

Martin Kuna et al.

Structuring archaeological evidence



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The Archaeological Map of the Czech Republic
and related information systems

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Prague 2015

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Martin Kuna,

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Dagmar Dreslerová, Martin Gojda, Iva Herichová, Dana Křivánková,
Olga Lečbychová, Jan Mařík, Jana Maříková-Kubková, Michal Panáček,
Jaroslav Podliska, Adéla Pokorná, Jaroslav Řihošek, Eva Stuchlíková,
Marek Suchý, Jan Válek, Natalie Venclová, Libuše Haišmanová*

Institute of Archaeology of the Czech Academy of Sciences, Prague, v. v. i.
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6 Down to the trenches: the Integrated Information System of Archaeological Sources of Prague – an adjustment to the AMCR for urban archaeology

Ivana Boháčová – Jaroslav Podliska – Jan Hasil

The Integrated Information System of Archaeological Sources of Prague (IIS ASP) is a virtual research environment (VRE) which aims to streamline or even allow the management of archaeological data and heritage information originating from the most complex archaeological site in the Czech Republic, the historical centre of Prague. The information system has been developed since 2013 by the Institute of Archaeology CAS in Prague in collaboration with the National Heritage Institute (The Department of the Capital City of Prague) and the company SmartGIS. The freely available internet interface will be filled in from 2015 with data regarding archaeology, building history and interdisciplinary scientific research on material culture from the historical centre of Prague. As a part of this task, an extension of the AMCR was created that can be used for the collection of data on fieldwork events in complex stratified situations, especially within urban areas; this tool can be applied to other sites in the future. The IIS ASP adopts the AMCR identifiers of fieldwork events and, thus, becomes an integral part of a broader information system of Czech archaeology. Although the data contained in the IIS ASP come from various sources and are diverse in their technical adjustment, it will be possible to perform common database operations through unified interfaces. General, special and old maps are also included in the VRE and they allow further contextualization of contained information and the creation of more personalized custom map layouts.

The IIS APP is available on <http://www.praha-archeologicka.cz>; the English version of the website will follow.

6.1 PREHISTORY: PROJECT FOUNDATIONS

Research in the historical centre of Prague – the Prague Heritage Reservation (PHR) – probably represents the most complex challenge that Czech archaeology has ever faced. It includes all key components of the historical Prague agglomeration which

has undergone continuous development from the second half of the 9th century up to today. Moreover, this already quite broad topic also includes studies of its hinterland or previous residential structures that preceded its founding. The beginnings of systematic archaeological research of Prague can be linked with the activities of the Heritage Board of the City of Prague. Since the early 1920s, the Board has, within the Prague City Hall, initiated and largely also organised fieldwork or at least archaeological supervision in the course of construction activities in the historic core of Prague and in its immediate vicinity, including the establishment of inter-institutional committees for the research of Prague Castle and Vyšehrad (Boháčová in prep.). A further increase in excavations occurred in the late 1960s and 1970s in connection with the construction of urban infrastructure, especially the subway and the new commercial and office buildings (Richter – Smetánka 1965; Richter, 1984; Podliska – Tryml 2012, 101-102). The intensity and scope of rescue excavations increased significantly in the last two decades of the 20th century and then reached its peak at the dawn of the 21st century (see Fig. 6.1; Boháčová 2015).

Conditions for the implementation of close co-operation between institutions providing rescue excavations, archaeological heritage management and building-historical survey have been built in Prague since the mid-1960s. A local platform to perform these tasks was created: in 1969 the Committee for Archaeological Research of Greater Prague was established before being transformed in 1978 into a co-ordinating body of Prague archaeology called the Prague Archaeological Committee (PAC). At the same time, individual research institutions began to focus their research on particular areas within the city (see Fig. 6.2). Such regionalization allowed individual research teams to concentrate better on specific archaeological sites as well as topics and professional issues. Besides, standards of archaeological fieldwork, mainly documentation, recordkeeping and archiving were set in practice.

The concept of the coordination of institutional activities as well as the guarantee of the scientific level of their outputs was advocated primarily by Miroslav Richter, at the time the director of the Institute of Archaeology CAS Prague (IAP; Richter 1984). Eventually, the key person in terms of the development of research methodology for rescue excavations became Ladislav Hrdlička (Fig. 6.3). He improved the evidence system of Prague's rescue excavations created and used within the PAC, from simple administrative records to the level of a structured registration tool – the *Map of Archaeological Documentation Points* (MADP; Hrdlička 2005; Hrdlička 2009). The Map focused on registering archaeological fieldwork events (or rather their documentation units – individual trenches) within the PHR (Fig. 6.4).¹ The Map's beginnings can be traced back to the 1970s, when L. Hrdlička began to register all basic information that was copyright-free due to his interest in the historical development of the Prague agglomeration and the reconstruction of the land relief in its historical centre.

