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1.4. DIY Digital Workflows on the Athienou Archaeological Project, Cyprus

Jody Michael Gordon

Wentworth Institute of Technology, gordonj7@wit.edu

Erin Walcek Averett

Creighton University, erinaverett@creighton.edu

Derek B. Counts

University of Wisconsin-Milwaukee, dbc@uwm.edu

Kyosung Koo

Davidson College, kykoo@davidson.edu

Michael K. Toumazou

Davidson College, mitoumazou@davidson.edu

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MOBILIZING *the* PAST *for a* DIGITAL FUTURE

The Potential of
Digital Archaeology



Edited by
Erin Walcek Averett
Jody Michael Gordon
Derek B. Counts

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FOR A
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Table of Contents

Preface & Acknowledgments	v
How to Use This Book	xi
Abbreviations	xiii
Introduction	
Mobile Computing in Archaeology: Exploring and Interpreting Current Practices <i>Jody Michael Gordon, Erin Walcek Averett, and Derek B. Counts</i>	1
Part 1: From Trowel to Tablet	
1.1. Why Paperless: Technology and Changes in Archaeological Practice, 1996–2016 <i>John Wallrodt</i>	33
1.2. Are We Ready for New (Digital) Ways to Record Archaeological Fieldwork? A Case Study from Pompeii <i>Steven J.R. Ellis</i>	51
1.3. Sangro Valley and the Five (Paperless) Seasons: Lessons on Building Effective Digital Recording Workflows for Archaeological Fieldwork <i>Christopher F. Motz</i>	77
1.4. DIY Digital Workflows on the Athienou Archaeological Project, Cyprus <i>Jody Michael Gordon, Erin Walcek Averett, Derek B. Counts, Kyosung Koo, and Michael K. Toumazou</i>	111
1.5. Enhancing Archaeological Data Collection and Student Learning with a Mobile Relational Database <i>Rebecca Bria and Kathryn E. DeTore</i>	143

1.6. Digital Archaeology in the Rural Andes: Problems and Prospects <i>Matthew Sayre</i>	183
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1.7. Digital Pompeii: Dissolving the Fieldwork-Library Research Divide <i>Eric E. Poehler</i>	201
---	-----

Part 2: From Dirt to Drones

2.1. Reflections on Custom Mobile App Development for Archaeological Data Collection <i>Samuel B. Fee</i>	221
---	-----

2.2. The Things We Can Do With Pictures: Image-Based Modeling and Archaeology <i>Brandon R. Olson</i>	237
---	-----

2.3. Beyond the Basemap: Multiscalar Survey through Aerial Photogrammetry in the Andes <i>Steven A. Wernke, Carla Hernández, Giancarlo Marcone, Gabriela Oré, Aurelio Rodríguez, and Abel Traslaviña</i>	251
--	-----

2.4. An ASV (Autonomous Surface Vehicle) for Archaeology: The Pladypos at Caesarea Maritima, Israel <i>Bridget Buxton, Jacob Sharvit, Dror Planer, Nikola Mišković, and John Hale</i>	279
---	-----

Part 3: From Stratigraphy to Systems

3.1. Cástulo in the 21st Century: A Test Site for a New Digital Information System <i>Marcelo Castro López, Francisco Arias de Haro, Libertad Serrano Lara, Ana L. Martínez Carrillo, Manuel Serrano Araque, and Justin St. P. Walsh</i>	319
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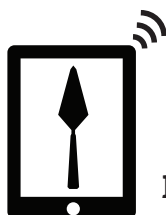
3.2. Measure Twice, Cut Once: Cooperative Deployment of a Generalized, Archaeology-Specific Field Data Collection System <i>Adela Sobotkova, Shawn A. Ross, Brian Ballsun-Stanton, Andrew Fairbairn, Jessica Thompson, and Parker VanValkenburgh</i>	337
3.3. CSS For Success? Some Thoughts on Adapting the Browser-Based Archaeological Recording Kit (ARK) for Mobile Recording <i>J. Andrew Dufton</i>	373
3.4. The Development of the <i>PaleoWay</i> : Digital Workflows in the Context of Archaeological Consulting <i>Matthew Spigelman, Ted Roberts, and Shawn Fehrenbach</i>	399

Part 4: From a Paper-based Past to a Paperless Future?

4.1. Slow Archaeology: Technology, Efficiency, and Archaeological Work <i>William Caraher</i>	421
4.2. Click Here to Save the Past <i>Eric C. Kansa</i>	443

Part 5: From Critique to Manifesto

5.1. Response: Living a Semi-digital Kinda Life <i>Morag M. Kersel</i>	475
5.2. Response: Mobilizing (Ourselves) for a Critical Digital Archaeology <i>Adam Rabinowitz</i>	493
Author Biographies	521



Preface & Acknowledgments

This volume stems from the workshop, “Mobilizing the Past for a Digital Future: the Future of Digital Archaeology,” funded by a National Endowment for the Humanities Digital Humanities Start-Up grant (#HD-51851-14), which took place 27-28 February 2015 at Wentworth Institute of Technology in Boston (<http://uwm.edu/mobilizing-the-past/>). The workshop, organized by this volume’s editors, was largely spurred by our own attempts with developing a digital archaeological workflow using mobile tablet computers on the Athienou Archaeological Project (<http://aap.toumazou.org>; Gordon *et al.*, Ch. 1.4) and our concern for what the future of a mobile and digital archaeology might be. Our initial experiments were exciting, challenging, and rewarding; yet, we were also frustrated by the lack of intra-disciplinary discourse between projects utilizing digital approaches to facilitate archaeological data recording and processing.

Based on our experiences, we decided to initiate a dialogue that could inform our own work and be of use to other projects struggling with similar challenges. Hence, the “Mobilizing the Past” workshop concept was born and a range of digital archaeologists, working in private and academic settings in both Old World and New World archaeology, were invited to participate. In addition, a livestream of the workshop allowed the active participation on Twitter from over 21 countries, including 31 US states (@MobileArc15, #MobileArc).¹

¹ For commentary produced by the social media followers for this event, see: <https://twitter.com/electricarchaeo/status/571866193667047424>, <http://shawngraham.github.io/exercise/mobilearcday1wordcloud.html>, <https://twitter.com/electricarchaeo/status/571867092091338752>, <http://www.diachronicdesign.com/blog/2015/02/28/15-mobilizing-the-past-for-the-digital-future-conference-day-1-roundup/>.

Although the workshop was initially aimed at processes of archaeological data recording in the field, it soon became clear that these practices were entangled with larger digital archaeological systems and even socio-economic and ethical concerns. Thus, the final workshop's discursive purview expanded beyond the use of mobile devices in the field to embrace a range of issues currently affecting digital archaeology, which we define as the use of computerized, and especially internet-compatible and portable, tools and systems aimed at facilitating the documentation and interpretation of material culture as well as its publication and dissemination. In total, the workshop included 21 presentations organized into five sessions (see program, <http://mobilizingthepast.mukurtu.net/digital-heritage/mobilizing-past-conference-program>), including a keynote lecture by John Wallrodt on the state of the field, "Why paperless?: Digital Technology and Archaeology," and a plenary lecture by Bernard Frischer, "The Ara Pacis and Montecitorio Obelisk of Augustus: A Simpirical Investigation," which explored how digital data can be transformed into virtual archaeological landscapes.

The session themes were specifically devised to explore how archaeological data was digitally collected, processed, and analyzed as it moved from the trench to the lab to the digital repository. The first session, "App/Database Development and Use for Mobile Computing in Archaeology," included papers primarily focused on software for field recording and spatial visualization. The second session, "Mobile Computing in the Field," assembled a range of presenters whose projects had actively utilized mobile computing devices (such as Apple iPads) for archaeological data recording and was concerned with shedding light on their utility within a range of fieldwork situations. The third session, "Systems for Archaeological Data Management," offered presentations on several types of archaeological workflows that marshal born-digital data from the field to publication, including fully bespoke paperless systems, do-it-yourself ("DIY") paperless systems, and hybrid digital-paper systems. The fourth and final session, "Pedagogy, Data Curation, and Reflection," mainly dealt with teaching digital methodologies and the use of digital repositories and linked open data to enhance field research. This session's final paper, William Caraher's "Toward a Slow Archaeology," however, noted digital archaeology's successes in terms of

time and money saved and the collection of more data, but also called for a more measured consideration of the significant changes that these technologies are having on how archaeologists engage with and interpret archaeological materials.

