The Use of Information Technology in Australian Archaeology: the FAIMS Digital Data Survey Report

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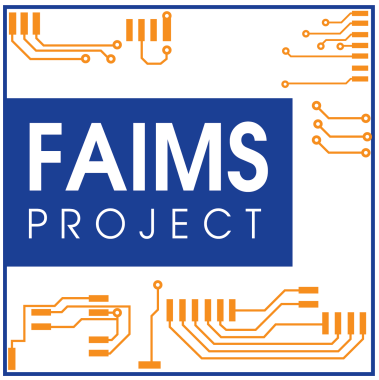
Adela Sobotkova



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CONTRIBUTORS: Australian Heritage Management Service Pty Ltd NSW ★ Australian Cultural Heritage Management Pty Ltd VIC ★ Archaeological Map of Bulgaria (BG) ★ University of California Berkeley (US) ★ University of Canberra ★ Flinders University ★ Godden Mackay Logan ★ Indiana University of South Bend (US) ★ James Cook University ★ University of Leicester (UK) ★ Macquarie University ★ Michigan State University (US) ★ University of New England ★ University of Queensland ★ Snappy Gum Heritage Services ★ Southern Cross University ★ University of Sydney ★ Vanderbilt University (US) ★ University of Western Australia

SUPPORTERS: Archaeology Data Service ★ Digital Antiquity ★ University of Texas, Austin (US) ★ Australasian Institute for Maritime Archaeology ★ Australian Archaeological Association ★ Australasian Society for Historical Archaeology ★ ACT Heritage Project ★ ACT Heritage Unit ★ NSW Heritage Branch ★ NSW Office of Environment and Heritage ★ Monash University ★ University of Melbourne ★ University of Sydney Library ★ Earth Imprints Consulting

1 Introduction and Rationale

This report presents the results of the Digital Data survey, undertaken by the Federated Archaeological Information Management Systems (FAIMS) project at its inception in July-August 2012[1]. The survey was conceived as the initial stage of an extensive stocktaking exercise, whose purpose was to gather information on the use of technology by archaeologists before the designing of a new archaeological information management infrastructure. Through this collection of information we have implemented as fully as possible the tenet that "stocktaking activities are the precondition to designing a successful tool" (Jones and Williams, 2005). The survey and following stocktaking activities involved FAIMS stakeholders and the broader archaeological community in Australia and overseas. Although our approach and execution of the survey itself was far from perfect in the details, it substantially improved our understanding of archaeological needs and requirements and impacted the FAIMS development plans.

2 Digital Data Survey – Aims and Goals

Digital Data Survey was the first task that FAIMS team undertook after the launch of the project on 5 June 2012. The survey was aimed at academic, consulting, and government archaeologists or related practitioners who produce or use archaeological or cultural heritage data, including students. The focus of the survey was to explore the current patterns in the use of information technology among archaeological community. In 31 questions we aimed to learn about computer literacy and define key obstacles to an increased use of technology within the archaeological community. While the goal was similar, its scope was smaller and design less complex than the "Strategies for Digital Data Survey" organized by the ADS in Britain to assess the creation, archiving, use and re-use of digital data in archaeology in late 1990s (Condron et al., 1999). Digital Data survey also complements the demographic analyses and vocational training survey of the archaeological community in the UK (Aitchison and Edwards, 2003 and Aitchison, 2004) and US (Zeder, 1997) and the surveys of archaeological profession in Australia with implications for teaching and learning (Ulm et al., 2005,2013).

[1] The survey was created by the FAIMS leadership team and distributed with the approval of the University of New South Wales HREA panel (under permit no.12071).

2.1 Survey Response Rate

The survey was sent out to the FAIMS contact list which in July 2012 included some 120 Australian stakeholder institutions and individuals as well as 40 overseas participants, majority self-enrolled through the word of mouth. Contacts on the FAIMS email list included members of Australian archaeological community as well as IT-oriented archaeological networks (e.g. members of the Digital Data Interest Group at the Society for American Archaeology, or affiliates of the Archaeology Data Service in the UK, etc.). AAA and OzArch lists were also used for survey distribution as were other social media. We encouraged our addressees to forward the survey to other colleagues. The survey was open for two weeks during late July-early August 2012 and reminders were sent on Fridays to encourage responses. By 12 August 2012 we collected 128 responses; 79 of them from Australians (additional 2 were eliminated as duplicates), the remaining 39 from overseas participants. The response rate was fairly high with regard to the short period of survey duration and we are very grateful to all the participants for responding and forwarding the survey on within the community.

The community of 79 Australian respondents to the Digital Data survey can be better contextualized within the Australian archaeological community thanks to the work of Sean Ulm et al. (2013). Ulm and his colleagues estimate the community Australian archaeologists to reach some 399 in 2010 (2013:35). Digital Data Survey respondents form a solid 20% fraction of this community. When compared to the number of current Australian Archaeological Association subscriptions of 900 (Wallis et al., 2013:53), the respondents to the Survey represent some 10% of this community. While the AAA community likely includes students, non-practitioners and fans of archaeology in Australia and abroad, the absence of other data on the size of Australian archaeological community makes it a useful frame of reference. Overall, we can conclude that the Digital Data survey captured between 10-20% fraction of the archaeological community in Australia. This fraction is satisfying especially when we take into account the technological focus of the survey. Focus on information technology frequently has a self-selective effect, constraining the pool of respondents to those who care about this aspect of archaeology[2]. As such, the survey response has fulfilled our expectations and provides a view of the FAIMS project's initial target audience of technology-minded archaeologists.