¹ For the more general strategy and principles of archaeological heritage management in Prague, see Boháčová et al. 1999

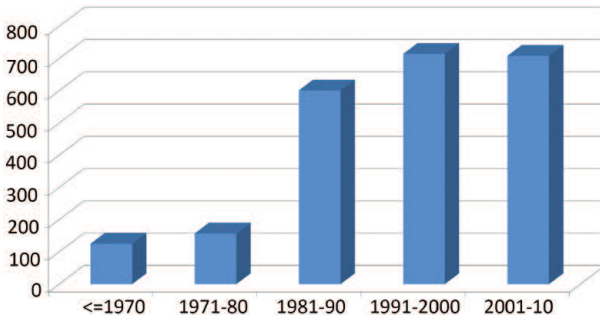


Fig. 6.1 Graph of the number of fieldwork events within the Prague Heritage Reservation. Data from ADB (AMCR) for the following cadastre areas of Prague: Lesser Town, Prague Castle, Old Town, Jewish Quarter (Josefov), New Town and Vyšehrad.

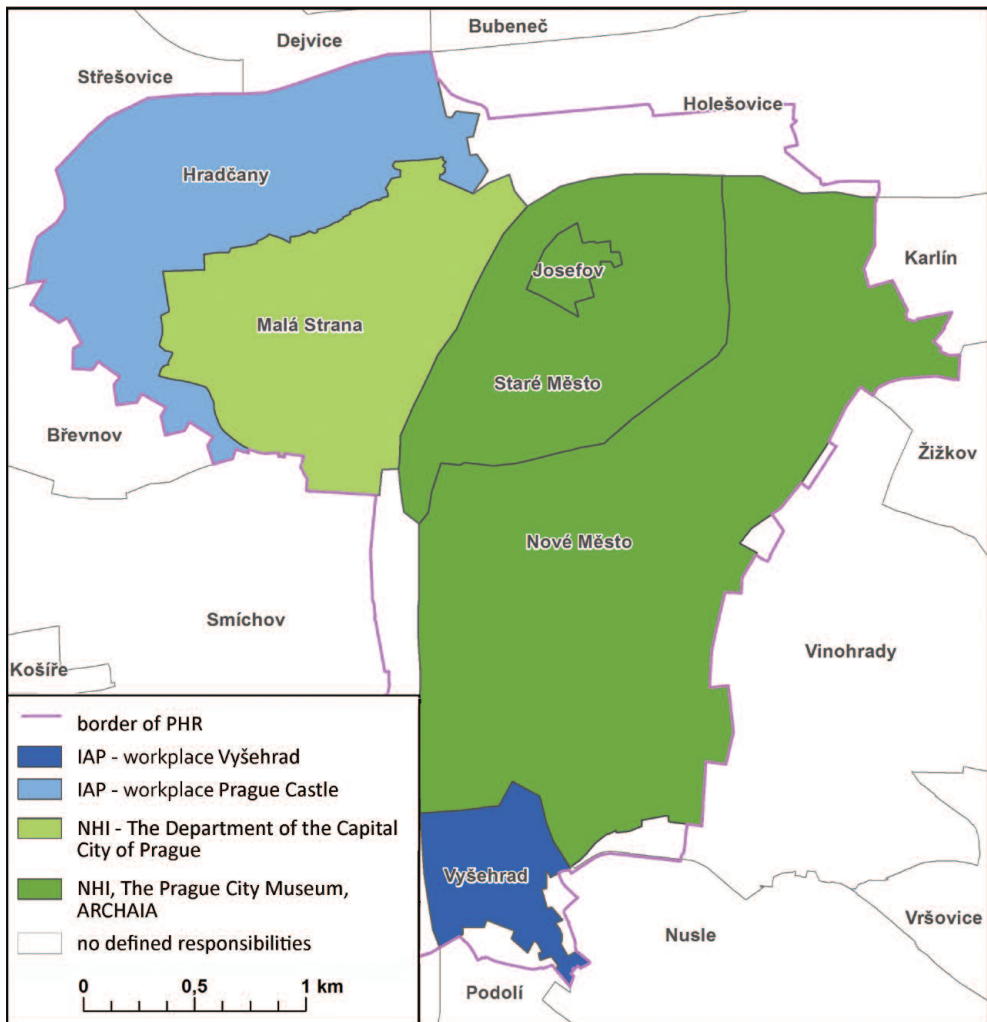
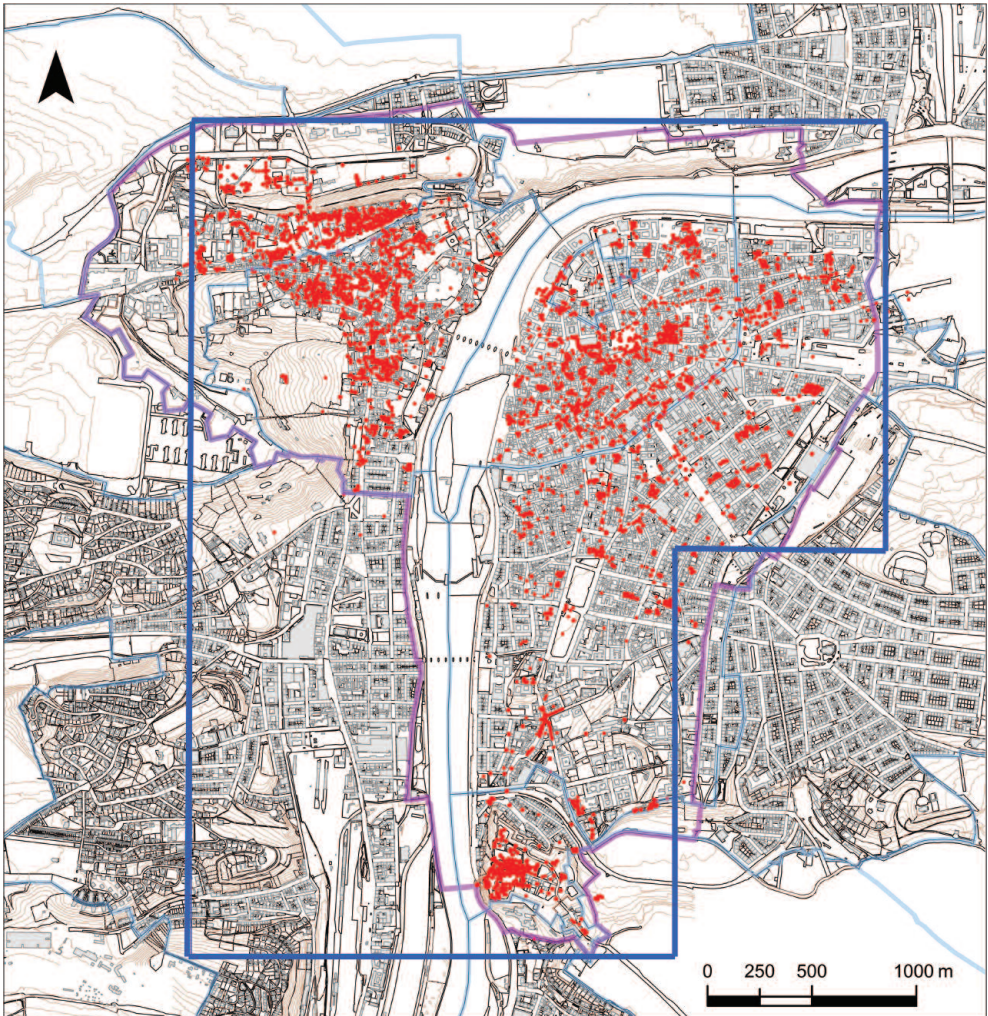


