The lifecycle of casks: the production, use, and repurposing of casks in the Netherlands (1300–1800)

Oosterbaan, J.

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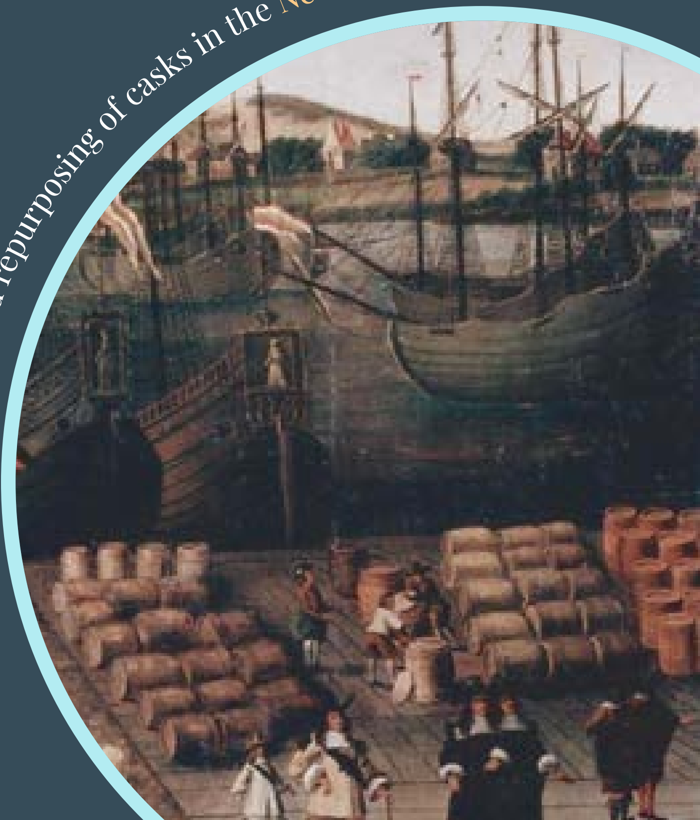

Jeroen Oosterbaan

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Colofon

Cover illustrator: Renate Ormel | Opscheppers

Printed in the Netherlands by: Gildeprint
ISBN: 978-94-6496-565-0
DOI: https://dx.doi.org/10.60602/1887-4301461

The Lifecycle of Casks

The production, use, and repurposing of casks
in the Netherlands, 1300–1800

De levenscyclus van vaten
De productie, het gebruik en herbruik van vaten
in Nederland (1300-1800)

PROEFSCHRIFT

Ter verkrijging van
de graad van doctor aan de Universiteit Leiden,
op gezag van rector magnificus prof. dr. S. de Rijcke,
volgens besluit van het college voor promoties

te verdedigen op donderdag 2 juli 2026
klokke 10:00 uur

door

Jeroen Oosterbaan
geboren te Nijmegen
op 18 februari 1980

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Dit proefschrift werd (mede) mogelijk gemaakt met de Promotiebeurs voor Leraren verstrekt door NWO (projectnummer 023.O14.O47 / 8231). Verder is financiële ondersteuning geboden door Saxion University of Applied Sciences, Stichting Nederlands Museum voor Anthropologie en Praehistorie, de Samenwerkende Maritieme Fondsen (SMFp22.31) en de Provincie Zeeland (zaaknummer 12576).

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Den Grooten Kuijper kuypt,
Can vaste banden buyghen,
Indien Hij niet kuypt,
De wereld valt in duygen.[1]

The great cooper coops,
Can bind firm hoops,
If he does not hoop,
The world falls apart.

1 *Inscription on the guild cup of the Coopers' Guild of Vlissingen (1704). De Ridder, 2004, 67.*

Content

Preface

In the Late Middle Ages and the Early Modern period, casks were a familiar feature in the urban landscape. They were so common and useful that they even found their way into language, with sayings featuring casks to express ideas about value, danger, and change. In Dutch, several proverbs and expressions reflect this cultural importance: *wat in het vat zit verzuurt niet, het vat valt in duigen, kijken wat er in het vat zit, uit een ander vaatje tappen, hij is zo vol als een ton, oude wijn in nieuwe vaten, een vat vol tegenstrijdigheden,* and *communicerende vaten*. The same applies to the English language, in which 'casks' and 'barrels' appear in proverbs and sayings: a rotten apple spoils the barrel, to scrape the bottom of the barrel, like shooting fish in a barrel, an empty barrel makes the most noise, like putting new wine into old barrels, and a barrel of laughs.

Over the last six years, I have had the opportunity to study these casks, made possible by a grant from the Dutch Research Council (NWO, Promotiebeurs voor Leraren 2019-I). It was a journey I may have underestimated at the start, but one that ultimately demanded a great deal from me. None of this would have been possible without the support of my supervisors, Roos van Oosten, Frans Theuws, and Jos Bazelmans. Frans made this project possible in the first place, and Jos ensured it could be brought to a successful conclusion. Above all, it was Roos whose enthusiasm, sharp insight, and thoughtful guidance carried me through the most demanding stretches of this journey.

I am also fortunate to have been able to conduct this research in collaboration with others, because writing a dissertation, an essentially solitary undertaking, did not always feel that way. Many researchers contributed their expertise in ways that proved indispensable. I would like to specifically acknowledge my co-authors Sjoerd van Daalen, Petra Doeve, Liam Tran, Arent Vos, and Victor Enthoven, whose contributions were particularly valuable when incorporating data from written sources, dendrochronological research, and maritime archaeology. In addition, there are many others who supported me with advice, data, or in other ways, too many to mention individually, but I would like to specifically acknowledge the paleography working group based in Middelburg, Dr. Ferry Zwaan, Nicole Schoute, and Joran Smale.

One of the most extensive collaborative efforts I was involved in was the WOODAN Cask Marks Database project, in which I had the privilege of participating in the Cask Marks Working Group. Special thanks go to Liam Tran and Wouter Donders for their work in data collection, and to Jelte van der Laan and Stephan Nicolaij of Qursi Software and the WOODAN Foundation for developing the database.

Behind every object and every archive reference in this dissertation lies a field of expertise, and I have gratefully drawn on the knowledge of many specialists, too many to name individually. I would also like to thank the students from both Saxion University of Applied Sciences and Leiden University who carried out various sub-studies and contributed valuable input to this project.

My colleagues at Saxion University of Applied Sciences deserve special mention here. Completing a PhD project alongside a teaching position and a separate research project was a genuine challenge, and it would not have been possible without the understanding and facilitation of those around me. I would like to specifically thank Geert Roovers, Pim Alders, Ronald Frederiks, Arlette van Wijhe, Olaf Leppink, Suzan Veldhuis, Roeland Emaus, and above all Wouter Vos – for the substantive discussions, the space you gave me, and the easy way we worked together (No worries!).

I also want to mention the excavation team of ARC BV at the Vlissingen Groote Markt excavation, where the idea to study casks was born. I would especially like to acknowledge Steven Brussé for the close and enjoyable collaboration we shared during that project.

Work is, in the end, only work. Outside of it, I am fortunate to be surrounded by friends and family who kept me grounded. Tonz, Tinus, Rinke, Olivier, Klaas, Rob, Thomas, Joppe, Hugo, Hubba, Eelke, Joep, and Mattie – knowing you were there made all the difference. To my family, thank you for your unconditional support.

But I have saved the most important until last: Chrisje and Milou. I don't know who I would be without you. When I began this journey six years ago, Milou was just a toddler running around our house. Now, at the end of it, I see two teenagers standing before me. I am incredibly proud of you both. Hopefully, my intense focus on this PhD research hasn't set an example you will follow. Of everyone around me, I have asked the most of you, Jenny. You carried far more than your fair share at home, often taking on the responsibilities I had to set aside, and you had to live with me during the times when stress made me difficult and distant.

1. Introduction

1 Introduction

1.1 General introduction

Casks are a common find within Dutch archaeological contexts, hardly a month passes without a cask being unearthed somewhere in the Netherlands. These casks are most frequently encountered in urban archaeological contexts, where they were often repurposed as the lining of cesspits or water wells (Figure 1.1 left). In addition to their terrestrial occurrences, casks are also regularly encountered within the maritime landscape (Figure 1.1 right). On nearly all shipwrecks where cargo has been preserved, casks are among the most ubiquitous artifacts, originally used for the storage and transport of various merchandise. Yet, despite their frequent occurrence and broad functional spectrum, casks have attracted surprisingly little scholarly attention. This lack of focused study can largely be attributed to an underestimation of their interpretive potential, resulting from a general lack of background knowledge about casks.

First of all, this issue becomes most apparent in the way casks from urban contexts are studied and interpreted. Exca*vat*ions at the Groote Markt in Vlissingen, for instance, yielded a total of eighty-five barrel wells, many of which were constructed from multiple repurposed casks. The contents of these features were analyzed meticulously, but the casks have only received minimal attention. Based on the recovered ceramics and metal artifacts, an assessment was made of the users' socio-economic status. In addition, the study of animal bone material and macro-remains (such as seeds and pits) contributed to the reconstruction of their dietary practices. The casks themselves, however, were examined only at a very basic level. None of the recovered casks were subjected to such a detailed analysis that the commodities they once contained could be identified, despite the fact that such information could have provided valuable insights into their users' consumption patterns and the broader networks in which they participated.

Furthermore, cask marks were observed on 55 casks recovered from the urban archeological exca*vat*ion in Vlissingen. Although these marks were described, they could not be further interpreted in a way that would provide greater insight into the purpose of their application, their production context, or their possible association with specific goods or commercial systems. Consequently, the absence of a detailed analysis of the cask marks has prevented a deeper understanding of the casks' lifecycle, leaving aspects of their production, use as transport containers, and broader role within systems of distribution and consumption underexplored.

Figure 1.1: Left: A fifteenth-century water well constructed from four repurposed casks from Raversijde (Belgium), illustrating how archaeologists typically encounter casks in an urban archaeological context (M., Pieters & et al. (2013). Right: a cask in maritime archaeological context, on the 19th century Bermuda Shipwreck (United States, https://www.reddit.com/r/submechanophobia/comments/14uzuku/bermuda_shipwreck_lake_superior/, last accessed on 28-10-2025).

Secondly, maritime archaeologists constitute another key group investigating casks, as these are among the most common finds in shipwreck contexts. Ships from the Late Medieval and Early Modern periods routinely carried casks, which are often found on wrecks when preservation conditions are favourable. Such preservation is typically ensured when casks or their parts become trapped within the ship's structure, preventing them from being washed away.

This was the case with the shipwreck *Burgzand Noord 4*, located in the roadstead of Texel, where a total of 887 cask components were recovered, representing at least 47 individual casks, of which some still contained coffee beans.[2] A similar situation was observed at *Scheurrak S01* (late 16th century), also found in the Texel roadstead, where numerous cask remains were discovered.[3] In total, approximately 800 cask fragments were recorded, prompting archaeologists involved in the excavation to describe these find as "an orgy of staves".[4] Unlike those from *Burgzand Noord 4*, the casks from *Scheurrak S01* had disintegrated into separate staves and headboards.

