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MEDEA: Crowd-Sourcing the Recording of Metal-Detected Artefacts in Flanders (Belgium)

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Abstract: Since 2016, hobby metal-detecting is legal in Flanders (Belgium), although it was unofficially tolerated for many years before. However, research on metal-detected artefacts in Flanders is hindered by a low reporting rate. The MEDEA project aims to address this by encouraging detectorists to record their finds on an online platform. Finds experts are invited to enrich records with further information and thus instigate a rewarding feedback cycle. This paper discusses MEDEA's 'Human-Centred Design' development process and the design choices underpinning the platform. MEDEA may be seen as an example of 'Open Archaeology' and related trends in digital humanities.

Keywords: Metal-detecting, heritage management, public archaeology, digital humanities, human-centred design

1 Introduction

The metal-detecting hobby is probably just as popular in Flanders as it is elsewhere in north-western Europe. The initial professional response to this phenomenon, over two decades ago, was to prohibit it. Now, after many years of being tolerated – if not condoned – by the heritage authorities, a new legal framework has been drawn up in which hobby detecting is acknowledged as a legitimate form of non-professional heritage engagement. In order to complement this change in legislation, and to make the rich and continuously growing harvest of decades of metal detecting in Flanders available to researchers and the wider public, MEDEA establishes an online platform that:

1. provides an encouraging environment for detector users to record their finds;
2. ensures the reliability and detail of these records, so that they can be used for research and heritage management.

In the following sections, the legal and policy context of hobby detecting in Flanders as well as the practices and motivations of detector users are briefly introduced (a complete review of these issues can be found in Deckers 2013a, Deckers forthcoming). The main goal of this contribution is to present the rationale for MEDEA, and the approaches taken during development, both from a user and a technical perspective.

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2 Background: Metal Detecting in Flanders

2.1 Legal Context

In the wake of the Council of Europe Recommendation nr. 921 (1981) and the Valletta Treaty (1992), metal detecting outside the context of professional fieldwork was prohibited in Flanders[1] with the introduction of the Archaeology Decree in 1993. Since the mid-2000s, authorities have largely tolerated the practice, despite it being illegal, as long as it occurred within the guidelines of a code of good practice, agreed by both the heritage managers of the government agency and representatives of the detecting community. Although there was never an obligation to turn in finds, the law did require any finds of archaeological significance to be reported to authorities for inclusion in the *Centrale Archeologische Inventaris* (CAI). This database collates all known archaeological information from the territory of Flanders. Among other factors, this shift in policy was the result of a growing awareness amongst professionals of both the relatively limited damage caused by the hobby in Flanders, with its largely agricultural (arable) open space, and the hobby's potential for heritage management - notably, identifying and monitoring of eroding sites.

Recently, this evolution from a restrictive to a liberal stance on hobby detecting has culminated in section 3.6.1 of the new Immovable Heritage Decree (2014), that institutes a licensing scheme for detector users, and thus officially accepts detecting as a legitimate form of public heritage engagement. This section of the legislation came into force on 1 April 2016.

The practicalities of the legislation are outlined in section 3.6 of the Immovable Heritage Regulation. Applying for a licence is as simple as filling in and submitting a form with one's personal details[2], and providing a certificate of good conduct and morals. The conditions for approval are, essentially, being of adult age, and not having breached heritage legislation in the past five years. While a licence is awarded for an indefinite term, the Government can revoke it temporarily when the holder violates the legislation or the legally binding Code of Good Conduct (Onroerend Erfgoed 2015). Infractions can be punished more severely than before, with fines of up to €400.000 and jail sentences of up to five years (Immovable Heritage Decree art. 11.2.2).

One of the central principles (Immovable Heritage Regulation art. 3.6.6) is that all finds and sites of archaeological significance - a distinction which, as before, is left to the discretion of the finder – are reported to the government through the website of Flanders Heritage.[3] The legally required information to be submitted with each finds report consists of a brief description of the artefact, the location where it was found (at least to the level of the cadastral plot) and where it is subsequently kept. This information is then considered for inclusion in the CAI.

The Code sets some bounds to the activities of detectorists. Areas that are the subject of regular archaeological fieldwork are off limits, as are the 30 protected archaeological sites (of which 25 are on rural or largely unbuilt terrain suitable for detecting).[4] Anywhere else, detectorists are not allowed to dig deeper than 30 cm below the surface, regardless of the presence or actual depth of a plough-soil.

Other stipulations in the Code include that (oral) permission of the landowner has to be obtained before detecting on his or her land (as this is the legal owner of any objects found there); that detecting is prohibited between sunset and sunrise; that finds need to be kept in good condition and that, 'preferably', a professional conservation specialist is consulted before any treatment; that researchers are granted access to the finds upon request; and that detectorists generally behave respectfully towards other people and towards the natural environment.

1 In the federal state of Belgium, immovable heritage is subject to the authority of the regions. Hence, it is the responsibility of Flanders Heritage Agency (Agentschap Onroerend Erfgoed). In the other constituent regions of Belgium, Wallonia and the Brussels Capital Region, metal detecting is prohibited.

2 The form can be found on the website of Flanders Heritage Agency: https://www.onroerenderfgoed.be/nl/formulieren/categories/42#4700 (30.09.2016).

3 The online form for reporting detector finds can be found at https://www.onroerenderfgoed.be/nl/melding-metaaldetectievondst (30.09.2016).

4 As of 30 September 2016. The full list of protected sites can be consulted at https://inventaris.onroerenderfgoed.be/aanduidingsobjecten/zoeken (30.09.2016).

2.2 Detectorist Practice and Self-Representation

The number of detectorists in Flanders has in the past been estimated at between 1,000 and 2,000 (Deckers 2013a, Deckers forthcoming). At the time of writing over 700 detectorists have applied for a licence, confirming that the number may well lie in this range. An online survey, conducted in 2013 as a first exploratory step towards the MEDEA project (introduced further on), furthermore underscores the intensity of metal-detecting in Flanders (Deckers 2013b). Over 90% of the 160 respondents indicate going out to search at least 10 days per year, while almost 40% do so on a weekly basis. Taking into account the reported number of hours per search session, this amounts to an annually detected surface area equivalent to up to 8% of Flanders' arable land – by the respondents alone.