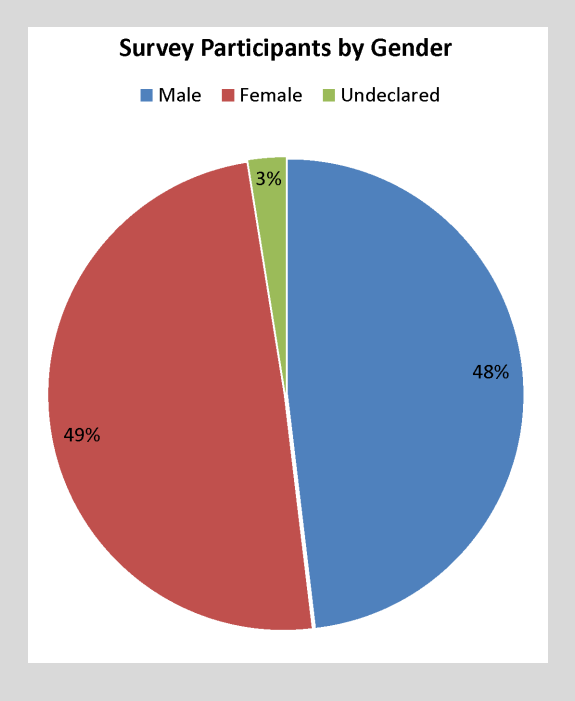

Figure 1 Participants by Gender

We would like to take this opportunity to again thank the participants for their time and effort. Presentation of the 79 Australian responses follows, while the survey questionnaire can be found in the appendix.

[2] A recent (October 2013) example from the UK shows low response rates to data management surveys: Higher Education Research Data Management Survey, a Loughborough University Research Data Management Project collected 38 responses after a month of online promotion. Martin Hamilton has written a blog post (http://goo.gl/VAaf8U) describing the results.

3 Profile of Respondents

The demographic composition of the FAIMS survey sample tested in questions 1-5 has turned out to be fairly consistent with the profile of the Australian archaeological community presented by Ulm, Nichols and Dalley (2005 and 2013).

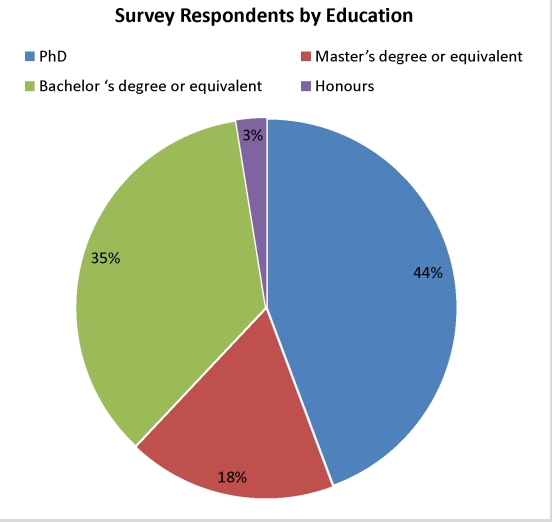

Figure 2 Participants by Education

Men and women are almost equally represented in the survey, with a ratio of 49:48 (with two participants abstaining from gender declaration). In terms of geography, most Australian states were represented in the survey; only the Northern territory and ACT failed to produce any respondents. 14 participants did not declare state of origin, which leaves a large margin of error for any geographic analysis.

When assessing education, the methodology in the survey was admittedly flawed. The list of options included only Bachelor's, Master's, and Ph.D. degrees. We had omitted Honours, which some of the respondents additionally filled in. Overall, 37% of participants declared a Bachelor's degree or equivalent, 3% Honours (volunteered), 17% Master's degree and 43% PhD. The final results, acknowledging the under-representation of Honours graduates (who likely selected "Bachelor's degree"), is not dissimilar from the qualifications reported in Ulm, Nichols and Dalley (2005:16, fig.7), who report Honours degrees and PhDs as the most frequent highest qualifications among Australian archaeologists.

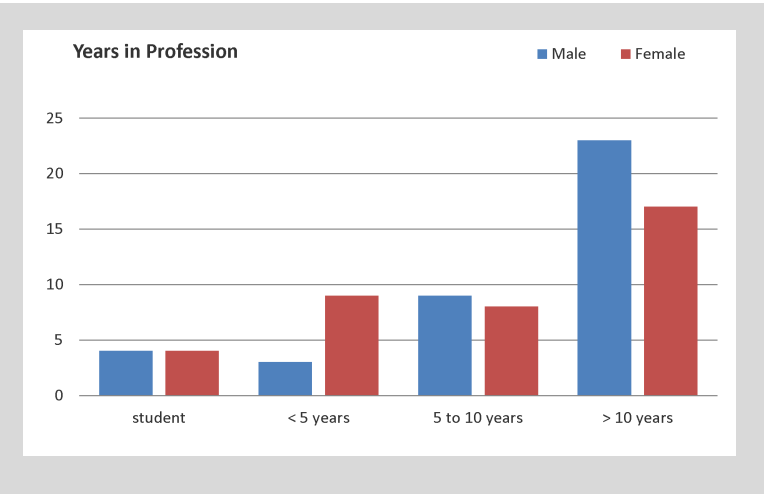

Figure 3 Years in Profession

The time spent working in the archaeological profession (rather than age) was considered an important factor to assess the proportion of senior and decision-making respondents versus younger practitioners. We broke the time in the profession in three groups: less than five years, five to 10 years, and over 10 years. Our sample favoured more experienced archaeological practitioners, with 55% having spent over 10 years in the profession, 21% in the profession between 5 and 10 years, 15% in the profession for less than 5 years, while only 9% of the sample comprised students of archaeology. The higher ratio of experienced professionals to junior practitioners and students has implications on two important aspects that FAIMS project is interested in: awareness of issues of data management (which should be higher with more

experienced population) and digital literacy and familiarity with recent hardware and software (which is likely going to be lower in a more senior population).

When asked about primary workplace, 41% of respondents classified themselves as primarily academic and 37% as consulting archaeologists. After these two large groups all other workplaces were less well represented in the survey: government archaeologists occupied a fraction of 4%, museum employees 3% and students comprised 8%. Only 3% of respondents identified themselves as straddling the private and academic sector. The prevalence of academic over private sector employees differs from Ulm, Nichols and Dalley (2005).

In their survey of Australian archaeology in profile 25% of archaeologists were employed in academia and 48% in the private sector (2005:14). The high ratio of academic respondents to Digital Data survey may be the result of our limited address list (which included many consulting archaeologists, but overrepresented those based at universities), or access limitations on part of the consulting archaeologists, who frequently work in remote locations[3]. Our response rate is consistent with the Strategies for Digital Data survey, organized by the Archaeology Data Service in the UK, where "the worst response rates were from field archaeology units, the best from national bodies" (Condron et al., 1999).

