Archeologia e Calcolatori
36.2, 2025, 131-137
doi 10.19282/ac.36.2.2025.11

A REVIEW OF TWO RECENT VOLUMES ON ARCHAEOLOGICAL NETWORK RESEARCH

The study of network science in archaeology has emerged as a promising and dynamic field, offering innovative tools and methodologies to analyze the past in its diverse components. The recent publication of *Network Science in Archaeology* (edited by Tom Brughmans and Matthew A. Peeples) and *The Oxford Handbook of Archaeological Network Research* (edited by Brughmans, Barbara J. Mills, Jessica Munson, and Peeples) marks a significant milestone in the development of this interdisciplinary area of research. These two volumes provide complementary insights, and they were likely intended to be published in the same year, 2023. Notably, the *Handbook* is listed in the bibliography of *Network Science in Archaeology* with a 2023 publication date, even though it was officially published in 2024.

Archaeological network research holds considerable promise, as it enables scholars to structure and investigate large-scale relational phenomena that have historically been difficult to analyze using traditional methods. The ability to map and explore connections – whether social, economic, or ecological – provides a new framework for addressing both longstanding and emerging questions in archaeology. By emphasizing relationships between elements, this approach allows researchers to move beyond isolated artifacts or sites and instead focus on the broader patterns and systems that shaped past human behavior. Indeed, one of the most compelling aspects of network science in archaeology can be considered as its versatility. The methodologies introduced in these volumes can be applied to a wide range of periods and regions, from prehistoric societies to more recent historical periods. The flexibility of network analysis allows archaeologists to investigate relationships and interconnections across diverse datasets, whether these involve material culture, social interactions, trade routes, or spatial arrangements. Furthermore, by examining the intricate web of connections that characterize these systems, network research offers a unique lens through which to understand how change occurred over time and how it was influenced by the flow of information, resources, and people.

Network Science in Archaeology offers a comprehensive and accessible guide to the application of network science within the field of archaeology. This work is particularly focused on helping archaeologists navigate the often complex process of turning archaeological questions into actionable network data, performing analyses, and generating meaningful results. While network science offers a set of powerful tools for exploring relational phenomena, the

editors stress the importance of aligning these tools with relevant theoretical frameworks. Network science in archaeology, as presented in the book, is not just a set of methods, but a theoretical perspective that offers new ways of thinking about relationships between entities, such as social connections, trade routes, or communication networks.

One of the key strengths of this volume is its practical focus also. The editors and contributors emphasize the hands-on application of network science tools, offering step-by-step guidance on how to collect, manage, and analyze archaeological network data. Through a variety of methods, including exploratory network analysis, network visualization, and spatial network analysis, the volume teaches how to explore and represent complex data sets, even though the mathematical and statistical content is kept to a minimum and relegated to appendices, making the volume more user-friendly for those less familiar with complex quantitative techniques. Furthermore, the Online Companion to the volume further enhances its usability. Accessible through a dedicated website (https://book.archnetworks.net/), the companion includes downloadable datasets and R code that demonstrate the application of the network science methods discussed in the book. This feature allows readers to replicate examples, explore datasets, and experiment with the methods on their own, providing a hands-on learning experience that reinforces the concepts presented in the text.

Chapters 1 through 3 lay the groundwork for the entire volume. Chapter 1 (pp. 1-25) introduces the theoretical underpinnings of network science, explaining how it fits into archaeological research. The focus here is on demonstrating how network science can be both a methodology and a theoretical framework for understanding past relational phenomena. Chapter 2 (pp. 26-63) reviews the primary applications of network science in archaeology, such as the study of social networks, transport systems, and exchanges. Chapter 3 (pp. 64-102) defines network data, providing the foundational knowledge required to handle and manipulate them in the context of archaeological research. The subsequent chapters – 4 through 7 – serve as more technical guides. They focus on practical applications and methodologies in network analysis, including exploratory analysis, uncertainty quantification, visualization techniques, and spatial networks. These chapters provide clear guidance for archaeologists looking to incorporate network methods into their research, offering both conceptual explanations and practical advice for implementation.

For example, Chapter 6 (pp. 196-236) on network visualization discusses how to graphically represent complex networks to better understand relationships between elements in archaeological contexts. Chapter 8 (pp. 263-280) returns to a critical theme introduced earlier in the volume: the relationship between method and theory. The authors argue that network

science in archaeology should not be applied in isolation from the theoretical perspectives that drive its use to ensure that the insights generated are meaningful and contribute to broader understandings of the past.

Complementary to the manual in many respects, *The Oxford Handbook of Archaeological Network Research* is the first comprehensive and authoritative reference work that explores the application of network science in archaeology. The introductory chapter, authored by Matthew A. Peeples, Jessica Munson, Barbara J. Mills, and Tom Brughmans, provides an overview of the role of network research in archaeology. It discusses the evolution of the field, the increasing adoption of network approaches, and the potential of network science to address archaeological questions (pp. 1-11). The chapter also outlines the structure of the volume, which is composed of ten thematic parts, each containing several chapters that address different aspects of archaeological network research.