Fig. 6.2 Common delimitation of territorial responsibility for archaeological heritage management (rescue fieldwork) in the Prague Heritage Reservation.

Fig. 6.3 Ladislav Hrdlička (1937-2011) at a conference in 1984. Photo M. Fokt, The City of Prague Museum.



Fig. 6.4 Records of the Map of Archaeological Documentation Points (MADP). Maps ZM 1:1000 were used as the background, trench numbering ran in three independent series according to three map sheets of SMO 1:5000 (sheets 6-1; 7-1 and 7-2). For details, cf. Hrdlička 2005. Data source (digital cadastral map of Prague) © Institute for Planning and Development of the City of Prague.



Data on archaeological events were subsequently collected in available database systems, since the early 1990s as a dBASE IV file. Descriptive data and comments on the concept of the Map were subsequently published in a book (Hrdlička 2005) accompanied by a map example (part of the left bank of Prague, extracted from the map sheet 7-1) and later updated in electronic form (Hrdlička 2009). In addition to the so-called “**archaeological documentation points**” (usually represented by individual trenches) with precise spatial localization, field situations only tentatively localized were also recorded, e.g. in relation to the building plot. Besides the database a “paper” version of the MADP was created using a combination of sheets of cadastral map 1:1000 with astralon films upon which the documentation units were manually drawn in ink (Fig. 6.5) wherever it was possible to localize individual trenches with a reasonable degree of accuracy. Originally, this map was created in two copies; later, however, only one of them was updated.

The construction boom that occurred in the historical centre of Prague from the mid-1980s and its further expansion in the 1990s clearly showed the unsustainability