In the subsequent analysis of the cask assemblages from both shipwrecks, efforts were made to reconstruct the cargo through the study of the casks and to identify

2 Overmeer, 2004, 1; Vos 2012, 183-184.

3 Burger, 2025, 174.

4 Maarleveld, 1993, 215.

the parties involved in the associated trade by examining the cask marks. However, these analyses had not yielded results that allow the archaeological evidence to be linked to written sources, connections that could potentially have contributed to the identification of the shipwrecks themselves.

Archaeological timber specialists and dendrochronologists constitute a third group of researchers who work to enhance the interpretation of casks, which are recovered from both urban and maritime archaeological contexts. The study of timber from Dutch archaeological contexts holds a special position due to the exceptional preser*vat*ion conditions for organic material in the typically oxygen-poor Dutch soil. These conditions allow well-preserved staves from urban features such as cesspits or water wells to be precisely dated through dendrochronological analysis.

In dendrochronological research, staves from maritime archaeological contexts are often used to approximate the date of a shipwreck's sinking. The assumption is that dating the cargo provides a timeframe closer to the ship's final voyage than dating the ship's construction timbers, which were felled prior to the ship's building. Consequently, a dendrochronological date from a stave belonging to a cask carried on the ship's last journey can offer a more accurate indication of the wreck's date.

Accurate interpretation of dendrochronological dates from staves in both urban and maritime contexts requires a clear understanding of cask production. Key factors include the provenance of the timber, its processing location, and the range of timber ages within individual casks. Equally important are fundamental aspects of their use after production, such as the typical lifespan of casks as transport containers, which have yet to be thoroughly investigated. Understanding these factors is essential for situating dendrochronological dates within a framework that can, for example, provide a more reliable estimate of a shipwreck's date. In interpreting dendrochronological dates from staves in urban archaeological contexts, it is also necessary to gain insight into how casks were repurposed and the duration of their use in this secondary phase.

Across these examples, the untapped research potential of casks, whether studied by maritime or urban archaeologists, dendrochronologists, or other specialists in archaeological timber, can be traced to a common cause. The lack of comprehensive research on casks from archaeological contexts has resulted in insufficient knowledge of their entire lifecycle, leaving aspects such as the casks production, use as transport containers, repurposing, and cask marks underexplored. By situating casks within their production, use, and repurpose contexts, this study aims to provide a comprehensive framework for understanding their archaeological significance and to enhance the interpretive potential of cask-derived data across both urban and maritime contexts.

The study employs a multidisciplinary methodology, drawing on a diverse range of sources. These include archaeological data from both urban and maritime contexts, some of which were additionally examined through dendrochronological analysis, 3D scanning, and photometric stereo techniques. Complementary sources include historical written records, iconographic representations, and interviews conducted with present-day coopers. By integrating these approaches, this research provides a comprehensive understanding of casks as widely used and functionally versatile material culture in the Late Middle Ages and Early Modern period.

1.2 Casks as part of the maritime and urban landscape

The frequent occurrence of casks in archaeological contexts can be explained by their status as ubiquitous elements of the Dutch urban and maritime landscape during the Late Middle Ages and the Early Modern period. Casks were prominently present on quaysides, in warehouses, and aboard ships, underscoring their integral role in transport and trade logistics. However, the presence of casks was by no means confined to port areas. In marketplaces and trade fairs across Europe, goods were commonly displayed and sold in casks. In this way, casks were directly associated with commerce, not only as a container, but as a functional container in the sale of goods. Within these interconnected urban and maritime landscapes, casks fulfilled a variety of functions, forming part of a continuous sequence of use across both maritime and urban settings.

Cask in the maritime landscape

Most visibly, casks played a central role in maritime contexts, serving as essential transport containers for a wide range of merchandise from the Late Medieval period onwards. Nonetheless, the use of casks predates this period, with examples recovered from Dutch archaeological contexts as far back as the Roman period.[5] Their numbers, however, increase significantly from the Late Middle Ages, marking the large-scale adoption of the cask as a transport container in maritime contexts, a practice that continued well into the twentieth century.

The cylindrical shape and relatively uniform dimensions of casks facilitated efficient handling, allowing casks to be loaded and unloaded with ease across various modes of transport, including seagoing ships, river barges, and horse-drawn wagons (Figure 1.2_1,3). The widespread adoption of casks as transport containers from the Late Middle Ages onwards also led to a growing standardization of container forms. This offered a distinct advantage over loose cargo carried in ships' holds or other forms of packaging, such as sacks and bales, which typically varied greatly in size and thus complicated efficient loading and unloading.
In several key respects, the large-scale adoption of casks from the Late Middle Ages onwards can be compared to the introduction of the shipping container in the

5 Marlière, 2001; Lange et al., 2017, 115.

mid-twentieth century[6], a parallel that allows modern readers to better appreciate the significance of casks within the maritime landscape. Both developments transformed the handling of goods by increasing the efficiency of loading, transport, and unloading processes.[7] These advances not only transformed patterns of trade and the organization of labour but also had a lasting impact on the physical infrastructure of maritime transport. The design of ships evolved to accommodate larger and more efficiently arranged cargoes, while ports were expanded and restructured to facilitate these new modes of transport, handling, and storage. Together, these developments mark pivotal moments in the long history of logistical innovation in seaborne trade.

Figure 1.2: 1: The port of Bruges in 1525; 2: The MS Fairland, the first container ship to arrive in the port of Rotterdam in 1966. 3: Sketch of the reconstructed Kamper cog with main deck and "between" decks; 4. The container ship Ever Given. Sources: 1. Labors of the Months: October [Oil on canvas, Cod. Lat. 23628, fol. 11v.], by Simon Bening, 1525. Bayerische Staatsbibliothek, Munich, Germany; 2. Jan Voets, "Speciaal voor container-vervoer ontworpen schip Fairland in Rotterdam," March 3, 1966 (Den Haag, Nationaal Archief, toegangsnummer 2.24.01.03). Foto: Nationaal Archief, Den Haag. http://hdl.handle.net/10648/aae8bdf6-d0b4-102d-bcf8-003048976d84.; 3. Vlierman, 2021, 647; 4. Robert Schwemmer, "Ever Given", March 14 2015, https://www.noaa.gov/topic-tags/hydrography?page=2, Gelicenseerd via: https://creativecommons.org/licenses/by-sa/2.0/deed.en, CC BY-SA 2.0.

6 Oosterbaan, 2024.

7 Levinson, 2016.

Ships

The first comparable effect between the large-scale adoption of the cask as a transport container and the introduction of the modern shipping container was the substantial increase in the carrying capacity of ships.[8] The first container ship to dock at the Port of Rotterdam carried only 226 containers in 1966[9] (Figure 1.2_2), whereas one of the world's largest presently used container ships, such as the *Ever Given*, can accommodate more than 20,124 containers (Figure 1.2_4), an almost ninetyfold increase achieved in less than sixty years. A comparable development occurred during the Late Middle Ages, when ships also began to grow significantly in size. Prior to the Late Middle Ages, ships built according to the northern shipbuilding tradition (c. 700–1250) had a cargo capacity of approximately 50 tons.[10] By the Late Middle Ages, this had increased to approximately 160 tons with the introduction of the cog (*kogge*, Figure 1.2_3), and by the Early Modern period to around 1,000 tons with the carrack (*kraak*)[11], representing a twentyfold increase in cargo capacity of ships compared to the period before the Late Middle Ages.

Ports (cranes)

The introduction of the modern shipping container not only led to the construction of larger ships designed specifically for container transport, but also required major adaptations to port infrastructure. Ports where these new container ships docked had to be deepened and expanded to accommodate their size and draft. This transformation had a profound impact on both the spatial layout and the scale of modern harbors. The Port of Rotterdam, for instance, has tripled in surface area since 1960, largely due to the construction of new port complexes such as the Europoort and the Maasvlakte, which were developed to accommodate container shipping.[12]

Not only did the size of ports change, but their facilities also evolved in line with the emerging container transport system. The installation of container cranes enabled standardized containers to be efficiently transferred between ships, trains, and trucks, greatly streamlining the processes of loading and unloading (Figure 1.2_2).[13]

The large-scale adoption of casks from the Late Middle Ages had a comparable impact on the development of the transport system, particularly visible in port infrastructure. Across the Low Countries and other regions, many ports were newly constructed or expanded to accommodate the new types of ships, which had

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8 Levinson, 2016.

9 Port of Rotterdam, n.d. History of the harbor. Available online at: https://www.portofrotterdam.com/nl/online-beleven/geschiedenis-van-de-haven. Last accessed on 01 May 2025.

10 Asaert et al., 1976.

11 Asaert et al., 1976.

12 Peek & Stam, 2016.

13 Levinson, 2016.

increased in size and had a greater draft than older ships. The merchant ships that arrived in these ports were increasingly loaded with goods packed in casks. Many of these casks could be manually loaded and unloaded, as seen in an illustration from a 1502 manuscript of the Swedish porters' guild. The image shows two individuals carrying a cask using a carrying beam with supporting stands (Figure 1.3_left). This method of moving casks was only possible with casks that weighed no more than 150 kilograms when fully loaded. This was the case, for example, with herring casks from Zeeland and Holland at the end of the 15th century, which had a prescribed capacity of 120 liters and weighed approximately 150 kilograms.[14]

Figure 1.3: Left: Two individuals transporting a cask using a carrying beam and supports (The image is taken from the PORTERS' GUILD BOOK from Stockholm. Dragare Skraan [Manuscript, Invnr. B594], Unknown author, 1502–1503. Photo: Kungliga biblioteket, Stockholm, Sweden); Right: The Port of Riga. (Riga [Oil on canvas], Unknown author, second half of 17th century. Museum of the History of Riga and Navigation, Riga, Latvia).

For heavier cargo, manual labour alone was no longer sufficient. This applied, for example, to wine oxhead casks with a capacity of around 230 liters, which, when filled weighed approximately just under 300 kilograms.[15] To handle such loads, ports were adapted through the installation of cranes (Figure 1.3_right). That these cranes were primarily used for shipping casks is evident from iconographic sources. A 1525 painting of the Bruges port, for example, shows the various steps involved in transporting wine casks (Figure 1.2_1). In addition to depicting the unloading of wine casks with the use of a crane, the sale of the wine is also featured. To further transport the wine cask that is being sold, two draft horses with a sledge are standing ready. Archival sources from Dutch urban authorities further confirm the use of port cranes for loading and unloading relatively heavy cargo. That this

14 Oosterbaan, 2023.

15 Database De oude Nederlandse maten en gewichten, n.d., https://mgw.meertens.knaw.nl/plaats/44.

heavy cargo was primarily wine casks is evident from the leasing of the port cranes to wine merchant guilds, as recorded in the Raads Dagelijks Boek (Council Daily Book) of the city of Utrecht in 1532[16], and in the (City Book) of the city of Leiden (1391), a "wine crane" is referenced.[17]

Preservation

One key characteristic of casks, in which casks differ from the modern shipping container, is their preservative function. While this aspect may not align with the analogy of the contemporary shipping container, it played a critical role in the development of late medieval trade markets. The use of casks in extending the shelf life of perishable goods enabled them to be stored for longer periods and, therefore, they could be transported greater distances. This, in turn, facilitated regional specialization and interregional trade in regional goods.