The section on *Archaeological Networks in Practice* (Part I, pp. 15-83) lays the methodological and theoretical groundwork for network research in archaeology. Clara Filet and Fabrice Rossi present the diversity of the methods most frequently applied in archaeology and to introduce the basic properties of graph theory mobilized by these approaches (pp. 15-33), while Matthew A. Peeples, John M. Roberts Jr., and Yi Yin discuss challenges specific to archaeological network research, such as data limitations and interpretative uncertainties (pp. 33-49). Benjamin Bach and Mereke van Garderen explore advancements in network visualization, emphasizing the need for effective representation of archaeological networks (pp. 50-66). Per Östborn and Henrik Gerding address some challenges related to the definition and exploration of spatial single mode networks inferred from archaeological data, with the aim to introduce a mode of thinking about archaeological network analysis (pp. 67-83).

The section on *Material Culture Networks* (Part II, pp. 88-161) investigates how networks can help analyze material culture and culture change. Jennifer Birch presents concepts and cases focusing on temporal and material dimensions of culture change as investigated through social network analysis (pp. 87-102), while Elliot H. Blair discusses a selection of case studies and a series of issues, related to the process of abstraction and representation that are required to generate meaning from archaeological material culture similarity networks (pp. 101-116). Daniel Sosna examines networks within mortuary archaeology (pp. 117-131), and Mark Golitko introduces the definition of 'geochemical' network as «any archaeological approach that combines geochemical information on artifacts with methods drawn from network science/analysis to examine the structure or dynamics of ancient exchange and interaction» (pp. 132-148, p. 132). Sarah M. Griffin and Florian Klimm discuss the application of network methods to museum collections, focusing

on the Met's collection illustrating how digital and physical archives can be interlinked (pp. 149-161).

The section on *Geographical Networks* (Part III, pp. 165-263) starts with Diego Jiménez-Badillo's discussion on several models for network retrieval with specific characteristics, focusing especially on the concept of relative neighborhood (pp. 165-185), while Ray Rivers, Tim Evans, and Eleftheria Paliou discuss gravity models, debating the approach of MaxEnt (maximum entropy) that lends itself naturally to networking (pp. 186-199). Irmela Herzog examines transportation networks and least-cost path (LCP) models (pp. 200-216). Mu-Chun Wu applies space syntax and pedestrian modeling techniques to facilitate studies of social-spatial phenomena from a spatial network perspective (pp. 217-229), whereas Zoran Čucković focuses on visibility networks, defined as models of explicit visual relationships between one or more observers and their visual targets (pp. 230-247). In conclusion, Eduardo Apolinaire and Laura Bastourre analyze hydrographic networks to investigate «key phenomena in archaeological research, such as large-scale population movements, the spread of ideas and material culture, exchange systems, and control over the landscape» (pp. 248-262, p. 248).

The section on *Network Simulation* (Part IV, pp. 265-307) start with Iza Romanowska's discussion on the intersection of complexity science concepts and methods and archaeology (pp. 265-279), while Wendy H. Cegielski examines the integration of agent-based modeling (ABM) with social network research (SNA) for the advancement of archaeological research (pp. 280-293). In conclusion, Viviana Amati introduces random graph models, explaining that their use in investigating archaeological data requires further investigation (pp. 293-307).

The section entitled *Biological Networks* (Part V, pp. 311-344) provide valuable perspectives on human evolution and ecological interactions. Kent M. Johnson explores the use of network analysis techniques to investigate patterns of phenotypic variation in human skeletal remains within biological distance research (pp. 331-330), while Stefani A. Crabtree and Jennifer A. Dunne examine food webs «as a type of ecological network that represents the topic interactions, or consumption links, within a community» (pp. 331-344, p. 333). The section *Text-Based Networks* (Part VI, pp. 347-426) examines the study of textual and inscriptional data through network analysis. Claire Lemercier discusses the integration of historical and archaeological network data (pp. 347-362), while Diane Harris Cline and Jessica Munson explore epigraphic networks by considering the dual nature of epigraphic evidence as artifacts and historical sources (pp. 363-377). Valeria Vitale and Rainer Simon introduce Linked Open Data (LOD) and discuss differences, commonalities and touch points of this method for publishing structured data on the web and network analysis (pp. 378-391). Allison Mickel, Anthony

Sinclair, and Tom Brughmans examine knowledge networks and the role of bibliometrics in academia (pp. 392-412), while Vojtěch Kaše, Tomáš Glomb, and Jan Fousek investigate the potential of formal network analysis for the study of religious transformations in past societies (pp. 412-426).

