Ringwalburgen in Network Perspective: Using artifact type similarity networks to study the relations between Zeeland’s ringwalburgen and trade

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Cover figure.

stylistic representation of a ringwalburg co-occurrence attribute-type similarity network (Figure by N. Passier).

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Master Thesis Applied Archaeology

Final Version

Course code: 2324-HS

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Leiden University, Faculty of Archaeology

Leiden 15-06-2024

ACKNOWLEDGEMENTS

This thesis has been a long time coming, and I would like to thank everyone who has supported me over the years.

First and foremost, I would like to thank my supervisor, Letty ten Harkel. Her support, extensive knowledge, and invaluable guidance have been instrumental not just in finishing this thesis, but also in my personal growth.

I am also very grateful to Marike van Aerde, for sparking my interest in networks and whose support allowed me to enjoy network theory.

I am incredibly fortunate to have been surrounded by friends and family who have been very supportive over a long period of time. My girlfriend, Ismay, deserves my deepest gratitude for her endless kindness and patience. My parents are deeply appreciated for all the same reasons and lastly, I want to thank all my friends who have helped ground me and motivated me in finishing this thesis.

This thesis would not have been possible without all the people who have aided and supported me. You all have my deepest gratitude for the help you have given me throughout this journey.

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CHAPTER 1. INTRODUCTION

The Dutch province of Zeeland is home to several circular fortifications that are of particular interest in understanding the early medieval history of the region. These fortifications, or *ringwalburgen*, are argued to have been constructed around the end of the 9th century (van Heeringen, 1995b, p. 17), and the partial excavations of these sites have been key in understanding the region, as much of the known early medieval archaeology on the island is concentrated in the three *ringwalburgen* at Middelburg, Domburg, and Oost-Souburg (ten Harkel, 2019, p. 1-2). These *ringwalburgen* have already been the subject of extensive discussion and research and scholars have underscored the complexity of both the region and the fortifications. Despite their importance for understanding early medieval Zeeland, the archaeological material and historical sources are limited, complicating the study of the area (Tys et al., 2016, p. 188; ten Harkel, 2013).

Figure 1.1. Map of Zeeland and the location of known ringwalburgen

Figure 1.2. Oost-Souburg: aerial view of the partly reconstructed fortress in the year 2005 (van Dierendonck, 2009, Figure 3)

The relation between the *ringwalburgen* and trade is recognized as important in understanding both the early medieval structures and the region of Zeeland (ten Harkel et al., 2023, pp. 62-63). While recent scholars, such as Deckers (2022), have provided significant insights into the connection between trading places and *ringwalburgen*, more remains to be explored. The complexity inherent in both trade and the broader connections associated with the fortresses necessitates further exploration. Additional investigation, utilizing the available material to its fullest potential, on the relation between *ringwalburgen* and trade is warranted to gain a better understanding of both. A methodology particularly suited for investigating relationships is network methodology (Peeples, 2019, pp. 453-454). This methodology is typically employed in cases where substantial datasets are accessible. However, this study aims to contribute to our understanding of the relation between *ringwalburgen* and trade by applying network methodology to analyze the relatively limited available archaeological material from the Zeeland *ringwalburgen*. Simultaneously, this study aims to assess the validity of the network methodology employed.

Network methodology represents a versatile approach in archaeology for exploring inter-site relations (Evans, 2016, p. 150). It offers a distinct advantage by presenting data in a manner that captures the intricate and interconnected nature of these relationships, leveraging the inherent non-linear properties of networks for complex data visualization (Brown et al., 2005). Particularly notable are the contributions of Sindbæk (2007b; 2007c), whose studies have involved constructing networks based on artifact types found at Viking Age settlements. By analyzing network patterns, Sindbæk has significantly advanced our understanding of early medieval Scandinavian trading networks and settlement dynamics. The methodologies introduced by Sindbæk serve as a foundation for the approach adopted in this study.

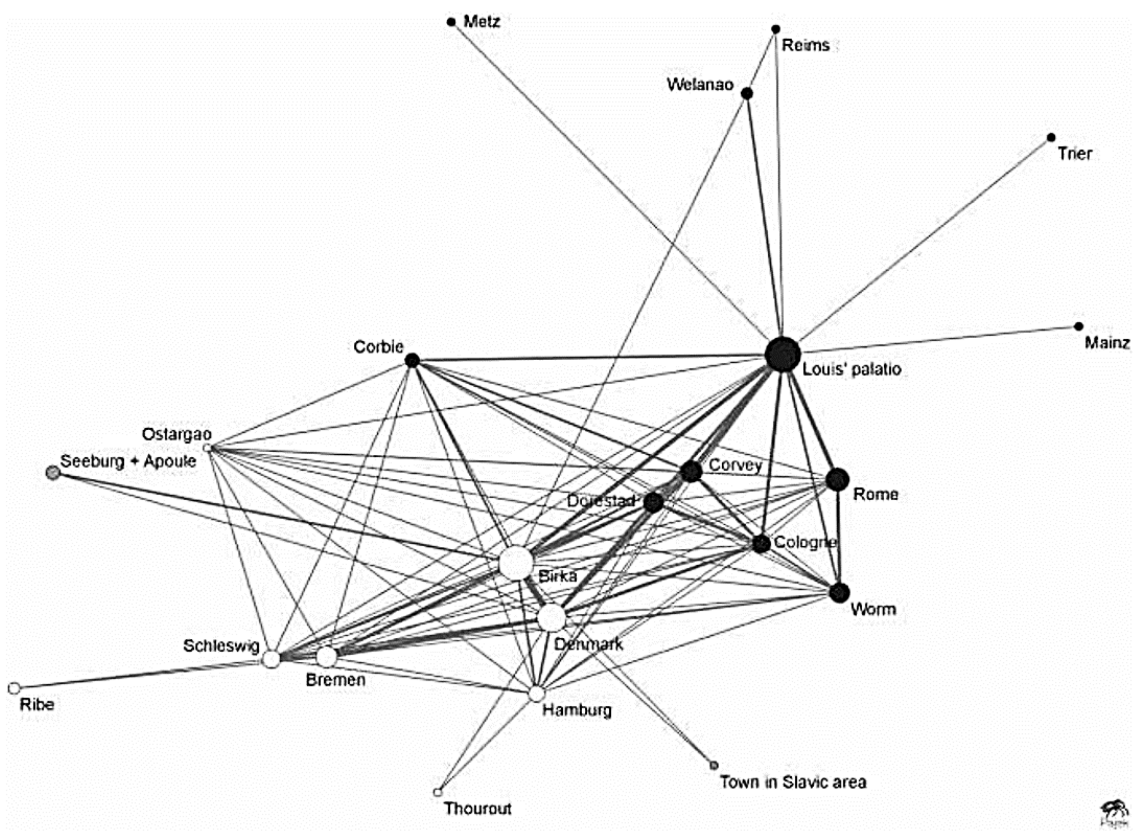

Figure 1.3. Example of a network graph, Graph of affiliations of 22 sites by 55 groups or individuals in Anskar's vita (Sindbæk, 2007c, Figure 3)

The application of network methodology in this study introduces several challenges, which will be discussed in detail in Chapter 3. A primary concern is the relatively sparse archaeological dataset available for the *ringwalburgen*. It is crucial to acknowledge that network methodology serves as a tool for analyzing existing archaeological data and does not generate new data. Therefore, the scope of this study does not include the creation of a new trade network. Instead, our approach involves a comparative method aimed at examining variations among site assemblages. Through this comparative analysis, we will construct graphs to depict relationships between selected sites, offering insights into the trade connections involving the Zeeland *ringwalburgen*.

The primary selected sites are the *ringwalburgen* of Zeeland. Currently, there are five known examples of these circular fortifications, located in Domburg, Middelburg, Oostburg, Oost-Souburg, and Burgh (ten Harkel, 2013, p. 224). In line with developments observed in many other parts of

Europe, the coastal region of Flanders and Zeeland saw the establishment of fortified sites from the 9th century onwards (Tys et al., 2016, p. 188). The *ringwalburgen* were constructed at the estuary of the Scheldt River, which was part of the larger Frisian Rhine delta. This area held a significant position in early medieval trade, connecting Flanders and Rhine trade routes with the North Sea (ten Harkel, 2019, p. 1). For this study, we will focus on the main sites of the Zeeland *ringwalburgen* that provide sufficient material for comparison: Domburg, Middelburg, Burgh, and Oost-Souburg. These sites will be compared with other locations connected to trade in the North Sea area.

The following research questions have been developed to gather insight and achieve the overarching research aim of this study: What significance did trade have for the Zeeland *ringwalburgen* during the 7th through 11th centuries AD?

Four sub-questions have been formulated to assist in answering the main research question. The first two sub-questions are designed to facilitate the interpretation of the gathered data using network methodology and are as follows:

1. Is there a ringwalburg that appears to have functioned as a regional trade hub?
2. What insights do the observed patterns in the generated networks provide regarding the role of *ringwalburgen* within the broader trade network of the North Sea area?

The second set of sub-questions is meant to place the data in a broader academic framework and further evaluate the used method:

3. How do the observed network patterns fit within and compare to the existing historical narrative and academic discussion?
4. How effective was the network methodology in answering questions regarding the *ringwalburgen*?

Following the research questions, several hypotheses have been proposed. Firstly, I propose that trade will be demonstrated to hold significant importance for the *ringwalburgen* of Zeeland. Moreover, I suspect that network analysis will reveal the ringwalburg of Domburg to exhibit qualities indicative of a trading hub. Positioned strategically in the landscape, I believe the patterns within the networks will indicate that the *ringwalburgen* are well-connected to the North Sea area trade network and, through Domburg, are crucial in providing the wider area with trade goods from the Scheldt area. Additionally, it is anticipated that the network patterns will align with existing historical narratives that underscore the complexity of the region (see Deckers, 2022; ten Harkel, 2019). Lastly, the network methodology is expected to serve as a valuable tool for evaluating and analyzing the existing archaeological data. The effectiveness of this tool is likely to be determined by the availability of data and the construction of the dataset.

This thesis is subdivided into the following chapters: Chapter 2 provides the necessary background that will assist in interpreting the networks of this study. In Chapter 3, the theoretical framework essential for understanding the methodology used in our study is explained. Chapter 4 presents and analyzes the results. These results will subsequently be discussed in Chapter 5. Finally, in Chapter 6, the answer to the primary research question will be provided, and further research that could benefit the academic discussion will be covered.

CHAPTER 2. HISTORICAL BACKGROUND

In this chapter, the essential context related to answering the research question will be briefly discussed. This context is crucial for interpreting and understanding the network graphs presented in Chapter 4. The chapter will provide the necessary background to contextualize the *ringwalburgen* of Zeeland and early medieval trade in the region. Given the limited archaeological data available, it is essential to situate our findings within the historical landscape and to explore the relationships of the Zeeland *ringwalburgen* within the broader North Sea context. Therefore, an overview of the background of the geographic setting, the history, historiography, archaeology, and trade within the region, related to *ringwalburgen*, will be covered.

2.1 GEOGRAPHIC BACKGROUND

The Zeeland *ringwalburgen* were all situated within a landscape threatened by the sea and shaped by the Scheldt River estuary, which was continuously evolving and changing during the early medieval period (ten Harkel, 2019, p. 2; van Heeringen, 1995c, p. 15). At the start of the 9th century, Zeeland began to transform from a tidal zone into sets of silted-up, low-lying salt-marsh or peat-marsh areas, gradually silting up the area (Vos, 2015, pp. 22, 87). Zeeland remained primarily a shifting fluvial floodplain and marine salt-marsh area throughout the period. Changes such as coastal erosion, dune recession, and the silting of salt-marsh areas created a dynamic landscape, forcing inhabitants to adapt and resettle (Deckers, 2022, p. 202). The region became increasingly habitable during the early Middle Ages. Continuous silting resulted in the creation of elevated ground, reducing the frequency of floods during the studied period. In the 10th century, significant man-made elevated constructions, such as dwelling mounds, protected inhabitants during storms and floods (Vos, 2015, pp. 22, 87). Within this dynamic and evolving landscape, construction of the *ringwalburgen* took place around the end of the 9th century on the various islands of Zeeland (van Heeringen, 1995b, p. 17).

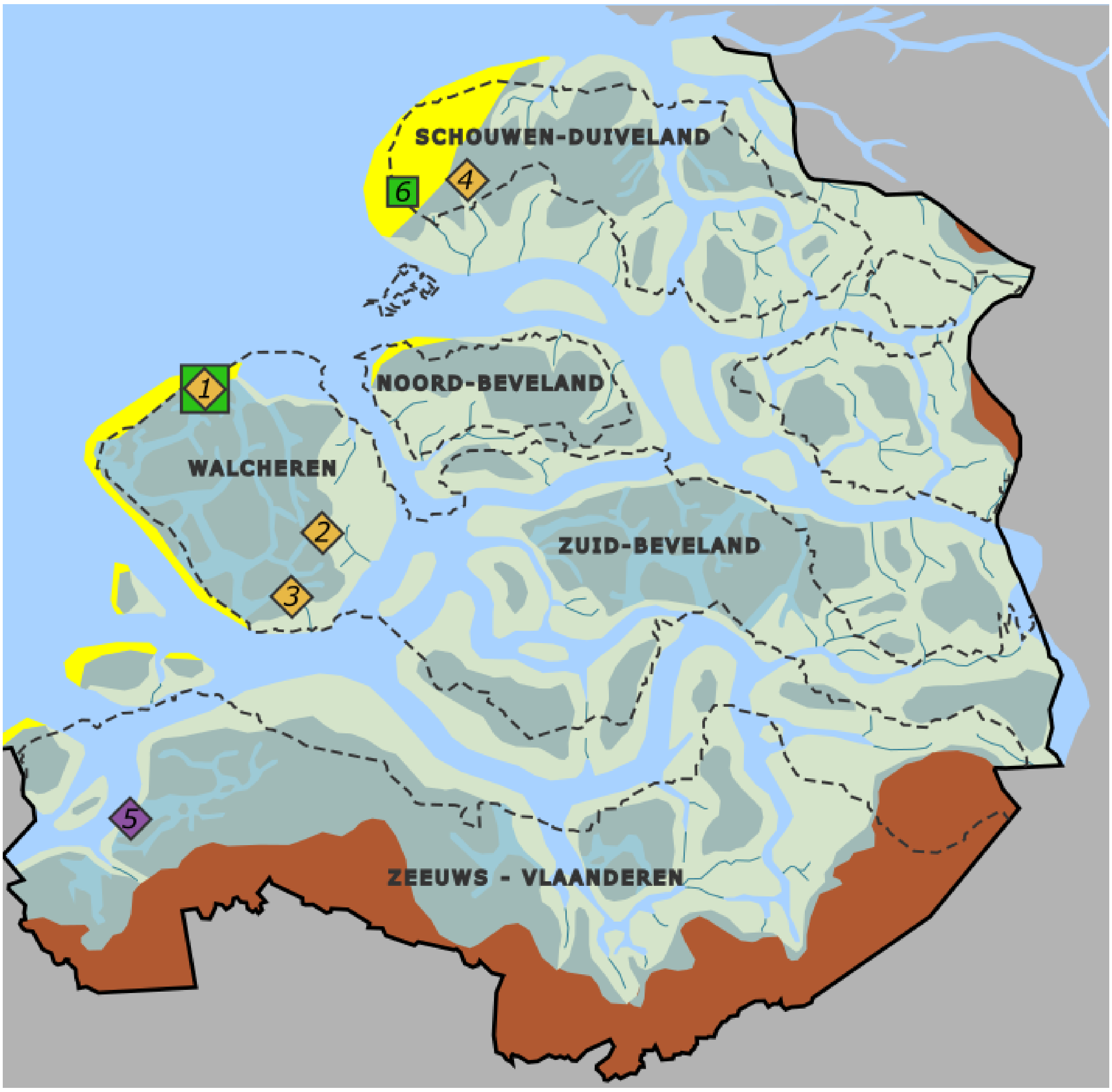

Figure 2.1. Paleographical map of Zeeland that shows the relevant ringwalburgen and emporia. Adapted from van Dierendonck (2009, p. 250, Figure 1) and Vos (2015, p. 76, Figure 2.11 & p. 85, Figure 3.11).

Of the islands of Zeeland, Walcheren is the most significant for the purpose of this study. Three of the four studied *ringwalburgen* and the trading site of *Walichrum* were located here (ten Harkel, 2019, pp. 1-2). Walcheren formed from a narrow dune-barrier that expanded due to the silting of the surrounding salt-marsh area. This process made the island more suitable for agriculture, particularly sheep herding, and human settlement (Vos & van Heeringen, 1997). As mentioned before, the *ringwalburgen* on Walcheren are the primary localities on the island, and much of the known early medieval archaeology is found at the sites of the *ringwalburgen* of Middelburg, Domburg, and Oost-Souburg (ten Harkel, 2019, pp. 1-2). The island was also centrally positioned relative to other significant geographic areas relevant to this thesis. To the north was the island of Schouwen (modern-day Schouwen-Duiveland), and to the south was the mainland area of Zeeuws-Vlaanderen. On Schouwen stood the ringwalburg of Burgh, and in Zeeuws-Vlaanderen stood the ringwalburg of Oostburg (ten Harkel, 2013, p. 224).