The workshop's overarching goal was to bring together leading practitioners of digital archaeology in order to discuss the use, creation, and implementation of mobile and digital, or so-called "paperless," archaeological data recording systems. Originally, we hoped to come up with a range of best practices for mobile computing in the field – a manual of sorts – that could be used by newer projects interested in experimenting with digital methods, or even by established projects hoping to revise their digital workflows in order to increase their efficiency or, alternatively, reflect on their utility and ethical implications. Yet, what the workshop ultimately proved is that there are many ways to "do" digital archaeology, and that archaeology as a discipline is engaged in a process of discovering what digital archaeology should (and, perhaps, should not) be as we progress towards a future where all archaeologists, whether they like it or not, must engage with what Steven Ellis has called the "digital filter."

So, (un)fortunately, this volume is not a "how-to" manual. In the end, there seems to be no uniform way to "mobilize the past." Instead, this volume reprises the workshop's presentations—now revised and enriched based on the meeting's debates as well as the editorial and peer review processes—in order to provide archaeologists with an extremely rich, diverse, and reflexive overview of the process of defining what digital archaeology is and what it can and should perhaps be. It also provides two erudite response papers that together form a didactic manifesto aimed at outlining a possible future for digital archaeology that is critical, diverse, data-rich, efficient, open, and most importantly, ethical. If this volume, which we offer both expeditiously and freely, helps make this ethos a reality, we foresee a bright future for mobilizing the past.

* * *

No multifaceted academic endeavor like *Mobilizing the Past* can be realized without the support of a range of institutions and individ-

uals who believe in the organizers' plans and goals. Thus, we would like to thank the following institutions and individuals for their logistical, financial, and academic support in making both the workshop and this volume a reality. First and foremost, we extend our gratitude toward The National Endowment for the Humanities (NEH) for providing us with a Digital Humanities Start-Up Grant (#HD-51851-14), and especially to Jennifer Serventi and Perry Collins for their invaluable assistance through the application process and beyond. Without the financial support from this grant the workshop and this publication would not have been possible. We would also like to thank Susan Alcock (Special Counsel for Institutional Outreach and Engagement, University of Michigan) for supporting our grant application and workshop.

The workshop was graciously hosted by Wentworth Institute of Technology (Boston, MA). For help with hosting we would like to thank in particular Zorica Pantić (President), Russell Pinizzotto (Provost), Charlene Roy (Director of Business Services), Patrick Hafford (Dean, College of Arts and Sciences), Ronald Bernier (Chair, Humanities and Social Sciences), Charles Wiseman (Chair, Computer Science and Networking), Tristan Cary (Manager of User Services, Media Services), and Claudio Santiago (Utility Coordinator, Physical Plant).

Invaluable financial and logistical support was also generously provided by the Department of Fine and Performing Arts and Sponsored Programs Administration at Creighton University (Omaha, NE). In particular, we are grateful to Fred Hanna (Chair, Fine and Performing Arts) and J. Buresh (Program Manager, Fine and Performing Arts), and to Beth Herr (Director, Sponsored Programs Administration) and Barbara Bittner (Senior Communications Management, Sponsored Programs Administration) for assistance managing the NEH grant and more. Additional support was provided by The University of Wisconsin-Milwaukee; in particular, David Clark (Associate Dean, College of Letters and Science), and Kate Negri (Academic Department Assistant, Department of Art History). Further support was provided by Davidson College and, most importantly, we express our gratitude to Michael K. Toumazou (Director, Athienou Archaeological Project) for believing in and supporting our

research and for allowing us to integrate mobile devices and digital workflows in the field.

The workshop itself benefitted from the help of Kathryn Grossman (Massachusetts Institute of Technology) and Tate Paulette (Brown University) for on-site registration and much more. Special thanks goes to Daniel Coslett (University of Washington) for graphic design work for both the workshop materials and this volume. We would also like to thank Scott Moore (Indiana University of Pennsylvania) for managing our workshop social media presence and his support throughout this project from workshop to publication.

This publication was a pleasure to edit, thanks in no small part to Bill Caraher (Director and Publisher, The Digital Press at the University of North Dakota), who provided us with an outstanding collaborative publishing experience. We would also like to thank Jennifer Sacher (Managing Editor, INSTAP Academic Press) for her conscientious copyediting and Brandon Olson for his careful reading of the final proofs. Moreover, we sincerely appreciate the efforts of this volume's anonymous reviewers, who provided detailed, thought-provoking, and timely feedback on the papers; their insights greatly improved this publication. We are also grateful to Michael Ashley and his team at the Center for Digital Archaeology for their help setting up the accompanying Mobilizing the Past Mukurtu site and Kristin M. Woodward of the University of Wisconsin-Milwaukee Libraries for assistance with publishing and archiving this project through UWM Digital Commons. In addition, we are grateful to the volume's two respondents, Morag Kersel (DePaul University) and Adam Rabinowitz (University of Texas at Austin), who generated erudite responses to the chapters in the volume. Last but not least, we owe our gratitude to all of the presenters who attended the workshop in Boston, our audience from the Boston area, and our colleagues on Twitter (and most notably, Shawn Graham of Carlton University for his word clouds) who keenly "tuned in" via the workshop's livestream. Finally, we extend our warmest thanks to the contributors of this volume for their excellent and timely chapters. This volume, of course, would not have been possible without such excellent papers.

As this list of collaborators demonstrates, the discipline of archaeology and its digital future remains a vital area of interest for people who value the past's ability to inform the present, and who

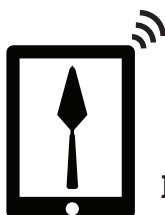
recognize our ethical responsibility to consider technology's role in contemporary society. For our part, we hope that the experiences and issues presented in this volume help to shape new intra-disciplinary and critical ways of mobilizing the past so that human knowledge can continue to develop ethically at the intersection of archaeology and technology.

Erin Walcek Averett (Department of Fine and Performing Arts and Classical and Near Eastern Studies, Creighton University)

Jody Michael Gordon (Department of Humanities and Social Sciences, Wentworth Institute of Technology)

Derek B. Counts (Department of Art History, University of Wisconsin-Milwaukee)

October 1, 2016



How To Use This Book

The Digital Press at the University of North Dakota is a collaborative press and *Mobilizing the Past for a Digital Future* is an open, collaborative project. The synergistic nature of this project manifests itself in the two links that appear in a box at the end of every chapter.

The first link directs the reader to a site dedicated to the book, which is powered and hosted by the Center for Digital Archaeology's (CoDA) Mukurtu.net. The Mukurtu application was designed to help indigenous communities share and manage their cultural heritage, but we have adapted it to share the digital heritage produced at the "Mobilizing the Past" workshop and during the course of making this book. Michael Ashley, the Director of Technology at CoDA, participated in the "Mobilizing the Past" workshop and facilitated our collaboration. The Mukurtu.net site (<https://mobilizingthepast.mukurtu.net>) has space dedicated to every chapter that includes a PDF of the chapter, a video of the paper presented at the workshop, and any supplemental material supplied by the authors. The QR code in the box directs readers to the same space and is designed to streamline the digital integration of the paper book.

The second link in the box provides open access to the individual chapter archived within University of Wisconsin-Milwaukee's installation of Digital Commons, where the entire volume can also be downloaded. Kristin M. Woodward (UWM Libraries) facilitated the creation of these pages and ensured that the book and individual chapters included proper metadata.

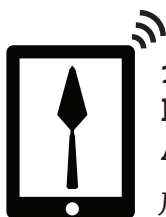
Our hope is that these collaborations, in addition to the open license under which this book is published, expose the book to a wider audience and provide a platform that ensures the continued availability of the digital complements and supplements to the text. Partnerships with CoDA and the University of Wisconsin-Milwaukee reflect the collaborative spirit of The Digital Press, this project, and digital archaeology in general.