Preservation of perishable goods was vital in pre-industrial societies, and from the Late Middle Ages onward a variety of methods were employed to reduce spoilage caused by microbial activity or environmental factors. Food preservation works by slowing down spoilage caused by mold, bacteria, or chemical and physical processes. In the Late Middle Ages, a variety of preservation techniques were employed that can be broadly categorized as cooling, drying, the addition of substances for preservation, and sealing from sunlight and open air (Figure 1.4).[18] Different types of food were preserved using one or more of these techniques. Fish, for example, could be dried, smoked, or salted resulting in products such as dried stockfish or salted and gutted herring. For fruits, drying and the addition of sugar were the most common methods of preserving. Regardless of the specific preservation technique, limiting exposure to air was essential for all perishable goods. The cask as a sealed container met this requirement effectively and thus played an essential part in prolonging the usability of various foodstuffs.

Figure 1.4: Overview of the preservation techniques used in the Late Middle Ages and Early Modern period (light green = rarely used, green = used in moderation, dark green = frequently used).

16 Smit, 2002, 19.

17 Barendrecht & De Boer, 1981, 118.

18 Jobse-van Putten, 1989.

Specialization of trade markets

The introduction of the modern shipping container led to a dramatic reduction in transport costs, making it economically viable to separate different phases of production, as well as final consumption, across vast geographical distances. This innovation transformed global trade, enabling Asia to emerge as the world's manufacturing hub and made an unprecedented variety of goods from around the globe accessible to the average consumer. As historian Marc Levinson observed in his study *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger*, the container quite literally shrank the world while expanding the scale of the global economy.[19]

The significance of the shipping container has also been recognized within the Netherlands. In 2014, *Koninklijke Hollandsche Maatschappij der Wetenschappen* and the *NCR Handelsblad* held an essay competition posing the question: "What is the most important invention of the past 100 years and why?".[20] Bart Kuipers, Senior Researcher in Port Economics at Erasmus University Rotterdam, won the first prize with his essay, in which he argues that the introduction of the shipping container is the most consequential invention of the last century. Kuipers compared the introduction of the shipping container to the invention of the wheel, emphasizing that modern society is now unimaginable without it.[21]

Like the modern shipping container, the cask played a crucial role in the specialization and expansion of trade markets across Europe during the Late Middle Ages and the Early Modern period. Although the cask itself was not a new invention, its widespread adoption in long-distance trade networks marked a significant shift in the storage, preservation, and transport of goods. This allowed products to remain in transit for longer periods, enabling trade over greater distances. In other words, producers and consumers could be located far apart geographically.

In the Netherlands, from the Late Middle Ages onwards, there was an increasing focus on the production and export of a variety of goods, which allowed the Netherlands to occupy a prominent position within overlapping trade networks.[22]

Among the most important of these were beer and herring. Beer production from the 15th century onwards was largely concentrated in cities such as Haarlem,

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19 Levinson, 2016.

20 Kuipers, B. (2014, october 10). Wat is de beste uitvinding van de laatste 100 jaar? Koninklijke Hollandsche Maatschappij der Wetenschappen. https://khmw.nl/nieuwsarchief-160/ .

21 Kuipers, B. (2016, may 10). Revolutie van de laadkist. Erasmus University Rotterdam. https://www.eur.nl/nieuws/revolutie-van-de-laadkist .

22 Yntema, 1992.

Gouda, and Delft, which exported much of their beer in casks.[23] The beer industry generated substantial demand for casks; in 1543–1545, approximately 950,000 beer casks were used in the nine major beer producing cities in Holland.[24]

To an even greater extent, the herring industry in the Netherlands was focused on export. By the Late Middle Ages, herring had become a staple commodity for export, with the cities located in Zeeland and Holland emerging as hubs for this thriving trade market.[25] The herring fishery also generated a significant demand for casks. Rotterdam, Brielle, Delfshaven, and Maassluis, located in the Meuse estuary, and Enkhuizen, in northern Holland, together brought in an annual catch veraging around 25,000 lasts at the peak of the herring industry in the first half of the 17th century.[26] Given that each last required 12 to 14 casks, approximately 350,000 casks were needed every year. In addition to the suitability of casks for storing large quantities of herring, their tight seal, combined with the brining process, significantly extended the herrings' shelf life.

The development of both Dutch beer production and the herring fishery demonstrates that the large-scale use of casks as transport containers had a significant impact on the development of export trade and generated a substantial demand for casks. These casks played a critical role in the late medieval and early modern maritime landscape, complementing developments in other parts of the transport system, including ships, ports, and related infrastructure.

Naturally, these developments in the transport system could not have taken place without other large-scale changes from the Late Middle Ages that also shaped the maritime landscape. These include the rising purchasing power of the urban middle class, the establishment of safe shipping routes, the emergence of institutional frameworks, and the increasingly professional organization of commodity markets.[27] Although many of these factors are difficult to trace archaeologically, casks represent an exception, as they are relatively abundant in the Dutch archaeological record.

Casks in urban landscape

Even those not directly involved in maritime trade or long-distance commerce would have encountered casks regularly in daily life. Casks of specific commodities were a familiar sight on quaysides, marketplaces, and fairs in European cities, which were locations where the urban and maritime landscapes overlap.

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23 Oosterbaan, 2023, 103.

24 Van Bochove, 2004, 5.

25 Oosterbaan, 2023, 104.

26 Epstein, 2000; North & Thomas, 1973.

27 Epstein, 2000; North & Thomas, 1973.

Within the urban landscape, casks were initially highly visible, as their production was primarily an urban activity (Figure 1.5_1). The 38 cooper guilds established within the present-day borders of the Netherlands were all located in cities,[28] making casks a familiar and integral part of everyday life for the residents of these urban centers. Their primary users, such as breweries and the herring industry, also conducted part of their activities in urban settings, ensuring that city inhabitants remained closely acquainted with the presence of casks in the urban landscape (Figure 1.5_2).

Also after the production phase and the filling with merchandise, casks remained highly visible in the urban landscape, when being sold at marketplaces, and fairs. Even after the casks had been sold, they remained visible, appearing in inns, taverns, and other establishments that offered food and drink (Figure 1.5_3). These venues relied heavily on casks for the storage and dispensing of products such as beer, wine, herring, and other foodstuffs. For the consumer, the cask was, therefore, a familiar part of both purchase and consumption.

Beyond their initial commercial function, casks also played a role in domestic and public interiors. Casks were often repurposed as furniture, such as tables or chairs, particularly in inns and among the lower classes (Figure 1.5_4). Equally important, but less visible, casks featured in early sanitation infrastructure. Stacked casks could serve as vertical shafts for cesspits, providing a rudimentary but effective means of waste disposal (Figure 1.1_left).

In sum, a cask could function in multiple capacities: as transport containers for trade goods, as a vessel for the storage and sale of merchandise, as repurposed material for domestic furnishings, and, eventually, as an element in urban waste infrastructure. Its omnipresence in both public and private spaces firmly embeds the cask within the material culture of the urban environment between 1300 and 1800.

28 Oosterbaan et al., 2022. 18.

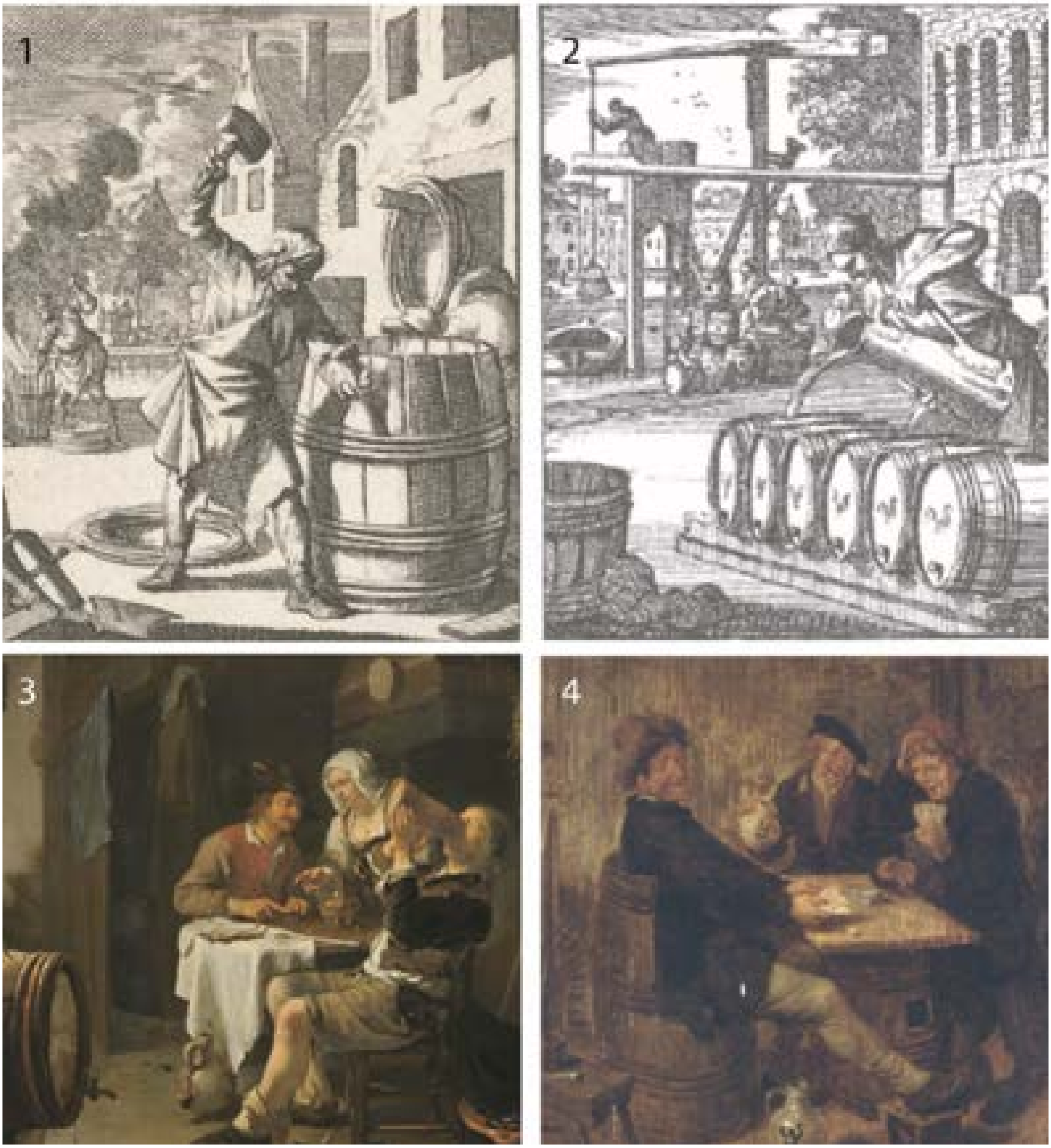

Figure 1.5: 1. Cooper hammering the hoops onto a cask; 2. Beer casks being filled at a brewery; 3. Beer cask in a tavern; 4. Cask used as a table and cask. Sources: 1. The cooper [Print, RP-P-OB-44.496.], by Jan Luyken, 1694. Rijksmuseum, Amsterdam, The Netherlands; 2. The Brewer [Etching, no. RP-P-OB-44.505], by Jan Luyken, 1694. Rijksmuseum, Amsterdam, The Netherlands; 3. Peasants inn [Oil on canvas, no. S 527], by Frans van Mieris (de Oude), c. 1655. Museum de Lakenhal, Leiden, The Netherlands; 4. Peasants playing cards in an interior [Oil on panel, private collection], by Jan Miense Molenaer, ca. 1650s. Database RKD Netherlands Institute of Art History, n.d., https://rkd.nl/images/110347.