By their own accounts, nearly 90% of detectorists prefer to search on arable land. Most (63%) indicate to nearly always stay within the plough-soil; and 90% never dig an area larger than 50x50 cm. Only 5% of detector users never make an agreement with the landowner, and over 80% say they report (some of) their finds. The motivations of detector users are predominantly a historical interest ('very important' for 80%), while financial reasons are unimportant to 95% of detectorists. Over 10% have already voluntarily participated in regular archaeological fieldwork in the past, and over 80% would like to do so.

The survey results paint a largely positive picture of the detecting community as well meaning and responsible, primarily motivated by the wish to engage with their regional heritage, and taking the deontological code to heart. While this may be true for many Flemish detectorists, there are a few elements that put these results into perspective. Firstly, 160 respondents do not form a representative sample of the whole population of detectorists in Flanders, as they self-selected for participation in a survey organized by a professional archaeologist. Secondly, this self-reported image may be biased due to the social desirability of certain responses. Participants may wish to distinguish oneself, as one of the 'good guys', from the 'cowboys' and 'nighthawks' out there (cf. Rasmussen 2014, 3-4).

One indication of this would be that while 10% indicate occasionally buying finds, only 2,5% admit to selling artefacts. Evidently, the latter is seen as somehow morally unacceptable. This could be a reflection of a genuine sentiment amongst detector users, although an element of desirability bias may also be at play. In past years, acquisitions of detected artefacts by museums have been controversial and deemed unethical by many heritage professionals. One such case, to Flemish norms highly mediatized and politicized, was that of the Everbeek Roman silver hoard (Deckers 2012). Interestingly, such transactions were, and still are, perfectly legal, as long as finds are reported, 'assemblages' (groups of finds reported together) are not split up, and the authorities are informed when the finds are moved to another location (Onroerend Erfgoed 2015, chapter 35).

Another indication of the self-representational biases inherent in the survey are the responses regarding reporting, which stand at odds with the actual numbers of reporting detectorists over the past years: 80 individuals over the period 2010-2013, reporting only a selection of their finds (Deckers forthcoming). The main reasons for this low reporting emerging from the survey and from personal contacts with detectorists were the deterrence of prosecution and a mutual lack of trust between detectorists and archaeologists. In part, this mistrust was caused directly by the prohibition of detecting in 1993, but likely the professionalization of Flemish archaeology throughout the 1990s and early 2000s also played a role, resulting in a sense of entitlement amongst heritage professionals and resentment within the detecting community. Indeed, in the Everbeek case cited above, the finder of the Roman silver hoard (as well as the museum that acquired it) was criticized because his discovery had not been reported to the authorities in a timely fashion, rather than receiving praise for agreeing to sell the hoard to the museum at a fraction of its market value.

While important to consider, it would be unwarranted to qualify the survey results into an overly negative conclusion based on these caveats. At the very least, these results indicate the willingness of a sizeable proportion (10% or more?) of very active Flemish detectorists to collaborate with archaeologists, and a demonstrable, if perhaps mostly theoretical knowledge of the deontology desired by the heritage profession. Furthermore, the reporting rate is undeniably on the rise in recent years (Deckers

forthcoming), as is the trust of detectorists – clear signs for the latter development can be found in the unexpectedly large numbers of licence applications and the amelioration of the relationship with (the younger generation of) archaeologists reported by survey respondents.

3 MEDEA as a Necessary Complement to the New Legislation

3.1 Introducing MEDEA

The MEDEA project, based at the Vrije Universiteit Brussel, Belgium, was set up to develop an open source platform that provides detectorists, researchers and heritage professionals with digital access to metal-detected artefacts in Flanders. In order to be successful, MEDEA must overcome the obstacles that, even under the new legislation, impede the reporting, accessibility and usability of information on metal-detected artefacts to researchers and other interested parties.

While policy changes over time and the recently implemented, highly accessible licensing scheme have increased detectorists' confidence in collaboration with professional archaeologists, the new legal framework is unlikely to increase the reporting rate to a level useful for scientific research. It has been argued elsewhere (Deckers forthcoming) that the current legal setup, despite being a significant step towards resolving many issues, presents an incomplete solution from the perspective of research and heritage management. Firstly, it provides little enticement to report more than the absolute minimum of finds deemed 'important' enough by detectorists themselves, and it leaves the huge backlog of unreported finds collected before April 2016 unaddressed. Secondly, it does little to facilitate consultation of finds reports and ensure the level of reliability and detail that research requires.

Both challenges - motivating detectorists to report finds and ensuring reported data are accessible and usable by all interested parties – need to be addressed by MEDEA for it to successfully complement current legislation. These challenges are discussed in more detail below, followed by a more detailed overview of the setup and the philosophy of the MEDEA platform.

3.2 Challenge 1: Gaining Detectorist Trust and Enthusiasm

The results of the above-mentioned survey, as well as other evidence (e.g. Ribbens 2011) show that detectorists are often, and increasingly, keen on collaborating with professional archaeologists, by volunteering in the field and by sharing information on their finds, as long as the latter handle this potentially sensitive information with the necessary tact. Despite these positive developments, the opaque nature of the official reporting scheme and the lack of positive motivation for reporting remain considerable hurdles in the information flow between detector users, researchers and heritage managers.

Successful examples abroad, notably the Portable Antiquities Scheme (Lewis 2013, 2016) and the Danish Danefae (Dobat 2013, Dobat, Jensen 2016) confirm that key factors in mobilizing detectorists are feedback from the 'experts' – professional archaeologists and heritage managers – in the form of recognition and knowledge; not necessarily financial remuneration. Another element contributing to the success of these schemes is transparency: making clear how researchers make real use of the reported information. The Heritage Agency's inventory CAI is accessible only to heritage managers and academic researchers, and thus in most cases forms a 'dead end' for finds reported by the public. If the success of the Portable Antiquities Scheme is any measure, a freely accessible finds database, and the sense of contribution and recognition it affords to detectorists, is a major motivating factor for voluntary finds recording.

