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## 31 Greek and Roman Ceramic Producers: Operational Knowledge and Networked Mobilities

As the contributions in this volume clearly demonstrate, the study of Ancient Greek and Roman ceramics continues to flourish, improving our understanding of the workshop crew (potters and painters), and their work in all sectors (roof tiles, terracottas, plain and figured pottery) and periods (Archaic/Orientalizing, Classical, Hellenistic, and Roman) of the ceramic industry in various Mediterranean regions, including Attica, Laconia, Corinthia, the Cycladic islands, Magna Graecia and Sicily. Inspired by Social Network Analysis, we make an attempt to visualize below as a knowledge graph the various aspects of ancient life that ceramics shed light on. In this way we can better appreciate how the materiality of ceramics helps understand ancient communities and their technological, social, and economic perspectives, from workshop-level to intraregional and overseas levels (Fig. 1). The 29 papers in this volume represent two thematic horizons: a) how workshops developed a highly sophisticated operational knowledge, and b) how they, along with distributors and customers, maintained equally sophisticated networks for trading their wares, and for shaping and responding to customers' preferences at home, away from home, and while traveling.

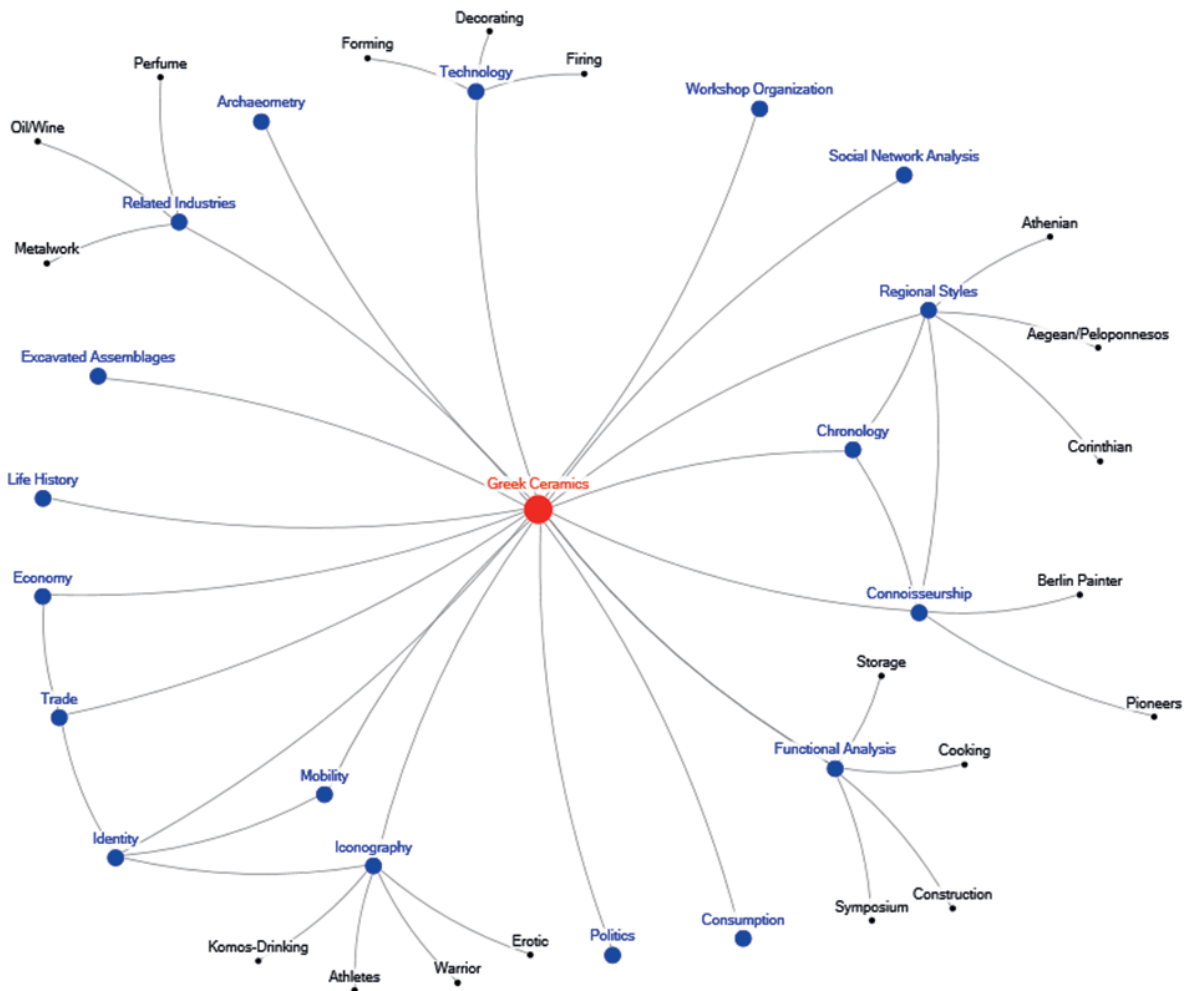


Fig. 1: Knowledge graph of select themes connected with the study of Greek ceramics. The nodes in black are listed only as examples. © Eleni Hasaki.

## Operational Knowledge of Ceramic Production

The requisite knowledge underlying the *chaîne opératoire* in ancient pottery workshops was immense. All stages were of paramount importance: the tilemakers, coroplasts, vase potters and painters must have developed quality control tests for different stages including shaping, modeling, painting, drying, firing, and even repairing their artifacts. Papers in this volume highlight some of the most challenging aspects of the manufacturing process: slight changes in the colors of raw clays that become evident during the drying process (De Natale *et al.* through the case study of the Teanum Ware); changes in weight and size both during the drying and the firing stage; fingerprints on roof-tiles (Giuliano); and the appropriate method for assembling in terracotta figurines and models to ensure that the ceramic object had undergone appropriate drying (Meirano). Any miscalculations, whether due to impatience or to inexperience, would have incurred the wrath of Omodamos (Conqueror of the Unbaked) in the kiln.<sup>1</sup>