1.3 Theoretical framework

This dissertation presents the first comprehensive study of casks from Dutch archaeological contexts dating between 1300 and 1800, which can be regarded as pioneering research. Prior to this study, only limited attention had been given to this relatively common category of finds within the Dutch archaeological record. An overview of previous research on casks, their scope, and the resulting limited knowledge of casks derived from these studies is provided for each sub-study in the corresponding chapters of this dissertation.

As stated, casks are frequently encountered in the archaeological record. Their frequent occurrence can be linked to the widespread production of casks, their use as transport containers, and their repeated repurposing for various functions. In addition, the excellent preser*vat*ion of this organic material in the Netherlands' waterlogged soils has further contributed to their survival.

To situate the study of casks within their broader maritime and urban contexts, it is essential to begin with a detailed examination of the casks themselves, given the limited knowledge available. This involves analyzing the distinct phases of their lifecycle: production, use as transport container, and subsequent repurposing. Each phase is analyzed separately to develop a comprehensive understanding of the casks' material biography. The *chaîne opératoire* provides the most appropriate theoretical framework for this analysis, as it emphasizes the sequence of actions, choices, and transformations that shape an artifact throughout its lifecycle.

Only once insight has been gained into the lifecycle of the cask itself can the next step be taken: situating the cask within the maritime cultural landscape. This approach allows casks to be studied through the lens of maritime cultural landscape theory, placing them in a broader context and examining them not as isolated finds or assemblages, but as elements connected to people, products, institutions, and locations.

Accordingly, the research presented in this dissertation applies a layered theoretical framework. First and foremost, the study focuses on analyzing the casks' lifecycle through the lens of *chaîne opératoire* theory. Where possible, the subsequent step of situating the studied casks within the maritime landscape has been undertaken. Due to the pioneering nature of this work, this was not feasible for every sub-study, but the dissertation nonetheless aims to provide a foundation for more comprehensive analyses of casks as part of a maritime landscape in future research.

The following sections provide a brief explanation of how the *chaîne opératoire* approach is applied in this study, followed by an outline of the theoretical framework concerning the maritime landscape.

1.3.1 Chaîne opératoire framework

The study of casks from archaeological contexts yields valuable insights when analyzed through the lens of the *chaîne opératoire* theory. This theoretical framework facilitates an understanding of the sequential processes and events that define an artifacts' lifecycle, encompassing the phases from raw material procurement, through production, use, repurposing, and ultimately, disposal. The theory prioritizes material objects, situating them within the technical and social processes that characterize their lifecycle.

Initially developed in France during the first half of the previous century, the theory was predominantly applied to the study of lithic artifacts.[29] Over time, its scope has broadened to include the other artifacts and the context of its creation, encompassing the actions and cognitive processes involved.[30] *Chaîne opératoire* analysis comprises three levels:

1. All components of the construction and its technique, including materials, tools, fuels, and movements required.
2. The sequence and relationship between the factors of the artifact, such as the steps of the production process.
3. The socio-cultural context of the artifact, such as gender roles and labor division.

In the context of late medieval and early modern archaeology, casks can be utilized as a case study for the application of the *chaîne opératoire* theory. These wooden vessels represent far more than mere storage containers, as they encapsulate the technical, economic, and social dynamics of their era. Casks display a long and traceable lifecycle, reconstructable from their presence in diverse archaeological contexts evident in diverse archaeological contexts, such as both shipwrecks containing raw material for cask production and those containing casks filled with merchandise. In urban archaeological contexts, casks are encountered in their repurposed phase, providing valuable insight into the secondary uses of these containers. When the cask from these two different archaeological contexts is studied in detail, insight can be gained into the three distinct phases of its lifecycle: production, use as a transport container, and subsequent repurposing (Figure 1.6).

29 Leroi-Gourhan, 1945, 1964; Mauss, 1947.

30 Schiffer, 1972, 1976; Lemonnier, 1993, 2012; Soressi & Geneste, 2011; Blonk-van den Bercken et al., 2020.

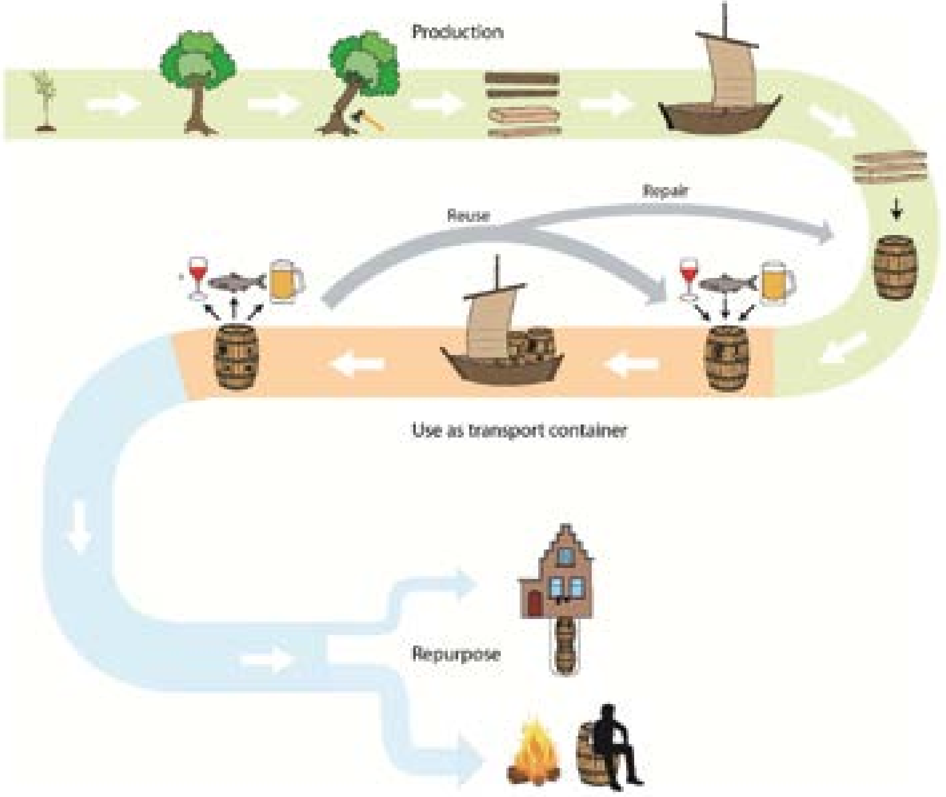

Figure 1.6: Schematic overview of the lifecycle of a cask. Production phase – green; its use as a transport container – 1orange; repurposing – blue.

Coopers, the artisans responsible for crafting casks, adhered to a sequence of selection criteria and technical procedures that converted raw materials into functional containers. When examined through the framework of the *chaîne opératoire* theory, the first stage of the production phase encompasses the procurement of the timber used by coopers. The selection of timber for cooperage reflects a careful consideration of the specific requirements imposed on the material, including durability, flexibility, and suitability for different types of casks. It also takes into account the various processing steps necessary to convert raw timber into semi-finished products, such clapboards.

The next phase of production involves the actual assembly of the casks. This process reveals the cognitive and practical skills inherent in cooperage, as well as the decisions made at each stage, which were shaped by available resources, technological expertise, and market demands. A key distinction between casks and the lithic objects, for which the *chaîne opératoire* was originally developed, lies in the presence of written sources. These documents record both technical production steps and detailed specifications for casks for specific products, providing casks recovered from archaeological contexts with additional contextual information. As a result, the study of casks allows for a comprehensive reconstruction of their production sequences, linking material evidence to documented practices and further illuminating the cognitive and decision-making processes underlying their manufacture.

Casks therefore provide a valuable case study for a more detailed application of *chaîne opératoire* theory, in which the regulatory features imposed on casks play a prominent role. They can also be used to investigate the enforcement of these regulations by examining the marks found on casks, which materialize this enforcement. In this way, casks fit well within the revision of *chaîne opératoire* theory proposed by Slaughter (2024), referred to as network opératoire. This framework envisions *chaînes* as interconnected nodes within a larger network, allowing for a more dynamic analysis of technological and cognitive processes. For example, the production of a cask can be examined as a network of interconnected *chaînes*: the selection of suitable timber, its processing into semi-finished components, the transport of these materials by ship, their arrival at the cooperage, the actual assembly of the cask according to prescribed dimensions and properties, and the oversight and inspection conducted by guilds or urban authorities. Each of these *chaînes* intersects with others, forming a complex network that links technical practices, regulatory norms, social roles, and economic relationships.

During their use as transport containers, casks underwent transformations as they circulated among producers, merchants, and consumers. Furthermore, casks were often reused as transport containers, potentially across different regions, encountering evolving regional market demands. This illustrates Schiffer's concept of the behavioral chain, in which material objects bear the traces of human action.[31] Such traces are visible not only in the spatial distribution of the casks in archaeological contexts reflecting their movement through trade networks, but also in the marks applied during their use as transport containers. These inscriptions and physical modifications make the tangible changes to the casks apparent, documenting human decisions and practices throughout their lifecycle. Naturally, casks could be repaired during their use as transport containers whenever necessary to maintain their functionality. Only when the decision was made to stop repairing them did the casks enter the next phase of their lifecycle.

Additionally, the repurposing of these casks in urban environments, such as their utilization in the lining of cesspits and water wells, underscores their adaptability and secondary utility. During this phase of their lifecycle, casks frequently underwent physical modifications, such as the removal of their heads. Within the *chaîne opératoire* framework, these alterations are treated as integral steps in the artifacts' operational sequence, shedding light on its behavioral chain. It is important to recognize that repurposed casks cannot be directly tied to the

31 Schiffer, 1976.

consumption patterns of the original product, since empty casks were sometimes traded or relocated to locations where a cask was needed for lining a cesspit or a water well.

In sum, the approach enables the tracing of such transformations throughout the casks' lifecycle, providing deeper insight into the social practices and contexts in which these objects were embedded.