A final element, also evident from experiences in Flanders (e.g. the already-mentioned survey, the PhD research of one of the authors (Deckers 2014), and the Laufeld battlefield survey (Vanderbeken, Vansant 2013, 55)) is the crucial role of professional archaeologists in reaching out to detector users, rather than vice versa. Archaeologists, who stand to gain the most from the collected data, evidently need to take the initiative in this.

3.3 Challenge 2: Ensuring Accessibility and Usability of Data on Metal-Detected Artefacts

A second challenge is to ensure that finds reports are available for re-use by researchers, heritage managers and other interested parties. As described above, the type of data collected by the CAI, in itself representing only that fraction of the finds reported in the past, is insufficient for any in-depth study of topics such as artefact distributions, technology and typology. This is the case for several reasons:

- The reports lack detailed information, such as multiple photographs and a thorough basic description;
- The CAI database does at present not have a search function able to filter at the level of individual finds, as these are seen as attributes of locations, not as entities in their own right;
- The reliability of the finds reports is uncertain as far as artefact identifications are concerned.

This is by no means intended as a criticism towards those responsible for developing and maintaining the CAI. The database was not developed to serve as a source for material culture research, but as a tool for assessing and managing locations with archaeological value, intended for internal usage by Flanders Heritage Agency (Meylemans 2004). However, the result of these restrictions is that metalwork as a category of material culture has been strongly overlooked so far in scholarly research in Flanders, and that MEDEA will need to independently collect, store and make accessible the data necessary for such endeavours.

A second necessary element is that the collected dataset needs to aspire to a degree of quality and representativeness. Obviously, errors and biases can never be excluded (e.g. Robbins 2013), but nonetheless the quality of the dataset as a research tool can be improved significantly in ways other than merely maximizing the number of records. This may be attained in several ways, for example by collecting data on a wide range of find categories rather than solely those most favoured by detector users, by consistently documenting relevant metadata such as finds circumstances and locations at a sufficient level of precision, and by enriching the finds records with interpretive information pertaining to typology, chronology and relevant literature.

It is evident that all these conditions rely on the effort invested in entering data by detector users; as such challenge 1, gaining the motivated collaboration of the latter, is to be considered the key for success of the platform. On the other hand, quality control and interpretation cannot be the sole responsibility of this one user group.

3.4 Basic Setup and Philosophy of the MEDEA Platform

Against the background of these explicit goals, motivating detectorists to record their finds, and ensuring the quality and accessibility of the find records for scholarly research, MEDEA has to work within certain constraints. Most importantly, there is at present no structure in place that allows for the routine recording of detectorist finds by a network of dedicated professionals, similar to the Portable Antiquities Scheme's Finds Liaison Officers; and the awarded budget of the MEDEA project does not provide the means to set up such a structure. This implies that detectorists need to record their own finds, and that the platform must ensure that this information is complete and reliable.

Therefore, the basic workflow of the platform, as it is currently envisioned (Figure 1), begins with direct input by registered detector users. The minimal information provided is a factual description of each find, including measurements (dimensions, weight), one or more photographs of sufficient quality, its finds location and, preferably, a first high-level attribution of the find to a major finds category and period (e.g., a Roman brooch). MEDEA enables structured data entry and provides contextual support to guide its users, who are not necessarily well versed in IT or in detailed archaeological recording. Interaction with the existing CAI infrastructure and process will be ensured by automating the exchange of both old and new finds reports between both schemes. As a result, any finds information recorded in MEDEA will be accessible to the Flanders Heritage Agency, and can thus be used for heritage management and spatial planning purposes.

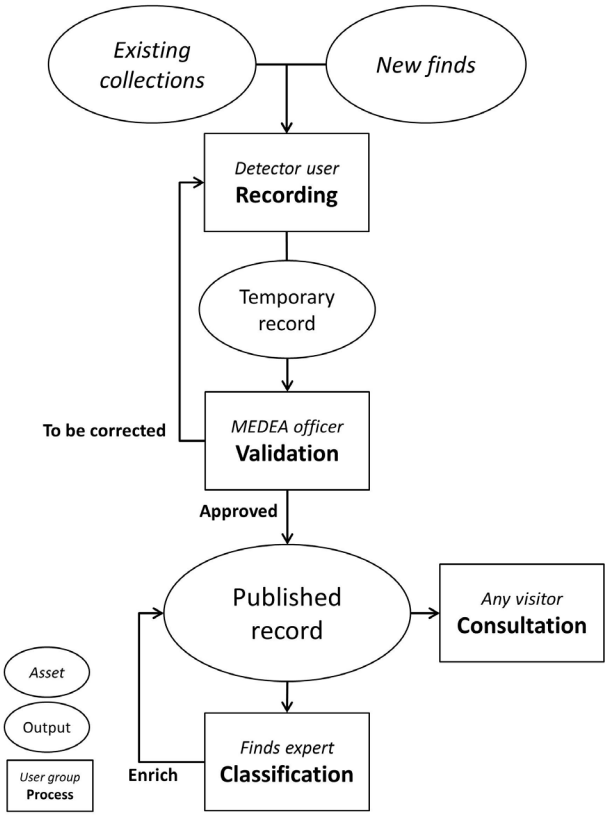

Figure 1. The basic workflow of the MEDEA platform, structured using the terminology of Dunn & Hedges (2013).

Following submission, a MEDEA officer or a trained volunteer validates each finds record. This 'human' phase of validation is necessary because some information, such as the high-level find categorisation and date and the quality of the photograph, cannot be fully verified automatically. Nonetheless, the user interface envisioned for this validation phase enables a swift and routinely decision process. If errors are detected, the validator can choose to rectify these himself in certain circumstances (e.g. by entering the most probable find category and date). Otherwise, the associated recording detectorist is notified with the request to rectify any issues.