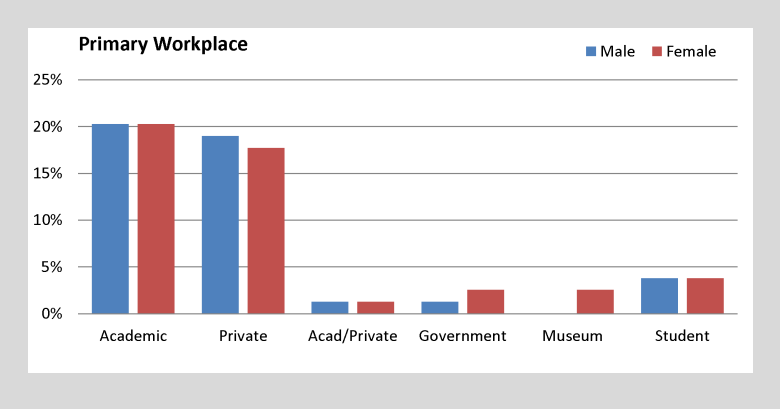

Figure 4 Workplace

In summary, the survey population provided us with a well-educated sample of prevalently senior practitioners, who may be conservative and out-of-date in their use of digital technology, yet have the experienced to grasp the significance of data management, data sharing and dissemination. This group is the closest we can get to a group of early adopters, as no matter what their digital competence may be, their self-selection marks them as a group most concerned about the digital future of archaeology.

4 Current Digital Practices among Archaeologists

Given the purpose of the FAIMS project to develop a suite of applications for archaeologists, we surveyed their current use of digital technologies in order to assess adoption rates for new digital tools. We asked a series of questions mapping various aspects of digital practices. The questions included the self-assessment of digital skills and literacy, survey of software and hardware platforms in use, common digital recording practices at current projects, and the use of different media during archaeological data collection, analysis and processing.

[3] http://ads.ahds.ac.uk/project/strategies/4.html#4.2

4.1 Digital literacy and competence self-assessment

In questions 13 and 14 we asked the respondents to rate their digital literacy. A majority of respondents (45.6%) rated their digital literacy as "average". The next largest group (36.7%) claimed "above average" digital skills, while 11.4% asserted "expert" competence in digital technologies. Only 6.3% reported "below average" competence in the use of digital technologies. As the terms "average" and "expert" can be highly subjective without a frame of reference we asked respondents to further characterize their digital skills and provided a range of descriptive scenarios (see Table 1 below). 19% of respondents reported the use of simple software (Office), 50.6% characterized themselves as competent users of more complex software (GIS and databases) and 17.7% reported database building skills. Some 12.7% claimed scripting and programming skills. These characterizations align well with the subjective ratings, matching expert status to scripting and programming. The characterizations further show that the "average" assessment of skills overlaps substantially with the statement: "I can competently use basic Office software".

Rate your digital competence		Characterize your digital skills	
Below Average	6.3%	I can competently use basic office software	19.0%
Average	45.6%	I can use more complex software (database and GIS software)	50.6%
Above Average	36.7%	I can build databases	17.7%
Excellent - Expert	11.4%	I can do basic scripting	7.6%
		I am a programmer	5.1%
	100%		100.0%

Table 1 Digital skills and competence

Overall, more than 90% of the respondents reported average or better competence with digital technologies, and 80% of respondents characterized themselves as users of more complex software. While some of these self-assessments may be subjective and result of sample bias to tech-savvy respondents, their value lies in reporting positive attitude to technology. These results defy the assumption of lower technological expertise based on the demographic profile in the previous section. Our initial scepticism appears to have been unfounded. The responses give us hope as they reveal a sizeable group of potential users of the FAIMS infrastructure, who see themselves on the left half of Rogers's bell curve as "innovators", "early adopters", or "early majority" with regard to the use of technology(Xxxxxxxxxx, 0000). Such a technological self-assessment supports the idea that a receptive initial target audience for FAIMS applications exists in Australia.

4.2 Software Platforms Used by Archaeologists

The ease with which archaeologists may adopt a new digital tool partially relies on their current use of specific operating systems and hardware devices[4]. The use of a specific platform provides an indication of user expectations (in terms of software design, intuitiveness, commercialization, etc.)

[4] For a detailed, if a bit out-dated, breakdown of the use of software in archaeology see Condron et al. (1999), section 8.3 "Software used to create digital datasets".

and the variety of tools used to create archaeological data. Questions 7-8 explored what platforms respondents currently use.

All (100%) respondents reported using a desktop or laptop computer for their archaeological work. A majority use Windows (69%), followed by Mac (20%), with the remainder using a combination of commercial and open source operating systems (11%). No one reported the exclusive use of an open source operating system (e.g., Linux). When asked about the deployment of mobile devices for archaeological fieldwork, 68% of respondents reported the use of some mobile device. A balanced variety of mobile operating systems were reported, starting with iOS (23%), Windows (16%), Android (14%), or a combination (15%) of the above. In short, the respondents seem well used to Windows (and Microsoft products) as well as Mac desktop environments, but less familiar with open source desktop applications. A wide variety of mobile environments is currently in use, offering equal chances of success (with appropriate training and support) to the FAIMS development for Android.

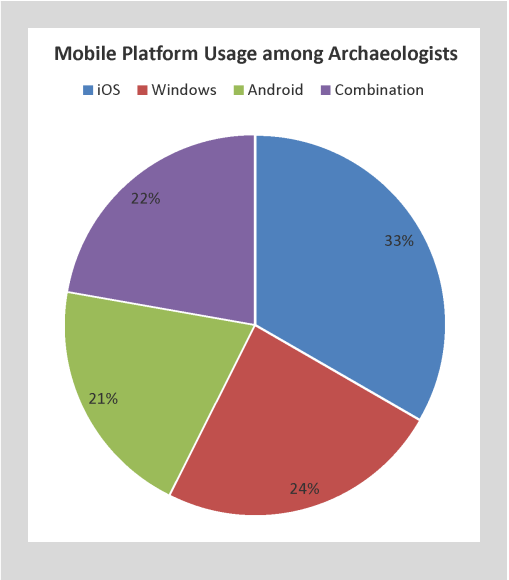

Figure 5 Platform

4.3 Recording Practices and Programs Commonly Used by Archaeologists

The knowledge of specific recording practices and programs currently used by archaeologists forms an important part of stocktaking before the design of a generalized tool for the creation and sharing of digital data. Questions 6 and 9-12 asked for details of the media and programmes used to create or process digital datasets. Table 2 lists four to five most popular packages for each category of recording.