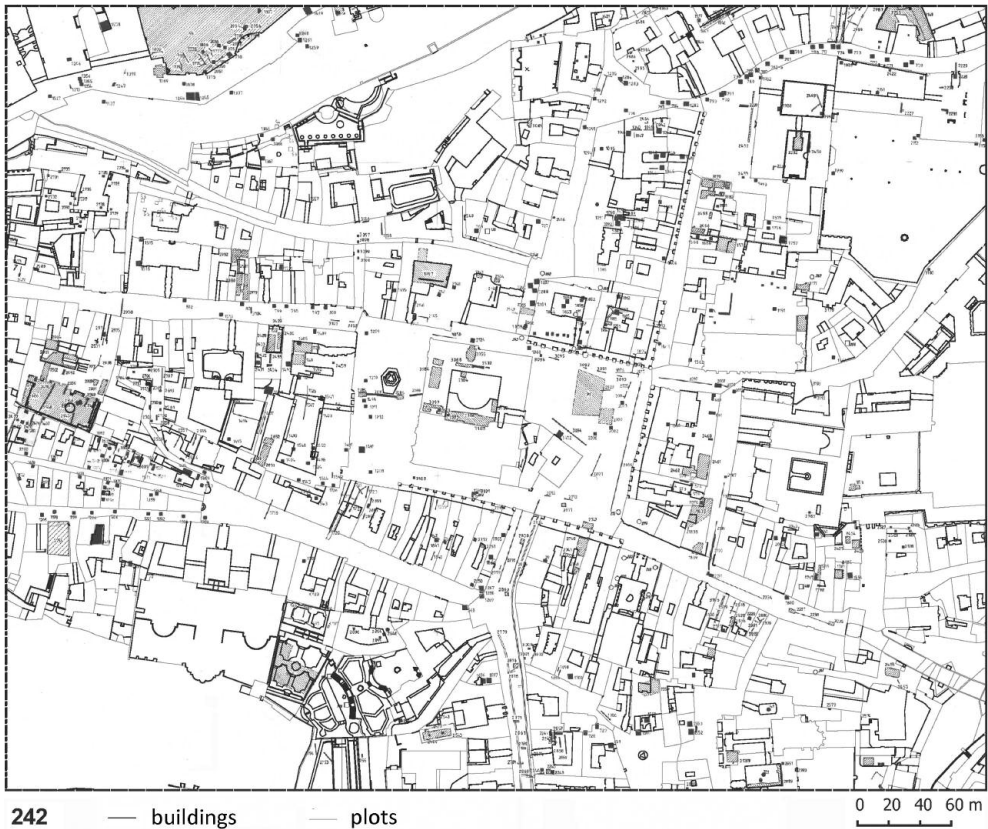


Fig. 6.5 An astralon sheet of the Map of Archaeological Documentation Points (MADP; SMO 1000 LM 7-1/14, formerly 242), backed with the cadastral map of Prague 1:1000 (from the estate of L. Hrdlička, compiled by R. Vlčková 2013). IAP Archive, PY-20091364.

of the analogue map. The collection of data became increasingly difficult under the new situation. There were many reasons: the increasing number of archaeological events as well as their accumulation in smaller spaces, changes in the organization of archaeological monument management, the rather limited capacity of Prague archaeology, etc. Despite the best efforts of L. Hrdlička, it was obvious that (i) the given task was beyond the capabilities of one individual, and (ii) it was absolutely necessary to upgrade the original system of spatial evidence. In 2008, a team consisting of IAP specialists was officially commissioned and the software application Archive 3.0 (otherwise used for managing the ADB; cf. Herichová et al. 2009) was modified for use. Even this system, however, did not prove to be functional, as the team was not able, for capacity reasons, to ensure the inputting of new data or the revision of the already existing data; therefore, the Map has never been fully completed.

During the continuous archaeological fieldwork in Prague, numerous data has been obtained by interdisciplinary research, especially by the natural sciences. Prague ranks among the archaeological sites where it was applied in some of its topics quite early and systematically, especially from the 1980s. After the first analyses of archaeobotanical macro-remains (1960s) and pollen samples (as early as in 1946 – samples from the slopes of Prague Castle), the systematic collection of samples for pollen analyses from excavations conducted on the Prague left bank was initiated; for example, L. Hrdlička and his project entitled *The Beginnings of Prague*.² For many reasons (they could not be statistically verified, whether or not due to the rather complex genesis of the unearthed stratified situations, to the rather small extent of the samples or not always suitable conditions for pollen preservation, etc.), the results of these analyses have not been published. Anyway, valuable pieces of evidence have been obtained by macro-remain and pollen analyses of materials from the earliest phases of the Early Medieval Prague (Kozáková – Boháčová 2008; Čulíková in print). The creation of dendrochronological standards for oak in the Czech Republic (CR) was also of the utmost importance. The course of the curve is based on the Early Medieval wooden constructions of the left bank in Prague (Dvorská – Boháčová 1999). Systematic studies of production technologies and processing of metals have developed in connection with the increasing frequency of discoveries of pyrotechnological facilities (Havrda et al. 2001; Podliska 2014). In the scope of Prague archaeology, considerable attention has also been paid to geomorphological processes, raw materials and resources (e.g. Hrdlička 1984, 1994; Zavřel 2001).

A third group of information relevant to the archaeological research of Prague was created in particular by the employees of institutions involved in heritage management. An especially important source is the building-historical passports of selected historical monuments or larger urban units (so-called block passports) that were systematically created from the 1950s until the 1980s in the former State Institute for Reconstruction of Historical Towns and Buildings (abbrev. SÚRPMO in Czech). Essential resources for the evaluation of the potential of the archaeological

■ ² *The Beginnings of Prague* project: GACR 1994-1996, Reg. Nr. 404/94/100.

heritage of the historic centre of Prague were collected within the scope of a project administered by the Prague Institute for Heritage Preservation (currently the Prague office of the National Heritage Institute, NHI), conducted in the two following periods of 1996-1998 and 2000-2001 (Wallisová – Omelka 1998). This project was aimed at creating records of destroyed surfaces and archaeological fieldwork, accompanied by other documents such as the construction plans of cellars obtained in archives of municipal offices and selected historical plans.