Once the record is successfully validated, it is published - i.e. the finds record becomes publicly available, also for non-registered users. At this point, the information is freely available for all to consult through a Creative Commons 'Attribution-NonCommercial' licence (CC BY-NC 4.0[5]), with the exception of potentially sensitive information, notably exact finds coordinates.

As a next stage in the workflow, 'finds experts' are invited by the system to enrich finds records with additional information. These finds experts will be drawn not only from academic archaeologists and other professionals, but also from detector users and other amateur enthusiasts. Indeed, many amongst the latter group are often very knowledgeable with regards to (specific categories of) archaeological metalwork due to decades-long handling and collecting. Conversely, institutional expertise of archaeological metalwork in Flanders is largely underdeveloped compared to, notably, England or Denmark.

Finds experts identify their field of expertise during registration, and MEDEA subsequently notifies them when new finds of interest have been published. In addition to typological classifications, datings and literature references, it is also possible to add a literature reference to a MEDEA record when a find is published outside the platform, in order to keep track of the contribution of MEDEA to research. Detector users are in turn notified when new information is added to their finds records.

5 See https://creativecommons.org/licenses/by-nc/4.0/ (30.09.2016)

As the dataset grows, MEDEA will build a valuable and publicly accessible reference base for the benefit of professional archaeologists and detectorists alike, similar to the Portable Antiquities Scheme today. Equally importantly, MEDEA will have established a vital feedback mechanism that encourages detectorists to continue recording, and researchers to continue exploiting the dataset in their research, while linking the results back to MEDEA.

MEDEA can be situated within the growing Open Science movement, also present in archaeology (see Beck, Neylon 2012, Wilson, Edwards 2015). The platform operates as `a transparently accessible knowledge base that can be used for many different scales of enquiry by many different audiences' (Beck, Neylon 2012, 494). It conforms to recent perspectives on the position and role of 'data' within the archaeological discipline, and instigates an interaction between the various producers and consumers of archaeological information. Finally, it highlights the dynamic interplay between the growing corpus of raw data and ever-changing frameworks of knowledge and interpretation which is inherent in all scientific research. For example, in contrast to the PAS and to reporting requirements in most countries, there is no restriction on the types of metal-detected artefacts that are accepted into the database. This allows for new topics of interest to emerge amongst the detecting and scholarly communities alike, as previously underrepresented time periods and object categories are added. However, in spite of these aspirations to 'openness', it may be noted that full access to all collected data for all users is not necessarily feasible or desirable (see below, Beck, Neylon 2012, 490).

Given these international trends, it is no coincidence that similar initiatives are currently underway in other European countries, such as the recently announced project *Portable Antiquities of the Netherlands* (PAN) (NWO 2016). In Germany, academic archaeologists have recently published the *Tübingen Theses*, calling for a more open, community-minded approach to archaeology and heritage management. They explicitly list the importance and potential of developing collaborations with detector hobbyists in order to bridge the gap between professional and amateur archaeologists (Scherzler, Siegmund 2015, thesis no. 2). The impact of such initiatives clearly transcends a mere optimization of the data flow from detector users to professional archaeologists. By acknowledging the efforts and genuine historical interest of members of the public and by enhancing understanding of the scientific process behind archaeological knowledge, its effect will be a greater shared knowledge of and responsibility for our archaeological heritage.

More particularly, MEDEA may be characterized as an exercise in crowdsourcing as it relies on participation from the public to record and create content (see Dunn, Hedges 2013). The crowdsourcing aspect of MEDEA is twofold: it applies to (professional and amateur) researchers who will make use of the data but are requested to feed their research results and acquired expertise back into the database, as well as to detectorists recording the finds. As such, MEDEA to some extent breaks down the asymmetry of the public stake in many crowd-sourced projects described by Shirk et al. (2012) as limited to data collection and thus purely 'contributory'. Instead, MEDEA endeavours to be a 'collaborative project' in which users of the platform participate in the analysis of the data, and not just in creating a product benefitting a small group of professional scientists. Not coincidentally, the feedback loop highlighted above has been identified as an important motivator in crowdsourcing projects more generally (Dunn, Hedges 2013, 153).

4 The Development Approach of the MEDEA Project

In the preceding section, MEDEA has been described as part of the wave of Open Science approaches, more specifically applying crowdsourcing as a response to the particular challenges and constraints currently inhibiting access by researchers and heritage managers to the multitude of dispersed metal-detected finds collections in Flanders. This section is devoted to a discussion of the development approach taken to realize the MEDEA platform and its goals. As will be shown, MEDEA may be described as a 'co-created project', following the terminology of Shirk et al. (2012), with regards to involvement of the future users of the platform in the design process.

4.1 Human-Centred Design

The MEDEA project follows a Human-Centered Design (HCD) approach in close collaboration with three stakeholder groups: detectorists, archaeological researchers and heritage managers. Stakeholders have been involved prior to the development and will continue to be involved during development through different testing stages. At the time of writing, development is still ongoing. As a result, this paper will focus on describing the overall process and highlight some of the results that we have obtained thus far.

As Steen (2012, 72) clarifies, referring to ISO guidelines, "HCD is based on four principles: 1) involving users to better understand their practices, needs, and preferences; 2) searching for an appropriate allocation of functions between people and technology; 3) organizing project iterations in conducting the research and generating and evaluating solutions; and 4) organizing multi-disciplinary team work." Overall, different approaches are understood to be part of HCD, such as participatory design and co-design (Steen 2012). What unites them is that end-users and/or other stakeholders of the envisioned technology are involved in the design process to some extent.

The rationale for a HCD approach is based on potential benefits both for the project outcome as well as the stakeholders involved. Kujala (2003, 4) refers to the work of Damodaran (1996) to discuss potential benefits of involving users in the design process. One of those benefits is an improved, cost-efficient system (or product or application) without unnecessary features because user needs have been properly taken into account. Other benefits mentioned include higher acceptance, better understanding and more effective use of the system, which make it an ideal approach in particular in relation to the detectorist user group. As Kujala (2003) points out, although there is good evidence for the overall positive effects of following a HCD approach, the actual accomplishment of these anticipated benefits is not always reported. For this reason, we plan to explicitly assess the results of the HCD approach by collecting relevant data on the link between stakeholder participation and expected benefits (e.g. heightened sense of satisfaction and involvement with the platform) throughout the development process.