The shelves and rows for drying vases in the pottery workshops at Pompeii underscore the importance of this phase (Cavassa *et al.*). It is interesting to consider whether workshops developed specific types of drying supports, perhaps similar to those for stacking in the kiln to ensure that all areas of the vases were adequately and evenly dried. The diversity of kiln supports – from Metapontum, Locri, Syracuse, and now Selinous – show how critical it was to stack the kiln with the appropriate spacers and supports. Tools for firing like tools that would have been used inside an ancient workshop are rarely recovered during excavation. The ones from the Kerameikos of the Greek colony of Selinous (Adorno) serve as bridges (or ‘edges’ in network terms) between artifacts and the hands of ancient craftspeople. From fingerprints to tools to drying shelves, to volumes of production we can better approximate the scale of production of vase-painting workshops both in Western Greece and in Athens (Sapirstein), one of the largest mainland Greek ceramic industries in the Archaic and Classical Mediterranean.

The production lines of pottery workshops may not correlate to the strict scholarly and strict divisions of slipped (glossed) and figured pottery. The workshops of slipped pottery may have diversified their production to attract customers from all economic strata and to satisfy their differentiated needs. The glossed equivalents of many figured shapes in the Athenian Agora reveal a blossoming industry of black-gloss ceramics (Lynch). Improving the composition of the slip and its application (through better tools and techniques) on those pots in turn led to advances in the decoration process of figured pottery, as the slip still constituted the primary background of the exterior (and interior) surfaces for the figural compositions. As some efforts are already under way to identify the potters who produced both slipped and figured pottery (Lynch, Silvestrelli), the increasing use of profile drawings in publications of figured pottery can help detect the potters.