The Scheldt River is another significant element of the region. The Zeeland *ringwalburgen* are all situated within the estuary of the Scheldt River, which formed a crucial connection between areas such as Flanders and the North Sea trade area (ten Harkel, 2019, p. 1). *Walichrum* likely served as a market for the long-distance trade of Frisian cloth, produced from wool sourced from sheep raised on the expansive salt marshes of the hinterland (Tys, 2010, p. 172). During the early medieval period, salt production was established in Zeeland, exploiting the rich salt-marsh areas through a process called moernering. Salt was a precious resource, and the presence of freshwater rivers complicated extraction from the sea, leading to the adoption of moernering as the primary extraction method in the region. This process occurred on a large scale during the 11th century and continued until the latter half of the 15th century. It is highly likely that this extraction process has destroyed parts of the archaeological record, further complicating archaeology in the region (Bos et al., 2011).

Regardless of these challenges, recent finds have delivered an increase in evidence that supports significant human activity in Zeeland as early as the 8th century. Previously, it was long accepted that prior to the 9th century, the province of Zeeland remained sparsely populated, if at all, due to large parts of the region being prone to flooding (van Heeringen, Pol, et al., 1995, pp. 49-50). The scarcity of textual evidence regarding activities in the area before the late 8th century was interpreted as indicative of a lack of permanent settlement and human activity, with historical documents dictating the understanding of early medieval activity in Zeeland and the surrounding regions. However, Loveluck and Tys (2006, pp. 147, 157) have drawn attention to evidence suggesting more widespread and enduring settlement activity in the vicinity of Domburg and Oostburg. Additionally, archaeological evidence of a Merovingian farmstead north of Serooskerek dating to the end of the 7th century fills a significant archaeological gap and indicates that settlement in the region was more extensive than previously thought (Dijkstra, 2011, p. 72).

Moreover, Deckers (2022, p. 200) has utilized data from known households within the Domburg ringwalburg to propose a population estimate of approximately 600-1000 during the 10th century, comparable to contemporary population levels in Tiel or Utrecht. Settlement expansion initially concentrated along the banks and ridges of estuary channels, suggesting that environmental constraints, rather than socio-economic or cultural factors, primarily dictated the timing and pace of occupation (Deckers, 2014). This challenges the long-held notion of sparse settlement in Zeeland prior to the ninth century and underscores the importance of revisiting historical interpretations in light of this demographic evidence. For the purposes of this study, it is relevant to contextualize *ringwalburgen* as defensive structures within a demographic framework where a relatively sizable population could have contributed to the regional trade network.

The region of Zeeland holds strategic significance due to its geographical positioning. The mouth of the Scheldt River served not only as a pivotal area for trade but also as a dividing line between various political realms. Notably, it demarcated the West and Middle Frankish Kingdoms and functioned as a frontier where various groups such as Franks, Vikings, and Frisians interacted (IJssennagger, 2013). Ownership of the coastal salt-marsh islands of Zeeland allowed for control of the trade routes of the Scheldt estuary and made the region strategically important (Henderikx, 1995, pp. 99-101). The transition from the river estuary to the broader North Sea region within the Scheldt estuary facilitated long-distance trade, supported by archaeological evidence found at ringwalburg sites (ten Harkel, 2013, pp. 250-251). Examples include ceramics such as Badorf and Pingsdorf wares, originating from contemporary German regions along the Rhine and discovered within the wider North Sea region (Sindbæk, 2007a, p. 308).

2.2 HISTORICAL BACKGROUND

The region of Frisia, including Zeeland, remained politically important throughout the early Middle Ages. Zeeland existed within a complex network of relations and connections between Franks, Vikings, Frisians, and others, which is crucial to understand when analyzing the network graphs. Older narratives placed great importance on Viking attacks on the Frisian and Frankish realms, starting around 830 AD (ten Harkel, 2013). In these narratives, *ringwalburgen* were originally thought to have been built around 880-890 AD specifically to defend inland regions against coastal Viking attacks (Tys et al., 2016, p. 175). These Viking attacks were significant for Zeeland and the *ringwalburgen*, with a notable example being an 837 AD Viking attack on Walcheren, recorded in the Frankish Annals of St. Bertin for the years 835-836 (ten Harkel, 2013, p. 244). While older narratives emphasize these attacks, more recent interpretations present a more nuanced view, suggesting that the relations between Vikings, Franks, and Frisians were increasingly complex (ten Harkel, 2019, pp. 3-4; Tys et al., 2016, p. 175).

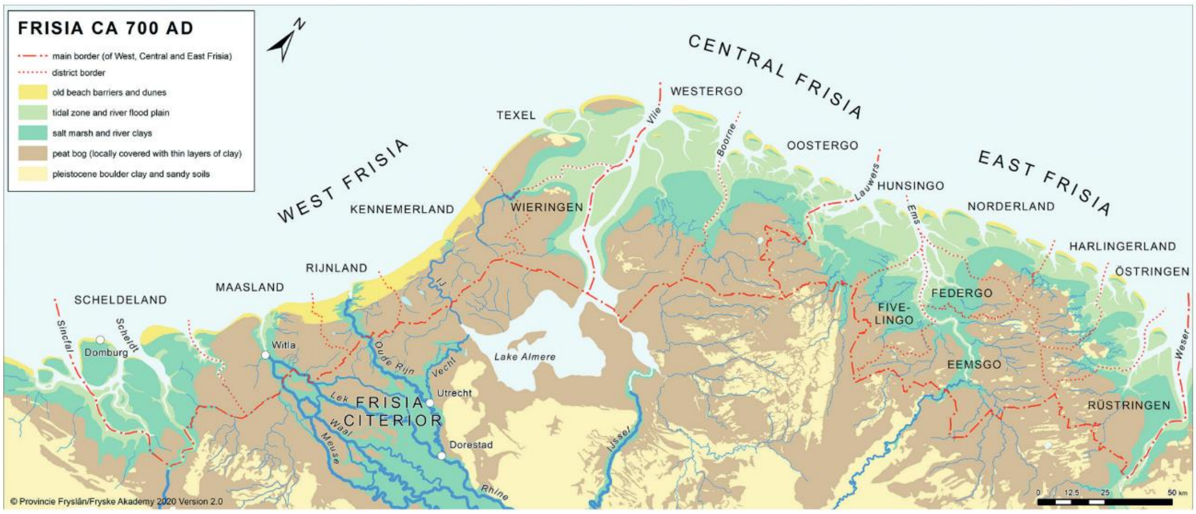

Figure 2.2 Early-medieval Frisia and its districts c. AD 700. (de Langen, G., & Mol, J. A., 2021, figure 4.1)

The region became a focal point for Frank-Viking interaction following its incorporation into the Carolingian sphere of influence. During the 7th and 8th centuries, the Frankish Empire sought to control the domains of the neighboring Frisians. Although the area initially resisted Carolingian influence, it was largely subdued after the death of the Frisian king Redbad in 719 AD, enabling the Carolingian realm to expand into Frisian territory (IJssennagger, 2013, p. 70). Following this initial conquest, the 9th century saw a dynamic shift in Carolingian power in the region. This era is historically quiet, with fewer historical records documenting the region of Zeeland (ten Harkel, 2013, p. 245). During the 9th century, royal control of the area weakened, allowing local and regional actors, such as Vikings, to diminish central Frankish authority and establish their own territories within the realm (Tys et al., 2016, p. 188; ten Harkel, 2019, pp. 5-6). Within this context, there was a high potential for interaction between different groups of people.

IJssennagger (2013) contextualizes this interaction within a framework wherein Frisians aligned themselves either with the southern Frankish realm or the northern Viking realm. IJssennagger argues that while the Franks succeeded in assimilating the Frisians into their sphere of influence, some Frisians still engaged in interactions and cultural exchanges with Scandinavian groups, thereby establishing Frisia as an intermediate realm. This intermediate or multicultural expression is further evidenced in the material culture of Zeeland. An example is the copper alloy mounts from Walcheren, which suggest, based on analysis of stylistic and compositional attributes, that Walcheren likely served as a meeting point for Frisian, Viking, and Anglo-Saxon influences (Roxburgh et al., 2018).

Within this intermediate realm, there was extensive room for cultural and political interaction among Frisians, Franks, and Vikings that transcended mere trading and raiding activities. The Carolingians, for instance, distributed Frisian fiefs to Danish Vikings (Henderikx, 1995, pp. 83-84).

Danish leaders Harald and Rorik held positions in the military and feudal structures of Frisia, controlling the trading settlement of Dorestad and supporting the Carolingian emperors between 840 and 875 AD (Tys et al., 2016, p. 177). Harald was also granted the island of Walcheren, as recorded in the Annals of St. Bertin in 841 (Henderikx, 1995, pp. 83–84). Additionally, archaeological evidence attests to continued trade between Vikings and Frisian communities, exemplified by material finds from sites like Dorestad and Scandinavian settlements like Kaupang (IJssennagger, 2013, p. 72). Vikings did not dominate the entire feudal structure of Zeeland. During the 9th and 10th centuries, Zeeuws-Vlaanderen became part of Flanders while Walcheren and Schouwen-Duiveland were part of Frisia (Henderikx, 1995, p. 81). These political connections could have influenced trade relations between these places, which in turn influenced the *ringwalburgen* in the region.

The role of Zeeland as an intermediate realm concluded at the end of the period studied in this thesis. During the 9th and early 10th centuries, Viking attacks and political connections with the Frisian realm peaked (IJssennagger, 2013, p. 70). It was only from the mid-10th century that the coastal regions began to experience centralized control under the Ottonian rulers (ten Harkel, 2019, p. 3). By the 11th century, both the settlements and the associated *ringwalburgen* at Oost-Souburg and Domburg had largely been abandoned. Deckers (2022, pp. 201, 205) argues that these locations could not compete as central places with Middelburg, which received support from Frankish noble and ecclesiastical powers.

2.3 RINGWALBURG HISTORIOGRAPHY

In the following paragraphs, we will focus on the relevant aspects of the historiography of the *ringwalburgen* that are crucial for our analysis. These parts provide context and allow us to compare them with the network graphs generated in our thesis. Considering the scope and research goals of this thesis, three main academic narratives will be discussed: the 'chain of defense', 'local initiative', and the 'landscape of negotiation' narratives.

The first academic narrative to be discussed, the "chain of defense narrative," is an older perspective that has been significantly challenged by more recent evidence and argumentation, suggesting that the theory may no longer hold true (Deckers, 2014, pp. 96-114; ten Harkel, 2013). However, it remains a useful narrative for understanding the discourse and can be used for later comparison with our network graph results. The "chain of defense" narrative originates from Huizinga's (1935) identification of the *ringwalburgen* as a chain of *vluchtburgen* (refuge fortifications) built by Carolingian rulers to offer the local population refuge from Vikings and defend the coast from attacks. Central to this narrative is the historical source *Libellus miraculorum sancti Bertini*, which identifies the *castella recens facta*, or "recently built fortifications" constructed in 891 AD, as the *ringwalburgen* in Zeeland and surrounding areas (Tys et al., 2016, p. 177). Building on earlier observations, Van Werveke (1965) determined that a series of circular coastal fortifications existed as part of an organized defensive system against Viking attacks, based on circular topographical patterns. This organized defense was supported by typology, distance, and the place-name "burg" (Tys et al., 2016, p. 177), forming a cohesive defensive network to protect the Frankish coast (Deckers, 2022, p. 193; ten Harkel, 2019, p. 8; van Werveke, 1965, pp. 5-6).

The arguments supporting the "chain of defense" narrative have been challenged, particularly due to discrepancies between the dating of the *ringwalburgen*, which were not built simultaneously, and the descriptions of the *castella recens facta* (see van Heeringen, 1998, p. 245). New archaeological evidence has increasingly highlighted the need for a more nuanced approach that accounts for the distinct characteristics and variations within the ringwalburg typology, such as the considerable differences in size and internal occupation of the Zeeland *ringwalburgen* (ten Harkel, 2019, pp. 1-2). More recently, scholars have interpreted the *ringwalburgen* as local initiatives of fortress building, serving the various interests of local actors. Dijkstra and de Ridder (2009, p. 215) have argued that these structures were built at different times and served distinct purposes. Additionally, Dierendonck (2009, p. 254) suggests that the Zeeland *ringwalburgen* form a northern ringwalburg cluster, built by different actors than those responsible for the fortifications south of these structures, such as those at Veurne and Oostburg. These clusters could be distinct in their purposes and functions, for example, defending regional trade or local populations (ten Harkel, 2013, p. 245; Henderikx, 1995, pp. 99-101; Loveluck & Tys, 2006, p. 160).

The final narrative covered here, the "landscape of negotiation" argued for by ten Harkel (2013, pp. 4, 246; 2019, p. 2), explicitly acknowledges the complexity of the region and the multifaceted functions of the *ringwalburgen* beyond merely being defensive refuge structures. This narrative suggests that various factions used the construction of fortifications to lay claim to the region's land, people, and resources. It is the most complex and nuanced of the narratives, building on evidence that the *ringwalburgen* served a more permanent population and could function as an "imposition of inland power." It also argues for the possibility of Viking actors imposing their power in the region through the *ringwalburgen* (van Dierendonck, 2009, pp. 268, 271; ten Harkel, 2013, pp. 245-246; Loveluck & Tys, 2006, pp. 159-162). The actors involved in the construction of *ringwalburgen* represented various groups for whom the structures held different meanings. Vikings, Franks, Christians, pagans, and local populations engaged with the *ringwalburgen* as places for trading, manufacturing, or imposing political and religious authority, among other functions.

2.4 RINGWALBURG DESCRIPTIONS

The following paragraphs give context to the excavations and places where the archaeological assemblage of the sites was found. The material itself will be discussed more in depth in Chapter 3.3

2.4.1 OOST-SOUBURG

The ringwalburg of Oost-Souburg was situated in the southern part of Walcheren on a prominent elevation in the landscape (ten Harkel, 2013, p. 226). The surrounding area of the ringwalburg has been subject to extensive excavations and reconstruction efforts. Excavations have occurred intermittently since 1944, primarily conducted by the Rijksdienst voor het Oudheidkundig Bodemonderzoek (ROB). Significant rescue excavations took place during the construction of a supermarket between 1969–1971, in 1981, and again in 1983, resulting in the excavation of a substantial portion of the ringfort during these periods. The earthworks of the ringwalburg were reconstructed in 1994, and additional investigations were undertaken in response to proposed road and building developments (ten Harkel, 2013, p. 228; van Heeringen, 1995a, pp. 115-117; Raven, 2023, p. 22).

The rampart of the ringwalburg at Oost-Souburg had a circular layout with a diameter of 132 meters, making it the smallest among the *ringwalburgen* in the Zeeland region. Constructed using sand and clay sods, the rampart was approximately 6 meters wide (ten Harkel, 2013, p. 228; van Heeringen, 1995c, p. 21). A cross-shaped road system has been identified, facilitated by existing gates with wooden bridges spanning over a moat surrounding the rampart. Additionally, the rampart incorporated a wooden drainage system (ten Harkel, 2013, p. 229; van Heeringen, 1995a, p. 123; Trimpe Burger, 1973, p. 362). The site was inhabited, with several wattle-and-daub houses discovered within the internal area of the ringwalburg (Trimpe Burger, 1973, p. 363). Raven (2023, p. 39) suggests construction dates ranging from before 889–898 to 910–964 AD for the ringwalburg of Oost-Souburg.

2.4.2 DOMBURG

The ringwalburg of Domburg is located in the eastern part of Walcheren, situated within the northern dunes of the island, approximately 1.5 km from the *emporium* of *Walichrum* (ten Harkel, 2019, p. 6). The relationship between the ringwalburg and the *emporium* will be discussed in more detail in Chapter 2.5. Archaeological research began in 1986, followed by subsequent investigations in 1991, 1992, 1993, and 2001, all conducted by the ROB. Additional excavations were carried out by ArcheoMedia BV in 2007 and ARC in 2010 (ten Harkel, 2013, p. 237; Raven, 2023, p. 25).

Domburg's ringwalburg is the largest among the known *ringwalburgen* in Zeeland. It featured a rampart constructed of sand and clay sods with a diameter of 265 meters, laid out in a cross-shaped pattern with drainage systems, houses, and a moat estimated to be 20 meters in diameter (ten Harkel, 2013, p. 237; van Heeringen, 1995b, p. 29; Raven, 2023, p. 29). Two construction phases were identified for the rampart: the first phase had a width of approximately 12 meters, while the rampart in the second phase exceeded 20 meters in width (van Dierendonck, 2009, p. 263; ten Harkel, 2013, p. 237; van Heeringen, 1995c, pp. 30-31). Raven dates the construction of the ringwalburg to around 875–900 or earlier (Raven, 2023, p. 39). By the end of the 10th century, the ringwalburg was buried under a layer of dune sand, and in the 11th century, a new settlement was established atop the buried ringwalburg (ten Harkel, 2013, p. 239; van Heeringen, 1995c, p. 15; 1995b, p. 31).

2.4.3 BURGH

Burgh is the sole ringwalburg located on the island of Schouwen-Duiveland, nestled on the inner edge of the dunes, approximately 0.6 meters above sea level (ten Harkel, 2013, pp. 239-240; van Heeringen, 1995c, pp. 33–34). Situated near the *emporium* of Westenschouwen, this trading hub is supported by evidence from metalwork and occupies a strategic position opposite the Scheldt estuary, which will be further explored in section 2.6 (Deckers, 2022, p. 194; ten Harkel, 2013, pp. 239-240). Archaeological investigations at Burgh have been somewhat limited; however, despite the fragmented nature of the archaeological record, the preservation quality is deemed 'excellent' (Raven, 2023, p. 30). Excavations were conducted by the Rijksmuseum van Oudheden (RMO) in 1952, followed by efforts by the ROB in 1977 and 1987, with a final excavation led by the Rijksdienst Cultureel Erfgoed (RCE) in 2007 (Raven, 2023, p. 30).