From the beginning, the grant project was already conceived as a loose part of the *State Archaeological List of the CR* (SAL, abbrev. SAS in Czech; cf. Chapter 1.2), with the single purpose to utilize all available information for complex preventive archaeological heritage management. Subsequently, this evidence was used within a more conceptual approach towards archaeological heritage management, where a set of more than one hundred important archaeological areas in the Prague Heritage Reservation was defined (currently their number has reached 137) to become the target of active heritage protection. These areas represent mostly undisturbed grounds with significant archaeological relics, the value of which has been justified by complex field research. In 2010, the above-mentioned material became part of the urban planning analytical sources of the Capital of Prague (Podliska et al. 2010).

Our understanding of the historical development of the Prague agglomeration has in the first decade of the 21st century reached the point where there is, on one hand, a substantial and almost daily growing amount of earlier as well as more recent data on different levels of evaluation, synthesis, accessibility, adjustment and publication. Disproportionally to the growing archaeological field activities in Prague, the ability of Prague archaeology to target transverse topics that would thematise Prague and its archaeological heritage as a whole decreased. Thus, compared to neighbouring Germany, there is an obvious deficit in addressing general topics such as the settlement structure of the historical city, its spatial development, the functions of its individual sub-areas, the typology of buildings and/or its post-medieval changes. Moreover, the confusing nature of resources may also be the reason why only a small number of students have so far chosen Medieval or Early Modern Prague as topics for their theses. Moreover, the presentation of research activities to the broader public is also lacking (cf. Boháčová 2015).

6.2 INTEGRATED INFORMATION SYSTEM OF ARCHAEOLOGICAL SOURCES OF PRAGUE: BASIC PRINCIPLES

In 2012, the Ministry of Culture of the CR supported a five-year project entitled *Integrated Information System of Archaeological Resources of Prague* (IIS ASP) as part of the NAKI program.³ Its primary objective is to make information on archaeological

³ Project Reg. No. DF13P01OVV014, 2013-2017, principal investigator I. Boháčová. NAKI (abbrev. in Czech) – *Program of Applied Research and Development of National and Cultural Identity*.

sources of the historical centre of the Prague settlement agglomeration available to the professional community and the general public (Boháčová – Podliska 2015). The principal grantee and researcher became the IAP, in co-operation with the Prague office of the NHI.

This project was pursued for a number of reasons. The above-mentioned unsatisfactory state of evaluation and publication of the rich archaeological evidence that has been obtained from the historical centre of Prague more or less systematically for almost a century probably represented the main impulse. Another major reason was the lack of current, i.e. continually updated information about the extent of the in situ preserved archaeological fund of Prague; more precisely, the lack of effective possibilities to update information on archaeological interventions in the historical terrain on a scale appropriate to the historical centre of the town. Such information is essential for the protection of archaeological monuments as well as for the qualified preparation of any potential rescue archaeological fieldwork. A significant increase in data collected in the course of interdisciplinary studies represented a third key role, especially the fact that their adequate use for the documentation and interpretation of archaeological data is not possible without the systematic evidence records of the conducted activities and their results. Even though its construction is a general problem (see Chapter 13), at least in Prague it is possible to effectively contribute to its solution. The project aims to create a single access point (i) to information on archaeological activities in the PHR and their results, including links to digital texts, plan and photographic documents and bibliographic data; (ii) to the reconstructed features/areas of the historic landscape (such as city ramparts, cemeteries) known from the old cartographic, archaeological and other sources; (iii) to the evidence of expert analyses, mainly from nature sciences; (iv) to a register of areas destroyed by modern and recent construction activities; and (v) to the list of buildings as well as areas protected due to their heritage significance; together with (vi) the old plans of Prague, (vii) old and contemporary cadastral maps and (viii) a specialized map of technical land use.

The concept of IIS ASP project in particular addresses the following principles and requirements:

- (1) The basic aim of the project is to build a geographic information system intended for the on-line updating of information about archaeological fieldwork events within the PHR and their scientific results as well as for the on-going release of such information by their authors over the internet.
- (2) In the territory of PHR, the evidence is based on the MADP; the original descriptive system has been either adopted or advanced.
- (3) The MADP is understood as a general tool for collecting data, the management and publication of archaeological research in urban areas as well as sites with archaeological terrains of a similar nature (complex stratified situations).
- (4) The MADP application is built as an extension of the AMCR information system. System integration with AMCR data, i.e. the direct incorporation of information collected within its framework to the AMCR structure, will allow sharing of

descriptive systems and data as well as the use of other branch infrastructures of the IAP (bibliographic databases, digital archives, etc.). Unified user management and the total elimination of duplicate data collection and data management represent additional advantages.