Specifically, respondents were asked what spreadsheets, databases, and Geographic Information Systems (GIS) they used for their data. Spreadsheets proved almost universal, with 98% of respondents reporting their use. Spreadsheet users overwhelmingly favour MS Excel (98%). The remaining 2% of respondent use open source software (e.g., Open Office Calc or Google Spreadsheet) or Numbers (an iOS spreadsheet). Databases are also widely deployed by respondents (87%), the majority of whom use MS Access (67%, including 54% using it alone and 13% in combination with spreadsheets), followed by Filemaker (19%), open source databases like MySQL (10%), and ArcGIS geodatabases (4%). GIS constitutes the third most widely used class of software, deployed by 80% of respondents, amongst whom ESRI ArcGIS remains the most popular (65%), with the remainder using MapInfo (15%), open source GIS software (8%), Manifold (6%), and a combination of commercial and open source GIS (6%).

Majority of respondents use Microsoft products for cataloguing or reporting their data, while ESRI products appear most popular for spatial data processing. Open source or iOS products are in minority. The overwhelming preference for Microsoft is consistent with the ADS survey results from 1998. Overall, our survey population exhibits less diversity in software used that ADS sample did, a trend that is consistent with global convergence on few major platforms in the last decade. There is a different trend in cataloguing data in MS Excel (98%) among Australian respondents rather than MS Access (55%), which is reversed in the UK.

What emerges clearly is that the respondents capture a wide variety of data (textual, tabular, media, spatial) in a range of programmes and FAIMS needs to be able to support and archive these types of datasets and accommodate their collection in the mobile platform.

Spreadsheets		Database		GIS	
None	2.5%	None	12.7%	None	19.0%
MS Excel	94.9%	MS Access	46.8%	ArcGIS	51.9%
numbers	1.3%	Filemaker	16.5%	MapInfo	12.7%
OSS	1.3%	MS Access combined with others (Lotus, Filemaker, etc.)	11.4%	OSS	6.3%
		OSS	11.4%	Manifold	5.1%
		GeoDB	1.3%	Combination of the Above	5.1%

Table 2 Commonly Used Programmes for Digital Data Processing

4.4 The Persistence of Paper Recording in Primary Data Collection

Despite the above-reported ubiquity of computers and widespread use of mobile devices, 84% of respondents to Question 6 reported that they 'frequently' or 'most frequently' use paper forms and journals as their primary recording medium for raw data. Laptop and desktop are used by 70% respondents for data. Only 10% of the respondents claim to have shaken off the use paper and pencil.

The answers to the question of primary data collection medium demonstrate that paper remains the principal recording medium in Australian archaeology. While majority of archaeologists own a mobile device, only some 10-15% use it with any frequency for primary data recording. Furthermore, there is a significant overlap in the use of paper (84%) and desktop/laptop (70%) for primary data recording. This overlap suggests that many people enter their data twice, first on paper and second on a desktop. The amount of double-entry of primary data among our IT-savvy survey respondents is remarkable. It points out a major bottleneck in the daily workflow of archaeological data collection during which information collected in the field needs to be transcribed into the appropriate spreadsheet or database on the computer in the base or office. Studies in data management have pointed out that the investments into digitizing and streamlining primary data often equal or exceed the cost of data collection. The extent of primary recording on paper indicates a major overhead on the production of compatible and consistent digital data.

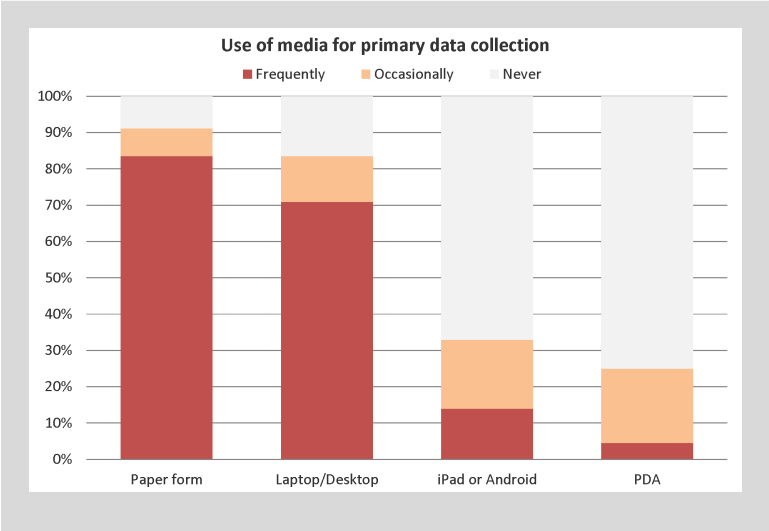

Figure 6 Collecting

The descriptions of the current recording practices and reliance on different media among Australian archaeologists demonstrate the need for a mobile recording platform in Australian archaeology. First of all, most respondents already have a mobile device and are familiar with its use, whether for personal or job-related purposes. Second, majority of respondents use digital applications and processing software for data analysis, archiving or submission, creating an urgent need for digital-born data. Finally, the amount double-entry present in the recording of primary data (and the subsequent need for data transcription and cleaning) indicates a major bottleneck in the workflow of archaeologists and a roadblock to the automatic production of compatible datasets. Altogether these findings indicate there is a sizable niche for the use of a mobile application in Australian archaeology.

5 Adoption of New Digital Technologies among Archaeologists

A number of scholars in Australia have explored the links in the ways archaeologists learn, do research and practice their profession (Wallis et al., 2013, Colley, 2003,2004 and Frankel, 1980). The discussion of the gaps in the training provided by universities and skill sets required by private sector has continued incessantly since early 2000's (Cosgrove et al., 2013 and Colley, 2004). The concern is not negligible, as gaps in the skillsets can negatively impact the profession and, in case of technical skills, form also a major obstacle to the adoption of new digital tools. Professional and practical skills, especially computer literacy and GIS, rank among top three "most valuable" non-archaeology specific skills in the most recent "Working profile" survey (Ulm et al., 2013:40-41, Tables 3, 4 and 5). Meeting the demand for these technical skills is a major challenge for the educators (Colley, 2004:192). Missing technical skills, however, can be successfully redressed by a training programme and support. In order to properly design the FAIMS training programme we asked our respondents about their preferred learning and communication styles.