4.2 HCD as Applied to MEDEA

Prior to development, the aforementioned stakeholder groups were consulted to determine key components of the MEDEA platform. Envisioning the platform as a hub for an online community of stakeholders, we inquired as to their opinions and priorities, organized by the following key facets (based on the Community Maturity Model, see The Community Roundtable 2014): strategic goals of the platform; roles and responsibilities of future users of the platform; norms and values users should live up to; and key content and tools that would be relevant to provide via MEDEA. This consultation, complemented with an online survey, resulted in a set of recommendations informing the development process, more specifically the use cases that formed part of the technical tender eventually submitted to the developer.

The actual development of the MEDEA platform is organized in three cycles, each consisting of a development phase followed by testing by stakeholders. During the first development and testing cycle, which was completed at the time of writing, the development team created a set of clickable wireframes that visualized key aspects of the future MEDEA platform. Stakeholders walked through the wireframes in pairs, following a series of tasks representing usage of the principal functionalities of the platform. Their feedback is taken into account in the development of the next iteration, which is followed by a small-scale test of a first functional version of the MEDEA platform including the majority of the planned features (closed testing). The subsequent iteration will involve an improved version to be tested on a larger scale (open beta testing), to be further refined in a final development cycle. See Figure 2 for an overview of the entire process.

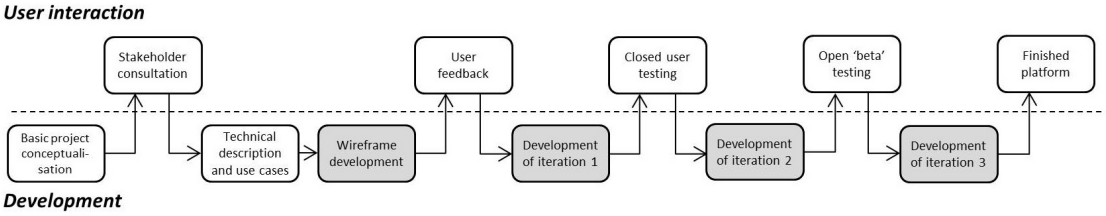

Figure 2. Simple flowchart of the development process of the MEDEA platform.

4.3 First Results

It is not within the scope of this article to report the entire set of results of the HCD process so far. Nevertheless, a few findings are presented to illustrate how the process has informed the project as well as how it has raised questions to be tackled.

Stakeholder consultation prior to development helped increase and refine our understanding of the sensibilities and priorities of the different stakeholder groups in MEDEA (see initial project report by Ruelens et al. 2015 where the results are described in full). Results confirmed the presumed importance that detector users attach to keeping finds locations private from other detectorists and to expert feedback in the form of enriched finds records. In their view, the platform should foster interaction between detectorists and other stakeholders, rather than amongst detectorists, as other means already exist for that purpose. In addition, all stakeholders saw the MEDEA platform as an opportunity for raising awareness on topics related to the metal detecting context, including how to search responsibly and reporting accurately. Furthermore, the use of gamification and competitive elements (Deterding et al. 2011, Seaborn, Fels 2015) was overall deemed undesirable. As in other crowdsourcing projects involving 'expert knowledge or deep interest' in the subject matter (Dunn, Hedges 2013, 154), such elements were described as unnecessary, distracting and even counterproductive for maintaining a respectful, collaborative scientific culture on the platform. Lastly, a number of more critical questions regarding the project were raised, including MEDEA's policy on dealing with sensitive finds, such as hoards and finds of high financial value, and how to keep the platform both manageable and sustainable in the long run.

Feedback gathered during the wireframe evaluation reaffirmed the importance of a user-friendly platform that minimizes workload, while also signalling various potential usability issues.

An important emergent theme in participants' feedback throughout the process was trust in the platform and the data it provides, as well as in fellow users. Firstly, professional identification by reliable finds experts - be they researchers, heritage professionals or detectorists - is seen by all stakeholders as a mechanism for quality control that fosters trust in the data and usage in research and publications. As such, it is not only considered to be an important means for feedback and acknowledgement towards detectorists that encourages them to contribute, but also an essential responsibility to be taken up by specialists if MEDEA's research potential is to be fulfilled. Secondly, how the platform treats sensitive information is foreseen by stakeholders to influence trust in and usage of the platform. Detectorists are expected to become more willing to provide detailed information when they come to understand that the platform shields exact location information from other detectorists.

These results helped to identify priorities in terms of user requirements and to refine the use cases as development progresses. The challenge for data modelling and development lay in identifying the optimal solution for meeting requirements, especially when conflicts of interest emerge. For instance, the preference of detectorists for unambiguous, definitive finds identifications clashes with the dynamic nature of archaeology as a scientific discipline that progresses through continuous discussion and the formulation of competing interpretations (also see Dallas 2015). Alternative typologies and datings may apply to the same finds category, and new comparable finds are always forthcoming. In addition, this preference for

authoritative feedback is difficult to reconcile with the notion of an open collaborative platform that levels the playing field for both amateurs and professionals (e.g. Phillips 2013).

Similarly, whereas researchers and heritage managers naturally prefer an exact localisation of each find, detectorists might not always be willing or able to provide such information, for instance, due to an initial lack of trust in the platform, or because they simply do not have the required information at hand. This leads to the challenge of designing a finds recording interface that encourages entering exact coordinates as much as possible, without precluding less precise localisations. The trust and willingness to cooperate of users will hopefully grow over time, and directed efforts can be undertaken to raise awareness about the ideal level of recording detail. In any case, a pragmatic balance that satisfies different stakeholders' needs as much as possible will need to be found and this decision-making process will be supported through further testing.