The ringwalburg is presumed to be circular, although it may also have an oval shape, boasting a diameter of 200 meters. Constructed with sand and clay sods, the rampart measures approximately 4-5 meters in width and remains remarkably well-preserved (ten Harkel, 2013, p. 240). Additionally, the ringwalburg features a moat spanning around 50 meters (Raven, 2023, p. 31). Notably, there is no evidence of a cross-road pattern; instead, a single straight road was uncovered (de Kort & van Doesburg, 2009, p. 15). Raven (2023, p. 39) has proposed a construction date for the Burgh ringwalburg ranging from 792 to 900 AD, with abandonment occurring around 1000 AD. Subsequently, in the eleventh century, a village emerged adjacent to the former fortified area (ten Harkel, 2013, p. 240; van Heeringen, 1995c, p. 15).

2.4.4 MIDDELBURG

Middelburg, situated on an inverted tidal ridge on Walcheren, lies merely 4.1 kilometers north of Oost-Souburg (ten Harkel, 2013, p. 234). Extensive investigations of the Middelburg site were conducted in the 1940s and 1960s, with various trenches excavated through the rampart, ditch, and center of the ringwalburg. Further excavations took place during the 1980s, 1990s, and 2000s, primarily by the ROB, with additional investigations carried out in 2004 by the Groningen company Archaeological Research and Consultancy (ARC) (van Dierendonck, 2009, pp. 259-262; ten Harkel, 2013, p. 235; van Heeringen, 1995c, pp. 22-24). The most recent excavation occurred in 2016 by Archeomedia (de Rijk, 2016).

The ringwalburg of Middelburg stands out as the only one among the Zeeland *ringwalburgen* to evolve into a town of significant importance (ten Harkel, 2013, p. 236). Today, the settlement that grew out of the ringwalburg remains the provincial capital of Zeeland. Infrastructure projects near or within the vicinity of the ringwalburg point to its central function, exemplified by the mid-tenth century royal minster church (Westmonster) and the later tenth or eleventh-century church (Noordmonster) (Deckers, 2022, p. 201). By the latter half of the 10th century, the population had expanded beyond the rampart of the ringwalburg (ten Harkel, 2013, p. 236). The ringwalburg boasted six radial, wood-paved roads, gates, and a drainage system (Deckers, 2022, p. 201; ten Harkel, 2013, p. 236; van Heeringen, 1995b, pp. 25-26; de Rijk, 2016, pp. 182-183). With a diameter of about 220 meters, the rampart of the ringwalburg was substantial (ten Harkel, 2013, p. 235; van Heeringen, 1995b, p. 24). By the eleventh century, Middelburg had emerged as a significant ecclesiastical and administrative center within the region (ten Harkel, 2013, p. 236). Houses within the ringwalburg likely date to the same period as the fortifications themselves (de Rijk, 2016, p. 185). The establishment of the ringwalburg is estimated to have occurred between the end of the 9th century and the early 10th century (Deckers, 2022, p. 201).

2.5 EARLY MEDIEVAL TRADE

To gain insight into the trade system within which the *ringwalburgen* operated, our study will contextualize trade in the region. We will discuss the important trading hubs connected to the *ringwalburgen*, such as Dorestad and Westenschouwen, and explore how these hubs functioned. Understanding the proposed relationship between the *ringwalburgen* and other trading sites is crucial for our analysis.

The strategic position of Frisia as an intermediary realm played a pivotal role in facilitating trade within the region. Intermediate regions like Frisia provided neutral ground for different groups to interact and engage in the exchange of goods. Trade routes linking central and northern parts of the

Frankish Empire held particular significance for regions such as Scandinavia and Great Britain (Verhulst, 1995, p. 507). Positioned favorably between the Viking realm and the Frankish realm, as well as within the important Frisian Rhine delta, Frisia, and Zeeland by extension, served as crucial intermediary regions (van Es & Verwers, 2002). This positioning allowed the Frisians to act as middlemen in trade, operating as independent agents trading goods controlled by landowners (IJssennagger, 2013, p. 90). Notably, the Frisians were particularly active in trade along the Rhine area (Verhulst, 1995, p. 509). The material culture found at the *ringwalburgen* sites in Zeeland, such as the presence of Rhenish Badorf ceramics, reflects this connection to the Rhineland. Thus, Frisia and its inhabitants played a crucial role in facilitating trade at the periphery of realms during this period.

Central to these trading networks on the periphery of realms were *emporia*, or wics—moderately sized trading settlements where merchants gathered regularly to exchange goods. These hubs often expanded into bustling markets during peak trading seasons and were strategically located on topographical or political peripheries, serving as neutral zones for commerce (Sindbæk, 2007a, p. 303). In Zeeland, two of the *ringwalburgen* are associated with such *emporia* (Deckers, 2022, pp. 193-194), underscoring their crucial role in connecting trade networks with the defensive structures of the region.

Since Hodges' pioneering work in 1982, the role and function of *emporia* have undergone extensive examination. Initially regarded primarily as centers for mercantile activities and the exchange of luxury goods, contemporary scholarship now recognizes *emporia* as multifaceted hubs integrating craft production and interconnected with their hinterlands (ten Harkel et al., 2023, p. 30; Verhulst, 1995, p. 508). These sites played a central role in early medieval trade, serving as pivotal hubs within the North Sea region. Notable examples such as Domburg and Dorestad were crucial for facilitating exchanges not only within the Frisian realm but also across the broader North Sea area (Verhulst, 1995, p. 507). Other significant *emporia* include Birka (Sweden), Ribe (Denmark), Lundenwic (England), and Quentovic (France). Archaeologically, *emporia* are distinguished from local trading sites by the presence of imported goods intended for personal use and production processes reliant on imported raw materials, such as metalworking or glass production (Sindbæk, 2007a, p. 303).

By the end of the 9th century, the *emporia* experienced a decline in prominence, with their functions gradually assumed by portus trading places during the tenth and eleventh centuries. Unlike the predominantly coastal *emporia*, these portus trading places were situated further inland and initially held lesser significance, but they evolved into central trading hubs characterized as fortified market towns (Deckers, 2022, p. 193). While traditionally viewed as a sequential evolutionary development, recent scholarship, such as that by Deckers (2022), interprets this shift as indicative of a change in the dynamics of early medieval trade (Deckers, 2022, p. 193).

Sindbæk (2007a; 2007b; 2007c) presents a nuanced perspective on the vulnerability of early medieval *emporium* trading networks, emphasizing their pivotal roles as hubs. Positioned as central nodes for both regional and long-distance exchanges, emporia were susceptible to disruptions that could trigger chain reactions within the network (Sindbæk, 2007a, p. 307). In the context of Zeeland, the evolutionary progression from *emporia*a to portus trading places includes the incorporation of *ringwalburgen* into the sequence. Chronologically situated between emporia and the eventual emergence of portus trading sites around the 12th century, the role of *ringwalburgen* adds complexity to this narrative. Deckers (2022, p. 193) has argued against this chronological sequence in favor of a more complex narrative.

Various scholars have explored the role of *ringwalburgen* in trade contexts. Deckers (2022), ten Harkel (2013, 2019; ten Harkel et al., 2023), and Loveluck & Tys (2006) have investigated this connection to varying degrees. Among all trading places in Zeeland, *Walichrum* is most notable. The probable site of *Walichrum* has been known since 1647, and coins, metalwork, and artifacts pointing to a trading site continue to be found on the beach near Domburg known as Westhove (Deckers, 2022, p. 191). Discoveries from ringwalburg sites like Domburg highlight their association with long-distance trade, evident through various artifacts such as coins, metalworks, quern stones, and pottery types like Badorf-Ware (ten Harkel et al., 2023, pp. 33-34; Sindbæk, 2007a, p. 121).

Aside from the Domburg ringwalburg and *Walichrum*, the other *ringwalburgen* used in this study also have known connections to trade and trading places. On the neighboring northern island of Schouwen, Burgh and its ringwalburg thrived in proximity to the *emporium* of Domburg. Despite being less extensively documented, the abundance of metal finds and artifacts from nearby Westenschouwen and the ringwalburg itself indicates its significant role in trade (Deckers, 2022, p. 194).

Middelburg stands out as the sole ringwalburg to evolve into a larger urban settlement (ten Harkel, 2013, p. 236), emerging as a prominent regional trading hub in later periods. Archaeological remnants from the ringwalburg also suggest its involvement in trade during the studied period, as evidenced by material discoveries of coins and ceramics (Deckers, 2022, p. 201).

The pottery and artifacts found in Oost-Souburg also indicate its participation in long-distance trade networks. Predominantly imported, the pottery suggests connections with distant regions. Notably, soapstone vessel fragments possibly from southwest Sweden were discovered. Additionally, a significant quantity of quern and millstones, mainly sourced from Mayen in the Eifel region, were found. Most whetstones were imported, with sandstone from the Eifel region and quartz phyllite from Norway being the primary materials (ten Harkel, 2013, p. 231).

During the latter half of the 9th century, many pivotal sites facilitating long-distance exchange in the North Sea region experienced a significant decline. This decline, once attributed solely to the disintegration of the Carolingian Empire and an increase in Viking raids, is now recognized as a more complex phenomenon (Hall, 2000). Concurrently, there was a shift from coastal trade routes to deeper sailing routes (McCormick, 2001). Amidst this decline, conflicts between the Carolingians and Vikings are believed to have hampered Dorestad's role as a trading hub, with the Danish settlement Hebedy emerging as a more prominent center for maritime trade (Sindbæk, 2007a, pp. 3-4; Theuws, 2004). The disruption of these trading hubs had ripple effects on interconnected trading sites.

2.6 CHAPTER SUMMARY

This chapter provided the contextual backdrop for the main themes explored in this thesis. The landscape of Zeeland, shaped by the Scheldt River and the sea, was dynamic and complex, influencing both settlement patterns and the strategic significance of the region. Frisia, positioned as an intermediary realm, experienced influences from both Frankish and Viking powers, fostering a wide range of interactions including raiding, trading, and alliances. The understanding of *ringwalburgen* in this region has evolved significantly, moving beyond simplistic explanations reliant solely on historical sources. Current narratives emphasize the nuanced and complex nature of these fortified sites. The chapter also reviewed the history of excavations and descriptions of the *ringwalburgen*, shedding light on their architectural and strategic significance. Furthermore, the chapter provided an overview of trade in the North Sea region, underscoring the close association of *ringwalburgen* with local *emporia*. These fortified sites were pivotal in facilitating both regional and long-distance trade networks.

CHAPTER 3. METHODOLOGY

This chapter provides a detailed description of the steps taken in the research process to ensure reproducibility and discusses the methodology used to address the thesis questions. As outlined in Chapter 1, the methodology and approaches employed in this thesis are framed within a 'network perspective'. The core of this framework will be discussed in the following paragraph, focusing on Social Network Analysis (SNA) and similarity networks.

Similarity networks are used to identify connections between sites based on shared variables and constitute the primary networks utilized in this thesis. Specifically, they have been generated based on the co-presence of artifact types. These shared variables serve as proxies for relationships, partially adapting the approach employed by Sindbæk (2007c). The resulting networks have been critically analyzed using a framework derived from academic debates and incorporating approaches from Östborn and Gerding's (2014) general similarity network analysis framework where applicable.

3.1 THEORETICAL FRAMEWORK

3.1.1 INTRODUCTION TO NETWORK THEORY

Network theory has been utilized in archaeology since the 1970s, experiencing a significant rise in the past decade (Peeples, 2019, p. 451). It integrates graph theory, social network analysis, and complexity science, adapting these approaches to various fields, forms, and contexts, including archaeology (Brughmans, 2014, p. 624; Brughmans & Peeples, 2023, p. 28; Peeples, 2019, p. 454). Central to network theory is the premise that entities (nodes) should not be studied in isolation but within the context of their connections, which are deemed significant (Brughmans, 2014, p. 625). Network-based methods are developed under this assumption, aiding in understanding relationships and patterns using available data. In archaeology, these methods have diversified to visualize connections and patterns across various datasets (Peeples, 2019, p. 454).

Brughmans (2012, p. 625) defines networks as representations of real systems. Networks are constructs made to depict connections using nodes and edges in a network graph. Nodes represent actors within the network, entities with agency, while edges denote connections between these entities. In archaeology, nodes and edges often represent material contexts and their relationships (Östborn & Gerding, 2014).

3.1.2 SOCIAL NETWORK ANALYSIS (SNA)

Social Network Analysis (SNA) in archaeology uses material culture as a proxy to study past social networks. This approach originates from the broader field of social network analysis, focusing on the complex relationships between social structure and differentiation (Brughmans & Peeples, 2023, p. 18). Archaeological network methods, drawing from SNA and other network science disciplines, adapt these methods to archaeological data and research goals. The methods employed in this thesis explore relations between sites, particularly in trade and exchange contexts (Brughmans & Peeples, 2023, p. 18). Similar methodologies have been applied to investigate settlement structures by Sindbæk (2007b, 2007c).

3.1.3 ARCHAEOLOGICAL SIMILARITY NETWORKS

To study connections between sites, network graphs are employed. These graphs require data inputs, often archaeological material culture from excavations discussed in Chapter 2 and related trade sites. Material culture within network graphs assumes that similarity between two sites implies a connection (Brughmans & Peeples, 2023, p. 28). Similarity networks use a chosen criterion to test similarity; for instance, the presence of the same artifact type at two sites constitutes a connection (Östborn & Gerding, 2014, p. 75). Such occurrences are termed copresences (Brughmans & Peeples, 2023, p. 29; Östborn & Gerding, 2014, p. 75). The connections in similarity networks are formed based on a quantifiable metric of similarity, which in this thesis is archaeological copresence (Brughmans & Peeples, 2023, pp. 84-85). Brughmans and Peeples (2023, p. 29) argue that groups using very similar materials, with high copresence of archaeological material, were more likely to have interacted, although this does not necessitate direct connection.

3.2 DATA COLLECTION

This thesis focuses on exploring the relationships and connections between *ringwalburgen*, geographically defined sites. Archaeological ringwalburg sites, along with relevant *emporia* and other archaeological sites, serve as well-defined social actors necessary for constructing an archaeological Social Network Analysis (SNA) (Peeples, 2019, p. 466). The available material record from these sites provides data to measure connectivity between them. However, the material record does not directly observe past relationships within its context, necessitating reliance on the assumption that present material culture can indicate connections between places. This is typically assessed by examining the presence, absence, or frequency of specific parts of the archaeological assemblage (Brughmans &

Peeples, 2023, p. 28). Unfortunately, the size, quality, and extent of excavations at ringwalburg sites vary significantly from site to site (Tys et al., 2016, p. 188; ten Harkel, 2013).

As excavations at the ringwalburg sites have varied in nature, including differences in size and quality, and given the limited scope of this thesis, it was necessary to adopt a method that minimizes reliance on weighted co-presence numbers. Instead, this thesis employs a simplified approach where the presence of artifact types at each site attributes to the generation of network graphs. This methodology draws on approaches by Sindbæk (2007b, 2007c) adapted to suit this study.

Archaeological data for the datasets were collected from available literature, including archaeological reports, academic journal entries, and other published sources. All relevant artifacts mentioned in the literature were selected and organized in tables by geographic area and material (see Appendix). These artifacts date from the 7th to 11th centuries AD and were selected to minimize bias, considering their preservation under varying conditions. The selection criteria for artifacts considered their importance, representativeness, and clarity in identification. This selection was informed by the context discussed in the previous chapter and other literature discussing trade indicators, briefly outlined below.

The collected data was organized by site, including the four *ringwalburgen* of Zeeland with sufficient data for network incorporation, three *emporia* sites represented by Westhove, Dorestad, and Birka, and an outlier, Torksey, further discussed in Chapter 3.5. Westhove is also an outlier due to its material consisting of beach finds, which presents complications discussed in Chapter 4. These sites were selected to represent different trading interests within the study's limited scope and had adequately documented assemblages suitable for analysis.

There are several materials specifically indicative of exchange or trade during the studied period. One of the clearest indicators is the presence of coins. Clusters of silver sceatta coins are particularly important for this period. These coins, modeled after earlier Merovingian gold tremisses, are clustered along the Rhine, in England, around the North Sea coast, and in southeast Denmark. They appear less commonly in Scandinavia and the Baltic Sea region (Sindbæk, 2007a, p. 303). Another significant type of coin is the Arabic silver dirham, which began appearing toward the end of the 8th century, mainly in Russia and the Baltic Sea region. An influx of silver through the Mediterranean allowed Charlemagne to introduce a heavier penny, which was matched in Denmark by 'Hedeby' coins (Sindbæk, 2007a, p. 303). In the northern parts of Europe, a bullion or bar-based exchange system was also important and widely used (Sindbæk, 2007a, pp. 304-305).

Other objects indicating exchange include quernstones, pitchers, glass vessels, and textiles (Gabriel, 1988). These items suggest intense trade relative to the rest of Northern Europe (Sindbæk, 2007a, p. 303). Pottery was mostly confined to its region of origin, but some ceramic wares had supraregional distribution. Badorf and Pingsdorf wares from the German Rhineland are the most relevant examples in this context (Sindbæk, 2007a, pp. 308-309). Another important indicator relevant to this study is quernstones. An important source for quernstones was the Rhineland's Mayen region, which began exporting them in the 10th century AD. During the Carolingian period, the region became a popular exporter of quernstones, which were transported over water and distributed along the Rhine and the coastlands of the North Sea area (Sindbæk, 2007a, pp. 310-311).