1.3.2 Maritime cultural landscape framework

Once the cask has been analyzed through the *chaîne opératoire* approach, in some cases an assemblage of casks can be analyzed within the framework of the maritime cultural landscape. Since these assemblages primarily originate from shipwrecks, this maritime-oriented concept is particularly well suited for understanding their broader social, economic, and spatial context.

The maritime cultural landscape was introduced in 1992 by the Danish archaeologist Westerdahl to provide a broader framework for interpreting archaeological remains found underwater.[32] His initial research, conducted along the east coast of Sweden, revealed that underwater remains could not be studied in isolation but were intrinsically connected to the terrestrial cultural landscape and areas of maritime exploitation. Westerdahl emphasized that these underwater and coastal sites should be seen as extensions of one another, rather than separate assemblages. In Dutch terminology, this distinction can be understood as encompassing both *landbouw* as *zeebouw*, reflecting the interconnectedness of land- and sea-based human activity.

Based on these principles, Westerdahl defined the concept of the maritime cultural landscape as 'the whole network of sailing routes, with ports, havens and harbors along the coast, and its related constructions and other remains of human activity, underwater as well as terrestrial'.[33] In 2013, Westerdahl further elaborated the framework by introducing seven sub landscapes, namely economy, transport and communications, power, outer resources, inner resources, cognition, and leisure. Each of these represents a distinct component of the maritime cultural landscape and facilitates the systematic study of the archaeological record.[34]

The introduction of the concept also stemmed from Westerdahl's criticism of the traditional division between terrestrial and underwater archaeology, as well as the tendency to study shipwrecks as isolated finds. As a result, the maritime cultural landscape framework offers a valuable approach for maritime archaeologists and

32 Westerdahl, 1992.

33 Westerdahl, 1992, 6.

34 Westerdahl, 2013, 746.

historians to investigate shipwrecks and related sites within their broader cultural and environmental contexts. This perspective also guided Burger's study of the *Scheurrak SO1* wreck, which was examined through the lens of this concept.[35]

Similar to shipwrecks, casks constitute a vital element of the maritime cultural landscape. They can primarily be understood as transport containers for merchandise, which were integral to maritime exchange networks. Beyond their functional significance, casks also represent the most frequently encountered archaeological remains within these maritime cultural landscapes, as discussed in section 1.2. Consequently, this category of finds offers an important archaeological entry point for the research of economic activities, communication networks, and resource use of maritime cultural landscapes.

However, to employ casks as an archaeological entry point for the study of maritime cultural landscapes, a more comprehensive understanding of the casks themselves is required. For instance, it is first necessary to determine the provenance of the timber used by coopers and to gain insight into the organizational and structural frameworks within which cask production operated, before the production of casks can be situated within the maritime cultural landscape. The same applies to situating casks as transport containers, where identifying the products once contained within a cask is essential, as this information allows them to be linked to specific trade network.

Cask marks represent another crucial aspect of casks, playing a key role in situating them within a broader maritime cultural landscape. Their significance lies in their ability to bridge archaeological and historical data, as they appear both on casks recovered from archaeological contexts and in written sources. However, to efficiently exploit the extensive archival material, it is essential to understand the purpose and function of cask marks. For example, a coopers' mark is most likely to appear in the archives of a coopers' guild, whereas a personal identification marks of a merchant may be recorded in commercial documents such of trade organizations, personal communication, or *cognossementen* (bills of lading). Determining the purpose and function of cask marks from archaeological contexts therefore provides a targeted entry point into the archives that can be consulted for identification.

When a cask mark from an archaeological context can be matched with one recorded in written sources, the cask can be associated with a specific individual, institution, or system of measurement. If the mark belongs to a merchant, for example, the merchants' trade network can potentially be reconstructed from the written sources. In this way, cask marks enable a more comprehensive reconstruction of maritime cultural landscapes, linking individual artefacts or entire assemblages, such as a shipwreck, to the broader systems of trade, production, and human activity along coastal regions.

35 Burger, 2025.

As outlined in the introduction to the theoretical framework, the sub-studies presented in this dissertation primarily focus on the different phases of the cask lifecycle, making *chaîne opératoire* the main analytical approach. In certain cases, however, such as the sub-study of the shipwreck BZN4 (Chapter 8), historical trade networks have also been reconstructed by matching cask marks with written sources. This method situates both the shipwreck and the individuals associated with it within a broader maritime cultural landscape based on the study of casks.

Research aims and questions

The primary aim of this study is to reconstruct the lifecycle of casks, including their production, use, and subsequent repurposing, within the socioeconomic context of the Netherlands in de Late Middle Ages and Early Modern period (1300–1800). This study centres on the lifecycle of casks, which can broadly be divided into three main phases: production, use as transport containers, and subsequent repurposing (Figure 1.6).

This study presents the results of several substudies, each addressing specific aspects of a casks' lifecycle. Where applicable, these are integrated into the dissertation following the chronological sequence of production, use, and repurposing. However, some of these studies cannot be directly linked to a single phase in this lifecycle. These are, therefore, presented either before or after the chronologically ordered chapters, depending on their thematic relevance.

The main research question is:
What do casks from Dutch archaeological contexts from 1300 to 1800, examined through an interdisciplinary analysis, reveal about their lifecycle (production, use, and repurposing)?

The individual case studies within this research are structured around four overarching themes. Each of these research themes comprises one or two substudies, which have been developed independently and are presented in separate chapters. These chapters are preceded by an overarching study that provides a broad contextual framework (chapter 2). The findings of each case study are presented in separate chapters, each guided by its own research question and addressing a distinct aspect of a casks' lifecycle. The overview below presents the question addressed in each chapter.

Overarching
Chapter 2: What is the nature and duration of a casks' lifespan?

Production
Chapter 3: To what extent can casks found in Dutch archaeological contexts be distinguished as locally produced or imported, based on the provenance of the timber and its diachronic patterns?

Chapter 4: How did cask production in the Netherlands develop diachronically in terms of organization, production technique, and pricing in the Late Middle Ages and the Early Modern period?

Use as transport containers

Chapter 5: How can Dutch herring and beer casks that were produced in the 15th till 18th centuries be identified?

Repurposing

Chapter 6: What factors determined the choice between bricks and repurposed casks in the construction of cesspits and water wells in urban Vlissingen during the Late Middle Ages and Early Modern period?

Cask marks

Chapter 7: What typology can be established for cask marks from Dutch archaeological contexts (1300–1800), and to what extent is this typology suitable for categorizing cask marks?

The research presented in Chapter 7 enabled the identification of the shipwreck BZN4 based on several marks linked to individual persons. As a result, a sub-study of this shipwreck was conducted, which is presented in Chapter 8 along with the following research question.

Chapter 8: To what extent can the shipwreck BZN4 be reliably identified as the ship *'t Hart*, based on its archaeological characteristics?

In some of the substudies, case studies have been employed, resulting in more specifically formulated research questions. The extent to which these case studies can be considered representative of the broader research theme, the entire study area, and the full chronological scope of 1300–1800 will be critically assessed in chapters containing the respective substudies, as well as in the conclusion. In the conclusion, presented in Chapter 9, the research results will be placed within a broader context to address the central research question of this dissertation.

1.5 Source material and datasets

The results of the substudies regarding the four research themes are presented in eight chapters, each addressing a subquestion, as outlined in section 1.4. Every of these sub-studies follows a consistent research framework and is structured uniformly throughout the dissertation. For each, a dataset was compiled, forming the empirical basis for the analysis. The data used and supplementary analyses are described in section 1.5.1, while the scope and nature of the dataset are outlined in section 1.5.2. Each chapter opens with an introduction that frames the specific question being addressed. This is followed by a detailed explanation of the research methodology used, alongside a discussion of the relevant sources, including historiographical context if needed. The core of each chapter presents the results of the analysis, leading to a concluding section that reflects directly on the chapters' research question and its implications.

The organization of the chapters follows the chronological phases of a casks' lifecycle, ensuring a continuity between chapters. In several cases, components of datasets created for one sub-study were used or expanded in another investigation. For instance, the dendrochronological dataset introduced in Chapter 3, which focuses on cask parts from Dutch urban archaeological contexts, was later enriched with additional data from maritime contexts and cask finds from maritime contexts outside the Netherlands. This expanded dataset served as the foundation for the broader inquiry into the lifecycle and lifespan of casks, the results of which are presented in Chapter 2. Although some of the datasets overlap, each dataset produced for the respective sub-studies is treated as a distinct entity.

The sub-studies presented in Chapters 1 through 8 have been disseminated through various publications, including five peer-reviewed journal articles and one online database (Table 1.1). These five peer-reviewed articles were prepared for inclusion in this dissertation and incorporated as individual chapters. To ensure consistency in style and presentation across the dissertation, minor editorial revisions were implemented, including formatting adjustments, improvements in clarity, and small modifications to wording. These changes were strictly editorial in nature and did not affect the original content, results, or conclusions of the articles.

Only Chapters 4 (Production of Casks in the Netherlands), 6 (Repurposing of Casks), and 7 (Typology for Cask marks) were not published as peer-reviewed articles. By incorporating these studies, the research captures all phases of the casks' lifecycle, offering a comprehensive understanding of its various phases. This approach positions the dissertation as a hybrid format, combining elements of both a monograph and article-based dissertation. The final chapter (Chapter 9) compiles the results of the individual studies in the context of the central research question. It draws together the key insights from each chapter to present a comprehensive analysis of a casks' lifecycle and its broader socioeconomic implications. Special consideration is given to the representativeness and limitations of the findings, particularly in sub-studies based on limited or imbalanced datasets. The chapter concludes by identifying opportunities for future research and highlighting possible avenues for further exploration of the archaeological significance and historical role of casks in trade and daily life.

1.5.1 Source material

This study adopted an multidisciplinary research design, integrating archaeological, dendrochronological, historical, iconographic, and material data from museum collections. In addition, further data were collected through 3D scanning, photometric stereo techniques, and interviews with present-day coopers practicing traditional methods. This multidisciplinary approach proved methodologically fruitful, as it enabled the analysis of casks not merely as material remains, but as historically embedded artefacts with social, economic, and technological significance. The integration of material and textual sources enriched the interpretative depth and provided multiple layers of evidence for reconstructing the casks' lifecycle.

Although this study employs a multidisciplinary approach, the archaeological data remain fundamental. This focus aligns with the overarching aim to reconstruct the lifecycle of casks recovered from archaeological contexts. From this perspective, the research must be regarded first and foremost as situated within the archaeological domain. The primary data originate from archaeological contexts, whose principal value lies in the opportunity they offer to be examined collectively, an approach not previously undertaken in this manner.