5 Data Model

The core of the MEDEA project is the development of an open source software platform that enables recording and retrieving information on metal-detected artefacts in a way that conforms to the project's aims and to stakeholder requirements. The platform essentially consists of a graph database that stores information about metal-detected finds, and a web interface that allows detectorists, finds experts and other interested parties to access and add to the database.

MEDEA has assigned a technical partner for the development of the platform through a public tender. All associated documentation is freely available through Project CEST, a web resource for Cultural Heritage Standards managed by PACKED.[6] The tender specifications, the selection of the technical partner and the technology used were inspired by four main principles which reflect the core goals set out at the start of the project and implement the user feedback gathered through the early stages of the HCD process:

1. MEDEA data should be interoperable with archaeological data from other sources. This requires the use of archaeological data standards for modelling the MEDEA data and for the procedures creating data, i.c. cataloguing rules and vocabularies.
2. MEDEA data should be extensible with new classes of information about archaeological finds. This requires a database management system that adapts to the shifting needs of archaeological research, preserving the internal consistency of the data, though allowing for different levels of granularity and specificity.
3. MEDEA data should be accessible via the web. This requires a database management system using technology that easily integrates with mobile apps and other research databases, especially developer friendly web API's that reduce the development cost of new web applications.
4. MEDEA data and tools should be reusable by other metal detecting communities. This requires the use of open standards (in accordance with the definition offered by European Communities 2004, 9) that allow for reducing maintenance and development cost and for building a community that supports the tools and data beyond the lifetime of the MEDEA project.

Since ensuring the quality of the finds data is an important requirement for MEDEA, the project uses a data model specifically designed to represent information about metal detecting practice (Figure 3). This data model represents information, not only about the archaeological find itself, but also about the main events associated with the find, including reporting the find to the authorities, its transfer to a collection, and classifications and citations by experts and researchers.

At the same time, this specific finds data should be interoperable with other research data from the humanities. Therefore, the MEDEA data model reuses concepts and relationships from the CIDOC Conceptual Reference Model (CIDOC-CRM, see Le Boeuf et al. 2015), a standard set of concepts and relationships defining the domain of discourse about cultural heritage that provides a blueprint for the design of interoperable

6 PACKED vzw, CultureelErfgoedStandaardenToolbox. https://www.projectcest.be/wiki/Publicatie:MEDEA (30.09.2016).

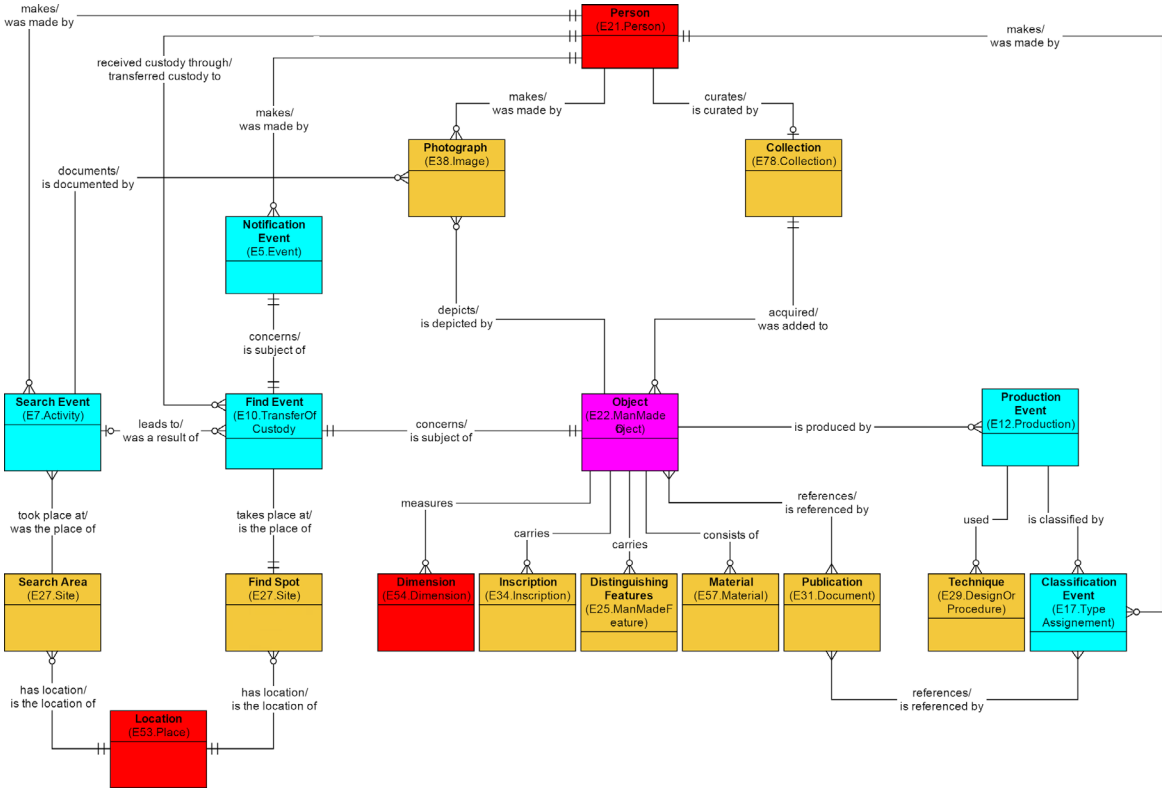

Figure 3. The MEDEA data model, identifying the 18 core entities and their relationships. These entities represents the domain knowledge captured by the MEDEA database.

heritage databases. Reuse of these concepts in the MEDEA data model should ensure that finds data can be easily associated with information from other disciplines and institutions in the humanities field. Within the MEDEA project, the CIDOC-CRM also provides a framework for extension of the MEDEA data model with new classes of information. For the specification of the data model, MEDEA made extensive use of existing implementations of the CIDOC-CRM in other archaeological research projects, such as ARCHES[7]. The specification of the MEDEA data model is freely available through CEST[8] and will be updated throughout the development process.