The section *Cultural Transmission and Human Evolution* (Part VII, pp. 429-473) starts with Valéria Romano and Sergi Lozano's analysis of primate social networks to infer patterns of human behavioral evolution (pp. 429-442); Claudine Gravel-Miguel and Fiona Coward discuss why formal network methods are difficult to apply to the Palaeolithic and suggest combining them with other approaches, especially the agent-based models (ABM) (pp. 442-458) while, in conclusion, Briggs Buchanan and Marcus J. Hamilton examine human networks and cultural transmission in hunter-gatherer societies (pp. 459-473). The section *Movement, Exchange, and Flows through Networks* (Part VIII, pp. 477-541) starts with Justin Leidwanger's discussion of maritime space approached through network thinking and analysis applied to the material culture of interaction (pp. 477-491). Barbara J. Mills and Matthew A. Peeples focus on how the study of past migrations can be conducted through network-based approaches (pp. 492-511), while Marek Vlach explore epidemiological modelling and methods of implementing it (pp. 512-527). Shawn Graham and Damien Huffer explore how digital networks, particularly social media, have transformed the antiquities trade, shedding light on illicit activities and their implications for heritage preservation (pp. 528-541).

The section *Assessing the Structural Characteristics of Networks* (Part IX, pp. 545-621) focuses on how archaeologists study the structural characteristics of networks. Matthew Pailes discusses inequality and social network analysis (pp. 545-560), while Erik Gjesfjeld examines how networks respond to catastrophes (pp. 561-572). Jelena Grujić and Miljana Radivojević debate the concept of 'archaeological culture' and explore specific community detection methods (pp. 573-592). Scott G. Ortman applies settlement scaling analysis as a form of social network analysis (pp. 593-607), and Jacob Holland-Lulewicz investigates the methodological principles and conceptual frameworks of archaeological network analysis that can help to characterize and evaluate organizational structures connecting members of different societies (pp. 608-621)

Looking Ahead and Beyond (Part X) reflects on the future of archaeological network research. Ulrik Brandes discusses the broader implications of archaeological network science, marking the importance of a data-centric approach that should be aligned with domain-specific theories to be usefully applied in empirical research (pp. 625-633, p. 626), while John Edward Terrell explores relational thinking and contingency analysis in network thinking in archaeology (pp. 634-648). Carl Knappett and Angus Mol

discuss how archaeological network studies form a point of connection for relational theories and practices (pp. 649-663), and the concluding chapter by Jessica Munson, Barbara J. Mills, Tom Brughmans, and Matthew A. Peeples summarizes the volume's most significant insights and anticipates future developments in the field, highlighting emerging methodologies and research directions (pp. 664-674).

As demonstrated in the concise review of the two volumes, network analysis can significantly enhance quantitative approaches in archaeology, and these works can be regarded as foundational milestones for future research in the field. However, to effectively integrate network analysis into archaeological research as a practical and applied method, it is crucial to stress the importance of proper methodological application and the development of a robust theoretical framework guiding its use. Only by adopting an appropriate approach can archaeological data be properly collected, organized, and analyzed to reveal meaningful results. As an emerging and promising field, network archaeology holds significant potential to transform the discipline. However, it should be introduced only after a thorough understanding of the foundational principles of archaeological research has been established. In this regard, a professional master's program could provide an optimal framework for advanced study and training, enabling students to first develop proficiency in traditional archaeological methods before engaging with more complex and innovative approaches such as network analysis.

In Italy, one of the main challenges to integrating network archaeological research lies in the fact that applied digital methods predominantly consist of relevant tools like GIS, BIM, and 3D modeling. These tools are essential – particularly GIS and BIM – for managing data that supports the conservation and promotion of the country's cultural heritage by both public and private organizations. As a result, the time and resources allocated for testing innovative archaeological network research methodologies within Italian academia are limited. However, the extensive availability of datasets on the country's heritage represents a valuable resource for researchers worldwide seeking to apply network-based approaches to archaeological research, offering innovative perspectives on relational data. Indeed, as a rapidly evolving field, network archaeology holds significant potential for future discoveries and insights. Nevertheless, its long-term success, I argue, depends on a thoughtful and comprehensive educational framework that equips future researchers with the methodological and theoretical skills necessary to apply these approaches effectively.

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ABSTRACT

This paper discusses two recent volumes that significantly contribute to the field of archaeological network research: *Network Science in Archaeology* (2023), edited by Tom Brughmans and Matthew A. Peeples, and *The Oxford Handbook of Archaeological Network Research* (2024), edited by Tom Brughmans, Barbara J. Mills, Jessica Munson, and Matthew A. Peeples. Together, these works provide a comprehensive overview of current methodologies and applications of network science in archaeology, offering valuable theoretical frameworks and case studies.