Many papers in this volume deal with well-known artisanal personalities responsible for potting and painting in their respective corpora: Euphronios and Euxitheos (Hasaki); ΣΩΣΗΝΟΣ (Giuliano/Montana/Portale *et al.*); Pisticci, Amykos, Dolon, Creusa and Anabates Painters in Metapontum (Silvestrelli); Locri Group and other local artisans from Locri Epizephyrii (Elia *et al.*); Himera, Santapaola, Chequer, and Dirce Painters from Sicily, Painter of the Geneva Orestes and Assteas from Paestum (Serino). But the distinguishable ‘hands’ tell only part of the story and detailed reconstructions of the broader workforce in the Athenian Kerameikos have started shaping the sector(s) of the decorated pottery, not just those who dominated the ancient markets and modern scholarship. The case of Nikosthenes and his wider circle of collaborators (Sapirstein) represents a real and symbolic bridge between the Greek and Roman spheres of ceramic production and overseas marketing.

## Layers of Technological Evidence: Between Materiality and Intangible Timetables

In the case of figured pottery, the advanced protocols of archaeometry (Mangone *et al.*) and diagnostic imaging with digital microscope have magnified (literally and metaphorically) the complexity of building up the figural composition, and how painters carefully planned the application of successive layers of treatment, whether this was the preliminary sketch, the background slip, the *mitos*, or the added colors (Elia *et al.*, Portale/Chirco, Serino). Thanks to experimental archaeology we can appreciate the experience of such layering, especially when the pre-firing coloring effects created much less contrast prior to firing (Hasaki, Serino). Such technical ‘stratigraphies’ lengthen and deepen the knowledge involved in the *chaîne*

<sup>1</sup> Hasaki (2021), (2024).

*opératoire*, especially when one adds the important element of time, and the intervals between all stages and micro-stages of craft manufacturing. The dimension of time needs to be further emphasized, not only the broader time commitment to acquire and master the knowledge of each manufacturing stage, but also the more specific, workshop/based, timetable of organizing the workflow.<sup>2</sup> The sequence of layering could point to specific workshops; scholars have recently used this information to revisit older attributions (Portale/Chirco) or to better define the technological features of a workshop and their affinities, or even the different procedures adopted by different workshops that can help us better identify the various production traditions.

The operational knowledge becomes even more complex when a workshop sets out to create ‘imitations’ of a non-local shape. Western Greek ateliers imitated amphoras from mainland Greece, Cumaean workshops developed several lines of Ionian-inspired shapes, from chalices to neck amphoras, and Locrian workshops produced variants inspired both from Athens and from their neighboring potting cultures in Magna Graecia (Ercolin *et al.*). Several ceramic ‘*koinai*’ had been developed and it is interesting to consider these local variations as constant reinforcers of their original cultural identity as pots and people moved around the Mediterranean. In terms of local production and local imitation of other productions, the case of Cuma in Magna Graecia and its Ionian cups, as well as that of Fregellae in Southern Lazio (Borgers/Diosono), can clearly demonstrate how the world outside the workshops is much more complicated and intricate, and that the dynamics of movements (not necessarily of people, but also of knowledge or even specific technological, morphological or aesthetic features) can be extremely fluid and eclectic (Di Virgilio). A similar vein can be seen in the case study of East Greek influences on Attic black-figured pottery, which also involves the analysis of clients and trade networks (Attout).

Archaeologists have developed strong interdisciplinary research agendas to recapture the complexity of that operational knowledge. First, archaeometry and computational imaging have been successful in extracting valuable information from the objects themselves and help us reconstruct the choices of ancient potters, coroplasts, and tile makers (D’Acri, Elia *et al.*, Ercolin *et al.*, Giuliano *et al.*, Mangone *et al.*, Serino). The archaeometric analyses through the elemental ratios in clay matrices have decoded what M. Rockman has termed “landscape learning” highlighting the agency of local communities of practice in understanding deeply their environmental resources “their fluctuations, their potentials, and their carrying capacity.”<sup>3</sup> While this was previously discussed within the framework of ceramic ecology, Rockman’s term allows for a wider applicability to several crafts.