Question 15 asked: "How do you learn to work with new digital tools and technologies?" and offered the survey participants a grid of options to choose from. We received the following answers: 8% respondents frequently engage in formal online training, ca. 42% frequently engage in formal in-person training, 62% frequently use online forums and blogs, 72% use self-directed online learning, 81% use manuals, and 87% frequently seek assistance from colleagues (note that respondents could select more than one answer). Responses to this question show that majority of our respondents acquire skills and knowledge independently, through the perusal of online tutorials or manuals. Their answers suggest that a well written set of documentation - manuals or online resources – should ensure good adoption of FAIMS tools.

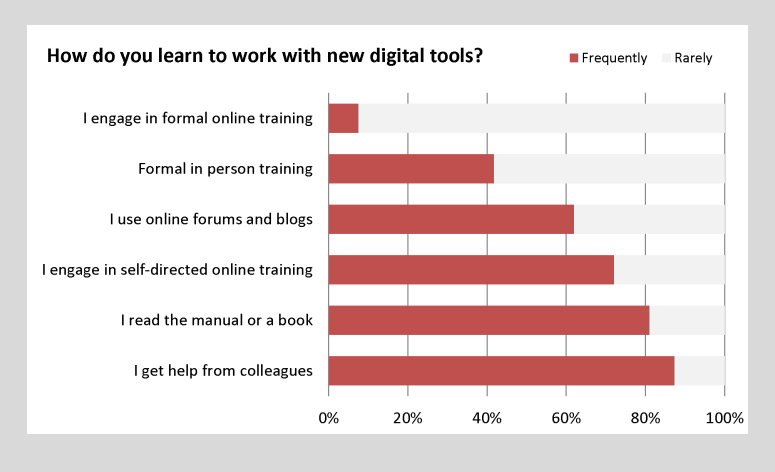

Figure 7 Training

However, next to the use of manuals and self-directed online learning, nearly 90% of archaeologists seek advice from their colleagues when dealing with new tools and technologies. This answer basically

indicates a preference for an in-person informal instruction. If we apply this preference into our future training package, it means that we cannot just rely on online documentation. We also need to include hands-on training via a series of workshops and training courses, that will be conducted in person and provide a safe and secure learning environment.

5.1 Challenges to the Adoption of Digital Technologies

In question 18 we asked the respondents what they perceived as the major obstacles to more widespread use of the digital medium in archaeology. Figure 8 illustrates the results. In informal discussions, mistrust of the medium (malfunction or data loss) often overrides other concerns. In the ranking exercise, however, mistrust was listed as the smallest obstacle to the use of digital media. The single biggest obstacle to the use of digital technology was the cost of hardware and software. Over 80% respondents agreed to the costs as the biggest deterrent in the adoption of digital media. The limitations of the software, the steep learning curve and constant change in the technology were well behind the cost factor, although they preoccupy 60% of the survey respondents.

In order to learn more about reasons that may be hindering adoption of digital tools in archaeology, we asked: "What other challenges or shortcomings inhibit your use of digital technology?" (Question 19) This question was a free text answer and we received a wide array of responses that fell into the following four categories:

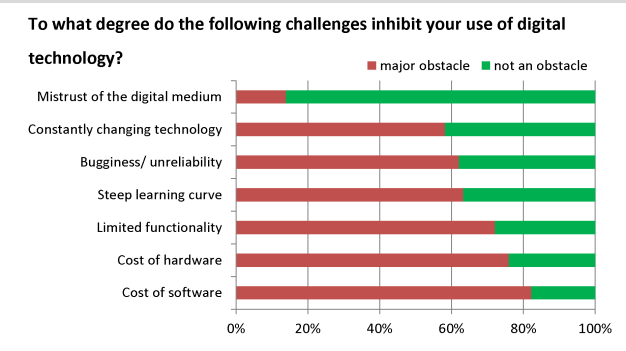

Figure 8 Challenges

Challenges to the use of digital tools:

1. unfriendly attitude to digital technology in the workplace (no support from colleagues to put limited budget in particular direction)
2. fear of data loss/hardware malfunction/battery life limitations/reliance on internet
3. lack of training, low accessibility of training
4. concern over the sustainability of digital medium (maintenance costs, etc. paper is cheap..)
5. lack of compatibility with other tools

Some of these responses refer to technical limitations (2) that are being overcome as we speak thanks to the competition in the digital market[5]. Other challenges (5) are product of ill-defined initial requirements. Many tools have been created as ad-hoc solutions to a particular problem and not designed to function as a part of particular ecosystem of tools. Supporting initiatives that place emphasis on interoperability is perhaps the best first step towards eliminating this challenge.

[5] Hardware improvements come with each new device release. The openness of the Android platform has made the software design open to any individual interested in learning this new system and increased the chances of compatible software customized to client's needs. The FAIMS app is being designed with a service call function by which any other app on the phone can be used and its product linked to a given record. Such calls build on pre-existing code and design, and make the FAIMS app fuller all around without reinventing the wheel.

Lack of training or low accessibility of training (3) is a statement that requires more analysis, especially with regard to the learning strategies explored above. Very few developers offer in person training, and very few archaeologists can read developer documentation. The expectations of training need to be explicitly articulated in order to be addressed.

Finally, hostile attitude to digital technology (1) and problems with the sustainability of digital medium (4) are critical concerns that reach beyond the scope of the FAIMS project.

Workplace attitudes can be fixed only gradually with a change in archaeological culture. Such a change can be started with a dedicated outreach and education programme at the community level. It will require a clear demonstration of the benefits of digital tools, especially in time savings, automated data submission and sharing capabilities.

As for sustainability, the FAIMS project is aiming to alleviate this concern by building sustainability into the design of its components. Firstly, we are attempting to boost our sustainability by using open source code base. Open source movement injects an element of renewal and synergy into the system, as every good piece of code can be reworked and reused, stimulating a cycle of constant improvement. Secondly, we are reusing existing tools wherever possible (Heurist, tDAR). Existing tools have the benefit of having a community of users and testers whose engagement forms part of the sustenance.