3.3 DEFINING MODEL, NODES & EDGES

There are many different models available for generating network graphs. The questions posed in this thesis and the available data will determine which models are best suited to provide insights that assist in answering the research questions. The first step in constructing a network is determining its nodes (Evans, 2016, pp. 151-152). In the data collection phase, the *ringwalburgen* have been defined as isolated geographical contexts and can thus be converted into the nodes of the network graph. The attributes of these nodes can be represented as the edges of the network graph. Our nodes represent contexts with geographical locations and will form a geographical space network (Östborn & Gerding, 2014, p. 76). The attributes of our nodes are the occurrences of specific classes of artifacts within their archaeological records. With these nodes and edges, a geographic similarity network that relies on the co-presence of classes of artifacts can be constructed.

Table 1.

Network Types Generated

NETWORK	MODE	WEIGHTED	DIRECTED
SIMILARITY NETWORK	Unimodal	Yes	No
SIMPLIFIED SIMILARITY NETWORK	Bimodal	Yes	No
SPARSE ATTRIBUTE NETWORK	Unimodal	No	No

The occurrence of a type of artifact in a given geographic area, or context, has been organized in a matrix (see Appendix) as described by Östborn and Gerding (2014, p. 76). In this matrix, the occurrence of an artifact type is an attribute of the context and is given a value. For example, the presence of a pottery type in the context 'ringwalburg Oost-Souburg' gives this attribute a value of 1, while the absence of this pottery type in the context 'ringwalburg Middelburg' gives it a value of 0. The contexts and their attributes have been organized into sets of matrices that form the database used in this thesis, where the rows represent contexts and the columns represent attributes.

A similarity network generated using this matrix was chosen as a tool for answering the first sub-question: Is there a ringwalburg that appears to have functioned as a regional trade hub? Nodes with a relatively high number of connections can indicate that a site functioned as a transport hub within its respective network (Sindbæk, 2007c, p. 61). Additional advantages of this similarity network include the ability to incorporate archaeological sites from outside the focus region of this study to check for clustering within the network and the possibility to overlay the network onto geographic maps for visual clarity.

Two additional simplified networks have been generated to assist in interpreting this similarity network. The first is a simplification of the aforementioned network, where the artifact classes used as nodal attributes have been organized into a small number of variables based solely on their materiality. This simplification enables the network to function as a tool for discussing biases in the archaeological record. The second network changes the nodal attributes to qualitatively determined attributes of trade within settlements, providing another perspective for analysis.

3.4 NETWORK GENERATION

To plot the required network graphs, a digital tool was needed that allowed for quick generation of network graphs and the ability to alter their presentation to effectively communicate and emphasize patterns. Gephi (Bastian et al., 2009) was chosen for this purpose, in combination with the Nocode (Levallois, 2021-2024) free plugin to import the required datasets. Several methods can be used to alter the presentation of a network to facilitate an intuitive visual understanding of connections, which network methods excel in (Brughmans, 2012, pp. 627-628). The relevant distinctions include unimodal and bimodal, weighted and unweighted, and directed and undirected networks, which will be briefly discussed.

Unimodal, or single-mode, networks contain only one set of nodes. When the attribute values of the network's nodes are binary, as is the case for the presence or absence of an artifact class, the network can be converted into a bimodal, or two-mode, network. Bimodal networks have two different sets of nodes with edges that only connect to the opposing set (Östborn & Gerding, 2014, p. 77). Such networks are useful when the relationship between the attributes and the contexts needs to be presented clearly. This is the case for the simplified similarity network, and thus this network has been generated as a bimodal network. As a result, both the context (archaeological sites) and the attributes (archaeological material) are plotted within the same graph, allowing for an easy understanding of possible bias and the impact of material preservation on the network graph patterns.

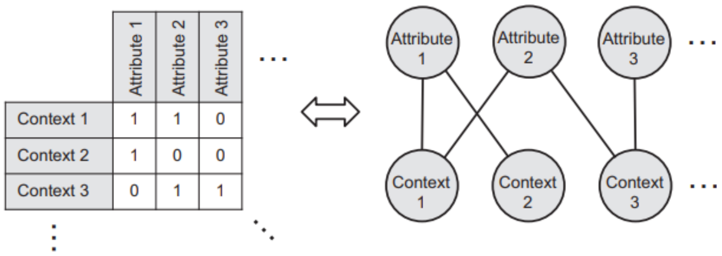

Figure 4. Bimodal network generation, (Östborn & Gerding, 2014, Figure 3)

Weighted networks have edges with measured values that vary across different edges. In network graphs, this variation can be visually represented by plotting thicker lines for edges with higher weights. In the similarity networks generated for this study, edges between nodes are assigned a measured value based on the number of attributes that are co-present between nodes. Therefore, nodes with higher similarity are connected by thicker edges, visually emphasizing stronger connections between them.

The network graphs constructed in this thesis will be of the undirected type. In undirected networks, vertices are connected by lines to represent bidirectional relationships. Directed networks, on the other hand, use arrows to indicate the direction of connections, which can be useful for depicting trade networks where the flow of goods is known. However, in archaeological studies, it is often challenging to ascertain whether artifacts were traded or locally produced. Even when such distinctions are clear, establishing direct trade routes requires specific evidence which may be lacking due to incomplete archaeological records.

In this thesis, the networks are constructed based on data that serve as proxies for connections between sites, allowing for inference of potential trade relationships. As noted by Sindbæk (2013), while the origins and destinations of trade routes may be known, details about intermediate nodes are often incomplete, influencing how connections are represented in network graphs. Therefore, the chosen undirected networks are suitable for visualizing similarities between nodes without implying directional flows of trade.

3.5 FALSIFICATION

"When producing networks using archaeological data, 'A common mistake is to use networks to find support for one hypothesis, without excluding others' (Östborn & Gerding, 2014, p. 79). To mitigate this issue, it is crucial to incorporate data that allows for falsification within the dataset. Archaeological sites such as Torksey, Birka, and Dorestad have been included for this purpose, as their distinct nature helps assess the randomness of relations between nodes. These sites serve to challenge the hypothesis that nodes representing the *ringwalburgen* will form a clustered network or that a specific node acted as a regional hub.

The observed patterns have been compared with hypothetical patterns represented in a predictive network. This hypothetical similarity network (see Figure 4.1) has been constructed to present the expected data patterns within the actual co-occurrence similarity graphs (see Figure 4.2, 4.3, and 4.4). Based on the historical background of the *ringwalburgen* and the archaeological material in the database, it aids in formulating hypotheses about the patterns observed in the co-occurrence similarity network graphs, which can then be contrasted against the actual results.

A second measure involves the inclusion of a simplified similarity network. This network facilitates discussion on the biases affecting the patterns in the network graphs due to archaeological excavation and material preservation. It is represented as the bimodal, sparse attribute network (see Figure 4.5).

To ensure the avoidance of random similarities, Östborn and Gerding (2014, p. 84) developed an approach within their general similarity network framework that allows for checking the significance of network patterns. This involves comparing the network with a randomly generated network using the same database matrix as the original network. The values in the database matrix are shuffled to create random relations between nodes. The resulting relations from this random similarity network are then compared with those observed in the actual network, aiming to reject the null hypothesis that there is no causal process (Östborn & Gerding, 2014, p. 84)."

3.6 CHAPTER SUMMARY'

This chapter has introduced network theory in an archaeological context. It has talked about archaeological similarity networks and how they rely on using copresences of artifacts as a proxy for a relation. This study has made use of a similarity network that relies on the copresences of an artifact type instead. The data will be collected using the archaeological data from the *ringwalburgen* and other key sites in the form of Dorestad, Birka, Torksey and Westhove. A set of networks has been generated using the Gephi software. The main networks that will be generated to answer the questions posed in this study are similarity networks, simplified similarity networks and Sparse attribute networks. Additional networks will be generated in order to assist with falsification and discussion, the bimodal material network and a predictive similarity network.

4. RESULTS

Using the method discussed in the previous chapter, network graphs have been generated to facilitate discussion and address the sub-questions of this thesis. This chapter focuses on the first two sub-questions: "Is there a ringwalburg that appears to have functioned as a regional trade hub?" and "What do patterns observed in the generated networks tell us about the role of *ringwalburgen* in the broader North Sea area trade network?" The primary objective of this chapter is to analyze the generated graphs, observe recognizable patterns, and describe their implications.

4.1 NETWORK INTERPRETATION

The generated Artifact-type Co-occurrence Network, shown in this chapter (Figures 4.2, 4.3, and 4.4), is generated using the same artifact-type co-occurrence matrix dataset (Appendix 2), but differs in the aspects of the network highlighted. This visualization emphasizes different patterns to assist in communicating and discussing the observed patterns, which are further explored in this chapter.

It is worth repeating that the dataset used to generate the networks is built using archaeological material that has a preservation bias. As mentioned in the previous chapter, this material is not sufficient to simulate trade during the selected time period and should not be interpreted as such. They represent connections based on selected archaeological data.

It is important to emphasize that the co-presence of a shared artifact type does not necessarily indicate a direct connection between sites. Within the context of a larger trade network, Sindbæk (2007b, p. 66) notes that while direct communication of trade is not necessarily present in the case of co-occurrence of shared artifact types, it could suggest that these sites are part of the same larger trading network, where each site is connected to at least one other site. Consequently, the networks generated in this thesis do not indicate direct connections between sites. Instead, they operate on the assumption that greater similarity in material culture between two sites suggests a stronger connection, as discussed in Chapter 3 (Brughmans & Peeples, 2023, pp. 28, 84-85).

While the node attributes (material types) have been chosen with archaeological bias in mind (see Chapter 3.2), artifact types have been chosen to construct a matrix that is identifiable and can be encountered at the studied sites. However, the studied sites are limited in the archaeological material they can provide, and differences in deposition, excavation, and documentation will nonetheless impact the archaeological material used to generate the networks in this chapter, introducing a bias that needs to be considered when analyzing the patterns.

4.2 HYPOTHETICAL SIMILARITY NETWORK

As discussed in Chapter 3, in a co-occurrence similarity network, the greater the similarity in function, location, and connections, the more likely it is for similar assemblages to be shared by nodes and vice versa. For the "hypothetical similarity network," I anticipated that the ringwalburg nodes would form clusters due to the perceived similarity in their assemblages; these similarities will be discussed in more detail below. They include shared artifacts such as ceramics, quern stones, as well as skates and tridents. As noted by Van Heeringen (1995b, p. 27), the assemblages of Oost-Souburg and Middelburg are remarkably alike, resulting in their proximity within the predictive network.

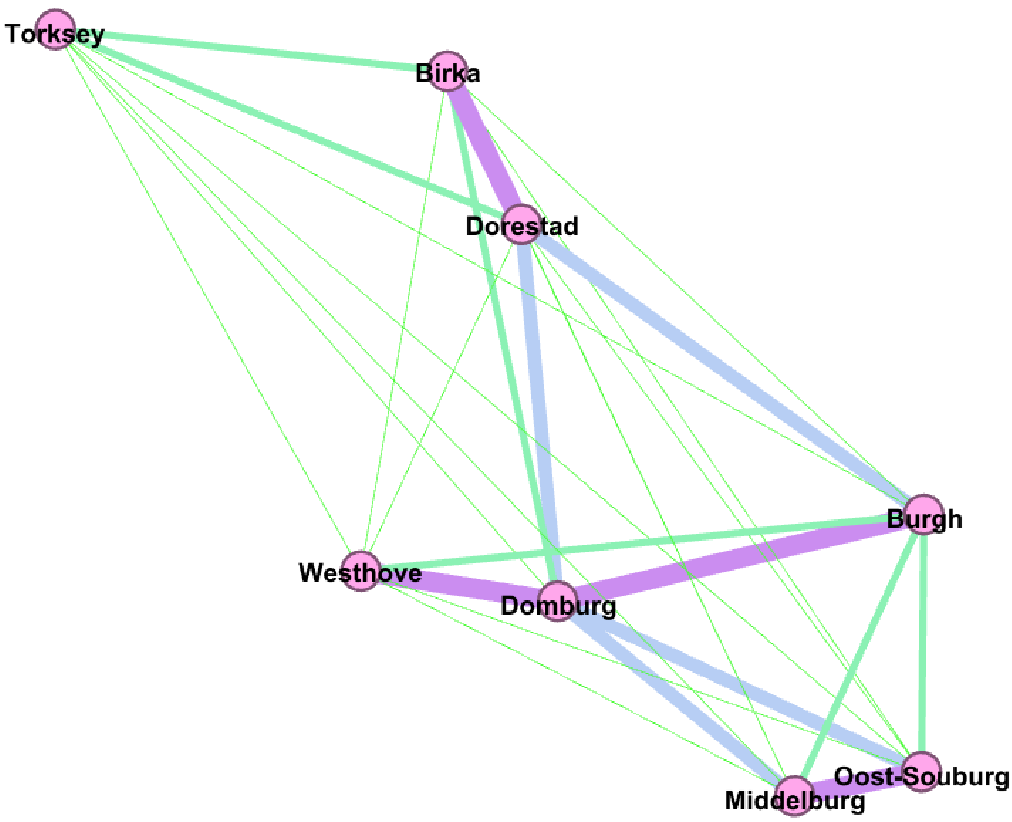

Figure 4.1. Predictive Artifact-type Copresence Network

Additionally, the *ringwalburgen* are all located near each other in the region of Zeeland. It is expected that there is also convergence in the assemblage due to shared experiences within the region. The three *ringwalburgen* on Walcheren are especially anticipated to have connections because of their close proximity, with Middelburg positioned in the middle of the island and Domburg and Oost-Souburg on the north and south coast respectively. Notably, Oost-Souburg and Middelburg are located only 4.1 km apart (ten Harkel, 2013, p. 234).

The ringwalburg of Schouwen-Duiveland, Burgh, is separated from the other *ringwalburgen* by the Scheldt estuary. This acts as a partial barrier hindering direct contact between the sites. As discussed in Chapter 2, Burgh is associated with the *emporium* of Westenschouwen. Domburg, associated with *Walichrum*, is located on the opposite side of the Scheldt estuary. Deckers (2022, p. 194) describes this situation as follows: "It flourished from the eighth century onwards in the periphery of *Walichrum*, which was directly accessible just across the estuary of the river Scheldt." Predicting a similar function due to their shared association with *emporia* would also result in these *ringwalburgen* nodes being positioned closer to each other in the predictive network.

The Westhove node represents the *Walichrum emporium* and should be closely positioned near the Domburg ringwalburg node, with which it is associated. However, the archaeological assemblage of Westhove is differentiated from the ringwalburg nodes because it consists of beach finds, which may complicate its positioning within the network graph. Additionally, as an *emporium* node, Westhove should be fairly well connected to other *emporium* nodes, such as Dorestad and Birka.

The Birka and Dorestad nodes are both *emporium* sites, functioning within the same North Sea trading network. Consequently, their proximity within this network is expected to be closer to each other. Similarly, the nodes of Domburg and Burgh, also linked to *emporia*, are anticipated to have closer ties to other *emporium* nodes compared to Middelburg and Oost-Souburg. Given Dorestad's geographical proximity to Burgh, Westhove, and Domburg, it is expected to share trade connections and material from the German Rhineland area with the *ringwalburgen*. Therefore, these nodes should logically cluster together more closely than they would in relation to Birka.

The Torksey node is positioned as an outlier within the predictive network, reflecting its historical function, which differed from the other represented sites. Torksey is associated with a Viking Winter Camp and later became a Saxon burh (Hadley et al., 2016). The well-documented finds from the Viking camp include items common within the Viking sphere of influence, such as dirhams and hacksilver (IJssennagger, 2013, pp. 87-88), positioning the Torksey node relatively close to *emporia* nodes known to have connections with the Viking sphere of influence or were heavily embedded within it, as discussed earlier in this thesis. Consequently, the Torksey node is positioned nearest to the Birka node and has relatively stronger connections to the Dorestad and Westhove nodes. Despite this proximity, Torksey remains relatively distant from these sites due to its distinct function, which significantly impacted its archaeological assemblage and its position within the network.

The predictive network succinctly analyzes the implied relationship between trade and *ringwalburgen* in the region. The resulting predictive artifact-type network (Figure 4.1) shows a distinct cluster for the Zeeland nodes and well-connected trading site nodes. Domburg is anticipated to function as a hub within this network, whereas Torksey is expected to be relatively isolated, serving as a node that highlights divergent results from other network graphs. The relationships depicted in the speculative network suggest that Zeeland forms a clustered network, with both Domburg and Burgh nodes well-connected within the Zeeland cluster. These nodes also link the Zeeland cluster with larger trading nodes, indicating that both Domburg and Burgh potentially serve as trading hubs for their associated *emporia*.