- (5) The IIS ASP assumes the contextualization of MADP data through further specialized map layers representing the synthesized results of archaeological research, data on interdisciplinary research and study of building-historical development of the PHR. The fulfilment of this task relies on the maximum possible reuse of existing data, their new adjustment and presentation within a unified internet GIS environment.
- (6) All relevant and currently available maps as well as old plans form part of the internet environment. Freely available data and viewing services will primarily be used.
- (7) The internet GIS environment will enable geospatial comparison and search within specialized map layers, basic database operations on the contained data and the production of lists and graphical outputs that can include the available maps. Thus, a simple yet comprehensive VRE will emerge. Even though the system is focused on a relatively small geographical area (the PHR covers 8.66 square kilometres), it has the potential to be a pilot project, as it contains sophisticated analytical tools which can later be applied to the whole territory of the CR (see Chapter 13).
- (8) The IIS ASP is aimed at the following potential user groups: (a) researchers of organisations authorized to conduct archaeological research (LAO – “licensed archaeological organisations”); (b) the broader professional community (research specialists dealing with interdisciplinary topics, monument heritage managers, students of archaeology and other relevant disciplines); (c) bodies of state as well as local administration, land-use planning; (d) the general public.
- (9) The principle of crowdsourcing applied at the level of institutions involved in (archaeological) heritage management within the PHR focuses on the control of data relevance, their long-term updating and access to the documents. The most important players in this field, i.e. the IAP and NHI, specifically the Department of Medieval Archaeology of the IAP (incl. the Prague Castle and Vyšehrad offices) and the Department of the Capital City of Prague of the NHI are the direct guarantors of the project. Other organisations working in this field (The City of Prague Museum, ARCHAIA) as well as city institutions holding and providing the relevant data (Institute for Planning and Development of the City of Prague) are involved in revising and reusing the data.

The nine above-mentioned principles are clearly reflected both in the basic scheme of data sources and their flow (Fig. 6.6) and in the form of the basic mapping and data interfaces of the IIS ASP available for website users (Figs. 6.7 and 6.8).

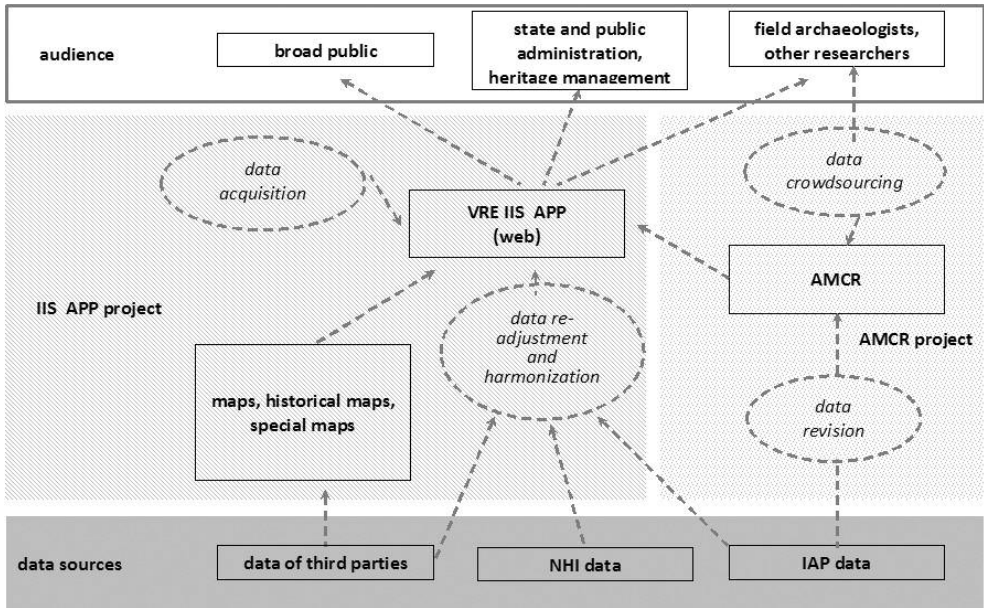


Fig. 6.6 Data flow scheme of the IIS ASP. Compiled by J. Hasil, 2015.