Abbreviations

AAI	Alexandria Archive Institute
AAP	Athienou Archaeological Project
ABS	acrylonitrile butadiene styrene (plastic)
ADS	Archaeological Data Service
Alt-Acs	Alternative Academics
API	application programming interface
ARA	archaeological resource assessment
ARC	Australian Research Council
ARIS	adaptive resolution imaging sonar
ASV	autonomous surface vehicle
BLM	Bureau of Land Management
BLOB	Binary Large Object
BOR	Bureau of Reclamation
BYOD	bring your own device
CAD	computer-aided design
CDL	California Digital Library
CHDK	Canon Hack Development Kit
cm	centimeter/s
CMOS	complementary metal-oxide semiconductor
CoDA	Center for Digital Archaeology
COLLADA	COLLABorative Design Activity
CRM	cultural resource management
CSS	Cascading Style Sheet
CSV	comma separated values
DBMS	desktop database management system
DEM	digital elevation model
DINAA	Digital Index of North American Archaeology
DIY	do-it-yourself
DoD	Department of Defense
DVL	doppler velocity log
EAV	entity-attribute-value
EDM	electronic distance measurement
EU	excavation unit/s
FAIMS	Federated Archaeological Information Management System
fMRI	functional magnetic resonance imaging
GIS	geographical information system
GCP	ground control point
GNSS	global navigation satellite system
GPR	ground-penetrating radar

GUI	graphic user interface
ha	hectare/s
hr	hour/s
Hz	Hertz
HDSM	high-density survey and measurement
ICE	Image Composite Editor (Microsoft)
iOS	iPhone operating system
INS	inertial motion sensor
IPinCH	Intellectual Property in Cultural Heritage
IT	information technology
KAP	Kaymakçı Archaeological Project
KARS	Keos Archaeological Regional Survey
km	kilometer/s
LABUST	Laboratory for Underwater Systems and Technologies (University of Zagreb)
LAN	local area network
LIEF	Linkage Infrastructure Equipment and Facilities
LOD	linked open data
LTE	Long-Term Evolution
m	meter/s
masl	meters above sea level
MEMSAP	Malawi Earlier-Middle Stone Age Project
MOA	memoranda of agreement
MOOC	Massive Online Open Course
NGWSP	Navajo-Gallup Water Supply Project
NeCTAR	National eResearch Collaboration Tools and Resources
NEH	National Endowment for the Humanities
NHPA	National Historic Preservation Act
NPS	National Park Service
NRHP	National Register of Historic Places
NSF	National Science Foundation
OCR	optical character reader
OS	operating system
PA	programmatic agreement
PAP	pole aerial photography
PARP:PS	Pompeii Archaeological Research Project: Porta Stabia
PATA	Proyecto Arqueológico Tuti Antiguo
PBMP	Pompeii Bibliography and Mapping Project
PDA	personal digital assistant

PIARA	Proyecto de Investigación Arqueológico Regional Ancash
PKAP	Pyla-Koutsopetra Archaeological Project
Pladypos	PLAtform for DYnamic POSitioning
PLoS	Public Library of Science
PQP	Pompeii Quadriporticus Project
PZAC	Proyecto Arqueológico Zaña Colonial
QA	quality assurance
QC	quality control
QR	quick response
REVEAL	Reconstruction and Exploratory Visualization: Engineering meets ArchaeoLogy
ROS	robot operating system
ROV	remotely operated vehicle
RRN	Reciprocal Research Network
RSS	Rich Site Summary
RTK	real-time kinetic global navigation satellite system
SfM	structure from motion
SHPO	State Historic Preservation Office
SKAP	Say Kah Archaeological Project
SLAM	simultaneous localization and mapping
SMU	square meter unit/s
SU	stratigraphic unit/s
SVP	Sangro Valley Project
TCP	traditional cultural properties
tDAR	the Digital Archaeological Record
UAV	unmanned aerial vehicle
UNASAM	National University of Ancash, Santiago Antúnez de Mayolo
UQ	University of Queensland
USACE	U.S. Army Corp of Engineers
USBL	ultra-short baseline
USFS	U.S. Forest Service
USV	unmanned surface vehicle
UTM	universal transverse mercator
XML	Extensible Markup Language



1.4.

DIY Digital Workflows on the Athienou Archaeological Project, Cyprus

Jody Michael Gordon, Erin Walcek Averett, Derek B. Counts, Kyosung Koo, and Michael K. Toumazou

LESSONS FROM A QUARTER CENTURY OF DATA RECORDING IN THE MALLOURA VALLEY

During its first two decades, the Athienou Archaeological Project (AAP; established 1990) developed a robust excavation recording system that closely documented stratigraphic and artifactual data via integrated paper and paper-to-digital methods. From the onset, paper forms and notebooks were used to record field notes, which became digital immediately afterward in the lab by re-entering the information into databases and word processing files. This two-step system served AAP's pedagogical and research goals because it employed a meticulous recording system and archaeological workflow that were user-friendly for both staff and field-school students. It provided both quantitative and qualitative information in written, drawn, and photographic form for all contexts, architecture, samples, and finds. The manual, secondary input of paper-based data into digital formats further provided the project with a large, queryable, and complementary (and duplicate) digital dataset.

Today, however, AAP has moved toward a more paperless system—a hybrid system that employs the same meticulous data recording protocols, while using some born-digital data in place of secondary data entry. In some ways, little has changed. AAP's long-standing recording system and workflows remain, yet, the project's DIY (do-it-yourself) movement into digital workflows at the advent of mobile computing devices via the adoption of Apple iPads for field



Figure 1: The Malloura Valley, Cyprus.

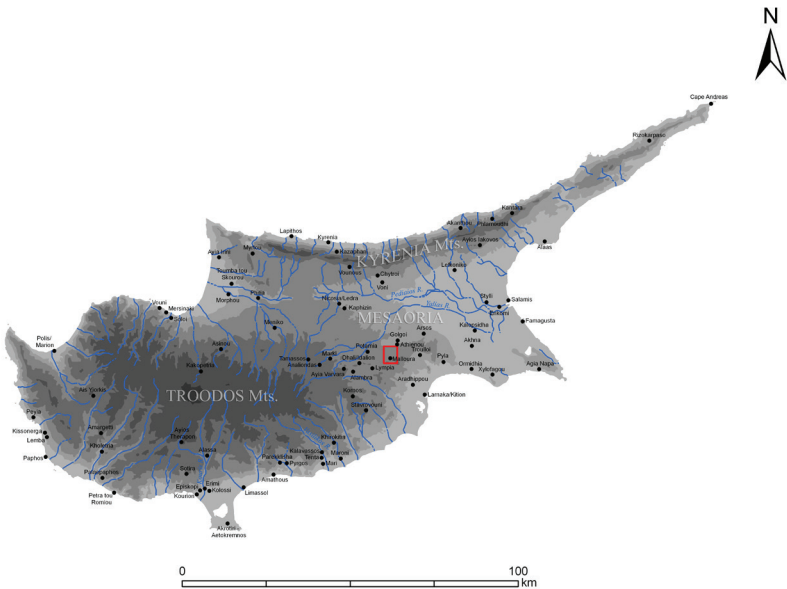


Figure 2: Map of Cyprus showing the location of the Malloura Valley in rectangle. Map by D. Massey.

recording reveals quantitative and qualitative changes to the ways that AAP staff members *do* archaeology at the trowel's edge.

This chapter explores the contexts, motivations, and decisions that influenced the shift to on-site mobile computing at AAP so that other field school projects grappling with the questions of whether and when to “go digital” might learn from our experiences. Since many scholars would now claim that “we are *all* digital archaeologists” or “excavation is digitization,” this seems a particularly pressing methodological transition to examine (Morgan and Eve 2012: 523; Roosevelt *et al.* 2015: 325). We discuss how even a modest-sized project without full-time digital technologists can transition to a tablet-based recording system that employs a hybrid digital/paper-based workflow, and how our experiment impacted both our research and pedagogical goals. Although our discussions of interpretive improvements mainly derive from the authors’ own reflections, our pedagogical successes are supported by user surveys and recorded team conversations focused on trench supervisor experiences.

METHODOLOGY, DATA RECORDING, AND THE ROLE OF TECHNOLOGY AT AAP IN THE PRE-TABLET ERA

Since 1990, AAP has been investigating long-term culture change in the Malloura Valley of central Cyprus’s Mesaoria plain through a multidisciplinary project for undergraduate students that combines field (excavation and survey) and laboratory training in archaeological methods with research analyses. The valley served as a locus for activity for nearly 3,000 years, a period that begins in the early first millennium B.C. and continues to the modern era. This long occupation, coupled with the diversity of archaeological remains encountered (domestic, religious, industrial, and funerary), makes the valley an ideal training ground in archaeological methodology (FIGS. 1, 2; see also Toumazou *et al.* 2011, 2015b).

More recently, the project has focused on the excavation of a Cypro-Geometric through Roman-period sanctuary at the site of Malloura (FIG. 3), and our excavations have shed new light on first-millennium B.C. Cyprus, especially regarding the nature of votive religion in the hinterlands of the island. Yet, Malloura has also proven to be a stratigraphically complex site because it was frequently looted



Figure 3: Aerial view of the sanctuary of Athienou-Malloura in 2005.