Due to urban development-driven archaeology in the Netherlands following the adoption of the Valetta Convention, Dutch archaeology has changed drastically. In recent decades, the amount of archaeological research has expanded rapidly.[36] In particular, the past two decades have seen a significant increase in archaeological research in historic Dutch city centers, largely in response to intensive urban redevelopment. These urban environments are especially conducive to the recovery of casks, as waterlogged conditions and deep stratigraphy often allow for the preservation of organic materials in archaeological contexts.[37]

The information derived from the archaeological investigations in which these casks were recovered, including dating, find location, and contextual associations, has been supplemented with data from dendrochronological analyses, which provided insights into provenance and further refinement of the chronological framework. In addition, casks recovered from archaeological contexts were further examined within several sub-studies through the application of 3D scanning (Chapter 4) and photometric stereo techniques (Chapter 7).

Additional data sources were employed to contextualize and, where necessary, supplement the data from archaeological contexts. Across all of the sub-studies (Chapters 2–8), written sources were consistently utilized, while in specific cases iconographic material (Chapters 5, 6 and 7), museum objects (Chapters 5 and

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36 Eerden et al., 2017.

37 Cleijne et al., 2017.

7), and interviews with present-day coopers (Chapters 2, 4 and 7) were also incorporated to provide complementary perspectives and enhance interpretative depth.

The majority of additional data comes from written sources, which, as noted, were primarily used to contextualize and supplement the archaeological evidence. For example, in Chapter 3, the provenance of coopers' timber is analyzed to reconstruct trade flows. To provide historical context for the archaeological data, information from sources such as the Sound Toll Registers was used to situate these trade flows within the broader exchange networks between the Baltic Sea region and the Netherlands.

Written sources are considered supplementary when they provide information on aspects of the cask lifecycle that cannot be inferred from archaeological data. An example is the specifications of beer casks recorded in urban ordinances issued by coopers' guilds. No beer casks containing beer have been recovered from archaeological contexts, as they were emptied in urban settings and beer casks on sunken ships were washed out. Consequently, beer casks cannot be confidently identified archaeologically, and their characteristics are instead obtained from written sources, which in such cases serve as supplementary rather than purely contextual data.

This dissertation is based on a total of eight sub-studies. The results of the first sub-study are presented in section 1.2, while the remaining sub-studies are discussed in Chapters 2 through Chapter 8. Each sub-study relies on a separate dataset and a distinct selection of supplementary analyses of the archaeological material, as well as additional data sources from outside the archaeological discipline. The specific source materials actually used in each sub-study are detailed in the "Sources and Methods" sections of the respective sub-studies. This is particularly important for the written sources, which encompass a diverse range of archival materials, including, among others, the archives of urban coopers guilds, to urban ordinances, to the archives of pri*vat*e commercial organizations such as the Sociëteit van Suriname. The table below presents, for each sub-study, a detailed overview of the data sources used, the supplementary analyses performed on casks from archaeological contexts, the additional data sources drawn from outside the archaeological discipline, and the corresponding publications.

Table 1.1: Overview of the supplementary analyses of archaeological data and of the additional sources incorporated in each chapter.

Chapters	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7	Ch. 8
Archaeological data	✓	✓	✓	✓	✓	✓	✓	✓
Additional analyses								
Dendrochronological analyses		✓	✓			✓	✓	✓
3D-scanning				✓				
Photometric stereo techniques							✓	
Additional data sources								
Written sources	✓	✓	✓	✓	✓	✓	✓	✓
Iconographical data					✓	✓	✓	
Museum collections					✓		✓	
Interviews with present-day coopers		✓	✓	✓			✓	
Related publication	Publication 1	Publication 2	Publication 3		Publication 4		Publication 5	Publication 6

The last row of Table 1.1 indicates which publications have resulted from the sub-study presented in the corresponding chapters. These publications are listed below, with each entry specifying whether it is a peer-reviewed article or an online database:

- Publication 1 (peer-reviewed article): Oosterbaan, J. (2024). Tonnen en vaten. De Zeecontainer van de Late Middeleeuwen. *Madoc, 39(3–4)*, 169–182. https://doi.org/10.5117/MADOC2023.3-4.006.OOST
- Publication 2 (peer-reviewed article): Oosterbaan, J. (2025). Lifespan of Casks. *International Journal of Wood Culture* (published online ahead of print 2025). https://doi.org/10.1163/27723194-bja10037
- Publication 3 (peer-reviewed article): Oosterbaan, J., Doeve, P., & van Daalen, S. (2022). Provenance and Production: Casks in the Dutch Archaeological Context. *International Journal of Wood Culture*, 3(1-3), 412-441. https://doi.org/10.1163/27723194-bja10007
- Publication 4 (peer-reviewed article): Oosterbaan, J. (2023). Identifying Content through Casks. Skyliss: Journal of Maritime and Limnetic Archaeology and Cultural History (23), 103-116
- Publication 5 (online database): Database WOODAN Cask Marks (2024). University of Leiden. Available online at: www.woodancaskmarks.org

- Publication 6 (peer-reviewed article): Tran, L., Oosterbaan, J., Vos, A.D. et al. The Coffee was Paid for Dearly: Shipwreck BZN4 and the Frigate't Hart. *J Mari Arch* (2025). https://doi.org/10.1007/s11457-025-09458-2

1.5.2 Datasets

As outlined in section 1.5, a separate dataset was established for each sub-study, each of which is regarded as a distinct entity. These datasets comprise a unique set of supplementary analyses of casks from archaeological contexts and additional data sources (Table 1.1). To provide insight into the scope of each dataset and the nature of the material used, a description is provided below for each sub-study.

Chapter 2: The Lifecycle and Lifespan of Casks

This chapter is based on 464 casks from archaeological contexts, all of which were successfully dated using dendrochronology. These include 345 casks from urban archaeological contexts and 119 from maritime archaeological contexts. The consulted written sources used consisted mainly of urban ordinances from cities such as Gouda and Haarlem. Information from present-day coopers helped to further interpret the results.

Chapter 3: Provenance and Production

This chapter draws on data from 357 casks, all of which were successfully dated using dendrochronology. These include 345 casks from urban archaeological contexts and 18 from maritime archaeological contexts. In addition, this sub-study made extensive use of written source material from the Sound Toll Registers (1497–1857), the Zaandam Timber Auctions (1655–1811), and the Database of Dutch Craft Guilds (1200–1900).

Chapter 4: The Production of Casks in the Netherlands

This chapter is based on four 3D-scanned casks but primarily draws on overview studies by other researchers. This information was supplemented with written sources from the Database of Dutch Craft Guilds (1200–1900) and archival records from coopers' guilds in cities such as Amsterdam, Vlissingen, Veere, Gouda, Haarlem, Dordrecht, and Rotterdam. In addition, interviews with present-day coopers were conducted to further elaborate on the cask production practices.

Chapter 5: Identifying Contents through Casks

The sub-study presented in this chapter primarily draws on written sources, including legislation from various levels of authority, namely urban, provincial, and broader jurisdictions such as the Habsburg Empire. However, the most consulted sources consist of urban ordinances from cities such as Gouda, Haarlem, Dordrecht, Amsterdam, and Leiden, along with archival material from organizations like the College van de Grote Visserij. In addition, extensive use was made of iconographic sources and objects from museum collections. Archaeological data, which is very limited available for this sub-study's research topic, is subsequently used to corroborate and verify the findings based on written sources.

Chapter 6: Repurpose of Casks

This chapter draws on 226 casks from urban archaeological contexts in Vlissingen, including both dendrochronologically analyzed and unanalyzed examples. To identify and classify different forms of cask repurpose, the RKD (Netherlands Institute for Art History) database was consulted. On a smaller scale, written source material was also consulted in this sub-study to estimate the construction costs of a water wells.

Chapter 7: Typology for Cask marks

A total of 1,901 cask marks are analyzed in this chapter, with 1,021 from archaeological contexts and 880 from historical sources. The cask marks from archaeological contexts can be further subdivided into 405 from maritime contexts, 527 from urban contexts, and 89 from rural contexts, a segment of which has been dated using dendrochronological analysis. The 880 cask marks derived from written sources were collected from various archival repositories, including the Craft Guild Archives of Zierikzee and Veere, the Amsterdam Notarial Archives, and the Archive of the Middelburgsche Commercie Compagnie. To examine the cask marks from archaeological contexts in detail, photometric stereo techniques were subsequently used.

After compiling the dataset, the interpretation of the cask marks relied primarily on written sources, supplemented by museum objects, iconographic material, and interviews with present-day coopers. These sources were used selectively and purposefully. When marks from archaeological contexts could not be interpreted, written records were consulted first; if these proved insufficient, additional sources were employed. For example, construction marks, which are poorly documented in written sources, were discussed with present-day coopers to better understand their function.

Most information came from written archives, particularly the coopers' guild records from cities such as Haarlem, Breda, Amsterdam, Veere, Dordrecht, and Vlissingen. In addition, urban ordinances from Gouda, Haarlem, and Dordrecht, as well as archives of organizations like the College van de Grote Visserij, were consulted.

Chapter 8: The coffee was paid for dearly. Case study

This sub-study differs slightly in its design from the other case studies, as its initial aim was to identify a shipwreck. The assemblage from the BZN4 wreck, which included 47 documented casks, served as the primary point of departure for this investigation. The remaining recovered material and the ship's construction were also examined, with dendrochronological analysis playing a central role in determining their age. The written sources consulted mainly comprise the Amsterdam Notarial Deeds, the Archive of the Sociëteit van Suriname, the Suriname Church Records of Christenings, Marriages and Burials (DTB), and the Suriname Notarial Deeds.

Data Availability Statement:

The datasets and related materials supporting the findings of this study have been deposited in the DANS Data Station Archaeology repository under the title *The Lifecycle of Casks* and are openly accessible via https://doi.org/10.17026/AR/IUWWEC. The data are publicly available without restriction and can be reused in accordance with the repository's terms of use.

1.5.3 Dataset delimitations

The geographical scope of this study is confined to the present-day boundaries of the Netherlands. This delimitation is not only a consequence of the practical constraints imposed by the PhD project's timeframe, but also reflects the relative ease of access to Dutch datasets and the consistency of the country's archaeological research tradition. The standardized nature of data collection within the Netherlands, as well as the researcher's familiarity with these datasets, further contributed to this decision.

In some chapters, datasets with data from Dutch archaeological contexts have been strategically supplemented with data from outside the Netherlands to enhance contextual understanding or address gaps. Moreover, international literature and written sources have been extensively consulted, reflecting the inherently transnational nature of cask circulation, which often transcended present-day national boundaries. As such, this research holds relevance for an international scholarly audience and justifies the choice to present the dissertation in English.

This study encompasses a broad chronological scope, focusing on the period 1300–1800, a span of five centuries marked by a profound socioeconomic transformation in the Netherlands. The rationale for selecting the timeframe lies in the central role played by trade during these centuries, much of which relied on the use of casks as the primary container for transporting goods. The importance of casks in this context is evidenced by the establishment of 38 coopers' guilds across the Netherlands, the earliest of which was founded in Sluis in 1397 (Figure 3.6).

Many of these guilds remained active well into the 20th century, highlighting the long-standing significance of cask-related craftsmanship and commerce.