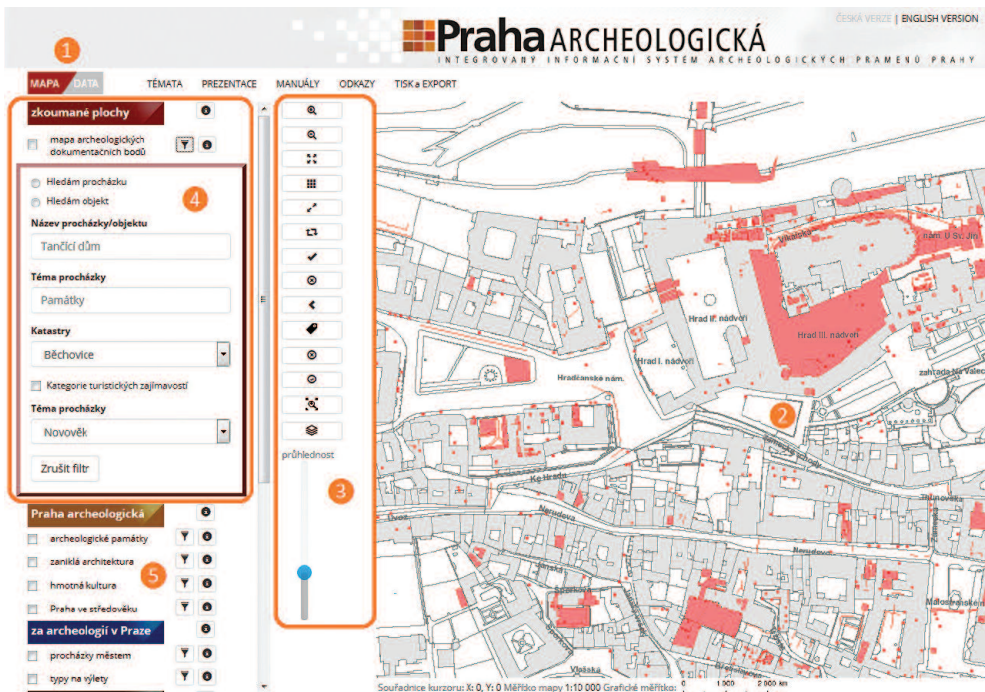


Fig. 6.7 Screenshot of the alpha-version of the GIS interface (map) of IIS ASP. 1: Switch of the map and data views; 2: mapping interface; 3: drivers and tools of the map interface; 4: filter form of an active specialized layer; 5: other specialized layers. Data sources: © Institute for Planning and Development of the City of Prague.

6.3 THE MAP OF ARCHAEOLOGICAL DOCUMENTATION POINTS AS AN EXTENSION OF THE AMCR

The confluence of favourable circumstances that led to the parallel existence of the projects NAKI AMCR (2012–2015) and NAKI IIS ASP (2013–2017) in a single institution has allowed both teams to cooperate in the development of the AMCR data model. Among other things, such cooperation has enabled the use of the AMCR identifiers (archaeological projects and fieldwork events) for the scopes of the MADP and the connection of the MADP units to the registry of archaeological projects and fieldwork events.

A detailed analysis focusing on the structure and nature of the existing data, the character of the ADB records as well as the demands of both systems in regard to future data collection was first conducted. The analysis resulted in the crucial finding that the basic evidence units of both systems (“archaeological documentation point” or “trench” in the case of the MADP and “archaeological fieldwork event” in the case of the AMCR) are defined by very similar attributes such as the director of the fieldwork, its date, cadastre area, etc. Moreover, both types of units are connected to spatial information. In the case of the AMCR records, the information is contained in the PIAN unit (cf. Chapter 2.1.3), while each entry of the MADP contains unique JTSK (Czech national grid) coordinates. On the other hand, the nature and especially the structure of other data is different. The AMCR represents a relational database containing data on the scientific results of particular archaeological events (dating of attested structures and artefacts, their assignment to specific activities areas, etc.), references to the database of archival documents as well as bibliographic records. In space, this data is mostly defined by larger “enclosing” polygons (cf. Neustupný 1995) that are, of course, not accurate enough for the archaeological documentation of urban areas. The MADP was provided with spatial information of higher accuracy consisting essentially of “delimiting” polygons of particular fieldwork events or their parts (individual trenches) and including altitude (levelling) data that are of key significance for urban archaeology. However, the MADP database did not in principle contain data on the fieldwork results (dating of the layers, etc.) Besides, it was not a relational database and, thus, it contained a large amount of text fields with redundant data. At the same time, the MADP failed to effectively assign an individual documentation point to a specific fieldwork (due to the absence of any authority list, this is completely understandable); thus, much information (almost half of the data fields) was repeatedly collected without a deeper sense. Unfortunately, ADB⁴ (AMCR) data, although kept in a much more advanced structure, also showed numerous errors and especially a rather high degree of multiplicity records resulting mainly from repeated recording of one event according to different source documents. Altogether, both evidence systems covered only about two-thirds of the archaeological activities in Prague; thus, we can estimate that a significant part of the field activities eluded any records.

■ ⁴ *Archaeological Database of Bohemia* (now converted into AMCR).

Although both systems – ADB (AMCR) and MADP – have certain imperfections or flows in the existing data and their structure, both teams were in complete agreement regarding the necessity of a thorough content (and in the case of MADP, also structural) review of already existing data prior to their release to the public within the framework of the new technical adjustment. Thus, it was clear that both systems can represent a valuable complementary source of information, naturally only after the revision of data. However, the analysis of the workflows clearly showed that the integration of both projects needs to be even closer in order to avoid any creation of the undesired dual records, discrepancies in the descriptive systems, and/or a completely redundant burden for the user providing the same data for two information bases. In the autumn of 2013, decided decision was made to create the key IIS ASP module (i.e. MADP) as an integral extension within the AMCR and to perform a joint revision of the existing data; the AMCR team mainly contributed with their know-how and specialists in data management, while the IIS ASP team conducted a revision of their own data content.