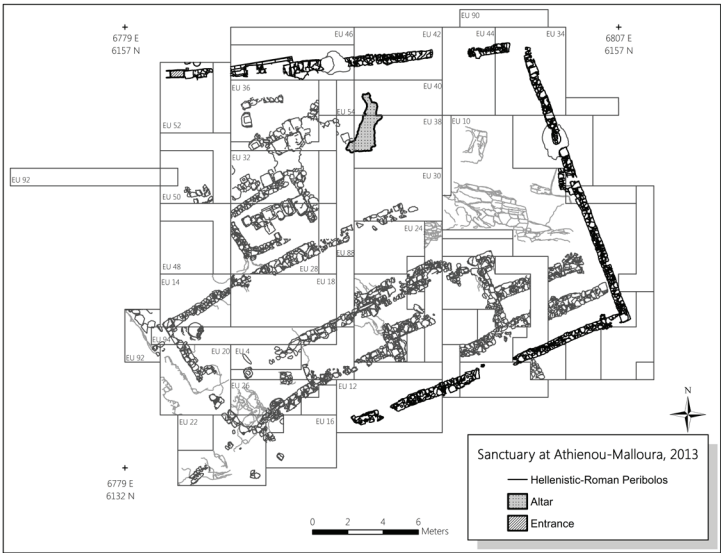


Figure 4: Site plan of Malloura showing excavation units (EUs). Drawing by Remko Breuker; updated by Kevin Garstki.

in the recent past. Hence, considering the site's archaeological importance and complexity, an exacting system of on-site data recording has always been a key part of AAP's *modus operandi*. Furthermore, throughout the project's history, AAP has also prioritized the archaeological training of undergraduate and graduate students, which includes instruction in excavation and survey methodologies and recording systems as well as the processing of finds and data in the lab and museum. Thus, a significant portion of the staff's time is devoted to on-site or classroom instruction, and the majority of funds (raised both via tuition and National Science Foundation Research Experiences for Undergraduates [NSF-REU] grants) are dedicated to student travel, room and board, and educational expenses. AAP's complementary goals of understanding the long-term history of the Molloura Valley and providing rigorous training of students in archaeological field techniques has led to a deliberate process of excavation, and these factors explain our cautious incorporation of technology.

Like many projects excavating in the 1990s and early 2000s (see e.g., Dibble and McPherron 1988; Ancona *et al.* 1999; see also Motz, Ch. 1.3), AAP embraced "digital" elements in its workflows from an early date in an effort to improve data quality and manipulation. Yet, in the absence of any durable and portable computing devices, these digital methods were lab-based and mainly focused on data duplication, preservation, and analysis (or querying). In terms of its more general data recording process, AAP developed a data workflow from the field to the lab that was primarily paper-based and tailored to the Molloura site, and this workflow has since permitted interpretation from the macro to micro levels as outlined in AAP's "Handbook of Excavations" (for an overview excavation methods, see Toumazou and Counts 2011: 71–75).

AAP's on-site data recording workflow primarily involves the following process. Excavation Unit (EU; i.e., trench) supervisors record stratigraphy and finds in an exacting manner using a variety of paper-based forms, hand-drawn sketches, photographs, and notebooks. Stratigraphic Unit (SU; similar to a "layer" or "stratum") forms record key data pertaining to the unit's location, stratigraphic position/nature (e.g., looters' pit/stratified or disturbed), features (e.g., walls, hearths), soils, organic and inorganic remains, ceramics, and objects, as well as references to associated photos and drawings (FIG. 5); a grid permits easy drawing of the SU's horizontal limits and any features. Square

Figure 5: A paper stratigraphic unit (SU) form used at Athienou-Malloura.

Meter Unit (SMU) forms provide further resolution and also include a gridded drawing that records the SMU's architectural features and in situ artifacts. Other forms (Object, Photography, Elevation) connect the field's data to the lab in a systematic way. Finally, EU supervisors maintain field notebooks (once paper-based, now entered digitally on mobile tablet computers) that provide them with a non-delimited writing space to record their excavation decisions and observations about the trench in narrative form.

The paper-based system was relatively simple to learn, implement, and archive. As with all paper archives, however, there were some logistical difficulties in terms of storage and collating that made long-term access and rapid synthesis for on-site and off-site decision making and interpretation slow and limited. For example, the database could not be accessed on-site. In addition, in the lab, the time required for the digitizing and transcribing of paper-based data was slow and increased the potential for human error with data entry.

During AAP's first 20 years, the project sought to create archaeological workflows that accurately recorded Molloura's ancient past, to help students engage with "hands-on" archaeological research, and to integrate computing tools aimed at strengthening data collating, integration, and analysis. The project was thus always "tech-friendly" and willing to entertain changes to its workflow when the technology was affordable and could enhance project goals. Although various computing tools were employed since its inception, AAP did not progress to a more digital stage in the pre-tablet era partly because of the harsh working conditions at Molloura. The site is extremely dry, dusty, and hot in the summer, and there is no available power source or Internet connection. Such conditions presented problems in the early 2000s because laptops were not robust enough in terms of battery power and design to endure an eight-hour workday in the site's torrid environment. Moreover, the project's FileMaker database would be of little use remotely without a Web-based interface and Internet access. As a result, there was a digital divide between the site (entirely paper-based) and the lab (a hybrid between paper and digital).

AAP AND THE ADVENT OF PAPERLESS WORKFLOWS

The decision to adopt born-digital field recording methods was based on AAP's research goals and openness to experimenting with new technology, as well as on the revolutionary changes that had begun to occur in archaeological computing (see also Levy 2014; Roosevelt *et al.* 2015: 326; Gordon *et al.*, Introduction). By the late 2000s, in tandem with the information technology revolution, progress in lowering the cost of nanotechnology led to the development of relatively cheap, light-weight, touch screen-enabled, Internet-ready, and camera-equipped mobile computing devices with long battery lives (e.g., iPhones). These devices were soon followed by the first tablet computers with the launch of the Apple iPad in April 2010. Because tablets were portable, user-friendly, and could be synched to existing databases via Web-based apps, archaeologists started to recognize their ability to integrate tasks into fieldwork that had once only taken place in the lab (Fee *et al.* 2013: 50). Within a year, Apple iPads had begun to be used by archaeologists needing durable, portable computing devices that could be used effectively in the field to record excavation data and function as "digital notebooks." It was this development that spurred the first attempts at so-called "paperless" excavation recording workflows (see Wallrodt, Ch. 1.1). These methods are now becoming more common on archaeological sites and—according to some scholars—are indicative of a significant shift in archaeological practice (Roosevelt *et al.* 2015: 339–340; Gordon *et al.*, Introduction).

The first major Mediterranean archaeological project to experiment with iPads as portable digital recording devices in the field was the Pompeii Archaeological Research Project: Porta Stabia (PARP:PS) where Steven Ellis and John Wallrodt devised a DIY mobile data-recording system. Trench supervisors were issued iPads equipped with "off-the-shelf" apps that could record, integrate, and analyze excavated field data and upload it to servers for long-term digital storage (Ellis and Wallrodt 2011; see Ellis, Ch. 1.2; Wallrodt, Ch. 1.1). Besides Apple's built-in iOS applications (e.g., iBooks and Camera), their original workflow included a database application (FM Touch), a digital drawing app (iDraw), a word processor app (Pages), and a flowchart app (OmniGraffle) used for creating Harris matrices. In the spirit of Web 2.0 data sharing and hacks, Wallrodt reflexively discussed the

PARP:PS system on his weblog, *Paperless Archaeology* (<http://paperlessarchaeology.com>). In addition to general observations about the tablets' user-friendly nature, their durability in the field, and how much written and photographic data they could record, Wallrodt also provided instructions as to how to develop a DIY digital workflow that would require little technical know-how, be cost effective, and would teach novice archaeologists digital skills and new ways of manipulating stratigraphic data.

The pioneering work done by PARP:PS is important to acknowledge here because Wallrodt's blog allowed AAP, under the supervision of assistant director Jody Gordon, to "go digital." This process of knowledge sharing and easy adoption/adaption is significant since it underscores the influence of new technological developments on archaeology in the Web 2.0 age (Morgan and Eve 2012; Caraher 2014b; Morgan 2015). Archaeological methods and practices can now be shaped by open-access digital means, and devices' and programs' utility and interoperability open the door to myriad ways to address archaeological goals and problems. For most projects, as Ellis has argued, a "digital filter" is inserted at some stage (Ellis, 1.2). Thus, archaeology's very transformation into a "digital" discipline that permits the enhancement of research goals, even within existing logistical limitations, influenced AAP's decision to move toward digital workflows and provided a kickstart to our thinking about the benefits of digital archaeology.