5.2 Incentives Driving the Adoption of New Tools

The way to get new digital tools and products adopted by a community is by properly responding to an existing need or scarcity. If users can see a benefit to a new tool, they are more likely to use it. In questions 16 and 17 we asked what tools archaeologists thought they needed. Question 21 asked what benefits archaeologists would expect of new tools. In questions 20-22 and 24 we presented a range of possible products and asked our respondents how interested they would be in each of them.

Answering to questions 16 and 17, the respondents outlined the three most desired sets of new tools as: laptop and desktop application for data entry which are wanted by 92% of respondents, followed by data analysis tools wanted by 91% of respondents and mobile device applications for field collection wanted by 87% respondents. On the bottom of the scale among the least desirable tools was the ontology and vocabulary generating tool (mere 48%). Tools facilitating online publication of data (81%) are closely behind the three most wanted ones, while tools for automatic submission of data to online registries (71%) and mobile apps for analytical work (69%) show a more marked drop in interest.

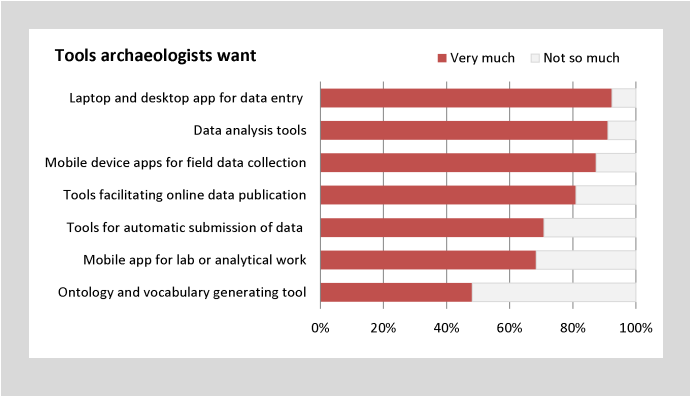

Figure 9 Tools Wanted

All in all, archaeologists report some interest in all of the suggested new tools, demonstrating an appetite for new products and dissatisfaction with current offerings. There is markedly less interest in

tools for the final stages of research such as automating publication and data transfer. The tools for initial stages of research such as data collection and data entry enjoy the highest popularity. While one may consider this result strongly biased towards the exciting parts of research (data collection) it is also an indicator of an area of the greatest need. Only after archaeologists adopt a digital workflow for the initial data collection and processing will they also start needing digital tools for publication. Providing more tools in the data collection sphere, therefore, seems a reasonable start.

Following up on the same topic of "what tools do you need", we repeated the question in slightly modified form: "which of the following services would you be willing to pay for?" (Question 24) The respondents were asked to rank four sets of tools according to their preference. These sets of tools were: desktop data collection tools, mobile data collection tools, visualisation and analytical tools and publication tools.

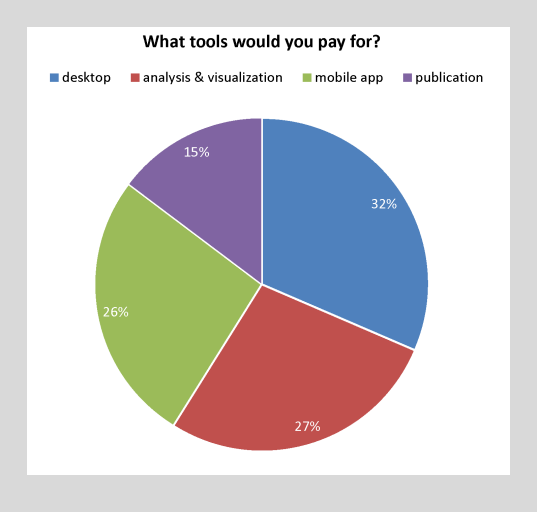

Figure 10 Payment Optionss

Desktop applications, visualisation and analytical tools and mobile data collection tools each were perceived with nearly equal importance among the respondents, each carrying about a third of the popular vote. Publication tools were liked only by a minority 15% of participants. The responses were identical to the results of question 16 and 17 and are well covered by the discussion above. Benefits that the respondents associated with the use of these digital tools were articulated in the answers to the following question.

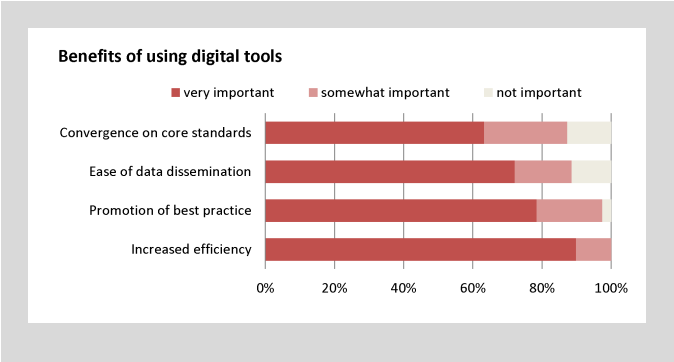

Figure 11 Benefits

A majority of respondents recognize that there are major benefits to the use of digital tools in all areas listed in the survey (Question 21). 90% of respondents see the principal benefit of having a digital workflow in the increase of the overall efficiency of their archaeological work. Over 60% of respondents recognize that there are important secondary benefits to having a digital workflow such as gradual convergence on core standards, ease of data dissemination and the promotion of best practices. A number of respondents added free-text comments with other expected benefits that a digital workflow would eventually produce (Question 22):

1. automated transfer of data, integration with databases,
2. elimination of double-entry and reduction of error,
3. increased accuracy and consistency,
4. data documentation (metadata),
5. decreased costs of work, increased productivity

6. instant visualization,
7. faster analysis,
8. better long-term preservation, data discoverability, more data recorded in searchable format

The majority of these loosely fall in the 'increased efficiency' category and comprise short- and long-term goals of the FAIMS project.

Question 20, the last question in the section dealing with new tool adoption, touched on licensing preferences. Archaeologists showed relatively little concern for the type of software licensing: majority of respondents (45%) stated they don't care how the tools are developed. 42% asked for open source licensing of the software. 13% asked for commercial licensing. The responses of half of the respondents suggest that there is considerable a lack of awareness among archaeologists of the difference between open source and commercial development. Given that this awareness impinges on the sustainability of the developed tools, it would be worthwhile to learn what these licensing schemes mean to our respondents.