Second, ethnoarchaeology and experimental archaeology have also been successfully integrated in research agendas. A rich but largely underutilized source of knowledge is the active community of modern artisans in several Mediterranean areas involved in the reproduction of ancient vases. Many of these artisans are involved in long-standing research and outreach collaborations with academic institutions and museums.<sup>4</sup> They often receive commissions by museums to produce replicas from museum for educational programming. These replicas generate great momentum: they help the artisans expand their skills, enable museums to offer tactile experiences to their visitors, and create opportunities for curators and archaeologists to develop interdisciplinary research projects for museum collections.<sup>5</sup> Experimental archaeology can really help us recognize various levels of technological knowledge, and thereby assisting archaeologists’ initial assessments of excavated materials. Archaeometry-based ‘hard science’ must be accompanied by handicraft-based wisdom and experience: the combination of the two approaches can truly advance our research (Cavassa *et al.*, Hasaki, Serino), as recent experiences with Cerveteri-based Roberto Paolini can well demonstrate.

Within the framework of the A.G.A.T.H.O.C.L.E.S. project R. Paolini completed guest artist residencies at the Laboratory for Traditional Technology of the University of Arizona and at the *Officina della ricerca e della Didattica* of the University of

<sup>2</sup> See the project “*Energetics of Potters and Painters in Ancient Greece*” discussed by E. Hasaki in this volume.

<sup>3</sup> Rockman (2003) 5. Also, Rockman (2012). This term can be useful for studying a variety of Mediterranean crafts and it has been successfully applied to the esparto basketry craft for the imperial Roman mining industry by Gosner (2021). Our warm thanks to L. Gosner for introducing us to this concept.

<sup>4</sup> Drawn from our experiences, we highlight Thanassis Katsaras from Eleusis who developed several educational programs for academic audiences and general public for the celebration of his hometown as Cultural Capital of Europe and created unique replicas of Protoattic amphoras at the Eleusis Museum. Dima Romanciuc and Maria Skliri-Starfa along with potter Dimitris Boutsalis held live demonstrations numerous times in the International Museum Day at the Archaeological Museum of Ancient Corinth bridging ancient and contemporary practices. As part of the dissemination strategy of the A.G.A.T.H.O.C.L.E.S. project, Roberto Paolini participated both in the European Research Night (2023 Edition) in Turin, and at a conference in Syracuse, at the Museo Archeologico Regionale “Paolo Orsi”, with two different ‘live painting’ sessions.

<sup>5</sup> As an example, A.G.A.T.H.O.C.L.E.S. collaborator Roberto Paolini has created commissioned vases like the Pyrgi Phiale (Rome, Villa Giulia Museum, inv. no. S13B-V6.; by the Brygos Painter; BAPD 23670), the Sarpedon krater (Cerveteri, Archaeological Museum, inv. no. 145139; by Euxitheos and Euphronios), for the Metropolitan Museum of Art and others. We thank Professor Guilia Rocco for further information on the Pyrgi phiale.

Turin in Spring and Fall 2023. He worked in tandem with archaeologists in both universities to decorate and fire a group of shapes in 1:1 scale from Corinth and Athens in black-figured, red-figured, and bilingual techniques and three South Italian red-figured vases (calyx krater, skyphoi, and lekane). The research questions included the time sequences of the manufacturing stages and the different gestures and types of coatings, including *miltos* in red-figured production (Fig. 2).<sup>6</sup>

### Mediterranean archaeology offerings help students 'rehumanize the past'

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By Kyle Mittan, University Communications  
June 21, 2023

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Roberto Paolini, an artist from Cerveteri, Italy, uses a brush to apply red clay onto a vase modeled after an ancient southern Italian vessel. Paolini, who is one of only a few artists today who practice the ancient style called red-figure vase painting, visited campus in April to demonstrate the craft for [University students](#).