The next step for AAP was to establish whether the perceived benefits of converting to digital data recording—most significantly, the collection of born-digital data captured on-site via tablet computers without paper complements/duplicates—were compatible with the project's dual goals of understanding the Cypriot past and training students. Wallrodt highlighted many of the benefits of mobile data recording in *Paperless Archaeology*, and since 2011 many more scholars have argued that utilizing tablets and creating born-digital files has many advantages (e.g., Motz and Carrier 2013; Wallrodt *et al.* 2013; Prins *et al.* 2014; Roosevelt *et al.* 2015). Mobile recording arguably produces "more and better" data with less human error, preserves it in more places, easily integrates it, permits immediate intra-site and eventual inter-site analyses via relational databases, and democratizes data by streamlining it so that it can be easily shared between team members or even the public through published digital archives affiliated with

linked open data or blogs (Kansa *et al.* 2007: 193–194; Kansa and Kansa 2011: 57–59; Morgan and Eve 2012: 526; Prins *et al.* 2014: 196; Roosevelt *et al.* 2015: 342). These digital advantages promised improvements over AAP's existing paper-based field recording system that might offer enhanced interpretations of Malloura's archaeology.

In recent years, scholars have also stressed that paperless archaeology is practical from a logistical standpoint, and these factors further influenced AAP's decision to “go digital” (Motz and Carrier 2013: 29; Wallrodt, Ch. 1.1; Ellis, Ch. 1.3; Fee, Ch. 2.1; Sobotkova *et al.*, Ch. 3.2; Dufton, Ch. 3.3; Roosevelt *et al.* 2015: 339, 341). By eliminating the recopying of paper forms and notes, some scholars have argued that valuable time required for site analysis and object processing is saved (e.g., see Motz, Ch. 1.3; Poehler, Ch. 1.7), while the outfitting of a project with the basic components of tablets, a desktop computer with a relational database, a high-end digital camera, and a series of off-the-shelf—or even open-source—apps is relatively inexpensive (Roosevelt *et al.* 2015: 341). Internet connectivity further enhances the digital process, but it is not always required or available. Another logistical benefit is that the technology is often user-friendly in that it can be easily taught and implemented by field supervisors without programming skills (Bria and DeTore, Ch. 1.5). Likewise, the device's usability encourages projects to attract students who have grown up using mobile devices and who are interested in learning about their applied use, with the result that over time, the project's technological knowledge base may be enhanced.

According to recent studies, the interpretive and pedagogical benefits of paperless archaeology are not uniform and seem to vary according to a project's implementation scheme and goals (Opitz 2015; Bria and DeTore, Ch. 1.5). Nevertheless, when first considering adoption in 2011, AAP identified several benefits based on the experience of PARP:PS, which have since been supported by other projects. For example, the time saved from digitizing paper records permits other research activities, like object drawing and student training, while the rapid accessibility and searchability of the data beyond the lab—especially *on-site*—promotes its sharing and interpretive power (cf. Morgan and Eve 2012: 525). In terms of pedagogy, the on-site entry of field data and the immediate accessibility of existing project files (which can easily be preloaded onto tablets) and online databases (when Internet access is available), provides excavators with new

transferable skills, including the ability to use mobile devices and apps (Opitz 2015; Bria and DeTore, Ch. 1.5) to multitask with several programs to solve stratigraphic questions, and to think volumetrically or in terms of wider project workflows (Wallrodt *et al.* 2013; Roosevelt *et al.* 2015: 339). Hence, traditional post-excavation activities, such as intra-site comparisons of materials, can now take place on-site *during* excavation (Opitz 2015). Digital workflows with real-time updateable databases also contribute to novel forms of group-think integration between excavators, artifact specialists, and IT professionals, allowing for multiple team members to offer rapid insights on excavations (Morgan and Eve 2012: 524; Wallrodt *et al.* 2013). These interactions also contribute to reflexive re-evaluations of the interpretive value of the workflows as they develop (Berggren *et al.* 2015). Together, these perceived pedagogical benefits initially pioneered by PARP:PS promised to enhance the AAP's goal of preparing college students for archaeological careers, which by the 2010s, would require some literacy in on-site mobile computing, in addition to traditional excavation and survey training.

More recently, however, some scholars have suggested that the complete abandonment of paper-based excavation recording or the uncritical adoption of new technologies to streamline workflows could be detrimental to some aspects of archaeological practice. William Caraher (2015; Ch. 4.1), for example, has proposed that digitization can result in de-skilling, or the loss of traditional archaeological skills like trench illustration, while other scholars, like Dimitri Nakassis (2015), have questioned whether the time saved by digital data entry truly results in better stratigraphic interpretations or engagements with other archaeological tasks (e.g., lab-based object analysis). In 2011, however, the perceived benefits of experimenting with paperless archaeology were great enough that AAP decided to follow the PARP:PS model and experiment with a DIY digital workflow using Apple iPads.

TOWARD DIGITAL DATA RECORDING AT THE TROWEL'S EDGE AT ATHIENOU-MALLOURA

The following section describes how the implementation of a DIY, near-paperless archaeological workflow successfully enhanced our project's goals. At present, there are three main ways to implement

digital archaeology: (1) the use of fully digital, customized devices, apps, and systems (e.g., Federated Archaeological Information Management Systems (FAIMS); see Sobotkova *et al.*, Ch. 3.2), (2) the use of fully digital DIY workflow solutions that leverage proprietary and existing systems and devices (e.g., Archaeological Recording Kit (ARK); see Dufton, Ch. 3.3), and (3) the use of a combination of the two previously listed approaches that also involves some paper (e.g., like that used at the Proyecto de Investigación Arqueológico Regional Ancash (PIARA); see Bria and DeTore, Ch. 1.5). With limited IT personnel and funding for technology, AAP opted to follow the third route and develop a DIY approach using off-the-shelf apps along with paper-based legacy forms.

In an ideal world with unlimited funding and access to technical equipment and trained support personnel, bespoke digital archaeology systems with custom-built apps (like FAIMS) might represent the best way to turn paper-based archaeology into paperless. In reality, however, low-cost DIY digital workflows that utilize off-the-shelf apps, like those of PARP:PS, play a key role in democratizing the use of digital archaeologies (Daly and Evans 2006: 5; Morgan and Eve 2012: 527). Recently, William Caraher has written about the importance of an “archaeology DIY” approach that has “its roots in the improvised and ad hoc approach to challenges in the field, limited resources, and difficulties accessing tools designed for every circumstance from remote locations” (Caraher 2014a). Overcoming these challenges with DIY solutions is important because it can assist the further implementation of digital methodologies that can improve data capture and analysis for a range of project types (see Watrall 2011: 171–172). For AAP in particular, the DIY approach enabled us to assemble a series of devices and apps that would fit our time restraints and budget, while simultaneously enhancing our research and teaching goals.

In the 2011 season, AAP decided to beta test a single 16 GB iPad 2 for in-field, born-digital data recording. The field testing was undertaken by Gordon, who had followed PARP:PS’ experiment online (FIG. 6). Since PARP:PS’s system was only a year old and untested elsewhere, AAP decided to progress cautiously and not abandon its well-tested paper-based methods until Gordon had tested the technology and developed a protocol that would function on-site and integrate with the project’s legacy data. Thus, our paper-based system was retained in 2011, while Gordon—who was *not* an IT specialist—experimented

with the single iPad 2 to test its on-site usability. The iPad was not used for full-time excavation recording during this trial season; instead, it was used periodically to test its functionality vis-à-vis data recording needs and Malloura's harsh conditions.

Gordon equipped the iPad 2 with many of the same off-the-shelf apps used by PARP:PS. He took field notes in Pages (made easy with a Bluetooth keyboard); tested digital drawings using iDraw (particularly EU plans and vector tracing of objects); drew flowcharts with OmniGraffle; and utilized Numbers for basic elevation calculations. He also tested the quality of the still and video digital cameras, as well as the feasibility of annotating digital imagery in iDraw. The iBooks app proved to be a useful repository for reference PDFs including the "AAP Handbook of Excavations," previous trench reports, balk and artifact drawings, and scanned images. These formerly paper-based resources, stored in the lab, were now immediately accessible on-site. A database program was not initially tested, however, because our FileMaker database was not yet Web accessible (there was no on-site Internet) and we did not have the IT personnel to monitor daily synching of the database records via USB to the master lab database. Nevertheless, in terms of the other more standard files generated on-site (e.g., PDFs of the daily notes), synching the iPad to both the lab registrar's desktop and a field-based laptop via USB was straightforward, and cloud-based data transfers in the Wi-Fi-enabled lab (using Google Gmail) were also successful.