In addition, the period 1300 to 1800 provides relatively rich archaeological evidence for the study of casks. A significant portion of the cask assemblages in the dataset is derived from urban archaeological contexts, where they were repurposed as cesspits and wells. This era is often referred to as the “cesspit period” due to growing urban populations which brought about an increasing concern for sanitation and hygiene. The widespread construction and use of cesspits reflect broader societal shifts toward regulating the management of domestic waste. The end of this period coincides with the transition to more modern forms of waste management, such as the development of urban sewer systems.[38]

The period 1300 to 1800 also provides a substantial body of maritime archaeological data, comprising the numerous shipwrecks discovered in Dutch waters. According to the Maritime Stepping Stones (MaSS) database, which catalogs approximately 1,500 shipwrecks, over 450 were found within Dutch maritime boundaries and can be connected in this timeframe.[39] This significant representation underscores the vital maritime component of trade during this era and emphasizes the relative abundance and accessibility of maritime archaeological evidence from this period.

Research spanning 500 years, in the tradition of Braudel’s *longue durée*, allows for the examination of broad, structural developments rather than granular, short-term fluctuations. When studying casks within this framework, a considerable number of data points can be collected from archaeological contexts spanning the Late Middle Ages and the Early Modern period. However, it is important to acknowledge that, despite this relative abundance, the datasets compiled for the research represents only a small fraction of the total number of casks that would have circulated during this extensive timeframe.

The delimitation of source material from outside the archaeological discipline also requires clarification. In each sub-study, written sources were employed primarily to contextualize and supplement the archaeological data.[40] The sources used, however, represent only a portion of the available material and should by no means be considered a complete record of information. For example, archives of the various coopers’ guilds within present-day Netherlands are highly informative about cask production. Although 38 such guilds are known, only nine were examined in the different sub-studies of this dissertation.[41] The selection of specifically these nine coopers’ guilds is based on the fact that they were located in cities with the greatest potential demand for casks, due to the prominent role of urban herring fisheries and

38 *Van Oosten, 2015, 18.*

39 *Database Maritime Stepping Stones (MaSS), 2020.*

40 *Carmiggelt, 2006.*

41 *The coopers’ guilds of Alkmaar, Amsterdam, Breda, Dordrecht, Gouda, Haarlem, Rotterdam, Veere, and Vlissingen.*

breweries. Additionally, these cities are located in the western Netherlands, the region where the majority of casks have also been recovered from archaeological contexts.

Other types of source material, including iconographic data, museum collections, and interviews with present-day coopers, are similarly incomplete. These data sources were primarily used when archaeological casks could not be further interpreted based on their features and information from written sources. In such instances, these supplementary sources were employed strategically to address gaps. For instance, when researching iconographic material, specific paintings listed in the RKD Netherlands Institute of Art History database were consulted.[42] This database allows targeted searches by keywords and contains many relevant historical paintings and etchings, but it does not cover all possible examples.

This inherent delimitation means the data used in this dissertation cannot provide a comprehensive or fully representative account of all cask production, use, and repurposing throughout the research period. Consequently, detailed, period-specific conclusions remain difficult to substantiate. Rather, the used data is better suited for identifying overarching patterns and long-term trends in casks' lifecycles. This research can thus be regarded as pioneering, as it outlines the major developments and overarching frameworks related to casks over a long time span. It establishes a foundational understanding of the casks' lifecycle, in other words its *chaîne opératoire*, as described in the theoretical framework (Section 1.3.1). Only after this lifecycle is understood can the subsequent step be taken: situating the cask within the maritime cultural landscape (Section 1.3.2). In doing so, this dissertation also aims to provide a basis upon which future studies can build.

1.6 Terminology

This study hinges on two "container" terms, *vat* (cask) and *ton* (barrel), whose meanings have shifted across time and place. According to the modern Van Dale dictionary, a *vat* is any cylindrical receptacle, while a *ton* is a wooden *vat* that bulges at the centre.[43] Although present-day Dutch often treats them as synonyms, product-specific compounds e.g., *wijnvat* (wine cask) and *haringvat* (herring cask) versus *regenton* (rain barrel) and *turfton* (peat barrel) hint at earlier distinctions. Medieval sources confirm this tension: historian Alberts found the two labels used interchangeably for beer[44], and Verhoeff noted their application to both wet and dry goods.[45] When the metric system was introduced in the Netherlands 1820, a concordance was compiled in which the old units were listed alongside the metric equivalents. In this overview, only the term *vat* (cask) was included, with its volume set at 100 liters.[46]

42 Database RKD Netherlands Institute of Art History, n.d.

43 Database Van Dale Online, n.d.

44 Alberts, 2010, 125–126.

45 Verhoeff, 1983, 128.

46 Verhoeff, 1983, 132.

Etymology reveals deeper contrasts. *Vat* appears in 10th-century Dutch texts meaning "container" or even "instrument."[47] In the Late Middle Ages, however, the meaning of the term *vaten* was more commonly used as a synonym for a container or, as in the following phrase, c. 1265–1270, a coffin: *"Die dat beslogen in din vate"* (who laid the body to rest in the coffin). In a phrase from 1276–1300, *vat* is used in its modern sense as a wine container: *"een vat dat vol van wine ware"* (a cask full of wine). Later, the term came to refer more broadly to wooden, s*ton*e, or metal vessels used to hold, carry, or store contents.[48]

On the other hand, the Dutch word *ton* has several meanings within the system of measurements and weights:

- Transport container
- The load capacity of a transport vessel (e.g., *tonnage* refers to a ship's cargo capacity)
- A unit of weight, specifically 1,000 kilograms
- A monetary unit, namely 100,000 (e.g., euros or guilders)

This study focuses only on the meaning of *ton* as a transport container. However, the other meanings consistently show that *ton* refers to a fixed unit. Both the weight and monetary measures were standardized, so it is evident that *ton* as a transport container also denoted a set volume. This is supported by the term's etymology, indicating a fixed capacity for goods stored in a *ton*.[49]

In the Late Middle Ages and much of the Early Modern period, the term *ton* (barrel) appears to differ from *vat* (cask). *Vat* was used as a general umbrella term for containers, while *ton* referred to containers made to specific sizes for particular products. Examples include the Dutch terms *harington* (herring barrel) and *bierton* (beer barrel), which were produced according to standardized specifications. This distinction likely explains why the terms *haringvat* and *biervat* were avoided, as *ton* referred to a specifically regulated transport container, whereas *vat* functioned as a more general designation for vessels of varying size and purpose. In this study, these terms will be used as outlined in Table 1.2.

47 Philippa et al., 2003.

48 Philippa et al., 2003.

49 Philippa et al., 2003.

Table 1.2: Overview of the meaning and translations of the terms vat *and* ton.

Dutch	**English**	**Old Dutch**[50]	**German**	**French**	**Definition**
Vat	Cask	*Vat*, *fat*	*Fass*	*Fût*	Wooden transport container with a cylindrical shape, in which the belly diameter is greater than the diameter of the ends.
Ton	Barrel	*Ton*, *tunna*, *tonne*	*Ton*	*Baril*, *tonne*, *tonneau*	Similar to a *vat* but constructed according to prescribed dimensions.

Furthermore, this study employs various terms that refer to the specific components of casks. To clarify which components are being discussed, the figure below provides a schematic overview of the relevant parts in both English and Dutch (Figure 1.7).

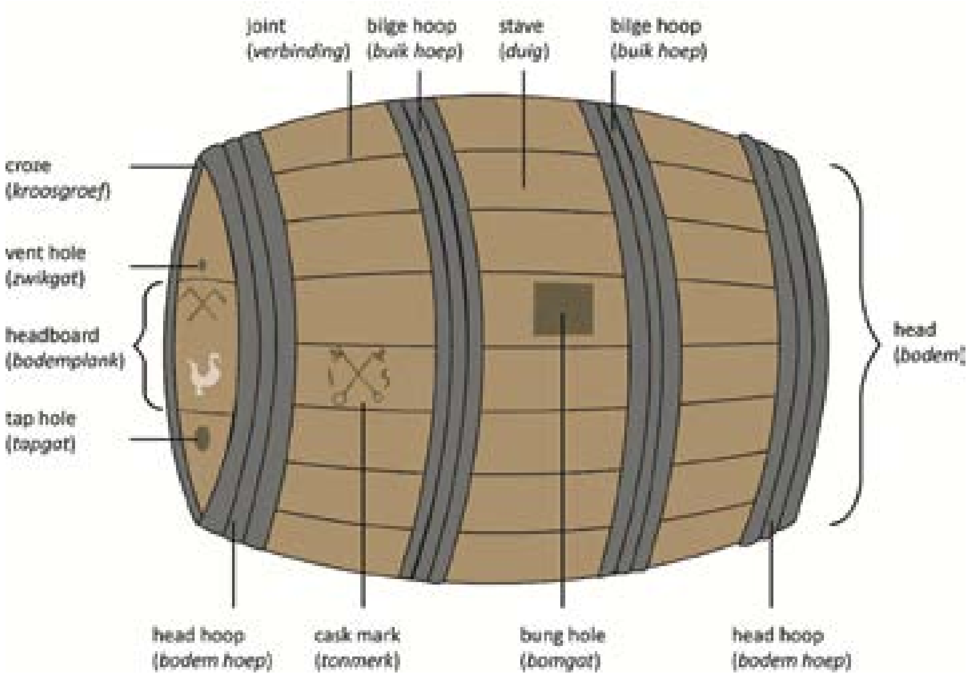

Figure 1.7: Schematic overview of the components of a cask, English and Dutch.

Several geographical terms used in this dissertation require clarification, as their historical and spatial meanings vary considerably. The Netherlands is used in a general and pragmatic sense to denote the territory corresponding to the present-day borders of the country. For much of the period under study (1300–1800), this area did not constitute a unified political entity, and both its administrative structure and territorial boundaries shifted considerably over time. The term

50 Database Historical dictionary of Dutch and Frisian, n.d.

therefore serves as a collective term, used strictly in a geographical sense and not as an anachronistic reference to the modern nation-state.

The Low Countries refers to a broader historical-geographical region, encompassing not only present-day the Netherlands but also large parts of present-day Belgium, most notably Flanders and Brabant. Its use thus reflects a wider regional configuration that transcends contemporary national borders.

The Dutch Republic is the conventional historiographical designation for the Republic of the Seven United Netherlands (1588–1795). It is reserved for contexts in which a more specific political and temporal framing is required, particularly where questions of institutional structure, sovereignty, and political development are central to the analysis.

2. The lifecycle and lifespan of casks

2. The lifecycle and lifespan of casks

This chapter is based on: Oosterbaan, J. (2025). Lifespan of Casks. *International Journal of Wood Culture* (published online ahead of print 2025). https://doi.org/10.1163/27723194-bja10037

2.1 Introduction

Casks are frequently encountered in urban and maritime archaeological excavations of sites dating from the Late Middle Ages and the Early Modern period. When subjected to thorough investigation, these casks offer significant potential for various fields of study. The initial exploration of the research potential of casks commenced several decades ago within maritime archaeology, particularly through the analysis of shipwrecks that yielded numerous casks.[51] A similar approach has been applied to casks recovered from urban archaeological sites, where they have been examined as a distinct artifact category when a substantial number is found.[52] However, studies exclusively dedicated to casks remain scarce. Consequently, there is a paucity of comprehensive knowledge regarding this type of transport container, including fundamental questions such as the duration of a casks' lifespan.

