. What are the opportunities ahead, but also the main limitations that have not yet been overcome?

Keywords: preventive archaeology; preventive evaluation; open source resources

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1. Introduction: Archaeological Risk

This paper reweaves the state of preventive archaeology after the recent DPCM (Prime Minister's Decree) of 14 February 2022 and circular n. 53/2022; it does not discuss the legislation and provisions issued by the regions and provinces that manage in autonomy their Cultural Heritage; the same applied for the relative open source tools and data. The importance and advantages of using open resources in archaeology is now a consolidated matter, addressed and analyzed in high detail in [1–3]. A trend toward the use of open access publications and data repositories has been clear for some decades: the foundation, as for world science, of the—costly for authors—journal Plos One in 2001 is a mark in this direction, as well as, for Italian archaeology, the—costless for authors—Fasti FOLD&R online journal, available since 2004. In the European Union, 2012 was a turning point, as Recommendation 2012/417/EU <http://data.europa.eu/eli/reco/2012/417/oj, accessed on 26 May 2023> was issued by the European Commission, on the access to and preservation of scientific information; this document followed on from the progress made in 2007 and made reference to a general path addressed by the OECD (Organisation for Economic Cooperation and Development) and UNESCO toward open access strategies. It was thus recommended that member states, "open access to scientific publications" and "open access to research data", in particular referring to research and innovation in the framework of the Horizon 2020 funding program (2014–2020). It is now over a decade that open access to data and results has been a matter of scientific life (and sometimes debate), overcoming academic and institutional perplexities (albeit not completely) and suggesting that performing research through and with open methods is rewarding, and sometimes a duty. This tumultuous process toward open (and responsible) science has reached the world of archaeology a bit late compared to other domains of knowledge and research. In the case of preventive archaeology, the advantages that the world of open source and

open data (and open publication) are able to provide were promptly seized above all in environments related to heritage protection and by scholars accustomed to geospatial and predictive analyses through GIS software [4–6].

In the academic field, the MAPPA project (2011) of the University of Pisa has certainly represented a crucial threshold for manifold methodological and dissemination developments. In Pisa, it gave birth to a series of outcomes such as MOD—Mappa Open Data (2012), MAPPAGIS (2013), and presently MAGOH—Managing Archaeological data for a sustainable GOvernance of the Heritage (2020). These enduring projects were flanked by the intense activity of training workshops and laboratories on the world of open data, under the care of the MAPPA-involved scholars. The most important aspect is the start of a thorough discussion on the subject, and G. Gattiglia, in 2009, presented the potential of opening data for preventive archaeology [7], somehow following the first steps of A. D'Andrea (2006).

The institutions dedicated to heritage protection and conservation of the Italian Ministry of Culture (known by a different name before 2021) have been at the same time implementing data for dedicated standardization projects—albeit on varying scales and, until recently, in a non-unified manner—aimed at creating geographic information systems (also) useful for preventive archaeology. Among these, the SITAR Project is certainly the most long lasting and organic project today, started in 2007 and online since 2011; other projects were developed together with local universities, such as SIUrBe (Benevento), SITAVr (Verona), SITAIS (Isola della Scala), WeBGIS Emilia Romagna or SITARu (Rubiera), and have been treated by other authors in greater detail [4–6]. Many of them are derived or related to SITAR [8], but some seem to be presently inactive on the web. Its start was fostered in 2005 by a memorandum of understanding between the superintendencies operating in the city of Rome, both the State- and Municipality-led ones, for the exchange and interoperability of the cartographic/orthophotographic bases of reference and of the archaeological locational data; today, it is an open GIS tool that collects data for the territory of the wide municipality of Rome, from both "daily" preventive archaeology and historical records. It is still not complete, but substantial; it has had an important role in defining standards for the preparation and delivery of data by professional archaeologists.