From a technical point of view, the MEDEA database has been implemented using the Neo4j database management system.[9] The project deliberately opted for native graph database technology, since the use of the CIDOC-CRM as a reference framework resulted in a database with an extremely fine-grained graph structure, posing considerable challenges for making this information searchable and retrievable. Other important motives for using Neo4j are the open source licence and the availability of a well-supported web API and query language, which allows easy integration of the MEDEA database with multiple web applications.

In addition to the database, the MEDEA project also entails the development of a first web application, targeting three important stakeholder groups: detectorists documenting new finds in the MEDEA database; heritage managers documenting finds reports; and find experts classifying objects. The expected behaviour of these stakeholder groups has been formally described in a series of seven use cases that serve as a reference point for the development of the web interface. The seven use cases are freely available on

7 Arches: Heritage Inventory and Management System. http://archesproject.org/ (30.09.2016)

8 PACKED vzw, MEDEA Graph Data Model, CultureelErfgoedStandaardenToolbox, 2016. https://www.projectcest.be/wiki/Bestand:MEDEA_Crosswalk.xlsx (30.09.2016)

9 See https://neo4j.com/ (30.09.2016).

CEST[10] and will be updated throughout the development process. The development of the web application follows a lightweight approach, with code written in PHP using the Laravel framework. The web application does not use a conventional web content management system such as Drupal. Rather, the contents of the webpages are loaded directly from the Neo4j database, without storing MEDEA in an intermediate database. The source code of the web application has been made available throughout the development process in the Github repository of the technical partner,[11] and will be available under an open source licence after completion of development.

6 Conclusion and Future Prospects

MEDEA aims to collect and make available reliable and useful information, in a standardized format, about the innumerable amount of artefacts that are currently dispersed amongst the private collections of detecting enthusiasts in Flanders, with plenty of new finds discovered every week. It is clear that such finds can contribute significantly to our knowledge of the past, and that the detecting hobby, if conducted responsibly, is an asset rather than a threat to heritage management. Indeed, there is good evidence that a sizeable group within the detecting community of Flanders takes an active interest in the historical value of their finds, and is willing to cooperate with archaeologists. Furthermore, the project complements a legal context that further instigates desirable behaviour, but also provides (at least theoretically) a deterrent for unethical conduct.

At a conceptual level, MEDEA obviously takes its inspiration from successful examples of similar schemes and projects elsewhere - in the first place the Portable Antiquities Scheme. A Human-Centred Design approach is taken in order to respond appropriately to the particular challenges posed by the local legislative context, the practices of Flemish detectorists, and the needs and concerns of both detectorists, researchers and heritage managers. The design process involves an iterative trajectory consisting of several development cycles and regular opportunities for users to give their input on issues ranging from the overall strategic priorities of the project to the conceptualisation of individual features of the interface. Ultimately, this will result in an open, inclusive platform that encourages reporting through its user-friendliness, but, most importantly, by instigating a rewarding feedback loop between detectorists on the one hand, and the archaeological profession (researchers, heritage managers) on the other. While the long-term, structural continuation of the platform is, at the time of writing, still subject to uncertainty, its crowd-sourced setup that can easily be extended to almost all functional roles in the workflow, helps to envisage sustainable scenarios for the future. As stakeholders themselves indicate, thanks to this inclusiveness, which allows to promote best practice, further research and enhance the mutual understanding and collaboration between the professional and non-professional communities, MEDEA can ultimately help to position the detecting hobby as a legitimate and recognized part of archaeological practice.

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10 PACKED vzw, MEDEA Use Cases Web Interface, CultureelErfgoedStandaardenToolbox, 2016. https://www.projectcest.be/wiki/Bestand:MEDEA_usecases_final.pdf (30.09.2016).

11 WeOpenData, MEDEA, Github, 2016. github.com/weopendata/medea (30.09.2016).

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Abbreviations

CAI: *Centrale Archaeologische Inventaris* (Central Archaeological Inventory)
HCD: Human-Centred Design
PAS: Portable Antiquities Scheme

References

Legal and policy documents

Archaeology Decree = Vlaamse Regering (1993). Decreet van 30 juni 1993 houdende bescherming van het archeologisch patrimonium, gewijzigd bij decreten van 18 mei 1999, 28 februari 2003, 10 maart 2006, 27 maart 2009 en 18 november 2011. http://codex.vlaanderen.be/Portals/Codex/documenten/1000978.html

Council of Europe (1981). Recommendation nr. 921: Metal detectors and archaeology. http://assembly.coe.int/nw/xml/XRef/Xref-XML2HTML-en.asp?fileid=14955&lang=en (30.09.2016).

Immovable Heritage Decree = Vlaamse Regering (2014). Decreet van 12 juli 2013 betreffende het onroerend erfgoed, gewijzigd bij het decreet van 4 april 2014. http://codex.vlaanderen.be/Portals/Codex/documenten/1023317.html (30.09.2016).

Immovable Heritage Regulation = Vlaamse Regering (2014). Besluit van de Vlaamse Regering betreffende de uitvoering van het Onroerenderfgoeddecreet van 12 juli 2013. http://codex.vlaanderen.be/Portals/Codex/documenten/1024695.html (30.09.2016).

Valletta Treaty = Council of Europe (1992). European Convention on the Protection of the Archaeological Heritage (Revised). http://conventions.coe.int/Treaty/EN/Treaties/Html/143.htm (30.09.2016).

Note: all Flemish heritage legislation can be found online in a booklet produced by the Flemish Heritage Agency (Onroerend Erfgoed, 2014).

Published references

Beck, A., & Neylon, C. (2012). A vision for Open Archaeology. World Archaeology, 44(4), 479-497.

The Community Roundtable (2014). State of Community Management 2014. http://www.communityroundtable.com/research/state-of-community-management-2014/ (30.09.2016).

Dallas, C. (2015). Curating Archaeological Knowledge in the Digital Continuum: from Practice to Infrastructure. Open Archaeology, 1, 176-207. https://www.degruyter.com/view/j/opar.2014.1.issue-1/opar-2015-0011/opar-2015-0011.xml (30.09.2016).