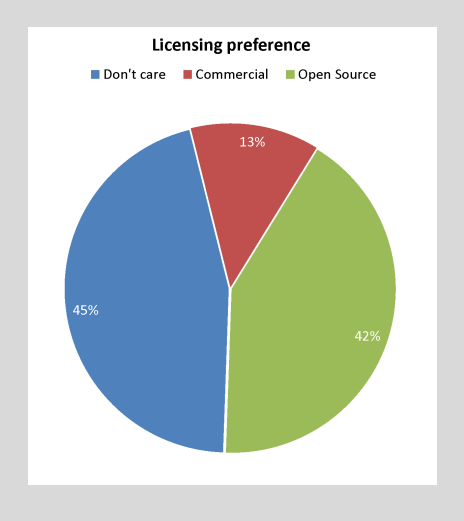

Figure 12 License

5.3 Data Sharing and Publication

Data sharing and publication eventually become a concern for every practising archaeologist. The need to share results can easily drive entire archaeological workflows and may provide strong incentive to adopting digital tools. The needs arise either in the context of regulatory requirement for a digital data submission (e.g. requirement for Data Management Plan is starting to accompany major grant applications), or from the context of work were members of team need access to the same dataset remotely. Finally, many a director may wish to give his or her dataset high profile and make it available for reuse by other scholars. The emergence of electronic journals (JOAD, PLoS) and platforms such as ADS, tDAR and Open Context now provide end points for reports and datasets. The cost and effort associated with publishing in these platforms, however, provides a prime incentive for archaeologists to adopt tools that would produce digital data immediately in the field. Archaeologists who plan to publish digitally, therefore, should have high motivation to use digital data collection tools. Fuelled by this rationale, we enquired what the current publication practice was among our community with regard to both final reports and primary data. Were Australian archaeologists aware of digital publication platforms and have they started publishing their work digitally?

When we asked: "Where do you publish your final reports?" (Question 25), 23% of respondents responded they published their reports online, and the remaining 77% publishing elsewhere (in paper). Out of the 23% of online-publishing respondents several specified the venue in textbox offered by Question 26. The platforms ranged from a corporate website, academia.edu, peer-reviewed online journal to a dedicated university online service.

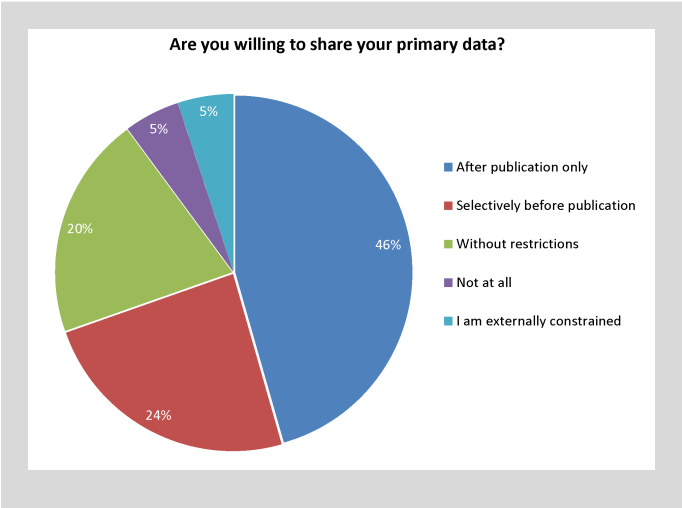

Figure 13 Sharing

When asked about primary data: "Do you publish your data online or digitally?" (Question 27), the percentages dropped yet lower. Only 19% of all respondents (one fifth) publish their primary data online. Most of them use the project website for this purpose and a few use dedicated university resources or open access journals (see Question 28). When asked whether they had heard of any of the following online services - Open Context, ADS, Heurist or tDAR (Question 29) - 70% of the respondents reported knowing at least one of them. 30% of respondents did not recognize any of the online services listed.

Question 30 asked about primary data sharing: "Which best captures your attitude to sharing your primary dataset pending ethical clearance?" 20% of respondents are willing to share even before publishing the data, 46% are willing to share after they have published their work and a quarter of respondents (24%) prefer to select whom they share their data with. Relatively few respondents (5%) are entirely averse to data sharing, or behind a sharing wall imposed by their employer (5%). All in all, the answers bode well for primary data sharing, as 90% of respondents are open to sharing primary data prior to publication under specific conditions.

According to the survey results, the respondents are quite willing to share and publish their data online, at least in theory. In practise, only one fifth of them publish their data online at the moment. It is obvious that besides having the available tools for online publication, there are too few incentives for both academics and consultants to pursue this activity at a larger scale.

While ADS has started promoting online publication of reports as regulatory requirement and best practice for consulting archaeologists, academics are more likely to respond to the incentive of academic credit. When asked "Would you agree that peer reviewed publication/sharing of data online should be given research credit or professional acknowledgement as a publication?"(Question 31), the response was overwhelmingly favourable. 86% of survey respondents agree with the idea of allocating credit, e.g., through the Higher Education Research Data Collection (HERDC) system, for the publication of substantial, peer-reviewed primary datasets. Only 14% oppose this idea. Taken together, the answers to questions about data sharing and publication indicate significant support for the overarching goal of the FAIMS project - to produce and disseminate high-quality, compatible, and reusable online datasets - as well as specific initiatives such as investment in an Australian data repository.