Both the academic and the institutional approaches discussed above are therefore related to knowledge and the standardization of past legacy data and to the need to generate working tools for the everyday protection of archaeological heritage, mainly related to preventive archaeology. As it is well known that preventive archaeology in Italy was borne from practice, initially without a dedicated regulatory framework, and it was during the early 1990s that procedures started to be defined and standardized. The construction of the new high-speed train line between Rome and Naples since 1994 is generally recorded as the first case in which preliminary archaeological operations were agreed between the TAV company building the line and the Ministry's local offices (Soprintendenze), deliberately applying the "Polluter Pays Principle". Indeed, instead of the notion of "prevention", "archaeological monitoring" was used, involving preliminary analysis of legacy data, landscape geomorphological and aerial photographic study and surface surveys. This preliminary process of informed knowledge was not sufficient, anyway, and many archaeological sites were identified only during the building of the high-speed train line, with 125 excavations, some modifications to the project and a final cost for archaeology calculated as 2% of the whole work [9]. These actions took place after the Valletta European Convention on the *Protection of the Archaeological Heritage* had been issued by the CoE (Council of Europe), and signed by many parties, including Italy, on 16 January 1992. However, by 1994, only a few countries had effectively ratified it, and Italy was not among them, even if it had contributed to write the document with Clelia Laviosa as an expert [10]: Italy ratified the convention only on 30 June 2015. In any case, the Valletta framework was already causing its effects in enhancing and favoring archaeological protection processes on a large scale during the construction of large public infrastructures [9,11–13].

The amount of data deriving from preventive investigations conducted in Italy in the last three decades, together with the regulatory processes following the 2015 ratification of the Valletta Convention, have produced an exceptionally large amount of data. The need to keep the records complete, functionally optimized for ongoing heritage protection, and constantly updated has been and still is a big issue. Institutional, academic and research efforts to create standardized, interoperable, clear and easily accessible tools, thence useful for the entire sequence of preventive archaeology, do exist, but their progress is apparently tiresome, time-consuming and seems often to lag behind the continuous needs.

The National Web Atlas of Archaeology (Geoportale Nazionale dell'Archeologia—GNA), which was conceived after the preparatory work by two joint Commissions between 2007 and 2011 [14], including scholars from universities and the Ministry of Culture, but was ultimately designed in 2017 [15]: it represents the widest-ranging project. In fact, the model and the procedures for the GNA are already operational and compulsory in preventive archaeology and research under state concession since the DPCM 14.2.2022 and circular n. 53/2022 is the access and exchange point, in open format, of the Italian archaeological heritage throughout the national territory. A specific task is the filing/collection and research/consultation of data derived from chance discoveries, university research and excavations and preventive or state-planned archaeology: this should be the great open data collector of preventive archaeology in Italy. The assumption that interoperability and data circularity is increasingly crucial and must be necessarily considered in academic and institutional planning is restated. In fact, some WebGIS-based projects already mentioned have already merged into the GNA and others are doing so.

Summing up, if we give a comprehensive look at the processes related to the conservation and preservation of archaeological heritage, through the creation of web atlases and the definition of open access frameworks, we can observe that

1. Preventive archaeology was coming of age, or at least approaching a developed perspective, exactly in the years of the Valletta Convention, which, also for Italy, intervened in a really significant moment, further pushing for a development of procedures;
2. In the second half of the 2000s, both the Ministry of Culture and universities, separately (SITAR since 2005/2007) or jointly (the 2007 Joint Commission) developed projects for the creation of web atlases—generally at an urban/periurban scale—and planned a nation-wide system;
3. After the ratification of the Valletta Convention and the growth of procedures and regulations of preventive archaeology, as well as the pressure from the economic system of developers and technical improvement of web interfaces, the strategy for wider and stronger open access systems started to become a reality, as the last SITAR improvement, MAGOH, GNA and many other projects demonstrate, after 2017;
4. The foundation of the Istituto Centrale per l'Archeologia (ICA—Central Institute for Archaeology) in 2016, as part of a renewed organization of the Ministry of Culture, was a crucial step in this process, harmonized with and dealing with the development of the above point 3.

It is now necessary that all these institutions and developments keep pace, and enable preventive archaeology to be more efficient, targeted and cost effective, while maintaining the responsibility to decide for in situ preservation or preservation by documentation (which must not be the only or preferred choice). Open access is a significant part of this process, we believe.

2. Preventive Archaeological Evaluation in Prodromic Phase

According to recent national legislation, the preliminary impact and risk assessment phase of a public or public utility work is subject to the VPIA process (Valutazione Preventiva dell'Interesse Archeologico—sometimes translated as Preventive Verification of the Archaeological Interest, formerly known as ViArch). In the starting (called "prodromic") phase, the a report is created to verify the incidence of risk and archaeological potential, that

is, a report by professional archaeologists, delivered to the territorially competent Ministry Office (Soprintendenze Ambiente Belle Arti e Paesaggio, or Special Soprintendenze or Autonomous Archaeological Parks, when foreseen) through the general contractor for the planned landscape development.