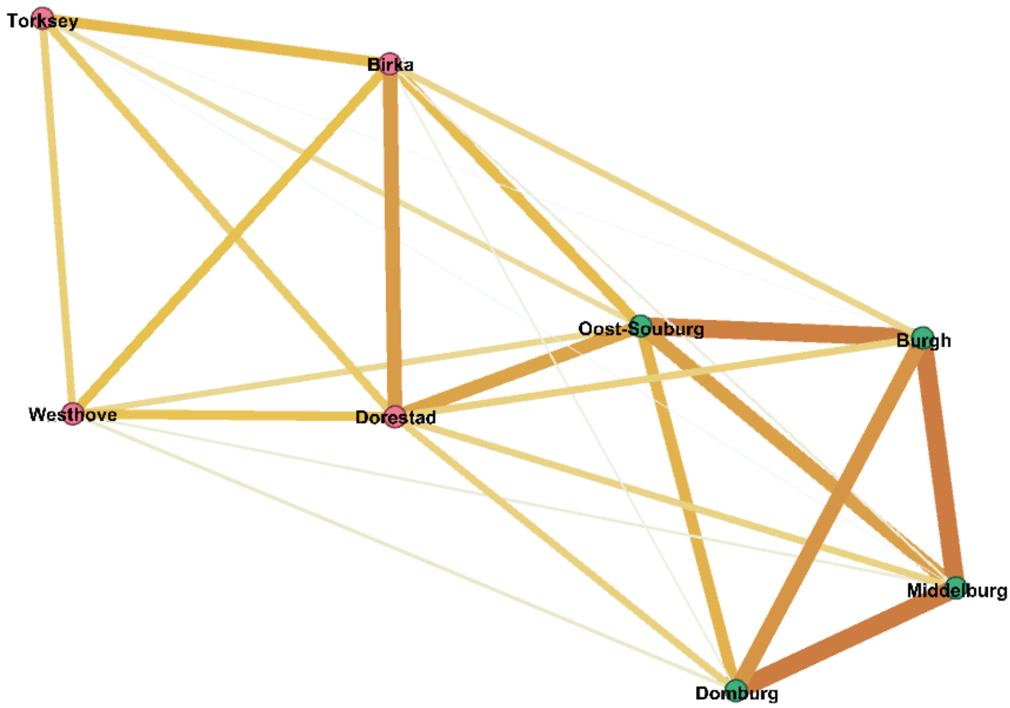

Figure 4.2.. Artifact-type Co-occurrence Network (Weighted)

4.3 CO-OCCURRENCE SIMILARITY NETWORKS

The artifact-type co-occurrence networks below (Figures 4.2, 4.3, and 4.4) each highlight different aspects of the network. Figure 4.2 is colored to indicate weight, representing the percentage of similarity between nodes. Figure 4.3 uses color to highlight clusters detected using the community detection algorithm provided by Gephi software. Figure 4.4 emphasizes the total number of shared artifact types. These graphs and their patterns will be briefly discussed in the following paragraphs.

As mentioned earlier, Figure 4.2 highlights the weight of edges within the generated similarity network. Darker-colored edges indicate a higher percentage of shared artifact types, suggesting a more similar material culture between sites. This visual representation using colors corresponds to the thickness of the edges, which is also determined by their weight. Most nodes are well-connected and share at least one attribute with other nodes. Figure 4.2 demonstrates that the ringwalburgen are all connected by darker-colored edges, indicating a high total percentage of shared artifact types among these sites. A similar pattern is observed for Dorestad, Birka, and Oost-Souburg, where thicker and darker edges denote a high total artifact percentage. In contrast, the edges for Torksey and Middelburg nodes show almost nonexistent shared artifact types, making them difficult to observe.

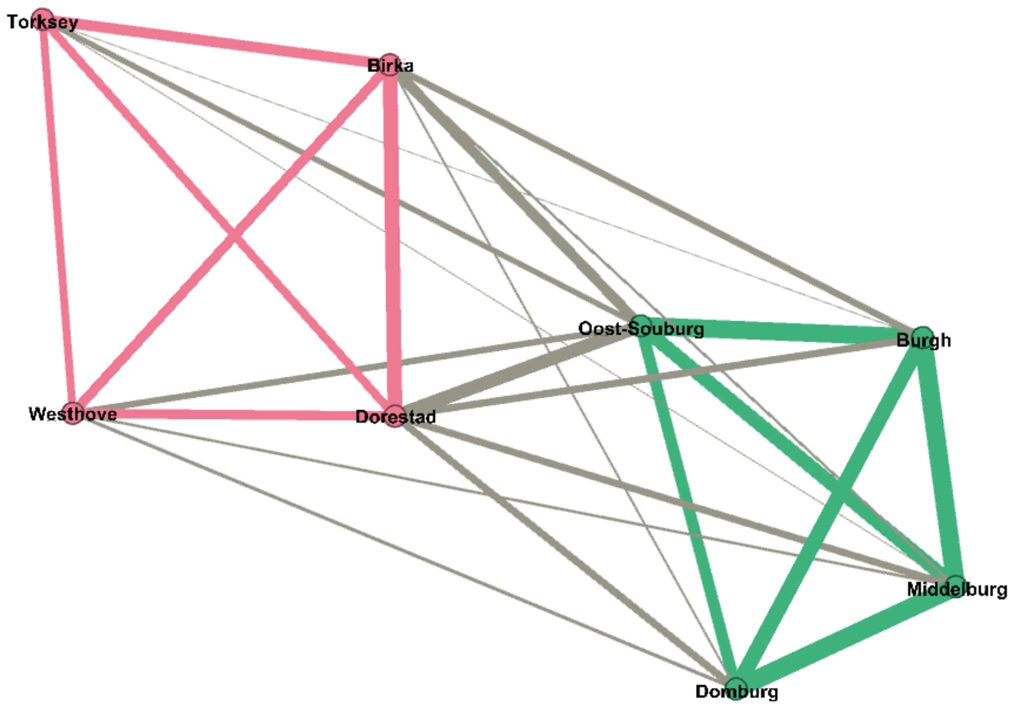

Figure 4.3. Artifact-type Co-occurrence Network (Modularity Class)

Figure 4.3 illustrates clusters identified using the Gephi community detection algorithm, represented in green and pink. This network remains a co-occurrence similarity network, where the thickness of vertices is determined by their weight (similar to Figure 4.2). The strong connections among the ringwalburg nodes observed in Figure 4.2 are also recognized by the Gephi algorithm (set at a resolution of 1.0), highlighted in green. The remaining nodes form a distinct cluster highlighted in pink. These clusters emerge because nodes within each cluster share more similarities with each other than with nodes in other parts of the network. In these clusters, Oost-Souburg and Dorestad emerge as central nodes. With higher resolution settings, these nodes may appear less central as they are excluded from their respective communities due to their well-connected nature in the graph. The detected clusters suggest that artifact types from the ringwalburg sites are more similar to each other compared to other sites. However, not all Zeeland sites exhibit this similarity, as evidenced by the Westhove node being classified in the non-ringwalburg cluster.

Figure 4.4 highlights the total number of shared attributes (artifact-types) between nodes. Lighter-colored edges indicate fewer shared artifact-types between connected nodes, whereas darker colors indicate a higher number of shared artifact-types. The range of shared artifact-types in the co-occurrence graphs (Figures 4.2, 4.3, and 4.4) spans from 1 to 39. Sites with a high number of artifact-types are more likely to share these types with other artifact-rich sites. For instance, Dorestad, Birka, and Oost-Souburg exhibit a high total number of shared artifact-types, which aligns with their status as artifact-rich sites (see Appendix). Importantly, a high total number of shared artifact-types does not necessarily correlate with a high percentage of shared attributes. When a node has both a high total number of shared attributes and a high percentage of shared artifact-types, it indicates a stronger connection and similarity. Conversely, Figure 4.4 shows that the ringwalburg cluster is supported by a moderate amount of shared artifact-types, ranging from 9 to 14. However, the connections between Dorestad and Oost-Souburg nodes are more robust.

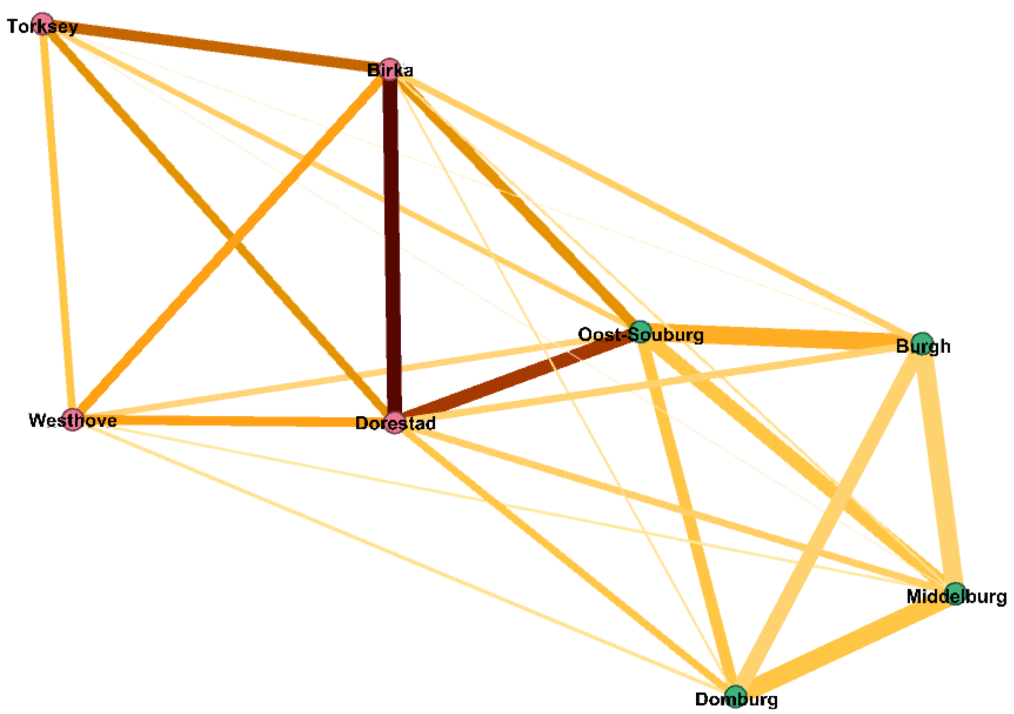

Figure 4.4. Artifact-type Co-occurrence Network (Shared Attributes)

4.4 HUBS & *RINGWALBURGEN*

Figures 4.2, 4.3, and 4.4 now allow us to address the first sub-question: Is there a ringwalburg that appears to have functioned as a regional trade hub? Typically, identifying a hub within a network implies pinpointing a central node that is well-connected to other nodes within its cluster and to nodes outside the cluster (Brughmans, 2012, pp. 644-645). Within the cluster of ringwalburg nodes, the Oost-Souburg node shows better connections to nodes outside the ringwalburg cluster compared to Domburg, Middelburg, and Burgh. However, relative to connections within the ringwalburg cluster itself, Oost-Souburg does not stand out as more connected. Burgh and Middelburg nodes, internally, show stronger connections among themselves with higher weights (see Figure 4.1). Both Domburg and Oost-Souburg nodes exhibit similar internal connectivity.

Thus, Oost-Souburg does not appear central within its cluster. This absence of centrality is evident in the cluster structure, where the ringwalburg nodes form a diamond shape without a clear central node. Additionally, while Oost-Souburg shows better external connections, it does not bridge isolated nodes. The other ringwalburg nodes are not isolated within the network and maintain high-weight connections among them. Despite Oost-Souburg's stronger external connections, it does not fulfill the criteria of a central node within the network. Therefore, while it displays hub-like characteristics, it does not meet the definition of a hub within the network or its cluster. Thus, the first sub-question can be answered: the network graphs do not support the presence of a ringwalburg node that functioned as a hub.

4.5 MATERIAL NETWORK

Figure 4.5 shows a bimodal weighted network with edges weighted based on the respective number of artifact types in a specific material group. Within this network, thicker and darker colored edges indicate a higher number of artifact types, while thinner and lighter colored edges indicate fewer artifact types. This differs from the weighted co-occurrence similarity network (Figure 4.2), where the weight and color values represent the percentage of similarity between nodes.

In this bimodal network, the nodes represent different contexts: the purple nodes represent material categories, and the cyan nodes represent the same geographical nodes used in the co-occurrence similarity network (Figures 4.2, 4.3, and 4.4).

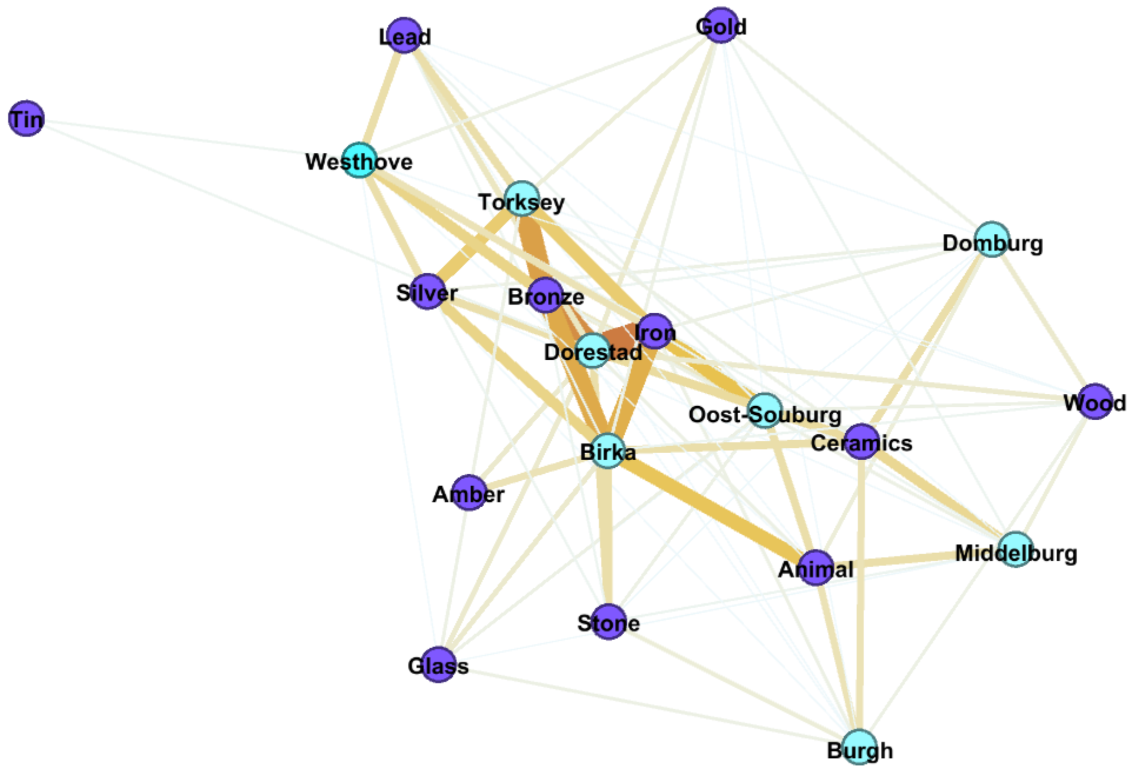

Figure 4.5. Bimodal simplified material Co-occurrence Network

Using Figure 4.5, several observations can be made regarding the material categories and their importance to the positioning of geographically determined nodes in the co-occurrence similarity networks (see Figures 4.2, 4.3, and 4.4). This network highlights the significance of material categories for specific nodes, particularly metals. The pink-colored cluster of non-ringwalburg nodes (see Figure 4.3) shows a strong association with metals. In contrast, Burgh had very few metal finds, leading to its isolation from the metal-rich trading nodes. However, the Oost-Souburg node exhibits greater similarity in connections to these metal-rich nodes. Some of these strong connections underscore a partial bias within the archaeology of these nodes.

The Westhove node, consisting mostly of beach finds, lacks connections to certain material types that are less likely to be preserved in the archaeological record. In the case of Torksey, heavy usage of metal detectors has disproportionately influenced its assemblage with metals, though metal was already considered significant at the site.

In addition to falsification, it is also important to examine how material categories crucial to trade are positioned relative to geographically determined nodes. Amber and glass, both trade indicators, are well-connected to nodes expected to play a significant role in exchange, such as Birka and Dorestad. These nodes also show the strongest connections to most material category nodes, reflecting their diversity in artifact types.

The Domburg node, however, is distant from material category nodes such as stone, amber, and glass, while other ringwalburg nodes are more closely associated with these categories. While these connections between location and material should not be considered definitive proof, they may emphasize patterns suggesting reasons for existing relationships or indicating biases in the materials used.

4.6 SPARSE ATTRIBUTE NETWORK

As mentioned in the previous chapter, the sparse attribute network is constructed based on characteristics documented in scholarly literature and reports. Its primary purpose is to identify biases within co-occurrence similarity network graphs (see Figures 4.2, 4.3, 4.4). The resulting network provides a simplified visualization of a dataset centered on academic discussion and archaeological evidence related to the *ringwalburgen*, emphasizing trade and production rather than generating new data. Key attributes considered include imported goods, potential for export, proximity to trade centers, and the presence of trade-related artifacts. The construction of the figures (Table 2 and Figure 4.6) is detailed in the following paragraphs.

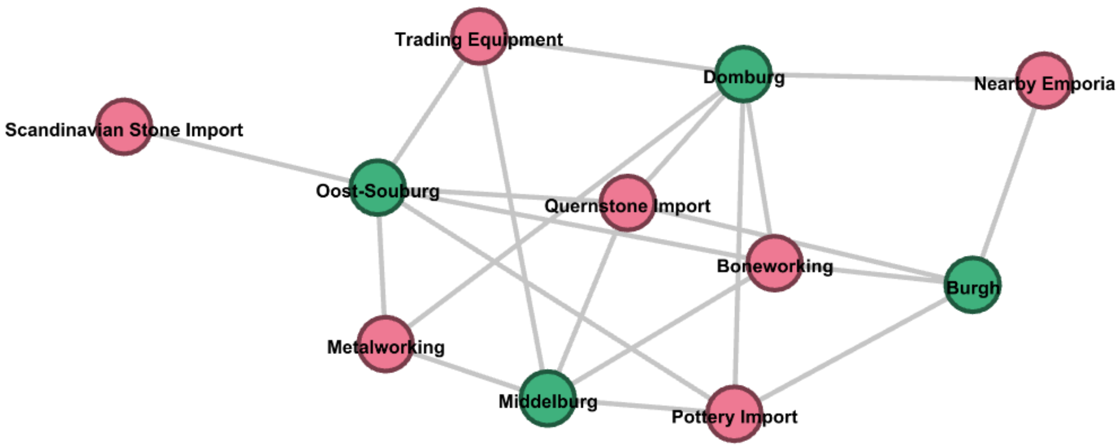

Figure 5. Bimodal Sparse Attribute Network

Table 2.