These on-site experiments demonstrated the iPad's overall ability to contribute to project goals. In terms of positive results, the iPad withstood Malloura's heat and dust, and it maintained its power supply for an entire workday as long as it was charged fully the night before. Apps like Pages and OmniGraffle were user-friendly and permitted the incorporation of text and images, while iBooks allowed for the accessing of reference images and files in a manner that facilitated intra-site decision making. The iPad's video camera could record site tours, which provided a completely new and highly descriptive source of field data, and the tablet's photographic and written data could be regularly backed up to a laptop in the field or in the lab. In terms of shortcomings, some recording elements were more elusive or ineffectual. Digital drawing was a complicated matter. For example, iDraw was useful for drawing trench outlines, but sketching finds with shading was more difficult. Photos taken by the iPad were of a



Figure 6: AAP assistant director Jody Gordon testing an iPad in the field.



Figure 7: AAP trench supervisor Kevin Garstki using a Bluetooth keyboard to write in the “digital notebook.”

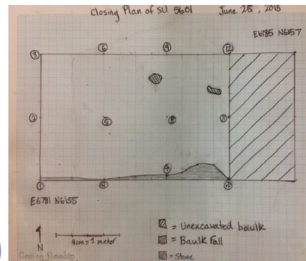
Excavation Unit 56 - Field Notes - 2015 Season

Thursday, June 25, 2015
 Field Supervisor - Kevin Garstki
 Students - Ariel Ehrman (University of Houston)
 Caity Ewers (Creighton University)
 Nina Raby (University of New Mexico)
 Will Pedrick (University of Virginia)
 Written by Kevin Garstki

Daily notes:

We began work today at 6:30. WP will not be in the field today. Our objectives for today will be to complete **SU 5601**, down the ~15 cm level, and to begin identifying and articulate the pits present in this EU. Once these pits are identified we will work to remove all of the pitted soil so as to leave only the stratified deposits. AE, CE, and NR worked together using trowels and crock picks to remove the **SU 5601** soil in the northwest 1/2meter of the EU. The pitting may be more extensive than KJG originally thought. A wallstone at ~N6156.60 E6783.9 had old looters pick marks on it, and stones at ~N6155.8, E 6781.8 with similar marks.

This 1/2meter area of the SU was a much more compact, silty clay soil in the previous SU (**5600**). However, CE and NR are finding a much looser soil. This does not appear to be an extension of the pitting, though this cannot fully be determined at the moment. Just a few pieces of pottery, bone, and shell were recovered from the remaining **SU 5601**. **SU 5601** was completed just after 9:30am and a photo was taken of the closing photos (IMG_4388.tif). A plan map was also completed for this SU, and elevations were taken (see table 1).



Following lunch, it was decided by MKT to begin a new arbitrary SU (**SU 5602**). This will be a single ~15cm pass down across the 3x2meter area of EU 56 we are currently digging (E6781 N6155). This SU will match with the SU 5203 closing from the EU 52 to the south. AE, CE, and NR began **SU 5602** by taking 15cm pass across the EU from the south baulk. This was decided because large areas of the SU are pits; at least 4 different pits and perhaps as many as 6 (see image below). By removing this level we hope to make the pitting more clear and begin to remove each on its own, leaving only the stratified deposits. **SU 5602** was removed approximately 15cm to the north of the south baulk with crock picks and trowels. The soil in the

Figure 8: A sample page from the “digital notebook” written by AAP trench supervisor Kevin Garstki in 2015.

Athienou Archaeological Project

Excavation Unit | Object | Photo | Personnel

Browse an SU - 5603 (EU: 56)

Log Out
Add an SU or SMU
Find SUs or SMUs
SU List or SMU List
Find All SUs
Find All SMUs
SU Summary Report
SMU Summary Report

date 06/30/2015
Excavator Initials KJG
Date Modified 07/06/2015
Modified By supervisor

EU 56

Primary X (E Coords) 6781
Primary Y (N Coords) 6155
Second X (E Coords) 6784
Second Y (N Coords) 6157

SU 5603

under_1 5602
under_2
under_3
level_top 208.335
level_bottom 208.105
stratigraphy mixed/contaminated

FEATURES

wall
wall_seq
bench

Figure 9: A queried SU form as it appears in the AAP's Web-based FileMaker database.

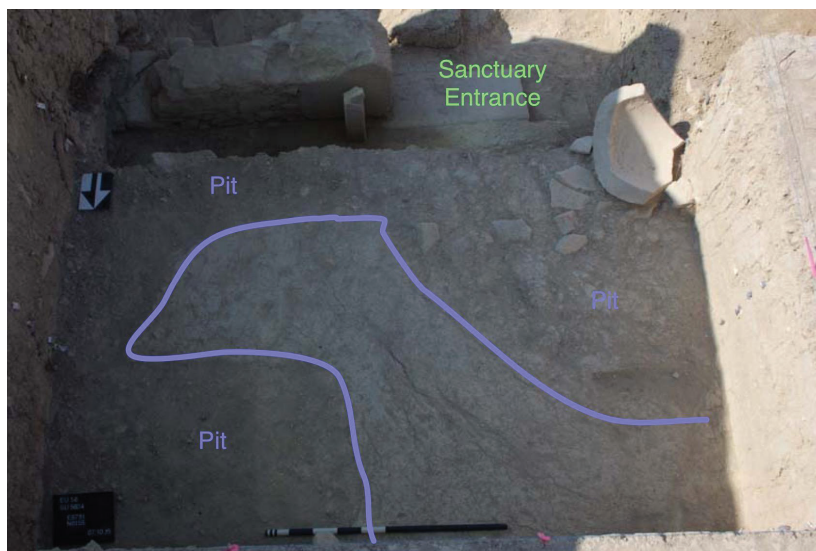


Figure 10: An iPad photo with annotations produced in iDraw.

good enough quality to be used for daily notes and annotations, but they were not archival quality, and a high pixel-rate digital camera was still required. Finally, typing on a reflective screen under direct Mediterranean sunlight proved difficult (cf. Fee *et al.* 2013: 53), and thus recording under a sunshade using a Bluetooth keyboard became a preferred method (FIG. 7).

This combination of programs, accessories, and workflow hacks ultimately proved that a user-friendly mode of digital archaeological recording using iPad tablets could provide AAP with born-digital data, save time, and teach students the basic rudiments of on-site archaeological computing in addition to traditional archaeological methods. From this experimental process, AAP's version of a "digital notebook" emerged, consisting of notes, photos, and drawings combined within the Pages app, and replaced AAP's paper-based EU notebook (FIG. 8). At the same time, Kyosung Koo, an academic technologist, was recruited to make the AAP database Web-accessible so that it could be accessed in the lab—and ideally on-site—by utilizing a Wi-Fi equipped mobile device. Koo migrated the database to a Web server and developed a Web application through which our staff could access the database via Web browsers on mobile devices (FIG. 9; Koo *et al.* 2013).

In 2012, based on our successful 2011 beta test, AAP implemented digital data recording in the field using iPads as part of its standard procedure (Toumazou *et al.* 2015a). Newly released and relatively affordable (under \$600 US each), 32 GB iPad 3s, with improved processors and cameras, were issued to each of the four trench supervisors, who would use the devices along with the traditional database forms (e.g., SU, SMU, Object) that could not be digitized due to lack of database access on-site. Our immediate goals consisted of introducing supervisors to iPad use, standardizing our digital workflows via the creation of a protocol and, most importantly, not losing any data (cf. Berggren *et al.* 2015: 443). We also recognized that conversion to digital workflows would be a gradual process that would involve some paper, at least until additional full-time IT staff and funding could be integrated into project logistics. The resulting recording system might be best described as "hybrid-paperless" because it combined both digital and paper-based recording methods.