The VPIA is a complex document, which requires an accurate analysis of the territory and of the archaeological presence. This assessment phase is fundamental and must be realized with extreme care, since it constitutes the main criterion for planning the need for further investigations before the Ministry assumes, through its offices, the definitive decisions about the feasibility of the development action.

The VPIA structure is now well defined by ministerial guidelines, that leave no room for interpretation. In addition to a precise definition of the analytical components of the VPIA, the need for a standardization of the information is clear, for example, through the standards of the MODI GIS Geodatabase for the organization of the archaeological site files, as issued by the ICCD (Istituto centrale per il catalogo e la documentazione—Ministry Central Institute for Cataloguing and Documentation). The DPCM 14.2.2022 and circular n. 53/2022 made the compilation of the MODI GIS Template mandatory for any preventive archaeology action, as well as for research (by universities, research institutes, etc.) under concession by the State. The archaeological site templates must be compiled by professional archaeologists or concessionaires in charge of the work, in open source QGIS environment. Some crucial parts of the VPIA, i.e., the development project design characteristics (MOPR), the map of archaeological potential as evaluated through the archaeological site mapping (MOSI), the surface surveys and the resulting areas of archaeological impact risk, are all digitized on a specific geospatial Template (MODI) issued by the ICA. A fundamental and non-trivial passage is determined: all appointed archaeologists or archaeological teams must be able to use open source GIS at the required elementary level, and insert data in a uniform way. This transition may be somehow compared to the introduction of the compulsory Stratigraphic Unit principle and form during the 1980s.

3. The Data Needed to Make a VPIA Report

The structure of a VPIA report requires the creation of a report with accompanying graphic–cartographic apparatus, the realization of which is now, in a certain sense, facilitated and simplified by the GIS Template.

The following is an explanatory synthesis exactly as issued in the last regulation (DPCM 14.2.2022):

- A general description of the characteristics of the development project design to be carried out (MOPR layer);
- A list (and map) of the areas and sites of archaeological interest located in the construction areas of the public or public interest work, as well as in the wider area affected by the works (buffer of 3 km radius), which justify the VPIA procedure (MOSI layer);
- A surface survey report (RCG);
- An aerial/satellite photointerpretation;
- A map of archaeological potential (VRP for areas and individual sites);
- A map of archaeological risk (VRD).

Therefore, in order to draw a correct VPIA, diverse types of data are necessary, even contextual ones, which are not always immediately available and accessible to the professional archaeologist or the archaeological company. On the other hand, web publishing and data opening are becoming faster and faster. What are the possibilities that the open world of the web offers us to shorten times, making VPIA production easier and more effective? What limits data mining? And which aspects are more affected? We will start from the main data needed for the VPIA, excluding the direct survey reconnaissance, which necessarily requires a direct presence in the territory. Furthermore, it has to be stressed that some of the quoted sources are not pure open data, but they all provide the possibility of reusing data. In fact, a diffuse risk is that of entering data in the VPIAs for which there are legal limits of use.

3.1. Data Collection from Already Known Sites, Past Research Results and Legally Protected (Registered) Sites

This part of the VPIA requires direct access to the superintendencies' archives, for the retrieval of the most up-to-date information, as well as to consult the relevant archaeological bibliography. However, there are some tools to be found and consulted on the web, which can help the archaeologist in a starting phase (and not only), particularly when dealing with a territory he barely knows; however, this web data mining phase may present very different details and accessibility, depending on the region.

First deserving of a mention are the online datasets of the Ministry of Culture (MIC), which provide us with both geospatial and information data on the registered (i.e., legally protected) sites and some indications on the already-known archaeological sites and single finds.