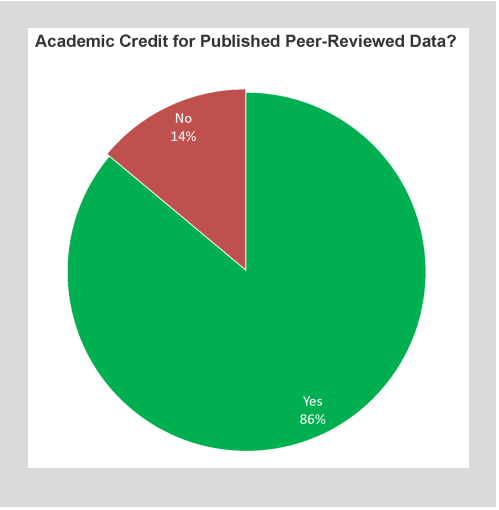

Figure 14 Credit

6 Sustainability

Sustainability is a core concern for every infrastructure project and this becomes doubly true for digital projects in archaeology, a field struggling with limited grant budgets (Kansa et al., 2013). While many may wish to share and disseminate data digitally, few are aware of the efforts, costs and vulnerabilities involved in the sustained maintenance of digital systems (McGowan, 2009). In our search for the right model, we asked our community "What is the best strategy for the sustainability of the digital tools"? (Question 23) As the FAIMS project is building digital tools that address different stages of archaeological data lifecycle we offered a variety of options, ranging for paying for customization of a tool, paying a one-time user fee for a tool or paying for data ingest and publication.

Most respondents (81%) were happy to pay to have their tools customized to their needs. A large portion of respondents wanted to see the costs of sustainability distributed and funded through institutions (75%) and grant schemes (65%). Only 50% were willing to accept a charge for the use of the applications and 38% found it acceptable to be charged for data publication and curation. This breakdown is partially consistent with the greater need for data collection tools as opposed to tools for data publication, expressed in responses to Question 24 above. The low tolerance for curation and publication fees indicates that there is a lack of understanding among our respondents of the issues and costs associated with long-term archiving, curation and management of archaeological data.

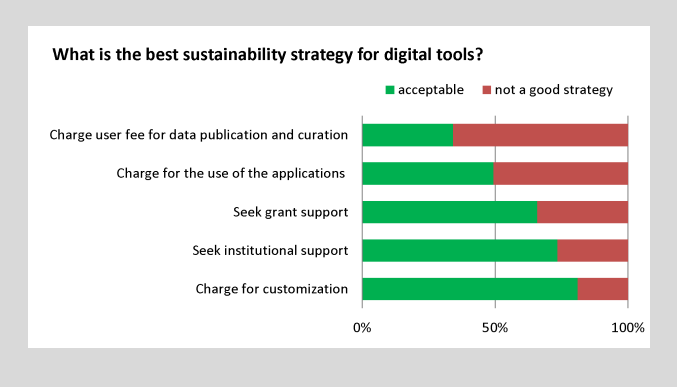

Figure 15 Sustainability

The sustainability preferences embraced by our community resonate with the leadership of the FAIMS project. At the moment of publication of this report, the ARC LIEF grant has secured basic functioning of the FAIMS project for 2014-2015, which will ease some of the sustainability concerns and allow us to deploy and improve the infrastructure. In terms of long-term sustainability, the current plan of the FAIMS project is to provide the mobile application for free, with extensive documentation provided to those who have time to spend on their own customization of the recording modules and templates. For those who do not have the time, the project will offer customization services for pay. The data editing space (Heurist) will incur user fees, and the FAIMS Repository will charge modest ingest fees for any submitted datasets.

7 Digital Data Survey Summary

The Digital Data Survey provides an overview of the use of digital tools and technologies among Australian archaeological community. The profile of the survey population is broad ranging but equally balanced with ratios between genders and disciplines approximating that of profiling surveys of the Australian Association of Archaeology. In terms of expertise, the survey attracted a lot of senior practitioners (practising for more than 10 years). These participants can be seen as having greater

awareness of the issues involved in archaeological data management given their experience. In both demographic sense and by self-selection for the survey, the respondents represent a body of potential early adopters, stakeholders who are most likely to pick up and apply the newly developed tools to address problems in their practice.

The survey results show a few paradoxes. While many respondents consider themselves to be technologically fairly proficient, the most common recording medium is paper or an excel sheet at the best. The self-perception of proficiency can be connected at the technical level to the use of GIS software, which is quite extensive among the respondents. At the social level, it expresses a positive attitude towards technology, a symptom of an early adopter.

There is a great appetite for new tools for digital data collection and data analysis among the respondents, and slightly less interest in data storage, transfer or publication. This imbalance is partially produced by different priorities among user groups at different stages of their career and partially caused by the mechanics of a digital workflow, where data collection precedes the publication.

Frustrations with low efficiency of paper workflows, incompatibility between existing tools or their high cost and technical limitations of hardware combine to fuel the desire for new, better performing and sophisticated tools. The order stands tall as the respondents provide long list of concerns they want addressed - mature tools capable of complex functionality with extensive customization options that would have human interface (ie. require no coding skills). This is hardly a task that can be accomplished within one year, although it is a challenge that the FAIMS project will try to respond to.

Overall, the respondents are highly enthusiastic about data sharing. They embrace digital publication and are ready to lobby for a system rewarding competent dataset publication. Sustainability remains a major concern, and while many respondents prefer to shift the responsibility to the institutional levels, many are equally willing to contribute their share and pay for tool customization.

8 Conclusions

The Digital Data survey was conceived as an initial and an extensive stocktaking exercise involving FAIMS stakeholders and the broader archaeological community. We invested considerable effort into our stocktaking efforts, and fundamentally revised our project in light of these activities, because we wished to avoid the problems that have undermined other information technology infrastructure projects.

The archaeological information management needs, as expressed through this survey, have been combined with the priorities of the initial FAIMS proposal, NeCTAR requirements, technical, time, and financial constraints, contemporary trends in software development, and the existing landscape of resources available to archaeologists to produce a software development plan for the FAIMS infrastructure. Taken together, these factors have produced a plan that responds to archaeologists' priorities, but does not mirror them exactly.

Given the great amount of expectations of a data collecting tool, we decided to develop a generic solution to digital data collection rather than a static datalogger. Our mobile application accommodates structured data, spatial data and multimedia recording and is amenable to customization. In

November 2013 about 75% the customization process can be done by the archaeologist him-/herself, while 25% of the process requires developer-level skills. For data processing we have customized Heurist, a graph database developed by the University of Sydney, which syncs seamlessly with the mobile application. For data storage we have contributed to the Australian implementation of tDAR, which is now at the basis of FAIMS Repository. All of these components will be ready for use in 2014. The continued existence of the FAIMS project, guaranteed by the award of the ARC LIEF grant makes it possible for us to provide assistance to the first projects that deploy these tools and thus start closing the gap between existing skills and those required for the use of the FAIMS infrastructure.

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