Gordon wrote a supervisor/lab protocol (see Supplement Material 1) with an introduction to the iPad and a discussion of how different apps incorporated much of our paper-based recording procedures

(for written protocols, see also Motz 2015; Motz, Ch. 1.3). The protocol described operating system basics as well as how to multitask between apps, and it outlined a workflow for the hybrid-paperless recording system built within AAP's existing excavation process. Apart from the paper-based forms and a paper sketchbook used for artifact and EU drawings, the EU notebook would be born-digital, recorded directly into a flexible Pages template that would also provide writing space for supervisors' analyses and observations. This narrative would also incorporate elevations from Numbers as well as annotated photos (of trench features or artifact sketches) and hand drawings, scaled and digitized SU top plans (imported from iDraw), and Harris matrices outlined in OmniGraffle. At the end of a workday, the "digital notebook" was saved as an archival PDF and stored in multiple places: on the supervisor's iPad, on the registrar computer's hard drive, and in the cloud on AAP's Gmail account (which has now been upgraded to Google Drive).

The AAP workflow provided immediate benefits. First, for our budget, the iPads were a relatively inexpensive purchase at around \$2,500 US for four units—they have been continuously used for field seasons through 2015. Second, they were user-friendly. No supervisor complained about using the tablet's apps (aside from iDraw), and all were able to master the workflow. As one supervisor remarked in a user survey focused on AAP's digital turn, "the transition [to digital recording] was fairly easy, and the device is user-friendly, with some idiosyncrasies that need to be learned." In addition, the entire workflow was DIY and therefore straightforward enough to be set up by a non-IT specialist. Third, since supervisors were accustomed to typing and using tablets/phones in their daily life, detailed descriptions of on-site work were created that were now enhanced by photos, photographed sketches, iDraw drawings, and elevations based on formulas. Annotated digital images (shaded with different colors and with text and arrows) particularly elaborated on the written narrative and enriched its explanatory power (FIG. 10). Fourth, several supervisors felt that they had learned new, more integrated, ways of recording using the iPad's camera and apps, and that they could work and make decisions faster based on the ability to reference and search previous days' PDFs as well as images and final reports from previous years. Responding to the user survey mentioned above, one supervisor provided the following testimony:

Looking back, I would say it caused me to document the excavation more closely, particularly through photography. It also made me more confident in my decisions about stratigraphy. Having daily overhead images of the trench gave me time to analyze what was going on in the trench after the day's excavation was done, which allowed for further analysis that I would not have had without an iPad.

Fifth, time was used more efficiently since born-digital note-taking now allowed the time previously devoted to retyping paper-based notes in the lab to be used for other tasks, such as object sketching or analysis. When asked whether time was saved, one of our supervisors in the user survey stated, "YES! It saved so much time because I didn't have to be redundant by copying notes. The app for elevations also saved time by having the machine do the math." Sixth, data were preserved in multiple, more shareable ways beyond paper, thus moving AAP data closer to their eventual reposition in a permanent digital repository. Our new digital workflows, therefore, enhanced AAP's dual goals: (1) more descriptive and visual data were collected that could be studied in depth by more people, and (2) students learned new ways to record, visualize, and understand site stratigraphy.

The 2012 season was a success in terms of hardware/software utility, student supervisor learning curve, and data collection and archiving. Therefore, during the 2013 excavation season we attempted to further enhance our digital recording system by establishing an Internet connection at Malloura in order to search and upload data on-site. Our part-time academic technologist enhanced the FileMaker app for uploading notes and images so that we could try to use a battery-powered, 3G, unlocked SIM card-based wireless router (We3G brand) with an Internet "hotspot" that could be accessed by the iPads. Unfortunately, it soon became clear that only a 2G wireless signal was available at the rural site of Malloura, which was too slow for efficient data recording (cf. Motz and Carrier 2013: 25–26). Thus, SU, SMU, and Object forms continued to be recorded on paper in the field and subsequently typed digitally in the lab. Paper also continued to be used for object drawings, although supervisors did improve their skills at image annotation in iDraw. For video recording, we solved an earlier problem of weak iPad microphone receptivity by utilizing a Panasonic

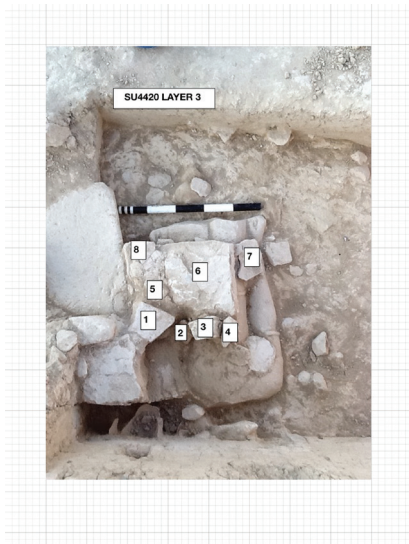


Figure 11: Using iDraw: annotated digital photo created to document the reuse of statuary in the sanctuary wall in 2011 (left); assistant director Jody Gordon documenting wall stones in 2015 (right).



Figure 12: Using iDraw: Annotated digital image of the central altar in the Malloura sanctuary produced in iDraw showing stratigraphic layers (left); unannotated cross-section of the central altar (right).

Bluetooth microphone that allowed the speaker to stand 20 m away from the videographer and still render clear sound. Following a 2014 study season, we continued to use our existing “hybrid-paperless” workflow during the 2015 excavation season with continued success.

MOBILIZING THE CYPRIOT PAST: ADVANCING ARCHAEOLOGICAL INTERPRETATION AND EDUCATION AT ATHIENOU-MALLOURA THROUGH MOBILE COMPUTING

Based on the first several years of “hybrid-paperless” data recording at AAP, our experiences have reinforced many of the perceived benefits of digital or “paperless” archaeology recognized by other projects, while also providing specific insights unique to AAP’s workflows and goals. To begin with, a primary argument for engaging in digital archaeology is the enhanced preservation of data (Faniel *et al.* 2013: 3; Berggren *et al.* 2015: 443; Roosevelt *et al.* 2015: 325–326). If data will be lost, then paper, which is relatively more durable, should not be abandoned. In over four years of tablet-based data recording at AAP, no files have been lost, all are backed up to multiple hard-drives and the cloud (Gmail and Google Drive), and no iPads have been damaged. Our data is now backed up in more formats and places than ever before.

AAP’s experience, like that of PARP:PS (Wallrodt *et al.* 2013), Gabii (Opitz 2015), and the Pyla-Koutsopetra Archaeological Project (PKAP; Fee *et al.* 2013; Fee, Ch. 2.1), has shown that tablet computers are user-friendly and their apps are easy to learn. Student supervisors are quickly able to use the devices to capture more information about a trench than was previously possible. More information is recorded because students can often type faster than they can write, and the visual data (e.g., annotated photos) can be inserted easily into the notebook narrative, a process that enriches supervisor descriptions. For example, with regard to the transition from paper to digital recording, one of our student supervisors remarked that:

The transition was very easy and the device very much user-friendly. The majority of functions were easy to pick-up, especially after having used a smart phone. The apps, especially [P]ages and [N]umbers, were fairly intuitive. iDraw was the only app slightly more difficult to use.

The ability to integrate imagery with interpretative note-taking has helped our supervisors document and better understand Malloura's complex site formation processes and architectural remains (as has been noted on other projects, e.g., Berggren *et al.* 2015: 437–438; Bria and DeTore, Ch. 1.5). In particular, iDraw's photo annotation capabilities are a valuable tool for stratigraphic recording. By allowing supervisors to mark up trench photographs with visual layers that can be annotated with writing, polygons, and drawings, iDraw has added a digital visual dimension to describing excavation processes. For example, in a unique instance, a small, upper portion of a wall was briefly disassembled to retrieve an exposed limestone statue in danger of being looted; each stone was photographed and then easily annotated in situ using iDraw on the iPad, so that this part of the wall could be reconstituted afterward (FIG. 11). Another example would be the annotation of artifact find-spots within a trench or the complex stratigraphic layers of Malloura's main mudbrick altar (FIG. 12). Such a visual narrative enriches a supervisor's ability to document the excavation process and interpret its results.

Moreover, the iPad's ability to store archival images and reports has put years of legacy data at the supervisors' fingertips. This immediate access to information has enhanced AAP excavators' ability to access existing project data, such as the locations of artifacts (e.g., fragments of limestone sculpture discovered in multiple trenches) or architecture (e.g., spatial data on the likely position of the sanctuary's boundary wall; see also Berggren *et al.* 2015: 443). For example, several looters' pits at Malloura are quite large, and the same pit can be found in EUs that do not share balks. Using the archival data on the iPad, a supervisor can easily compare images of pits discovered in nearby areas, even those from previous seasons that may also extend into their own trench. The ability to make such stratigraphic realizations rapidly on-site can quickly enhance decision-making with regard to how to excavate a SU. Such comparative references were previously more tedious when paper reports were stored in the lab.