By: [Mittan/University Communications](#)



**Fig. 2:** Roberto Paolini at work: (a) University of Arizona News on the workshop held at the University of Arizona with Roberto Paolini working on a South Italian krater (A.G.A.T.H.O.C.L.E.S. project). Photo: Kyle Mittan; (b) Selection of Athenian and Corinthian shapes made at the LTT (*Energetics of Potters and Painters in Ancient Greece* project) Lab. Photo: Eleni Hasaki; (c) Roberto Paolini working on a South Italian lekane's lid at the *Officina della didattica e della ricerca* of the Department of Historical Studies, University of Turin; (d) European Research Night (Edition 2023) with live vase-painting by Roberto Paolini in the framework of the A.G.A.T.H.O.C.L.E.S. project (Giardini Reali, Turin). Photo: Marco Serino.

## Networked Mobilities of Ceramic Workshops

The importance of specialized knowledge did not end in the technological realm. Pottery workshops and trading intermediaries had to capture the pulse of the market both at home and abroad. Trade networks, can shape and are influenced by a wide spectrum of factors relating to the choice of peculiar iconographies (Stansbury O'Donnell) or factors relating to technology, especially when a market leader industry spread in the Mediterranean (Klebinder-Gauß). Through trade networks we can trace migration of people/transfer of knowledge, following specific (sometimes hidden to the naked eye) technological procedures (Charalambidou, Di Virgilio, Serino) and we can better appreciate the power of such networks to connect markets with people (Attout, Delahaye, Mees).

The networked mobilities include the trading mechanisms that further underscore the concept of 'movement' we discussed in the introduction of this volume. Mobilities and overall 'movements' are keywords that cover trade markets (Klebinder-Gauß, Stansbury O'Donnell) and migration of people/transfer of knowledge of workshop's procedures and technological strategies, in the entire Mediterranean Sea as a network platform (e.g., Charalambidou, Gassner on amphorae). From this wide perspective, it is possible to follow the movements of iconographies in red-figured pottery and the specific market demands from indigenous people in Apulia (Stansbury O'Donnell), which implies cultural and mercantile links in an almost restricted area between Lucania and Apulia (Magna Graecia). Magna Graecia and Sicily are the geographic focus of the artisanal production techniques related to the coroplastic world: this case study demonstrates the

<sup>6</sup> All vessels were made by M. Patarino, a Cerveteri-based potter. Among these vases we highlight a bilingual amphora, at a slightly smaller scale than the original (Boston, Museum of Fine Arts, inv. no. 99.538; attributed to the Andokides Painter/Lysippides Painter), a red-figured South Italian calyx krater (Syracuse, Museo Archeologico Regionale "Paoli Orsi", inv. no. 47102; attributed to the Prado-Fienga Group), two different versions of the red-figured skyphos by an early Sicilian workshop – (Boston, Museum of Fine Arts, inv. no. 03.834; attributed to the Chequer Painter) –, and a lekane by the Locri Group (Private Collection: Elia (2010) FR 18).

importance of hand modeling and the various strategies of clay manipulations that spread in Southern Italy, and how they can help to recognize regional trends and specific local markets demands (Meirano). These movements reflect the products' performance and consumer preferences in several communities whether in the long-established Western Greek cities or among the transient trading crews crisscrossing the Mediterranean and carrying a memory of home along on their travels (Attout).

Movements of pottery in trade markets are not only a matter of fine and figured vases; even cooking pottery can be the focus of exchange dynamics, if it has a peculiar fabric and it is supported by a strong and well-organized system, as the case of Aegina can demonstrate (Klebinder-Gauß). Movements entail not only a displacement of objects, but also of people, and of technological knowledge from one place to another. One can see mobilities of potters for coarseware in Iron Age Cycladic Naxos and Sicilian Naxos (Charalambidou); in Classical times, similar mobilities appear in the wide interconnections persisting both in terms of temporary relocation to enable workshop's collaborations and in permanent migration to another area between Magna Graecia and Sicily. The dynamics of these short- or long-term mobilities are presented in case-studies from Sicily, Lipari and the Tyrrhenian coast (Serino), and Locri Epizephyrii (Elia *et al.*), underscoring the Mediterranean networks of knowledge at work. Tile makers were also part of these mobilities as the 3<sup>rd</sup> century B.C. ateliers in Reggio Calabria demonstrate with the stamped tiles produced by the workshops of ΣΩΣΗΝΟΣ (Giuliano/Montana/Portale).