This solution will naturally provide a number of other temporary as well as long-term benefits. In the course of the implementation of both projects, we tried to more efficiently use the working capacity both in the data revision as well as in co-operation with the supplier of both systems, in this case the company SmartGIS. In the long perspective, the goal is a significant increase in the sustainability of the achieved results and a reduction of related financial demands on institutional budgets, user management sharing as well as other infrastructures such as bibliographic databases or the IAP *Digital Archive*. Thus, under these circumstances the MADP can serve as a general instrument for organisations authorised to conduct archaeological fieldwork in Prague. Perhaps the most important contribution, however, represents the ability to integrate the groups of users and audience on different levels.

In terms of the interconnection of both data structures, only one significant change has occurred – a data class named **documentation unit** was inserted in the original ADB (AMCR) structure (see Fig. 6.9; cf. Chapter 2.1.3). Thus, the existing links of the PIAN units to archaeological fieldwork events were made more comprehensive and the system was enhanced for a more accurate description of events by dividing them into units corresponding to individual fieldwork sections. A fieldwork event, thus, can be described as (i) a single documentation unit, (ii) a whole with several parts (documentation units) or (iii) a set of discrete documentation units. Those may be linked with other data classes such as the **trench** (respectively **archaeological documentation point** – ADP, in a relation of 1:1 to documentation unit) and **levelling points** (1:N). In the future, however, this part of the system can also be used for other types of information in the context of different field methods such as the description of sampling sectors (field walking survey), soil cores, finds discovered by metal detectors, etc.

The revision and the subsequent data conversion to a new data structure is subsequently performed in several steps. First, the individual ADP entries were allocated to existing records in the ADB (AMCR) and on the basis of this link data contained in both systems they are harmonized in terms of their content. By inputting the ADP data into the AMCR relational links it will be possible to set aside a whole range of previously kept redundant data.

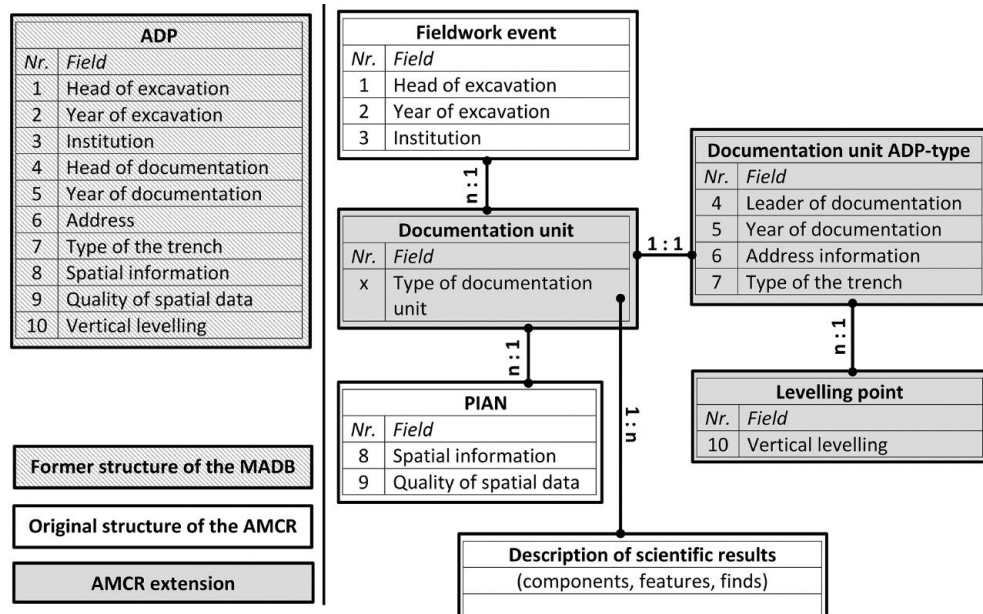


Fig. 6.9 Scheme of the extension of the data model for the scope of the AMCR and MADB harmonization. ADP = archeological documentation point. Compiled by J. Hasil, 2015 (data structure reduced).

6.4 CONCLUSIONS: FUTURE VISIONS

In the year 2017, Prague archaeology will obtain a freely accessible and effective tool with the launch of the IIS ASP virtual research application, a tool that should collect in one place large amounts of information essential for the evaluation of the complex archaeological records of Prague. The availability of this information can enable the solution of various research questions concerning the whole city agglomeration and also open up new topics, including interdisciplinary research. The Prague archaeological fund with its inexhaustible potential thus has a chance to become a widely accessible and inspiring source of knowledge. An equally important part, however, more directed to areas beyond the field of archaeology, is the information about the heritage values of Prague's "underground archives" as well as existing measures that are meant to protect them. The opening of such information to the public may also be seen as a tool of a preventive nature, as it makes it possible to avoid inconvenient interventions in the city's underground and to contribute to a more transparent heritage management based on relevant records.

The consequent information system will provide Prague archaeology with a public platform to be able to convince the general public that the archaeology of the city centre is a source of unique and valuable knowledge. The system can also serve as an inspiration within the framework of interdisciplinary research for providing

answers to socially topical issues. The joint efforts of two institutions such as IAP and NHI and the interconnection of the IIS ASP and AMCR provide a better chance for the sustainable functionality of the IIS ASP even after the end of the project itself, at least in the medium-term perspective.

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*Translation by Petra Maříková Vlčková
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