On the broader site level, having such information in a digital, searchable format has helped the directors rapidly synthesize information about an array of archaeological issues including: where and when the site has been affected by looting, the design of the Hellenistic-Roman *peribolos* wall, the form and use of the central altar, or the

location and nature of Roman era activity. In this way, crossing the “digital Rubicon” has helped with the swift production of synthetic site reports, conference papers, and recent journal articles (e.g., Toumazou *et al.* 2015b).

It is clear that even AAP’s hybrid-paperless workflow has led to progress in our ability to record, access, and archive data. Yet, this experience has also highlighted some common problems with digital archaeology at the trowel’s edge. The most obvious issue is that going completely paperless is difficult and the process must be handled gradually, especially on projects with legacy data and pre-existing effective workflows. At AAP, for example, the difficulty of mastering digital drawing (at least on iPads) and maintaining Internet connectivity (as well as the costs associated with full-time IT personnel; Roosevelt *et al.* 2015: 341) has forced us to retain paper-based drawing and paper forms, at least until more effective mobile drawing or modeling programs appear and Internet connectivity becomes reliable onsite (for advances in modeling, see Olson and Placchetti 2015).

Other problems have been related to the hardware, and such issues have resulted in logistical complexities. A major problem with iPads at Malloura has been the reflective sun glare, which makes typing in the trench extremely difficult (FIG. 13; cf. Fee *et al.* 2013: 53; Roosevelt *et al.* 2015: 334). Moreover, our supervisors (in recorded team discussions) complained that the iPads frequently overheat, rendering them unusable for approximately 20% of a typical workweek. Both of these hardware issues have affected the devices’ usability and have often forced supervisors to leave their trenches to work under a sunshade. Despite these complications, our supervisors unanimously argued that the tablets’ benefits—especially image annotation and the ability to multitask and create an illustrated daily narrative—outweighed hardware issues, allowing them to craft descriptively richer trench interpretations.

Conversely, one of the main benefits of adopting hybrid-paperless workflows has been the enhancement of AAP’s goal of training undergraduate students in archaeological methods. Yet, unlike projects like Gabii (Opitz 2015), our students (as opposed to graduate trench supervisors) do not employ digital workflows in their own recording. This was a deliberate decision since we felt strongly that students need to learn the traditional methods of field recording before being confronted with digital ones. As stated by Caraher (2015),



Figure 13: AAP trench supervisor Kevin Garstki (left), director Michael Toumazou (center), and associate director Derek Counts (right), examine an image on an iPad.

“archaeological skills are grounded in archaeology, not the attendant technologies relevant (or even vital) to the field” (see also Bria and DeTore, Ch. 1.5). Although our field school undergraduates often do data entry on their supervisors’ tablets, our methods still concentrate on providing undergraduates with a thorough training in excavation techniques, which involve recording daily notes in paper-based journals and drawing sketches of objects and trench plans.

For our graduate student supervisors, however, gaining competence in technological tools that improve on-site data collection and analysis are now key parts of their archaeological training. Given the increasing ubiquity of paperless workflows in archaeology, such experiences prepare students for future projects where mobile devices will be standard tools. Utilizing digital devices helps students to “think digitally.” By becoming proficient with apps, databases, and devices, our graduate students, like the students at PIARA (Bria and DeTore, Ch. 1.5) or Gabii (Opitz 2015), gain transferable, technical, and critical thinking skills (see also Burdick *et al.* 2012: 132–134) that can be used for intra-site archaeological analyses and that are widely used in careers outside archaeology. Although most AAP supervisors were literate with mobile devices *before* they used them on-site, one of our supervisors stated that she “learned about how multiple apps can be successfully utilized to solve problems.” Overall, such competencies are valuable in the Information Age where archaeological careers are in short supply and nearly every profession requires some ability to organize, analyze, and visualize data within a digital framework.

Lastly, despite the project’s educational successes, this case study of AAP’s experiment with paperless archaeology also reveals some pedagogical issues. First, some aspects of a born-digital process take more time for training than a six-week field season allows. As discussed, digital drawing, relational database creation and management, and data storage maintenance are three areas that are too difficult to teach supervisors rapidly (although cf. Wallrodt’s creation of “homework” exercises for supervisors learning app-specific skills on his *Paperless Archaeology* blog). Another issue is that some students do not immediately grasp how digital recording improves traditional paper-based tasks. As many projects have argued about communication (Motz 2015; Opitz 2015), students need to be informed of the entire digital workflow—either through protocols, meetings, or classes—so that they understand how the digital process enhances archaeological

work. A related issue is that some staff members—especially from the pre-mobile computing generation—resist using the technology, even as younger students are urged to adopt it (Zubrow 2006: 13; Caraher 2015). Although such resistance to technological change is common throughout history (for resistance to digital humanities, see Greetham 2012), such disunity can have an effect on team-based learning goals as students question the validity of technology adoption and use.

MAKING HASTE SLOWLY WITH PAPERLESS ARCHAEOLOGY AT AAP

The adoption of a hybrid-paperless, on-site workflow at AAP can be deemed a success because it has enhanced our project goals of understanding the Cypriot past and educating students in archaeology. In addition, it has underscored the efficacy of DIY digital archaeology. Like other projects, AAP operates within specific logistical parameters with regard to funding, staffing, and research—parameters developed over 25 years of experience. Our experience has shown that based on a careful decision making process, certain technologies and workflows can be employed that are both cheap and user-friendly, and they may provide better ways of understanding Malloura's complex stratigraphy.

When compared with the experiences of other archaeological projects engaged in implementing born-digital workflows, AAP has encountered similar benefits and problems. One observation is that there are many ways to engage in digital archaeology: from complete bespoke systems like TooWaste (Serrano and Martinez 2014) and FAIMS, to fully digital DIY systems like those employed at Kaymakçı Archaeological Project (KAP; Roosevelt *et al.* 2015) and PARP:PS, to mixed DIY systems like those used at PIARA, PKAP, or AAP. It is also apparent that all methodologies seem to have their pros (e.g., providing students with new digital skills and potentially collecting more and better data), as well as their cons (e.g., possibly de-skilling archaeological practitioners and creating a data “deluge” that still has to be studied by subjective human interpreters; see Bevan 2015). Yet, one thing that is becoming increasingly clear is that a shift is occurring in archaeology as the portability, durability, and utility of mobile devices affect archaeological practices (Gordon *et al.*, Introduction). Projects can choose to engage with this shift or not. As the chapters in

this volume illustrate, however, change is in the air, and it will arguably affect the way students learn and researchers *do* archaeology for many years to come.

Given this fluid atmosphere of change, it is important for projects like AAP to share their experiences while learning from others so that best practices can be developed that enhance paperless archaeology's power to interpret humanity's past and guide its future. Furthermore, by comparing its methods to those of other projects, AAP can continue to improve its engagement with paperless archaeology. For example, inexpensive improvements, such as the adoption of blue-tooth/or Wi-Fi-enabled digital cameras capable of geo-tagging (like the Samsung Galaxy cameras used by KAP; Roosevelt *et al.* 2015: 334), might improve the quality of image annotation in iDraw. In addition, creating bespoke forms in FileMaker (e.g., Motz and Carrier 2013: 26–27), using customized apps like PKAP's PKapp (Fee *et al.* 2013: 51–53) or Codifi (created by the Center for Digital Archaeology in partnership with the Jezreel Valley Regional Project; see Prins *et al.* 2014: 195–197), or testing an online app like Evernote (Fee *et al.* 2013: 53; Roosevelt *et al.* 2015: 335) for recording excavation narratives might improve the organization and quality of the digital notebook. Alternatively, future project grant proposals could center on procuring funds for enhancing AAP's digital workflow through the creation of a local area (or even relayed) network at Malloura (cf. Roosevelt *et al.* 2015: 332–333), the further development of AAP's Web-based database (Koo *et al.* 2013), and the development of a holistic plan for long-term, open-access, online data sharing and digital data stewardship (Kansa *et al.* 2007; Morgan and Eve 2012; Ashley 2015). As a project and team, we look forward to improving our workflows in reflexive ways that both intersect with innovative developments in digital archaeology and enhance the goals of our project.

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<https://mobilizingthepast.mukurtu.net/collection/14-diy-digital-workflows-athienou-archaeological-project-cyprus>

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