The Vincoli in Rete portal includes a webGIS interface in which the registered sites and areas are mapped (archaeological or architectural sites, UNESCO World Heritage Sites, as well as some recorded but not registered archaeological and architectural sites (http://vincoliinrete.beniculturali.it/VincoliInRete/vir/utente/login, accessed on 26 May 2023). The portal also includes a link to the vulnerability and risk data stored in the MIC Risk Map (Carta del Rischio) and with the SITAP (Sistema Informativo Territoriale Ambientale e Paesaggistico—Environmental and Landscape GIS), produced in 1996 by the ATLAS project (Atlas of environmental and landscape heritage), itself dating back to the late 1980s (http://sitap.beniculturali.it/, accessed on 26 May 2023). This is another webGIS tool of the Ministry, which maps both the ope legis landscape protections, that derive directly from the generally applied provisions stated in the 2004 Code of Cultural Heritage (Codice dei Beni culturali, art. 142), and those registered by decree by the State and by regional bodies (artt. 142 c. 1 M, 136, 157). However, in this webGIS, mapping with respect to regional protections is only partial. This is important since regionally protected areas can be absent on SITAP, while being relevant for the VPIA report: the tratturi (pastoral transhumance traditional tracks) are a typical example of this mismatch. Both webGIS (Vincoli in Rete and SITAP) are interoperable only with MIC tools; Vincoli in Rete allows for the import from outside of KML files or WMS layers and these functions can be used to insert project works (e.g., MOPR level) and detailed cartography. Even if both webGISs cannot be consulted through straight WMS connection nor layers or selections be exported toward other GIS-based infrastructures, they are useful tools to supply a general overview, and their consultation is specifically required by the procedures for the preparation of a VPIA report. Another major critical aspect of these tools lies in the data update, since not all the local superintendencies do upload and update the data with the same detail and regularity: data may be partial or even absent

Another online resource whose consultation is required by VPIA regulations is the General Catalogue of Cultural Heritage, i.e., the heritage materials catalogued by the ICCD's SigecWEB information system (https://www.catalogo.beniculturali.it/, accessed on 26 May 2023). The portal currently stores 349.294 files of archaeological finds from archaeological sites scattered throughout the country, some of which also derive from preventive archaeology investigations.

Other medium-scale geodatabases, relative to the territory of specific superintendencies, can be useful tools for the retrieval of data relevant for a VPIA. Some of them have a webGIS viewer and are in the open data format, while, in other cases, they present only descriptive site forms without spatial positioning. On the ICA web portal, a specific section, named "Repertorio preliminare delle banche dati territoriali reperibili online" (Preliminary repository of territorial databases available online") enables one to search for weblinks, although, in any case, the official webpages of the local offices (superintendencies) are still always the primary source for updates.

On the ICA and on the local office websites, a variety of links can be found, showing the lack of homogeneity of the process, so far; from this list are excluded the regions and

provinces which hold directly the administration of their cultural heritage, such as the regions Valle d'Aosta and Sicily, as well as the provinces of Bolzano/Bozen and Trento.

Raptor is a webtool used by some superintendencies of Northern Italy and developed with the help of external companies, starting from the Superintendency of Friuli Venezia Giulia, and soon becoming a project shared by more offices [16]. It was intended to help each office to follow the whole procedure of each archaeological intervention, both as data and correspondence recording, and mapping. The <https://raptor.cultura.gov.it/index.php> (accessed on 26 May 2023) gives access to data from the following superintendencies: Friuli-Venezia Giulia; Inside Veneto: Venezia e Laguna; Venezia, Belluno, Padova e Treviso; Inside Lombardy: Milano; Bergamo, Brescia; Como, Lecco, Monza-Brianza, Pavia, Sondrio, Varese; Cremona, Mantova, Lodi; Inside Piemont: Alessandria, Asti, Cuneo; Biella, Novara, Verbano-Cusio-Ossola, Vercelli. Other superintendencies of the same regions refer instead to dedicated (and partial) websites: Verona, Rovigo, Vicenza: <http://www.sbap-vr.beniculturali.it/vincoli> (accessed on 26 May 2023).

Torino: <http://www.sabap-to.beniculturali.it/index.php/vincoli/14-applicazioni/49-gestione-vincoli-monumentali> (accessed on 26 May 2023), where, together, monuments and many registered archaeological sites can be found.

Some regions, both in North and South Italy, have their own proper comprehensive regional webGIS, to whom all regional superintendencies refer, but as for Emilia Romagna, it is a direct resource of the Ministry, while for Apulia, it is a regional website:

Emilia-Romagna (Bologna, Modena, Reggio Emilia, Ferrara; Parma, Piacenza; Ravenna, Forlì, Cesena, Rimini): <https://www.patrimonioculturale-er.it/webgis/> (accessed on 26 May 2023). ArcheoDB, interoperable with GNA.

Apulia (Bari; Barletta, Andria, Trani, Foggia; Brindisi, Lecce): <http://sirpac.regione.puglia.it/> (accessed on 26 May 2023).