As they research the operational and networked knowledge of ancient producers, distributors, and customers, scholars now have powerful databases to aid in discerning trends and capturing nuances of ancient objects. The digital world also brings alive the ancient world of ceramics—whether through fascinating virtual reconstructions of workshops based on the archaeological records from excavations (Cavassa *et al.*, Xavier de Silva), or through restoration of the pottery itself, such as the case of the Apulian volute krater with iconography that can be 're-read' thanks to a virtual restoration of the entire scene (Tonna). The digital world can be also placed in a wider perspective, as the team publishing the two

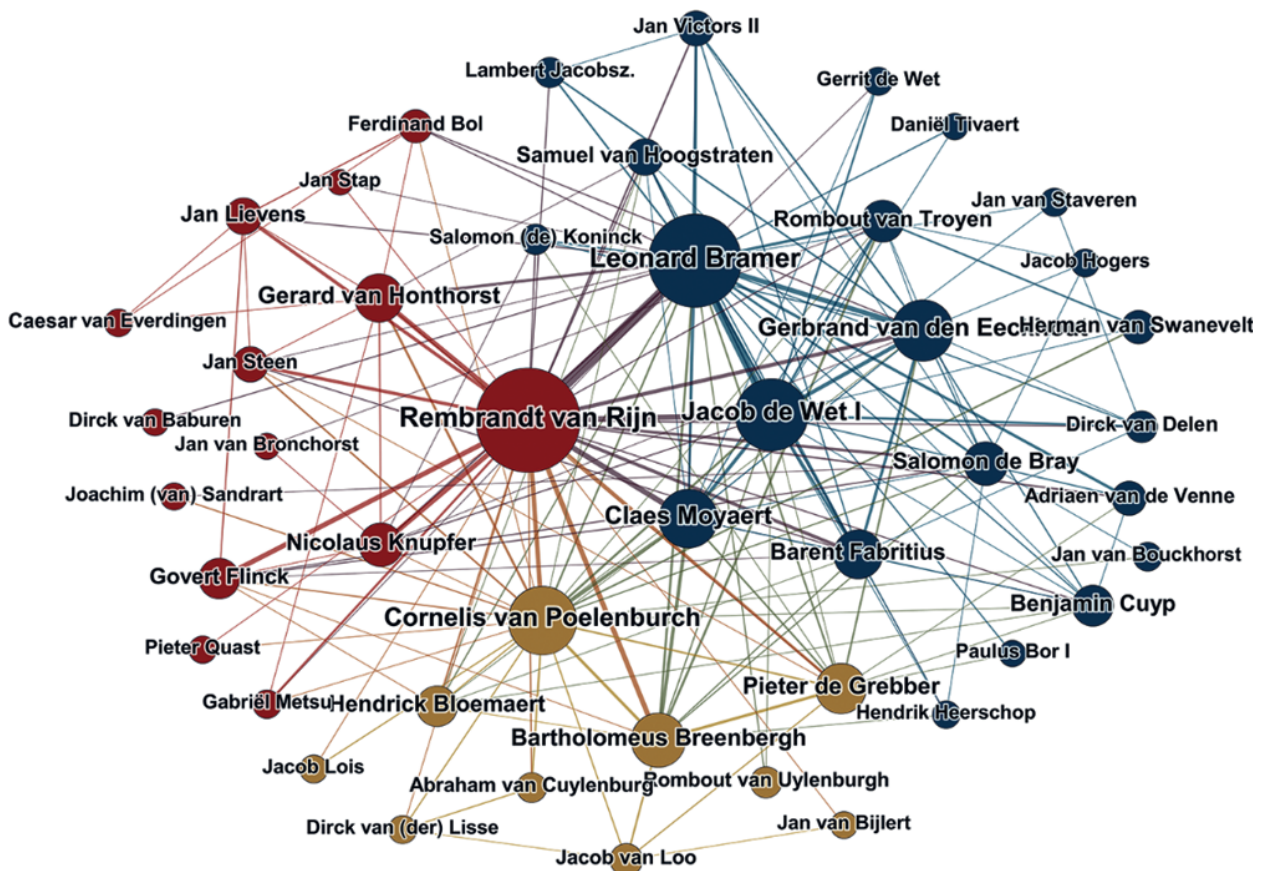


Fig. 3: Network of Dutch artists between 1620 and 1650, linked by at least three mutual subject matters. After Li (2021) 228 fig. 6.

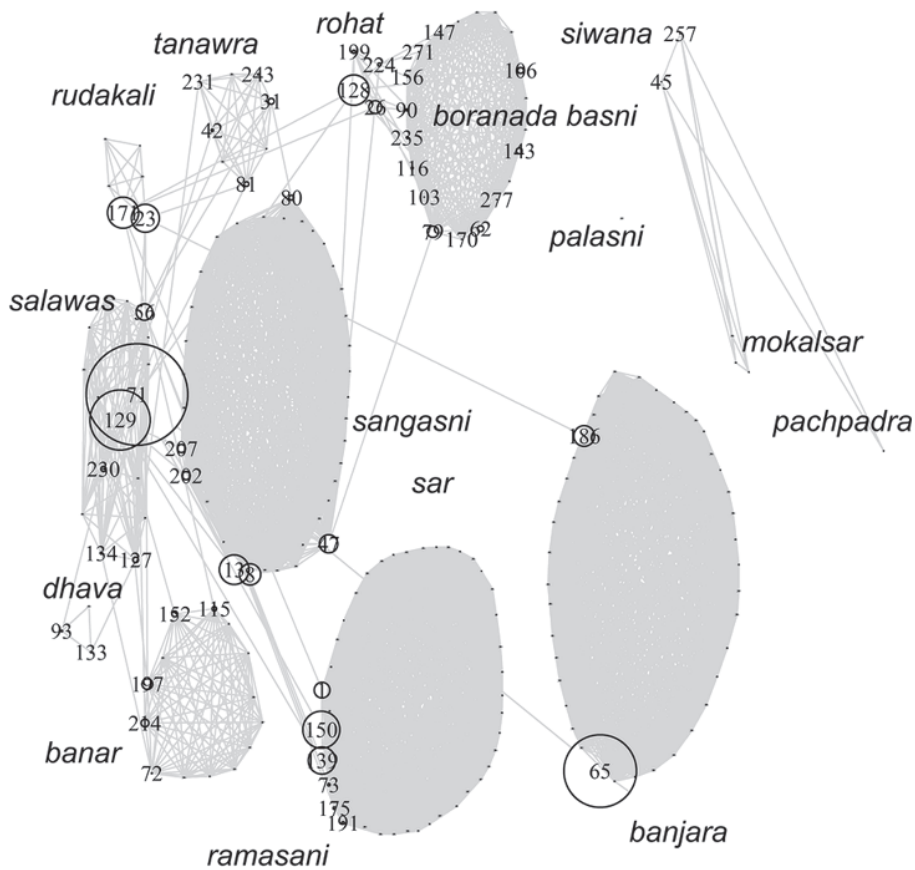


Fig. 4: Kinship ties among Muslim potters in Rajasthan. After Manzo *et al.* (2018) 1124, fig. 3.

workshops at Pompeii (Cavassa *et al.*) have done by adopting a multi-sensory immersion approach and connecting the tangible (and real) experience of the experimental archaeological sessions with the virtual reconstruction of a Pompeian workshop. Artificial intelligence (AI) will only advance existing processes and the potential of digital restorations.