Sparse Attribute Network Table

LABEL	OOST-SOUBURG	DOMBURG	MIDDELBURG	BURGH
IMPORTED POTTERY	1	1	1	1
IRONWORKING / METALWORKING	1	1	1	0
IMPORTED QUERN STONES	1	1	1	1
IMPORTED SCANDINAVIAN STONES	1	0	0	0
BONE WORKING	1	1	1	1
TRADING EQUIPMENT (WEIGHTS AND COINS)	1	1	1	0
NEARBY EMPORIA	0	1	0	1

To start with Oost-Souburg, ample evidence supports various types of production at the ringwalburg site. Metalworking was likely present, as ironworking slag made of bog-ore not corresponding to known Dutch ores has been found (ten Harkel, 2013, pp. 229-230; Joosten, 1995, pp. 177-178). The pottery from Oost-Souburg mainly consists of Pingsdorf ware, the vast majority of which was likely imported from the Rhineland (van Heeringen & Verhaeghe, 1995, pp. 145–146). Additionally, Andenne-type luxury ware from the Meuse valley and northern France was also present (Verhaeghe, 1995, p. 169). Objects made from natural stone were imported as well, including whetstones of Norwegian origin and quern stones from the Eifel region in modern-day Germany (Kars, 1995, pp. 185–186). A Swedish soapstone and locally produced whetstones were also found (ten Harkel, 2013, pp. 231-232). Evidence of trade includes a worn copper-alloy coin and lead weights (Joosten, 1995, p. 173). Local bone working is attested to, and both local and imported red deer antlers were used to create objects such as skates, small tridents, and combs (ten Harkel, 2013, p. 233; Lauwerier, 1995, pp. 214-216; Lauwerier & van Klaveren, 1995, pp. 193-197).

The artifact evidence from Oost-Souburg suggests its involvement in coastal North Sea trade and manufacturing, with a diverse assemblage that includes pottery from the Rhineland, querns from Germany and Norway, and metalwork such as weaponry and horse gear. However, the relatively low-quality metalwork compared to Domburg, along with evidence of ironworking slag and wool processing, indicates a smaller scale of manufacturing. The importation of raw materials like red deer antlers for comb making suggests connections with inland regions, while comb typology hints at ties with the British Isles and Denmark, reflecting the significance of the wool trade (ten Harkel, 2019, pp. 7-8).

Much of these discussed attributes are also found at the Domburg ringwalburg site. Pottery from the site is associated with Flemish wares and includes Kugeltopf ware, Duisburg ware, and Hunneschans ware (van Dierendonck, 2009, p. 263). Badorf and Pingsdorf ceramics from the Rhineland are also present in large numbers, with Pingsdorf once again forming the majority of the pottery shards accounted for. Andenne ware is also present (Schoneveld, 2011, pp. 112-114).

There is considerable ironwork found in Domburg, primarily brooches. Scattered iron slag suggests local metalworking activity (Daleman & Koopstra, 2011, pp. 125-128). Most of the stones found at Domburg are fragments of multiple quern stones from the Eifel region of the German Rhineland (Kars, 1995, pp. 185–186; Veldhuis, 2011, p. 133). Notably, flint was also found, possibly used as ballast for ships (Veldhuis, 2011, p. 139).

Both local and imported animal bones are used to create objects similar to those found in Oost-Souburg, including skates, combs, and whorls (Buitenhuis, 2011, p. 160). Several coins are also present at the Domburg ringwalburg site (van Heeringen, Pol, et al., 1995, p. 48). Lastly, it should be noted that Domburg is associated with the *emporium Walichrum* (Deckers, 2022, p. 191).

In the case of Middelburg, ceramics such as Pingsdorf, Kugeltopf, and Andenne ware are all present (Bosma, 2006, pp. 35-40; van Heeringen, 1993, p. 57). Metalworking slag has also been identified, most likely from bronze working. A bread oven, where slag has been found, was present at the ringwalburg site, though it may have been primarily used for baking bread rather than metalworking (Ufkes, 2006, pp. 80, 84-85). Quern fragments from the Eifel region were also found, similar to those at previous ringwalburg sites (van Heeringen, 1993, p. 57). The origin and subtype of a quartzite whetstone found at the site remain unknown (Ufkes, 2006, p. 80). Worked animal bone is also present, including products similar to those found at previous ringwalburg sites, such as skates and combs, found in various excavations (Braat, 1941, p. 58; Halıcı, 2006, pp. 47-49; van Heeringen, 1993, p. 57; Trimpe Burger, 1964, p. 110). No specialized trading equipment has been found at the site.

Lastly, Burgh will be covered. The ceramics at the site are very similar to those found at the ringwalburg sites mentioned above (Braat, 1960, pp. 96-97; van Heeringen, 1988, p. 13). Quern stone fragments from the Eifel region are also present once again at Burgh (de Kort & Doesburg, 2009, p. 22). However, the presence of ironworking and imported stone cannot be determined based on the current finds. While whetstones and iron tools have been discovered, it is unclear whether ironworking was conducted, and the origin of the iron material found at the site remains unknown (Braat, 1954, p. 16). Luxury products and trading equipment are also absent. Bone working, however, is evident, with bone combs, skates, and tridents found at the site (van Heeringen, 1987; van Heeringen, 1988, pp. 139-140). As discussed in Chapter 2, the ringwalburg of Burgh is associated with the nearby *emporium* of Westenschouwen (Deckers, 2022, p. 194).

The bimodal sparse attribute network shows that every ringwalburg node is associated with multiple trading attributes. Each ringwalburg has evidence of imports and production activities on site. This network provides context particularly to the positioning of Oost-Souburg and Domburg nodes in relation to nodes associated with metal materials, as shown in Figure 4.5. A difference in production quality at Domburg is attested to, which is not reflected in the generated network graphs. This indicates a risk of bias when considering production at Domburg. The quality and scale of production are not adequately reflected in the co-occurrence similarity networks (See Figure 4.1, 4.2, 4.3, 4.4, and 4.5) based on artifact-types, despite their importance in interpreting the relationship between the *ringwalburgen* and trade. Therefore, conclusions drawn from the networks must be made with this limitation in mind.

4.7 NORTH SEA TRADE NETWORK & *RINGWALBURGEN*

Now that all the generated networks have been covered, the following paragraphs can discuss the second sub-question of the thesis: What insights do the observed patterns in the generated networks provide regarding the role of *ringwalburgen* within the broader trade network of the North Sea area? This section will primarily cover relevant patterns observed in the network graphs to explain their relationships, supplementing these interpretations with relevant academic literature when appropriate.

4.7.1 MIDDELBURG

First, the placement of the Middelburg ringwalburg node within the co-occurrence similarity network will be briefly discussed. The placement of this node, as the furthest removed from the broader North Sea area nodes, might be partially due to its inland position, removed from the main trade routes (ten Harkel, 2019, pp. 9-10). Middelburg was not associated with trading sites and only gained a central position within the region of Zeeland during the 12th and 13th centuries (Deckers, 2022, p. 193). During the time period studied in this thesis, the Middelburg ringwalburg might have fulfilled functions related to trade, but not as intensely as is the case with other ringwalburg sites, which are closer to the Dorestad and Birka *emporium* nodes in the case of the Oost-Souburg node, or are associated with an *emporium* as is the case for Domburg and Burgh.

4.7.2 NETWORK HUB

The next pattern that will be discussed is the existence of a trading hub within the generated co-occurrence similarity networks (see Figure 4.2, 4.3, and 4.4). As concluded earlier, none of the Zeeland ringwalburg nodes fit the pattern of a local trading hub. The lack of a trading hub within the cluster of Zeeland ringwalburg nodes is a very apparent pattern. Figure 4.1 shows the expectation for such a hub to be present in the form of Domburg. However, the co-occurrence similarity network graphs (see Fig. 4.2, 4.3, 4.4) did not reveal observable patterns that confirm the existence of such a hub.

In contrast to the hypothetical similarity network (see Figure 4.1), the Westhove node is also further removed from the *ringwalburgen*, likely due to archaeological bias as it is the sole beach find site incorporated within the matrix (see appendix) and heavily reliant on metal artifacts for its placement (see Figure 4.5). Instead of Domburg, the closest a node comes to fulfilling the role of a hub within the co-occurrence similarity network graphs is the node of Dorestad. However, the same arguments given for the lack of a ringwalburg trading hub in Chapter 4.4 can be applied to Dorestad. It can thus be concluded that the patterns observed in this study's network graphs do not support a role as a trading hub for the *ringwalburgen*.

The ringwalburg nodes are, however, fairly well connected to the *emporia* nodes in the co-occurrence similarity network graphs (see Figure 4.2, 4.3, and 4.4), as opposed to how they are connected to the nodes of Westhove and Torksey. These results are aligned with the notion that the *ringwalburgen* are considered to be important for the North Sea trading area but do not play the role of trading hubs themselves. Questions regarding the existence of a hub in the Zeeland region that connects the Zeeland *ringwalburgen* remain unanswered, as there are no nodes that support such a trading hub being observable. This pattern thus suggests a general connection with the broader North Sea trade area, possibly through a regional trading hub not included in the network graph.

4.7.3 NODES AS POLYFOCAL SETTLEMENTS

The vicinity of Oost-Souburg near the Dorestad and Birka nodes in the co-occurrence similarity network graph (see Figure 4.2, 4.3, and 4.4) is worth discussing. When this pattern is observed in isolation, it implies that these sites were more similar as they shared a relatively high amount of their assemblage. However, this does not match up with the hypothetical similarity model (Figure 4.1). When comparing the results of these two graphs, the positioning of the Domburg and Oost-Souburg nodes is reversed. This suggests that Oost-Souburg’s ringwalburg is more similar in function to the Dorestad and Birka *emporia*, as originally predicted for the Domburg ringwalburg. This raises questions about why the Domburg node, apart from possible bias, is not as well-connected, and why Oost-Souburg is as well-connected as it is, and how this impacts their possible function.

When discussing this placement within the context of the academic debate, recent work by Deckers (2022) provides explanations for the role of *Walichrum* and the accompanying ringwalburg of Domburg, which can help elucidate the positioning of the Domburg node. The *emporium* itself is recognized as a significant market connected to North Sea trade routes, yet it also stands out as it was linked to a hinterland 'geared towards specialized production' (Deckers, 2022, p. 205). Some of this specialized production related to the *emporium* took place within the ringwalburg, while other specializations are evidenced by materials found outside the ringwalburg site (Deckers, 2022, p. 197).

The materials attested outside the ringwalburg site include those incorporated into the Westhove node, notably beach finds. Ten Harkel et al. (2023, p. 34) suggest that the ringwalburg and the *emporia* together formed a polyfocal settlement with multiple cores, advocating for a landscape-based approach rather than the commonly seen site-based approach. The Domburg node, representing the ringwalburg site, is limited in that it only encompasses materials from within the ringwalburg itself. The methodology supporting the separate inclusion of these assemblages was chosen due to the thesis's focus on *ringwalburgen*. However, exploring the role of ringwalburg in a broader context will be further discussed in Chapter 5.2.

When considering that the placement of Domburg may reflect its role as a polyfocal settlement influenced by the nearby *emporium*, a similar argument can be made for Burgh. Burgh is also associated with a nearby *emporium* site at Westenschouwen (Deckers, 2022, p. 194). Drawing a parallel between Domburg and Burgh in this context suggests that the Burgh node might similarly represent data from a settlement dispersed across multiple locations within the landscape. This dispersed nature could potentially influence its node placement, underscoring archaeological biases due to the lack of contextual information from associated settlement structures.

The ringwalburg of Oost-Souburg, however, is not associated with a larger settlement and thus may have played a more central role in trade within its immediate vicinity. The concentration of archaeological material within the well-excavated ringwalburg site likely results in a higher degree of co-occurrence with the nodes of Domburg and Birka in the network graphs (see Figure 4.2, 4.3, and 4.4). Therefore, a plausible explanation for the observed patterns is that the archaeological material from the North Sea *emporia* and Oost-Souburg nodes represents a more 'complete' part of the settlement, leading these nodes to cluster together. Based on this idea, we can suggest that the *ringwalburgen* could have fulfilled different functions within their trade network, depending on the roles required in the context of the trading network.

4.7.4 MANUFACTURING SITES

The simplified bimodal material network (Figure 4.6) and the sparse attribute network (Figure 4.7) offer valuable insights into the roles of *ringwalburgen* within the broader North Sea trade network. These networks provide a structured view of how these sites functioned and interacted within their economic context.

Figure 4.5 highlights that Oost-Souburg shares significant similarities with *emporia* nodes, primarily due to its association with metal artifacts. Notably, Oost-Souburg features a substantial amount of slag linked to an identified industrial site, suggesting its involvement in importing and processing metals (ten Harkel, 2013, pp. 231-232; Joosten, 1995, pp. 173-174). Similarly, Domburg shows evidence of metal production, with slag discovered at the ringwalburg site associated with several residential structures, although its production is considered on a household scale (Daleman & Koopstra, 2011, pp.125-128). These findings likely influenced Domburg's role within the network.

The specific roles fulfilled by the *ringwalburgen* in trade, such as craft activities, trade with the hinterland, and possibly protection of trade routes, remain uncertain within the current dataset. Preliminary conclusions drawn from the literature (see Figure 4.6) suggest that these sites served as centers for local production that relied on imports to function effectively. However, these roles do not preclude other potential uses of these structures.

4.8 CHAPTER SUMMARY

In this chapter, network graphs were generated, recognizable patterns were analyzed, and their implications described. These patterns were compared with hypothetical similarity networks (see Figure 4.1). The patterns observed within the artifact type similarity networks (see Figure 4.2, 4.3, and 4.4) were mostly in line with what was predicted. The first sub-question regarding the existence of a ringwalburg functioning as a regional trading hub was not supported by the patterns observed in the network graphs. The bimodal simplified co-occurrence material network (see Figure 4.5) and the sparse attribute network (see Figure 4.6) were utilized to identify potential sources of bias within the network and gain a better understanding of the observed patterns. Although no problematic biases were detected, some nodes were influenced by the material used to generate the networks. Preliminary conclusions were drawn about the roles the *ringwalburgen* played within the broader trade network of the North Sea area. The patterns support the inclusion of the *ringwalburgen* within a broader North Sea trade network and it is acknowledged that the structures could have fulfilled various roles within this trade network. The specific roles, such as craft activities, trade with the hinterland, and possibly the protection of trade routes, remain uncertain within the current dataset.

CHAPTER 5. DISCUSSION

This chapter discusses the results from Chapter 4 within the context of existing academic discussions. The connections between places, as implied by the network graph patterns, will be compared with the connections expected in the data when considering existing theories concerning the *ringwalburgen*. First, the ringwalburg narratives that do not focus on trade will be discussed and compared with the results. This discussion addresses the third sub-question of this thesis: How do the observed network patterns fit within and compare to the existing historical narrative and academic discussion? This sub-question, together with the results of the previous chapter, will inform the second part of this chapter, in which the effectiveness of the methodology used will be evaluated, answering the final sub-question of this thesis: How effective was the network methodology in answering questions regarding the *ringwalburgen*?

5.1 RINGWALBURG PATTERNS & ACADEMIC DEBATE

The data used in constructing network graphs was selected to explore the relationship between trade and the Zeeland *ringwalburgen*, yet it can also be used to discuss proposed or implied ringwalburg site relationships from the academic debate. The network graphs offer a different perspective on the relationships between sites, and comparing these results with existing narratives through a network perspective allows for our findings to engage with the broader context in which *ringwalburgen* are studied. While the results from this thesis can be compared to some cases from ringwalburg historiography, the observations are limited due to the different themes of the academic narratives and the network graphs of this study. The main aim of this comparison is to gain further insights into the patterns observed in the networks presented in the previous chapter.

The main narratives explored here concern the central debate about the organization and function of the *ringwalburgen*, discussed in detail in Chapter 2.3. Scholarly literature aimed at understanding the functions of *ringwalburgen* inherently considers the relationships between *ringwalburgen* themselves and with various 'outside' actors. The narratives interpreting the Zeeland *ringwalburgen* as part of a 'chain of defensive structures,' a 'local defensive landscape,' or 'impositions of power within a negotiated landscape' require certain connections for the narrative to hold or claim the existence of connections between *ringwalburgen* and other actors as part of their argumentation (Dijkstra & de Ridder, 2009; ten Harkel, 2013, 2019; Huizinga, 1935; van Werveke, 1965). The assemblage selected for this study was chosen to explore relationships through the lens of trade but is not inherently limited to this perspective. It is important to remember that the dataset was not primarily designed for this purpose. Therefore, the findings should be seen as preliminary suggestions, inviting further discussion and exploration.

5.1.1 CHAIN OF DEFENSE

The 'chain of defense' interpretation posits that the Zeeland *ringwalburgen* are the *castella recens facta* mentioned in the *Miracula Sancti Bertini*. This argument has long been considered refuted due to discrepancies between the dating and descriptions in the text and the evidence from the *ringwalburgen* (van Heeringen, 1998, p. 245). However, the patterns observed in the previous chapter can still be compared with this narrative. This follows the notion that networks should not just support a single hypothesis but should also be tested to potentially falsify others (Östborn & Gerding, 2014, p. 79). According to this interpretation, the *ringwalburgen* form a single coherent whole, primarily serving to defend against Viking attacks and protect the local population (Deckers, 2022, p. 193; ten Harkel, 2019, p. 8; van Werveke, 1965, p. 5-6). In this narrative, the *ringwalburgen* performing the role of *castella recens facta* would have been built with an overlapping goal and extremely similar purpose. While recent excavations have emphasized differences between the *ringwalburgen*, their construction as a Carolingian initiative for coastal defense implies a standardized base (ten Harkel, 2019, p. 7). *Ringwalburgen* in this narrative thus have a very strong relationship with each other and possible strong relations with other sites within the Carolingian realm. They wouldn't be expected to show strong connections to nodes considered Viking-related, as they are an anti-Viking defense measure initiated by the Franks (Huizinga, 1935).