Tuscany may refer to a regional website for all the superintendencies (Firenze, Pistoia, Prato; Lucca, Massa Carrara; Pisa, Livorno; Siena, Grosseto, Arezzo), <http://www502.regione.toscana.it/geoscopio/beniculturaliedelpaesaggio.html> (accessed on 26 May 2023), and to the already mentioned targeted projects, resulting from agreements with the University of Pisa: the Superintendency of Firenze, Pistoia, Prato and only the province of Pisa (out of the Pisa, Livorno Superintendency) share the MAGOH project (<https://www.mappalab.eu/magoh/>, accessed on 26 May 2023), while for urban Pisa, the former Mappa project website is also still active (<http://mappagis.cs.dm.unipi.it:8081/mappa/mappa.phtml>, accessed on 26 May 2023).

Both superintendencies of Liguria (Genova, La Spezia; Imperia, Savona) refer to a website which includes archaeologically and non-archaeologically relevant cave sites: <https://www.catastogrotte.net/liguria/index.php> (accessed on 26 May 2023) and to a website with registered sites <http://www.liguriavincoli.it/home.asp> (accessed on 26 May 2023).

As for Latium, the SITAR website of Rome is a crucial resource: <https://www.archeositarproject.it/> (accessed on 26 May 2023).

The webpage for the Basilicata region (single Superintendency of Potenza, Matera) is just a list of registered archaeological, architectural (not online) and landscape heritage: <https://soprintendenzabasilicata.cultura.gov.it/beni-tutelati/> (accessed on 26 May 2023).

Finally, the only webpage for Campania refers to the (old but still online) website of the single superintendency of Salerno, Avellino, and indeed only lists the archaeological sites open to the public. <http://www.soprintendenzabapsalerno.beniculturali.it/index.php?it/290/siti-e-aree-archeologiche> (accessed on 26 May 2023).

Therefore, some provinces do not have a reference in the website, and some superintendencies inside the same region, such as Latium and Campania, have no webGIS either, and the same applies for whole regions, such as Marche, Umbria, Abruzzo, Molise, Calabria, and Sardinia.

As a partial integration to the former list, useful tools are the completely open data provided within the Piani Paesaggistici/Paesistici Territoriali Regionali (PPTR—Regional Territory and Landscape Plans). Also, in this case, the quality and precision of the data varies for each region, but the tool is generally effective since it is supplied directly by the superintendencies and is therefore validated. Unfortunately, even if the law has required them since 2004, there are still Italian regions that do not have a proper PPTR, but all regions have at least produced a (lower-level) Territory and Landscape Framework (Quadro Territoriale Regionale Paesaggistico), where the main archaeologically protected sites are recorded. There is also a series of small-scale territorial tools under the authority of the provinces (e.g., Piano Territoriale Provinciale Generale—PTPG, General Territory Plan of the Province) or municipalities (e.g., Piano Regolatore Generale—PRG, Town and Country Planning Framework), which are particularly useful and generally very precise tools. For instance, the province of Viterbo has a webGIS including a layer with precise archaeological data, but it records them only for some province areas.

Some useful tools external to the ministerial and regional bodies do also exist, with varying precision and completeness: as an example, in Sardinia, there are several webGISs mapping the Nuragic sites of the Bronze Age; first of all, Sardegna Archeologica, since 2009 (https://sardegnarcheologica.it/nurmap/0/it, accessed on 26 May 2023), but also Nurnet http://nurnet.crs4.it/nurnetgeo/, accessed on 26 May 2023).

The review above highlights how much we need a comprehensive tool like the GNA, whose structure necessarily has to be simple, with basic information, in order to retrieve as many data as possible from this existing variety of solutions, and in order to guarantee a swift integration of missing ones. Integration with Raptor, MAGOH, SITAR, and ArcheoBD is already active.

3.2. Current Cartography

These data are the easiest to find. For cartography, the best tool is undoubtedly the National Geoportal (PCN—Portale cartografico, or Geoportale, Nazionale: http://www.pcn.minambiente.it/mattm/, accessed on 26 May 2023), which provides data both as a consultation service (WMS) and as a source for downloading (WFS, WCS). The National Geoportal helps both in the supply of base maps to be used for the map of archaeological potential and registered sites (MOSI), and of the maps for the geological and geomorphological context of the project area. The WMS services are practical as they can be loaded onto the MODI GIS Template very easily. The main data provided by the PCN which are useful for a VPIA are the geographic maps (at a scale starting from 1:25,000), as well as LIDAR and derivatives (unfortunately, in Italy, they do not cover completely the landscape, nor at the same level of accuracy), orthorectified images, idrographic maps, geological and geomorphological maps, CORINE land use and cover, etc. LIDAR data are downloadable upon request and payment of a negligible administrative fee.