Institutions and museum worldwide have made great strides in making their information and collections available online and facilitating inquiries on a larger scale. The open source format of those databases removes barriers of accessibility. The *Kerameikos.org* project represents 10 years' worth of metadata efforts to standardize and link separate databases. Consistency in terminology across collections is a major goal of this important project (Smith/Gruber/Harokopos).<sup>7</sup> Consistent terminology for descriptions of iconography is an especially desideratum for developing networks of iconographical themes. The full potential of this kind of standardization can be seen, for example, in networks of shared iconographies for Dutch paintings (Fig. 3).

The team led by G. Olcese (Olcese *et al.*) has undertaken a major project (*Immensa Aequora*) involving large datasets related to amphorae reaching Ostia, Rome's port. In connection with the research project on the amphorae and its link with a web-based information system, it is worth mentioning the FACEM project and its eighth release, with over 300 fabrics which highlights the importance of the fabric with the support of good images and archaeometric data that allows users to engage in analysis of distribution patterns and exchange modalities (Gassner).

<sup>7</sup> For example, even in describing iconography is a desideratum for developing networks of iconographical themes. The full potential of standardized iconographical terms can be seen in networks of shared iconographies for Dutch paintings Li (2021). This could revolutionize preferred themes among contemporary artists, or regional preferences, and or chronological distributions. See also Eleni Hasaki and Diane Harris Cline (2022); digital poster: Network Visualizations of Beazley's ABV and ARV Datasets: The Shape Sectors and Influential Artisans in the Athenian Kerameikoi (<https://www.carc.ox.ac.uk/XDB/DMS/Hasaki%20Cline%20Oxford%202022%20final2.pdf>; last access 03.06.2024).

Gradually our queries, relying on so many types of evidence (textual, epigraphical, stylistic, archaeometric, to name a few) will be best captured by knowledge graphs with incorporated ontologies (Smith/Gruber/Harokopos).<sup>8</sup> Quickly-generated results from statistical, digital, and other online applications are helpful but need always to be examined critically by archaeologists involved in such projects who will provide the necessary contextualization and the discussion of qualitative data along with the quantitative data. Another crucial aspect in data visualizations (whether graphs or network sociographs) is traceability and the ability to go back to the raw data.

From old data to contemporary data, archaeologists conducting ethnoarchaeological work in large potters' communities, continue their work of mapping social relationships among subgroups. Following Malkin's middle ground approach that a network could either simply be a metaphor or be the network of network theory, or both,<sup>9</sup> we have adopted different nuances of 'network approaches' in this volume. Networks have been discussed for the connections between Laconian pottery, Crete, and the whole Mediterranean area (Delahaye), for the hypothesized migration of red-figured painters from Sicily to Magna Graecia and vice versa (Serino), and for the production and marketing of terra sigillata (Samian ware) in the Roman empire, as explored by mathematical models (Mees). Drawing again on ethnoarchaeology, as for the operational knowledge, we can also turn to Social Network Analysis of contemporary potters' communities. A recent analysis of "emic" kinship ties and apprenticeship ties among potters of different religious groups in Rajasthan reminds us how differently (or similarly?) our etic stylistic ties in classical scholarship based on connoisseurship may map on ancient social relationships (Fig. 4).<sup>10</sup>

All of the contributions to this volume have allowed us to zoom in and out from local to Mediterranean horizons, and from individual makers to consumer communities. The authors have presented new material and have revisited known artifacts from new angles. From the digital microscope to networks of South Italian vases, and thanks to collaborations with artists, chemists, physicists and digital humanities specialists, these scholars have emphasized the importance of interdisciplinary collaborations, in a way creating modern networks of investigating teams to capture the dynamics of producers, promoters, and purchasers of ceramics in the ancient Greek and Roman world.

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<sup>8</sup> Dörpinghaus *et al.* (2022).

<sup>9</sup> Malkin (2011) 16. The attitude of mobility in the ancient Mediterranean world was explored by Horden/Purcell (2000) and, especially in relation to the Greek world, by Malkin (2011): both were inspired by the Graph theories and network theories and they can be considered the main pillars for subsequent studies on network topics.

<sup>10</sup> Li (2021); Manzo *et al.* (2018).