The assemblage of this 'chain of coastal defenses', built by a central power, would likely be highly uniform. For the results to support these expected relationships, the *ringwalburgen* would be expected to cluster closely together. While the assemblage used for the network graphs does indicate a degree of uniformity, there is a clear limit to this uniformity. In the previous chapter, it was observed that the Zeeland *ringwalburgen* form a cluster when compared to other sites, but they are clearly distinct and their positioning also implies slight differences in function. The weighted co-occurrence similarity network (Figure 4.2) shows that the *ringwalburgen* are clustered together with a relatively high degree of assemblage uniformity. However, the material network (Figure 4.5) shows that this uniformity is relative and there are significant differences between the assemblages used in the construction of the network graphs. Thus, the observed patterns do not match this narrative, as the archaeological data from the *ringwalburgen* is too distinct.

The *ringwalburgen* also do not show signs of being highly militarized. While they are defensive structures, their function as a centrally organized defense, at least over the period studied in this thesis, is not supported by the connections in the co-occurrence similarity network graphs (Figures 4.2, 4.3, 4.4). They do not plot near the more militarized Viking camp site node of Torksey, which has significantly more artifact types expected to be found at sites housing garrisons. The Oost-Souburg node plots the closest to the Torksey node (Figures 4.2, 4.3, 4.4), mostly due to similarity in metal artifact types (Figure 4.5), but it plots closer to trade nodes. Additionally, no material or production indicates a strong connection with the Carolingian realm, although the lack of a node with a high association with Carolingian influence makes this observation unsupported by the network graphs. Lastly, the patterns suggest relations with Viking-related nodes such as Birka, which does not fit the 'Chain of Defense' narrative.

5.1.2 LOCAL DEFENSIVE CLUSTERS

More recent narratives have scholars interpreting the *ringwalburgen* as part of local initiatives in fortress building, serving various interests of local actors. The nodes were built at different times and had distinct purposes, yet they operated within a shared context (Dijkstra & de Ridder, 2009, p. 115). This suggests we should expect a cluster of ringwalburg nodes with flexibility for these nodes to share different relationships due to their varied functions. The clusters proposed by Dierendonck (2009, p. 254) argue for a grouping of northern *ringwalburgen* that would overlap with the Zeeland *ringwalburgen* studied here. Since these clusters could serve different purposes within the region, it allows for multiple network patterns that align with this narrative.

As discussed in Chapter 2.3, Dierendonck (2009, p. 254) argues that the *ringwalburgen* studied in this thesis form a northern cluster, distinct from fortification sites to the south such as Veurne and Oostburg. These northern *ringwalburgen*, built by different actors, could serve varied purposes such as defending nearby *emporia* or local populations (ten Harkel, 2013, p. 245; Henderikx, 1995, pp. 99-101). Brughmans and Peeples (2023, p. 28), as discussed in Chapter 3, suggest that similar social structures and functions are reflected in the material culture of sites. This supports the notion that sites within the same sphere of influence, like the northern ringwalburg cluster, would cluster together in terms of their archaeological assemblages.

The *ringwalburgen* studied in this thesis, located on Walcheren and Schouwen-Duiveland, form a cluster within the network graphs, possibly reflecting a group of fortresses built by local actors. However, a direct comparison with this interpretation is impossible because the material from the southern *ringwalburgen* has not been included in the dataset used to generate the network graphs.

To falsify the clustering of the northern Zeeland *ringwalburgen* or confirm clustering among the southern *ringwalburgen*, inclusion of these southern sites would be essential. These sites were considered for inclusion but were deemed too fragmented. Despite significant excavations at locations like Veurne, which have provided valuable information on these southern *ringwalburgen*, the archaeological data, even from the best-documented sites, was not sufficient for inclusion in the dataset (Lehouck, 2001; De Meulemeester, 1979, 1980).

As mentioned, the *ringwalburgen* may have operated with varied functions within their cluster. This aligns with the patterns seen in the co-occurrence similarity network graphs (4.2, 4.3, 4.4), where the ringwalburg nodes exhibit diverse connections to external nodes without a clear correlation to different functions. A primary defensive role would suggest material similarities with other defensive sites, akin to the 'chain of defense' narrative, yet this is not evident in the ringwalburg nodes. For instance, while Domburg and Burgh might be expected to show similarity due to their association with *emporia* and defensive functions protecting trade routes (see fig 4.1), they do not cluster together in the co-occurrence similarity network graphs (4.2, 4.3, 4.4). None of these narrative aspects align closely with the observed patterns.

5.1.3 IMPOSITION OF EXTERNAL POWERS

Among the narratives that explain the construction and function of the Zeeland *ringwalburgen*, ten Harkel's concept of a landscape of negotiation (2013, p. 4; 2019, p. 2) stands out as the most intricate and nuanced. This narrative suggests that various factions utilized fortifications to assert control over the region's land, people, and resources. Moreover, these fortresses could serve multiple roles beyond mere refuge camps (ten Harkel, 2013, p. 246). The recognition of these complex relationships makes this academic narrative particularly suitable for comparison with the observed patterns.

The suitability of this comparison stems from the notion that the narrative of complex impositions of power in a landscape of negotiation provides a nuanced set of patterns to compare with those observed in the co-occurrence similarity networks (Figures 4.2, 4.3, 4.4). Ten Harkel (2019, p. 18) concludes that the locality and the broader world should not be treated as monolithic entities. The datasets collected for this thesis are limited in their ability to elucidate the relationships between external actors and the Zeeland *ringwalburgen*. Although the datasets did include the Birka site, which can be used for comparisons, using the Birka node as a proxy for 'Scandinavian trade interest,' the proximity of the Oost-Souburg node to both the Birka and Dorestad nodes may indicate a connection between Viking trade and Oost-Souburg.

This logic can also be applied to the Middelburg ringwalburg node. Its placement is further removed from the trading nodes compared to the other ringwalburg nodes (Figure 4.2). This position can be contextualized within the narrative that Middelburg emerged as a central power that replaced Domburg around the end of the studied period (Deckers, 2022, p. 205). Ten Harkel (2019, pp. 15-16) argues that the Frankish court used Middelburg and its ringwalburg to impose authority on the island. An interesting aspect of the Middelburg node's position is its fewer shared material types with the trading sites, known to have been influenced by Viking connections. If other Frankish centers of authority were included in the analysis, Middelburg might have plotted closer to them, though local materials and customs may have anchored it within a ringwalburg cluster.

The diverse connections of the *ringwalburgen* to trading site nodes align with the narrative that different ringwalburg nodes were linked in varied ways, reflecting material differences influenced by Frankish, Viking, or other regional interests in trade or other purposes. The nodes of Domburg and Middelburg *ringwalburgen* are closely connected to the Dorestad node but lack strong ties to Birka (Figure 4.2). This contrasts with the connections of Burgh and Oost-Souburg nodes, which are well-linked to both Dorestad and Birka nodes. These observations remain speculative, and the archaeological evidence underlying these strong connections should be carefully considered (Figure 4.5).

In conclusion to the third sub-question, "How do the observed network patterns fit within and compare to the existing historical narrative and academic discussion?", recent interpretations emphasize the complex relationships within the region and between the *ringwalburgen* and external powers. These connections and their nuanced implications strongly support the narrative of external power imposition. However, the other narratives find minimal or no support in the observed network patterns. The 'local defensive clusters' narrative aligns with expectations, but the support for academic narratives surrounding the *ringwalburgen* in this study remains preliminary, as nodes necessary to refute these narratives were not included in the network graphs due to the study's limited scope. This limitation also applies to the oldest 'chain of defense' narrative, although the network patterns that can be used are not in alignment with the narrative.

5.2 EVALUATION OF NETWORK METHODOLOGY

The final sub question of this thesis will be addressed in the following paragraphs: "How effective was the network methodology used in answering questions regarding the *ringwalburgen*?" This discussion will outline the principal strengths and weaknesses of the methodology employed, along with suggestions for improvements that could benefit study future research.

5.2.1 LIMITED MATERIAL

"The sites included in the dataset, such as the *ringwalburgen* and Westhove, had limited archaeological material available for constructing networks. A common challenge in archaeology is the scarcity and fragmentation of the material record (ten Harkel, 2019, p. 2). This limitation can be mitigated by leveraging existing frameworks to support and interpret data, yet it reduces the efficacy of networks in offering fresh analytical perspectives. While anchoring archaeological material and network graphs in historical debates is valuable for discussing observed patterns, there is a risk of excessive reliance on existing academic discourse, potentially limiting the generation of new insights.

Given the fragmentary nature of early medieval Zeeland's archaeological and written records (Tys et al., 2016, p. 188), conducting detailed quantitative network analyses on a larger scale remains largely unfeasible. Early sources and archaeological remnants typically lack sufficient detail for constructing robust networks. While this may suggest limited applicability of network analysis in this context, it remains possible to identify certain characteristics or patterns related to the structure or arrangement of the studied system. Despite fragmented and seemingly random data samples, they may still reflect statistical properties or trends of the broader system they once belonged to. Working with partial data requires adapting methodologies accordingly."

5.2.2 SELECTION BIAS

The most distinct aspect of the method used in this thesis is the use of artifact-type attributes. These attributes have a low cutoff point and rely on the notion that the archaeological material used is representative. This usage of an artifact-type methodology was necessary to include as many ringwalburg assemblages as possible. There are, of course, consequences to using this method. As discussed in Chapter 4.6, the quality and quantity of the used material are not acknowledged within the artifact-type networks themselves, and additional graphs and literature are required to provide context and validate the generated networks.

The method, however, does not produce nonsense data, and the smaller scale of the methodology used also has advantages. Network methodologies developed to handle large amounts of data make it difficult to construct a predictive network (see Figure 4.1) as done in this thesis. The results of the co-occurrence similarity network were fairly congruent with the predictive network. The use of artifact-type attributes thus allowed the relatively small ringwalburg assemblages to be included in a similarity network without substantial consequences to the structure of the networks.

Another noteworthy aspect of the methodology used is the focus on trade during the selection of artifacts suitable for inclusion in the matrix (see Chapter 3.3). The selection process was conducted with trade in mind, aiming to be as inclusive as possible and supported by existing literature to ensure an unbiased selection process. The end result was a matrix that included many different artifact types, encompassing more than just trading objects. This made the dataset useful for generating networks intended to study trade but less suitable for testing hypotheses centered on different themes and thus lacks reusability. While this aspect of the methodology was useful for answering questions regarding the *ringwalburgen* in this thesis, it might be less suitable in a different context.

5.2.3 TIME FRAME

In this thesis, the generation of networks resulted in snapshots of the past that cover multiple centuries. The significant developments that took place during the studied period are challenging to capture comprehensively through networks like the co-occurrence similarity network (see Figure 4.2, 4.3, and 4.4), which encompass all archaeological material across the timeframe of the study. This wide timeframe brings risks in understanding the context as it does not explicitly acknowledge the complexities of interpreting such long periods of time. Nodes can change over time, and their similarity in archaeological culture could have fluctuated.

Utilizing multiple snapshots could provide a more accurate representation of these changes over time. One of the main weaknesses of network theory lies in its handling of time and data. Adopting a film strip approach where sequential snapshots are used, could address this issue of dealing with developments that took place within the timeframe of the original snapshot. However, as pointed out by Sindbæk (2007c, p. 70), this approach requires the network to be segmented, which increases the demand for precisely dated archaeological data and effort. In the case of this study, the archaeological material was not deemed too fragmentary to attempt the film strip approach, but the method remains useful to keep in mind.

5.2.4 PRELIMINARY CONCLUSIONS

It was possible to answer the questions posed in this thesis, and the network graphs did not show any unusual or unexpected results that would suggest significant issues or flaws with the employed methodology. The predictive artifact-type co-occurrence network (see Figure 4.1) proved helpful in discussing the network graphs, and together with the bimodal simplified co-occurrence material network (see Figure 4.5) and the sparse attribute network (see Figure 4.6), it was possible to acknowledge possible sources of bias that could influence the results and then keep these in mind when conclusions were drawn. The use of these falsification graphs was thus a useful addition to the employed method and is deemed to have aided in the effectiveness of answering questions regarding the *ringwalburgen* by providing reliability and facilitating further discussion.

While answers to the questions posed in this thesis were provided, they remain preliminary and call for further research. When comparing patterns from the networks to narratives from the academic debate (see Chapter 5.1), the lack of additional nodes associated with historical actors made it impossible to comment on the relations between these actors and the *ringwalburgen*. Other ringwalburg sites, such as Veurne, were considered for inclusion, but due to the limited scope of this study, they could not be included. Similarly, nodes of sites fulfilling specific roles in trade networks would have been useful in providing more than a preliminary answer when discussing the second sub question of this thesis (see Chapter 4.7). The ability to falsify or support hypotheses is restricted when the number of nodes included is limited. However, the lack of such nodes is not directly related to the effectiveness of the employed network methodology, and adding these nodes is feasible but admittedly time-consuming, as a matrix must be constructed for each included site. Expanding the number of included nodes would thus greatly improve the effectiveness of the employed methodology and should be considered if the scope permits.

In conclusion, the methodology used proved fairly effective in addressing questions regarding the *ringwalburgen*. At worst, it provided preliminary answers to these questions while demonstrating significant strengths. These include the inclusion of *ringwalburgen* and their fragmented archaeology in the dataset, the utilization of additional networks to validate results or support hypotheses, and the application of artifact-type attributes to construct coherent similarity networks. However, the methodology was hindered by the limited datasets available, which restricted the number of nodes that could be included. This limitation affected the ability to create a sequential network or compare relevant nodes with proxies effectively. Improved consideration of node selection early in the methodology's application would greatly enhance its effectiveness, albeit at the cost of increased time and effort, making it feasible only within specific project scopes.

5.3 CHAPTER SUMMARY

Chapter 5 discusses the network patterns found in the previous chapter in the context of existing academic narrative and gives an evaluation of the network methodology. This answers the last two sub questions of this thesis: "How do the observed network patterns fit within and compare to the existing historical narrative and academic discussion?” and “How effective was the network methodology in answering questions regarding the *ringwalburgen*?”.

The third sub question was answered by concluding that the observed patterns align the best with the most recent ‘imposition of power’ narrative. This narrative acknowledges the complexities that are also apparent in network graphs and includes nuanced relations between different actors. The patterns observed in the network graphs fit the older ‘chain of defense’ and ‘local defensive cluster’ narratives less well, although only preliminary conclusion could be made due to the scope of this thesis.

It was concluded that the method used in this thesis effectively addressed questions regarding the *ringwalburgen*, thereby answering the final sub question of this thesis. Its main strengths include the incorporation of smaller ringwalburg sites into archaeological similarity networks through the construction of artifact-type attribute datasets, and the use of additional networks to support and falsify hypotheses. However, the methodology also has its shortcomings, such as obscuring quantitative and qualitative aspects of material attributes and lacking adaptation for handling the extensive timeframe of the included artifacts. The limited availability of additional nodes constrained the method to providing preliminary answers in this study, but this limitation can be addressed through investment of time and effort.

CHAPTER 6. CONCLUSION

This study focused on the relation between *ringwalburgen* and trade and the usage of network methodology to examine this relation. Four sub-questions have been formulated to assist in answering the main research question and have been answered using the generated networks.

The first sub-question "Is there a ringwalburg that appears to have functioned as a regional trade hub?" has been answered has been answered by using the artifact-type co-occurrence similarity networks (see Figure 4.1, 4.2, and 4.2) that could have shown patterns that would have indicated a node that held a central position in the cluster of *ringwalburgen*. While the node of the Oost-Souburg ringwalburg was slightly better connected it did not meet the definition of a central node within its cluster connecting other less well-connected nodes to the network as the other *ringwalburgen* were similarly well connected to this network. Thus, the network graphs do not support the presence of a ringwalburg node that functioned as a hub.

The Second sub-question "What insights do the observed patterns in the generated networks provide regarding the role of *ringwalburgen* within the broader trade network of the North Sea area?" was given a preliminary answer. Several options were given for the role of the *ringwalburgen* within the North Sea area trade network. The networks supported a cluster of ringwalburg nodes that was well-connected to the important trading nodes of Dorestad and Birka. The position of Oost-Souburg as the best connected to these nodes as opposed to the ringwalburg nodes associated with *emporia* was surprising. A explanation was given through the lens of multi-focal settlements which the dispersed nature could potentially influence its node placement, underscoring archaeological biases due to the lack of contextual information from associated settlement structures. Within this multi-focal settlement of within the cluster of *ringwalburgen* it remains unclear what the exact role of the *ringwalburgen* was within this trade context, but based on the archaeological material it could have ranged from craft activities and trade with the hinterland to protection trade routes.

The third sub-question "How do the observed network patterns fit within and compare to the existing historical narrative and academic discussion?" was partially answered. The network was lacked nodes that would allow for a better comparison with older academic narratives. The network patterns do however align with the more recent 'impositions of external power' narrative, which acknowledges the complexity of the region and the relations between its actors. The patterns and complexity implied by the network support these notions.