Deckers, P. (2012). Everbeek Roman Silver Hoard. Trafficking Culture Encyclopedia, http://traffickingculture.org/encyclopedia/case-studies/everbeek-roman-silver-hoard/ (30.09.2016).

Deckers, P. (2013a). Past, present and future of archaeological metal-detecting by amateurs in Flanders (Belgium). AP: Online Journal in Public Archaeology, 3, 13–17.

Deckers, P. (2013b). Resultaten van de online enquête “Amateurmetaaldetectie in Vlaanderen” (unpublished document).

Deckers, P. (2014). “Productive sites” in the polders? “Griffin brooches” and other early medieval metal artefacts from the Belgian coastal plain. Medieval and Modern Matters, 3, 21–43.

Deckers, P. (forthcoming). Legislation, policy and practice of a hobby: archaeological metal detection by amateurs in Flanders. In S. Campbell, S. Thomas & L. White (Eds.), Competing Values in Archaeological Heritage. Springer.

Deterding, S., Dixon, D., Khaled, R., et al. (2011). From Game Design Elements to Gamefulness: Defining “Gamification”. In Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments. (pp. 9–15). New York, NY: ACM.

Dobat, A.S. (2013). Between rescue and research: An evaluation after 30 years of liberal metal detecting in archaeological research and heritage practice in Denmark. European Journal of Archaeology, 16, 704–725.

Dobat, A.S., & Jensen, A.T. (2016). “Professional Amateurs”. Metal Detecting and Metal Detectorists in Denmark. Open Archaeology, 2, 70-84. https://www.degruyter.com/downloadpdf/j/opar.2016.2.issue-1/opar-2016-0005/opar-2016-0005.xml (10.11.2016).

Dunn, S., & Hedges, M. (2013). Crowd-sourcing as a component of humanities research infrastructures. International Journal of Humanities and Arts Computing, 7(1-2), 147-169.

European Communities (2004). European Interoperability Framework for Pan-European eGovernment Services, version 1.0. Luxembourg: Office for Official Publications of the European Communities.

Kujala, S. (2003). User involvement: a review of the benefits and challenges. Behaviour & Information Technology, 22(1), 1–16.

Le Boeuf, P., Doerr, M., Ore, C.E. et al. (Eds.). (2015). Definition of the CIDOC Conceptual Reference Model version 6.2.1. http://cidoc-crm.org/docs/cidoc_crm_version_6.2.1.pdf (30.09.2016).

Lewis, M. (2013). The PAS - a rather British solution. The mandatory reporting and voluntary recording of archaeological objects in England and Wales. In A. Largerlof A. (Ed.), Who Cares? Perspectives on Public Awareness, Participation and Protection in Archaeological Heritage Management (EAC Occasional Paper). (pp. 17–21). Budapest: Archaeolingua.

Lewis, M. (2016). A Detectorist's Utopia? Archaeology and Metal-Detecting in England and Wales. Open Archaeology, 2, 127-139. https://www.degruyter.com/downloadpdf/j/opar.2016.2.issue-1/opar-2016-0009/opar-2016-0009.xml (10.11.2016).

Meylemans, E. (Ed.). (2004). CAI-I. De opbouw van een archeologisch beleidsinstrument, IAP-Rapporten. Brussel: Instituut voor het Archeologisch Patrimonium.

NWO (2016). PAN: Portable Antiquities of the Netherlands. http://www.nwo.nl/onderzoek-en-resultaten/onderzoeksprojecten/i/20/26420.html (30.09.2016).

Onroerend Erfgoed (2014). Onroerend Erfgoed. De regelgeving. Brussel: Vlaamse Overheid, Agentschap Onroerend Erfgoed. https://www.onroerenderfgoed.be/assets/files/news/downloads/140915_LV_RWO_Brochure_regelgeving.pdf (30.09.2016).

Onroerend Erfgoed (2015). Bijlage. Code van goede praktijk voor de uitvoering van en rapportering over archeologisch vooronderzoek en archeologische opgravingen en het gebruik van metaaldetectoren (versie 1.0). https://www.onroerenderfgoed.be/assets/files/content/images/Code_van_Goede_Praktijk.pdf (30.09.2016).

Phillips, L.B. (2013). The temple and the bazaar: Wikipedia as a platform for open authority in museums. Curator: The Museum Journal, 56, 219–235.

Rasmussen, J.M. (2014). Securing cultural heritage and fencing stolen goods? A case study on museums and metal detecting in Norway. Norwegian Archaeological Review, 47, 83–107.

Ribbens, R. (2011). Facts of archaeology. Archeologisch Vlaanderen in cijfers: 2004-2010, in: Congresbundel Archeologisch Forum 16 April 2011, Vrije Universiteit Brussel. Forum Vlaamse Archeologie vzw, 16–17.

Robbins, K.J. (2013). Balancing the scales: Exploring the variable effects of collection bias on data collected by the Portable Antiquities Scheme. Landscapes, 14, 54–72.

Scherzler, D. & Siegmund, F. (Eds.). (2015). Tübingen theses on archaeology. Archäologische Informationen, Early View, published online 12 Nov. 2015. http://www.dguf.de/fileadmin/AI/ArchInf-EV_Tuebingen-Theses.pdf (30.09.2016).

Seaborn, K., & Fels, D.I. (2015). Gamification in theory and action: A survey. International Journal of Human-Computer Studies, 74, 14–31.

Shirk, J.L., Ballard, H.L., Wilderman, C.C., et al. (2012). Public participation in scientific research: a framework for deliberate design. Ecology and Society 17(2), http://www.ecologyandsociety.org/vol17/iss2/art29/ (30.09.2016).

Steen, M. (2012). Human-centered design as a fragile encounter. Design Issues, 28(1), 72–80.

Vanderbeken, T., & Vansant, V. (2013). ZOLAD+. Intergemeentelijke projectvereniging voor het onroerend erfgoed. Jaarverslag 2012. Riemst: ZOLAD+.

Wilson, A.T., & Edwards, B. (2015). Open Source Archaeology: Ethics and Practice. Warshaw-Berlin: De Gruyter Open.