In addition to the PCN, the regional geoportals and/or regional cartographic offices are also useful especially for more detailed map/photo scales and resolutions, as well as additional orthorectified images, in some cases downloadable upon request—and sometimes upon payment of a negligible administrative fee.

More detailed maps, such as the cadastral ones, are available from the Catastal Cartographic Geoportal (Geoportale Cartografico Catastale: https://geoportale.cartografia.agenziaentrate.gov.it/age-inspire/srv/ita/catalog.search#/home, accessed on 26 May 2023); in any case, they are a pre-set layer of the MODI GIS Template.

Another source for the consultation of the Geological Maps of Italy in PDF format is provided by the Italian Institute for Environmental protection and research, active since 2008, under the names of the Ministry of the Environment (ISPRA—Istituto superiore per la protezione e la ricerca ambientale—https://www.isprambiente.gov.it/Media/carg/index.html, accessed on 26 May 2023).

3.3. Orthophotos, Satellite Images for Photointerpretation and Historical Cartography

For satellite images, one can refer to some repositories which can be freely consulted (for example, through the Copernicus Open Access Hub, SEDAS, THEIA, USGS, etc.); the same applies—with some limitations—for Google Earth images (https://www.google.com/intl/it_ALL/permissions/geoguidelines/, accessed on 26 May 2023), or NASA Worldview (https://worldview.earthdata.nasa.gov/, accessed on 26 May 2023). Very-high-resolution satellite images, whose use in VPIA is generally limited to specific cases and to detailed analyses, are likely subject to proprietary rights. The same applies for aerial orthophotos, whose retrieval is generally subject to proprietary rights. Many aerial shot flights can only be consulted as WMS, for example, on the National Geoportal (PCN, see above: flights 1988–89, 1994, 1998, 2000, 2004, 2007, 2010, 2012).

Regional geoportals and WebGISs covering their specific territories can be another important free source for orthophotos, both historical and recent ones, and both freely and upon request.

As for historical cartography, whose consultation is no more compulsory for VPIA, but sometimes useful, the web offers some opportunities, but one must pay attention to the terms and rights of use, which can be easily viewed using the "Usage rights" filter to find images with a proper open license. In general, a recommended tool for a preliminary screening may be the portal of the National Catalogue for Spatial Data (Repertorio Nazionale dei Dati Territoriali https://geodati.gov.it/geoportale/, accessed on 26 May 2023), to obtain information on the availability of data for the landscape of interest and obtain useful links.

4. SWOT Analysis

This quick, preliminary, and not fully detailed report on the state of open source (and not always totally open) resources for preventive archaeology is closed by a SWOT analysis, in which we list many of the arguments raised above, and some more, often stemming from personal, and not quantitative/qualitative, considerations: we hope they can be considered as experts' observations. The SWOT analysis is closed by a "strategy" paragraph, which represents a wish for the future, and we assume it does not require further textual comment or explanation.

Strengths

- Web data accessibility.
- Speed and immediacy of data consultation/insertion.
- Shared standards and methodology.

Weaknesses

- Data fragmentation.
- Partiality of some repositories.
- Only partially open and closed repositories.

Opportunities

- GNA
- Ministry/local administrations/research institutions/professionals' interactions.
- Totally open databases for archaeological scoping.

Threats

- Resistance to unification; competing web systems.
- Data update and delay in uploading new data.
- Incomplete recording of legacy data.
- Overconfidence in the VPIA results (particularly the "negative" spots) and in webtools' exaltedness.

Strategy

- Open resource expansion (together with local administrations).
- Care for constant and timely data updating.
- Simplification of access.
- Integrated projects for data sharing and for systematic legacy data upload (between Ministry, local administrations, universities and research institutions such as CNR, professionals and big developers, such as Italferr, ANAS, ENEL Greenpower, etc.).
- Implementation of predictive assessments.
- Periodical sample cross-check of the original data (particularly the VPIA "negative" results) and of web system and web locational coherence.

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