The fourth sub-question "How effective was the network methodology in answering questions regarding the *ringwalburgen*?" was argued to be fairly effective. The methodology is not without flaw, but its ability to incorporate the *ringwalburgen* and their fragmented archaeology into the generated network graphs and the utilization of the additionally generated networks to verify and discuss the results of the artifact-type co-occurrence similarity graphs is valuable. Most of the flaws can be handled when time is invested in incorporating more nodes, but this is costly and the sources need to be available.

The answer to the primary research question "What significance did trade have for the Zeeland ringwalburgen during the 7th through 11th centuries AD?" is that an importance of trade for the ringwalburgen is supported, but the generated networks did not have sufficient data to support a certain degree of importance for the ringwalburgen. The ringwalburgen themselves were connected, but lacked a function as a trading hub. While there is support for long distance trade and the possibility for the ringwalburgen to have filled several roles within the network related to trade, a specific role was not supported by the data. This only partially aligns with what was initially hypothesized. This is partially because there were no proxies within the dataset that could confirm these hypothesis. Answering the research questions was hindered by a lack of compatible data, but this is something that could be adjusted during future research.

Future research would greatly benefit from investing time in incorporating more data in the network graphs so that viable proxies can be used to make coherent comparisons with relevant nodes. In the context of this thesis, the site of Veurne would have been a useful proxy and greatly beneficial to answering the research questions. Expanding the dataset and building upon the artifact-type co-occurrence similarity network based methodology could provide further benefits when more time is invested. A more robust, future network with expanded data could also benefit from stepping further away from trade in the data-collection process in order to make the datasets more widely available for other avenues of research, while still allowing them to be used in a trade context.

ABSTRACT

This thesis explores the relationship between Zeeland's circular fortifications, known as ringwalburgen, and the extensive trade network of the early medieval North Sea region. These fortifications have long fascinated historians and archaeologists due to their size and strategic placement in the landscape. Archaeological evidence supports their involvement in long-distance trade. However, the limited archaeological data poses a significant challenge to fully understanding their role in the region.

Using network theory, this study investigates the potential connections between ringwalburgen and other relevant archaeological sites across the North Sea area. The methodology utilizes similarity networks, which suggest that sites sharing similar artifact assemblages are likely linked. Specifically, an 'artifact-type co-occurrence similarity network' is employed to explore these relationships, adapting measures to include ringwalburgen despite the fragmented archaeological record. The study uses the limited data in a diverse way in order to reach its conclusions and further understanding on early medieval trade relations.

This study investigates the relationship between ringwalburgen and trade through network methodology, addressing four sub-questions using generated networks: the absence of a central trade hub among ringwalburgen, insights into their role within the North Sea trade network, alignment with historical narratives, and the methodology's effectiveness despite data limitations. While confirming trade significance for ringwalburgen, the study finds insufficient data to define their specific trade roles, suggesting future research focus on expanding datasets and refining methodologies for broader applicability.

In conclusion, the methodology used proved fairly effective in addressing questions regarding the *ringwalburgen*. At worst, it provided preliminary answers to these questions while demonstrating significant strengths. These include the inclusion of *ringwalburgen* and their fragmented archaeology in the dataset, the utilization of additional networks to validate results or support hypotheses, and the application of artifact-type attributes to construct coherent similarity networks. However, the methodology was hindered by the limited datasets available, which restricted the number of nodes that could be included. This limitation affected the ability to create a sequential network or compare relevant nodes with proxies effectively. Improved consideration of node selection early in the methodology's application would greatly enhance its effectiveness, albeit at the cost of increased time and effort, making it feasible only within specific project scopes.

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APPENDIX

Table 1.

Ceramic material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA	TORKSEY	WESTHOVE (DOM)
ANDENNE	1	1	1	1	0	0	0	0
PAFFRATH	1	1	1	1	1	0	0	0
PINGSDORF	1	1	1	1	1	0	0	1
KOGELPOT	1	1	1	1	1	0	0	0
RELIEFBAND	0	1	1	0	1	0	0	0
BADORF	1	1	1	1	1	1	0	0
HUNNESCHANS	1	1	1	1	0	0	0	0
TAITTINGER	0	0	0	0	0	1	0	0
MERKENDORF	0	0	0	0	0	1	0	0
TORKSEY	0	0	0	0	0	0	1	0
KILN	0	0	0	0	0	0	1	0
TEGULA	1	0	1	0	0	0	0	0
CASTING MOLD	0	0	0	0	1	0	0	0
SPINDLE WHORL	0	0	1	0	1	0	0	0
LOOM WEIGHTS	0	0	0	0	1	1	0	0
GAME TRAY	0	0	0	0	0	1	0	0
CRUCIBLE	0	0	0	0	0	1	0	0
OIL LAMP	0	0	0	0	0	1	0	0
TOTAL	7	7	9	6	8	7	6	1

Table 2.

Stone material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA	TORKSEY	WESTHOVE (DOM)
QUERN (TEPHRITE)	0	0	1	1	1	0	0	0
WHETSTONES	0	1	0	1	1	1	0	0
BOWL (SPEKSTEEN)	0	1	0	0	0	0	0	0
STONES	0	0	0	1	1	0	0	0
VOTIVE STONE	0	0	0	0	1	0	0	0
MORTARS	0	0	0	0	1	0	0	0
WEIGHTS	0	0	0	0	1	0	0	0
SWORD FRAGMENT (SOAPSTONE)	0	0	0	0	0	1	0	0
PENDANT (CARNELIAN)	0	0	0	0	0	1	0	0
PENDANT (ALMANDINE)	0	0	0	0	0	0	0	1
BEAD (CARNELIAN)	0	0	0	0	0	1	0	0
PUMICE STONE	0	0	0	0	0	1	0	0
GAME PIECE	0	0	0	0	0	1	1	0
SPINDLE WHORL	0	0	0	0	0	1	0	0
TOTAL TYPES	0	2	1	3	6	7	1	1

Table 3.

Wood material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA
STAKES	1	0	1	1	0	0
PLANKS	0	0	1	0	0	0
SEWER GUTTER	1	0	1	0	0	0
WICKER A	0	1	0	1	0	0
WICKER B	1	0	0	0	0	0
COFFIN	1	0	0	0	0	0
FYKES	0	0	0	0	1	0
WICKER BASKET	0	0	0	0	1	0
BUCKET	0	0	0	0	1	0
SHIP FRAGMENTS	0	0	0	0	1	0
BOWL (WOOD)	0	0	0	0	0	1
TOTAL TYPES	4	1	3	2	4	1

Table 4.

Animal material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA
OFFAL	1	1	1	1	1	1
SHELL REFUGE	1	0	1	1	0	0
LEATHER SHOE	0	1	1	0	0	0
COMBS	0	1	1	1	1	1
TRIDENT	1	1	1	1	0	0
SKATES	0	1	1	1	0	0
SPINDLE WHORL	0	1	0	1	0	1
PLATES	0	1	0	0	0	1
CROSS GUARD	0	0	0	0	0	1
PIN	0	0	0	0	0	1
NEEDLE-CASE	0	0	0	0	0	1
SPOON (HORN)	0	0	0	0	0	1
DIE	0	0	0	0	0	1
GAME PIECE	0	0	0	0	0	1
CHESS PIECE	0	0	0	0	0	1
FLUTE	0	0	0	0	0	1
STRING INSTRUMENT	0	0	0	0	0	1
HAMMER	0	0	0	0	0	1
LEATHER REFUGE	0	0	1	0	0	0
TOTAL TYPES	3	7	7	6	2	14

Table 5.

Bronze material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA	TORKSEY	WESTHOVE (DOM
COIN (STYCA)	0	0	0	0	0	0	1	0
FIBULA	1	1	1	0	1	1	1	1
BRACELET	0	0	0	0	1	1	0	0
RING	0	0	0	0	1	1	1	0
PENDANT	0	0	0	0	0	0	0	1
EARRINGS	0	0	0	0	0	0	0	1
ARM-RING	0	0	0	0	1	1	0	0
WRIST CLASP	0	0	0	0	0	0	1	0
THIMBLE	0	1	0	0	0	0	0	0
NEEDLE	0	1	0	0	1	1	0	1
NEEDLE-CASE	0	0	0	0	1	1	0	0
CHAIN	0	1	0	0	1	0	0	0
HINGE	0	1	0	0	0	0	0	0
PLATE	1	0	0	0	1	0	0	0
ENAMEL INSERT FITTING PLATE	0	0	1	0	0	0	0	0
PAN	0	0	0	0	1	0	0	0
PLATE (DISH)	0	0	0	0	1	0	0	0
CONTAINER	0	0	0	0	1	0	1	0
HANDLE	0	0	0	0	1	0	0	0
SCALE	0	0	0	0	1	1	0	0
WEIGHT	0	0	0	0	1	1	1	0
WEIGHING BOWL	1	0	0	0	0	1	0	0
TWEEZER	0	0	0	0	1	1	1	1
BUCKLE	1	0	0	0	1	1	1	1
STRAP END	0	0	0	0	1	0	1	0
KNOB	0	0	0	0	1	0	0	0
HORSE SPUR	0	0	0	0	1	0	1	0
MOUNT	0	0	0	0	1	1	1	0
NAIL	0	0	0	0	1	0	0	0
PIN	0	0	0	0	0	1	1	0
KEY	0	0	0	0	1	1	0	1
CANDLE HOLDER	0	0	0	0	1	0	0	0
TAP	0	0	0	0	1	0	0	0
SPOON	0	0	0	0	1	0	1	0
CHAINMAIL	0	0	0	0	0	1	0	0
SWORD	0	0	0	0	0	0	1	0
FRAGMENT	0	0	0	0	1	1	0	0
BELL	0	0	0	0	0	1	0	1
FITTING	0	0	0	0	0	1	1	1
CLAPPER	0	0	0	0	0	1	0	0
EARSPOON	0	0	0	0	0	0	0	0
INGOT	0	0	0	0	0	1	1	0
HOOKED TAG	0	0	0	0	0	0	1	0
SLAG	0	0	0	0	0	0	1	0
SPANGLE	0	0	0	0	0	0	1	0
VESSEL	0	0	0	0	0	0	1	0

CHEEK PIECE	0	0	0	0	0	0	1	0
SPINDLE WHORL	0	0	0	0	0	0	0	0
TOTAL TYPES	1	5	2	0	26	20	21	10

Table 6.

Copper material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA	TORKSEY	WESTHOVE (DOM
BALANCE	1	0	0	0	0	0	0	1
TOTAL	1	0	0	0	0	0	0	1

Table 7.

Iron material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA	TORKSEY	WESTHOVE (DOM)
BRACELET	0	0	0	0	1	0	0	0
FIBULA	0	0	0	0	1	0	0	0
SICKLE	1	0	0	0	1	0	0	1
SWORD	1	1	0	0	1	1	0	1
PLATE	0	1	1	0	0	0	0	0
LANCE	0	1	0	0	1	1	1	1
WING LANCE	0	1	0	0	0	0	0	0
SAX	0	0	0	0	1	0	0	0
KNIFE	0	1	0	0	1	1	1	1
ARROWHEAD	0	0	0	0	1	1	1	0
NAIL	0	1	0	0	1	1	0	0
NEEDLE	0	0	0	0	1	1	0	0
AXE	1	1	0	0	1	1	1	1
AXE-HAMMER	0	0	0	0	0	0	1	0
UMBO	0	0	0	0	1	0	0	0
SKEWER	0	1	0	0	0	0	0	0
BUCKLE	0	1	0	0	1	0	0	0
BOAT HOOK	0	1	0	0	1	0	0	0
ADZE	0	0	0	0	1	0	1	0
KEY	0	1	0	0	1	1	0	0
LOCK	0	0	0	0	1	1	0	0
BOX	0	0	0	0	1	0	0	0
HORSE GEAR	0	0	0	0	1	0	0	0
PLOUGH SHOE	0	0	0	0	1	0	1	0
SPADE	0	1	0	0	0	0	0	0
HACKLE	0	0	0	0	1	0	0	0
HOOK	0	1	0	0	1	1	1	0
CHAIN	0	0	0	0	1	1	0	0
SLAG	0	1	0	0	1	0	0	0
FRAGMENTS	0	0	0	0	1	0	0	0
HINGE	0	1	0	0	0	1	0	0
SCISSOR	0	0	0	1	1	1	0	0
FISHING ANGLE	0	0	0	1	0	1	0	0
FIRE STEEL	0	0	0	0	1	1	0	0
PITCHFORK	0	0	0	0	1	0	0	0
DUNG FORK	0	0	0	0	1	0	0	0
FORK	0	0	0	0	1	0	0	0
WEIGHT	0	0	0	0	0	1	1	0
RING	0	0	0	0	0	1	1	0
HAMMER	0	0	0	0	0	1	0	0
CHISEL	0	0	0	0	0	1	0	0
BOWL	0	0	0	0	0	0	1	0
COULTER (IRON)	0	0	0	0	0	0	1	0
TOTAL TYPES	2	15	1	2	30	19	12	6

Table 8.

Silver material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA	TORKSEY	WESTHOVE (DOM)
LUNETTE	0	0	0	0	0	0	1	0
PENNY	0	0	0	0	0	0	1	0
DENARIUS	0	0	0	0	1	0	0	1
SCAETTA	0	0	0	0	1	0	1	0
KUFIC COIN	0	0	0	0	0	1	1	0
BYZANTINE COIN	0	0	0	0	0	1	0	0
HACKSILVER	0	0	0	0	0	0	1	1
TOILET FITTINGS	0	0	0	0	0	0	0	0
BRACELET (SILVER)	0	0	0	0	1	1	0	1
PENDANT (SILVER)	0	0	0	0	0	1	1	1
FIBULA (SILVER)	0	0	0	0	0	0	0	1
SWORD (SILVER))	0	0	0	0	1	0	0	0
PLATE (SILVER)	0	0	0	0	1	0	0	0
RING (SILVER)	0	0	0	0	1	1	0	1
ARM-RING (SILVER)	0	0	0	0	1	1	0	0
BEAD (SILVER)	0	0	0	0	0	1	0	0
BUCKLE (SILVER)	0	0	0	0	0	1	0	1
FITTING (SILVER)	0	0	0	0	0	1	0	0
INGOT (SILVER)	0	0	0	0	0	1	1	0
PIN (SILVER)	0	0	0	0	0	0	1	0
NEEDLE(SILVER)	0	0	0	0	0	0	0	1
HOOKED TAG (SILVER)	0	0	0	0	0	0	1	0
STRAP (SILVER)	0	0	0	0	0	0	1	0
MOUNT (SILVER)	0	0	0	0	0	0	1	0
SLAG (SILVER)	0	0	0	0	0	0	1	0
WEIGHT (SILVER)	0	0	0	0	0	0	0	1
TOTAL FINDS	0	0	0	0	7	10	12	7

Table 9.

Gold material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA	TORKSEY	WESTHOVE (DOM)
SOLIDUS	0	0	0	0	0	0	1	0
DENARIUS	1	0	0	0	0	0	0	0
TREMISSIS	1	0	0	0	0	0	0	0
PENDANT	0	0	1	0	1	1	0	1
RING	0	0	0	0	1	1	0	0
FIBULA	0	0	0	0	1	0	0	0
INGOT	0	0	0	0	1	0	0	0
HACKGOLD	0	0	0	0	0	0	1	0
FITTINGS	0	0	0	0	0	0	0	1
SLAG	0	0	0	0	0	0	1	0
TOTAL TYPES	2	0	1	0	4	2	3	2

Table 10.

Lead material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA	TORKSEY	WESTHOVE (DOM)
WEIGHT	0	1	0	0	1	1	1	1
FITTING	0	0	0	0	1	0	0	1
CLOTH SEAL	0	0	0	0	1	0	0	0
HOOK	0	0	0	0	1	0	0	0
FRAGMENTS	0	0	0	0	1	0	1	0
PLATE	0	1	0	0	0	0	1	0
INGOT	0	0	0	0	0	0	1	0
GAMING PIECE	0	0	0	0	0	0	1	0
PENDANT	0	0	0	0	0	0	1	1
TRIAL PIECE	0	0	0	0	0	0	1	0
FIBULA	0	0	0	0	0	0	0	1
BUCKLE	0	0	0	0	0	0	0	1
KEY	0	0	0	0	0	0	0	1
SPINDLE WHORL	0	0	0	0	0	0	0	1
TOTAL TYPES	0	1	0	0	5	1	7	7

Table 11.

Tin material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA	TORKSEY	WESTHOVE (DOM)
BELL	0	0	0	0	1	0	0	0
RING	0	0	0	0	0	0	0	1
FIBULA	1	0	0	0	0	0	0	0
TOTAL TYPES	0	0	0	0	1	0	0	1

Table 12.

Glass material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA	TORKSEY
BEADS	0	1	0	1	1	1	1
IRONING GLASSES	0	1	0	1	1	0	0
VESSEL	0	0	0	0	1	1	0
WINDOW	0	0	0	0	1	0	0
PENDANT	0	0	0	0	0	1	0
BANGLE	0	0	0	0	0	1	0
INGOT	0	0	0	0	0	0	1
TOTAL TYPES	0	2	0	2	4	4	2

Table 13.

Amber material matrix

LABEL	DOMBURG	OOST-SOUBURG	MIDDELBURG	BURGH	DORESTAD	BIRKA
BEADS	0	0	0	0	1	1
PENDANT	0	0	0	0	1	1
SPINDLE WHORL	0	0	0	0	1	1
FRAGMENTS	0	0	0	0	1	1
GAME TRAY	0	0	0	0	0	1
GAME PIECE	0	0	0	0	0	1
TOTAL TYPES	0	0	0	0	4	6