The cask's lifespan is considered to begin with the formation of the oldest timber actually incorporated into the cask and to extend through all phases of human activity associated with it, including its production, use as packaging material, and subsequent repurposing. Consequently, the lifespan of a cask is anchored to the oldest tree ring present in the cask itself, rather than to the oldest growth ring of the tree from which the timber was sourced for its production. The lifespan of a cask is considered to end when it ceases to be actively employed, whether during its initial function as packaging material, for instance if a ship transporting casks sinks, or during a subsequent repurposed phase, such as when a cask used as a cesspit lining is no longer functional. Defining the cask's lifespan in this manner situates this sub-study firmly from the perspective of the cask itself, in line with the approach taken in the other sub-studies of this dissertation.

Prior to examining the lifespan of a cask, it is essential to clarify its relationship with the cask's lifecycle. In this study, the lifespan is understood as the total temporal span necessary for a cask to progress through all stages of its lifecycle. This lifecycle can be broadly divided into three phases: production, use as a transport container,

51 Manders, 1996; Loewen, 1999, 2017; Ratcliffe, 2012; Hansson et al., 2022.

52 Houbrechts & Pieters, 1996; Oosterbaan & Griffioen, 2015; Verduin, 2019.

and repurposing (Figure 2.1). In section 2.3 the lifecycle of cask is addressed in relation to the possible duration of its individual phases and the extent to which each phase can be independently dated using archaeological data.

The timeline of the three phases in a casks' lifespan can be accurately determined using archaeological dating techniques. Information about the production of casks can be obtained through dendrochronological dating of the timber used and marks made at the time of their commissioning. Marks can also be employed to ascertain the duration of the use of casks as transport containers, the second phase in their lifespan. The third and final phase, their repurposing as a shaft of a barrel well, can be determined through the datable artifacts found in the well. In this chapter, these dating methods are utilized to develop a comprehensive understanding of the lifespan of casks during the Late Middle Ages and the Early Modern period.

In addition to elucidating the lifespan of casks, this research significantly contributes to dating the context in which casks are found. Furthermore, this chapter involves a systematic comparison between dendrochronological dating and artifact dating of the contents. While these chronological indicators or dating evidences are often presented together in reports, a systematic comparison of *terminus ante quem* and *terminus post quem* dating has been lacking. This chapter conducts this comparison and evaluates how to interpret and utilize the dating of casks.

2.2 Materials and methods

Source material

The first step of this sub-study involved identifying casks recovered from Dutch archaeological contexts, dated between the 12th and 18th centuries. These spatiotemporal parameters were selected due to the relatively high number of casks from archaeological contexts found within this region and timeframe, facilitating the creation of a substantial dataset. Inclusion criteria for the casks required that at least one component, such as a stave or headboard, had undergone dendrochronological analysis. The dataset is divided into two segments: one comprising casks from urban archaeological contexts and the other from maritime archaeological assemblages.

For the urban archaeological segment, casks from Dutch archaeological contexts were used, resulting in a dataset of 345 casks, dated using 1048 dendrochronological samples from either staves or headboards. The analyses of these samples were conducted by four dendrochronologists: Ing. Petra Doeve MA (BAAC), Ir. Sjoerd van Daalen (Van Daalen Dendrochronologie), the late Em. prof. dr. Esther Jansma (formerly Cultural Heritage Agency), and Dr. Marjolein van der Linden (Biax Consult). These data were supplemented with information from archaeological project reports, primarily based on the dating of artifacts found in repurposed casks.

The maritime archaeological dataset predominantly comprises casks recovered from shipwrecks in Dutch waters, including ships such as *De Kamper Kogge*[53], *Burgerzand Noord* 2 and *9*[54], and the *Scheurrak S01*.[55] This dataset was augmented with material from four shipwrecks located outside Dutch waters: *the Copper shipwreck*[56], *the Gribshunden shipwreck*[57], *La Belle shipwreck*[58], and *the Skaftö shipwreck*.[59] Dendrochronologically dated casks from these maritime sites were incorporated into the broader database to enhance its representativeness and analytical robustness. These casks underwent extensive examination, and the ships were associated with trade networks that included the Netherlands. The maritime component of the dataset includes 119 casks, dated using 283 dendrochronological samples. When combined with the urban archaeological datasets, the complete dataset comprises 464 casks, with 1331 timber samples analyzed using dendrochronology. Notably, there is considerable variability in the number of staves or headboards per cask that were subjected to analysis (Table 2.1).

Table 2.1: Number of staves per cask analyzed dendrochronologically.

Number of staves or headboards per cask analyzed dendrochronologically	**Number of casks**
1	221
2	88
3	46
4	29
5	19
6	14
7	11
8	4
9	9
10	7
11	7
12	2
13	1
14	1

53 Schoute, 2017.

54 Vos, 2012, 2019.

55 Manders, 1996.

56 Poland; Ossowski et al., 2014.

57 Sweden; Hansson et al., 2022.

58 United States; Loewen, 2017.

59 Norway; Von Arbin, 2014.

Number of staves or headboards per cask analyzed dendrochronologically	**Number of casks**
16	1
17	1
20	1
25	1
35	1
Total	464

Notably, the dataset represents a specific archaeological sample of casks that circulated during the study period. The casks recovered from urban archaeological contexts, which comprise approximately 74% of the dataset, were predominantly repurposed as shafts or barrel wells. Not all casks were suitable for such repurpose; for example, smaller casks were generally excluded for this purpose.

The dataset includes the dating of the repurposing phase of the casks based on the context dating of the cesspit or water well containing the casks, primarily determined by the dating of the ceramic assemblage. However, this does not always correspond with the repurposing date, as ceramic predating the casks could have been discarded in the pit. Consequently, when necessary, the dating of the finds within the casks was reassessed. The date of the ceramic assemblage and other material finds was integrated with dendrochronological dating to establish a more precise dating of the casks' repurposing. These refined dates were subsequently incorporated into the dataset.

Furthermore, the dataset exclusively includes casks that have been subjected to dendrochronological analysis. This criterion also introduces a sampling bias selective effect, as only casks containing parts with a relatively high number of tree rings were selected by the researchers.

Dating accuracy

The study presented in this chapter employs multiple dating methods. The primary approaches used to date the cask are dendrochronological analysis and context dating of casks in their repurposed phase, based on the associated artefacts recovered from cesspits or water wells. These two methods rely on different techniques and therefore possess distinct levels of dating accuracy.

Dendrochronological dating is based on establishing a match between a tree-ring series and a reference chronology. Depending on the degree of parallel variation, assessed using the Student's t-value and *Gleichläufigkeit* (GLK), an absolute calendar year can be established. This allows for the determination of either the estimated felling interval, when sapwood is present, or the earliest possible felling date, when sapwood is absent.

Of the 464 individual casks examined, 157 (34%) contained at least one tree-ring series with sapwood. The proportion of sapwood-bearing components varied markedly between urban and maritime contexts. In urban contexts, sapwood was present in only 26% of casks (91 of 345 urban casks), whereas in maritime contexts it was found in 55% of casks (66 of 119 maritime casks).

In some cases, casks without sapwood were treated as having zero sapwood rings for estimating the felling interval. In such cases, several staves from the same cask displayed nearly identical outermost rings, indicating comparable felling dates. Based on the research of Van Daalen[60], it is assumed that these staves most likely extended up to the sapwood, which justifies recording them in the dataset as having zero sapwood rings.

In addition, a significant portion of the casks in this sub-study were dated based on their repurposed phase, using artefacts recovered from cesspits or water wells. This context dating is derived from an interpretative process in which the individual datings of the associated finds are combined to establish a period of use of the feature. The oldest and youngest artefacts together define the most probable period of use. Such context-based dates therefore represent a general chronological range rather than a precise year or *terminus ante quem*, as can be achieved through dendrochronology.

However, since dendrochronological and context-based dates provided the most comprehensive chronological evidence, both methods were nonetheless employed in this sub-study. The interpretation of the results, however, takes into account the inherent discrepancies between the two approaches. In interpreting the results of this sub-study, the inherent discrepancies between the two dating methods need to be taken into account.

Chronological distribution of the dataset over the research period

As stated, the dataset includes 464 casks dating from the 12th to the 18th centuries, each assigned absolute dates for various phases of its lifespan wherever feasible (Table 2.2). Dendrochronological dating is available for all 464 casks, as this was a prerequisite for inclusion in the dataset. For 157 casks, samples containing sapwood are also available, enabling the estimation of the felling interval.
Additionally, the dating of the casks in the dataset is informed by the dating of associated artifacts discovered during their repurposed phase as barrel wells. This determination was possible for 183 of the 464 casks.

60 Van Daalen, 2021.

Table 2.2: Chronological distribution of casks over the research period.

Grouped time periods		Number of casks				
Date (start)	**Date (end)**	**Oldest tree ring**	**Youngest tree ring tree ring**	**Youngest tree ring (sapwood)**	**Context date (start)**	**Context date (end)**
	<1000	7	0	0	0	0
1001	**1100**	25	6	0	1	0
1101	**1200**	76	13	3	5	1
1201	**1300**	125	34	8	9	4
1301	**1400**	80	126	43	38	16
1401	**1500**	109	89	49	29	36
1501	**1600**	37	123	28	60	46
1601	**1700**	3	63	22	35	52
1701	**1800**	2	10	4	6	24
>1801		0	0	0	0	4
Total		464	464	157	183	183

Provenance

To ascertain the origin of individual casks within the dataset, the documentation pertaining to the provenance of staves and headboards was utilized. In instances where a cask comprised timber from multiple origins, it was designated as having a "combination" of provenances. In total, the provenance of the timber used could be determined for 374 of the 464 casks.

Associated products (cask contents)

The database also includes information on the intended contents for which the casks were constructed. Of the 464 casks, the primary contents were identified for 126. In certain instances, the primary contents were ascertained from archaeological reports discussing the casks. Nevertheless, in most cases, the products could be inferred from the characteristics of the casks, as they were custom-built for specific products such as wine, beer, and herring during particular periods and in specific regions. Notable characteristics include cask capacity, the number of staves and headboards, stave thickness, hoop types, the timber used, and the presence of holes.[61]

61 Oosterbaan, 2023.

2.3 The lifecycle and lifespan of casks

The lifecycle of casks from the Late Medieval and Early Modern periods encompasses a sequence of events, divided into three distinct phases: the production phase (Figure 2.1_1a–1f), their utilization as transport containers (Figure 2.1_2a–c), and their subsequent repurposing (Figure 2.1_3a–3b). Each of these phases is characterized by specific features on the casks, which facilitate their dating.

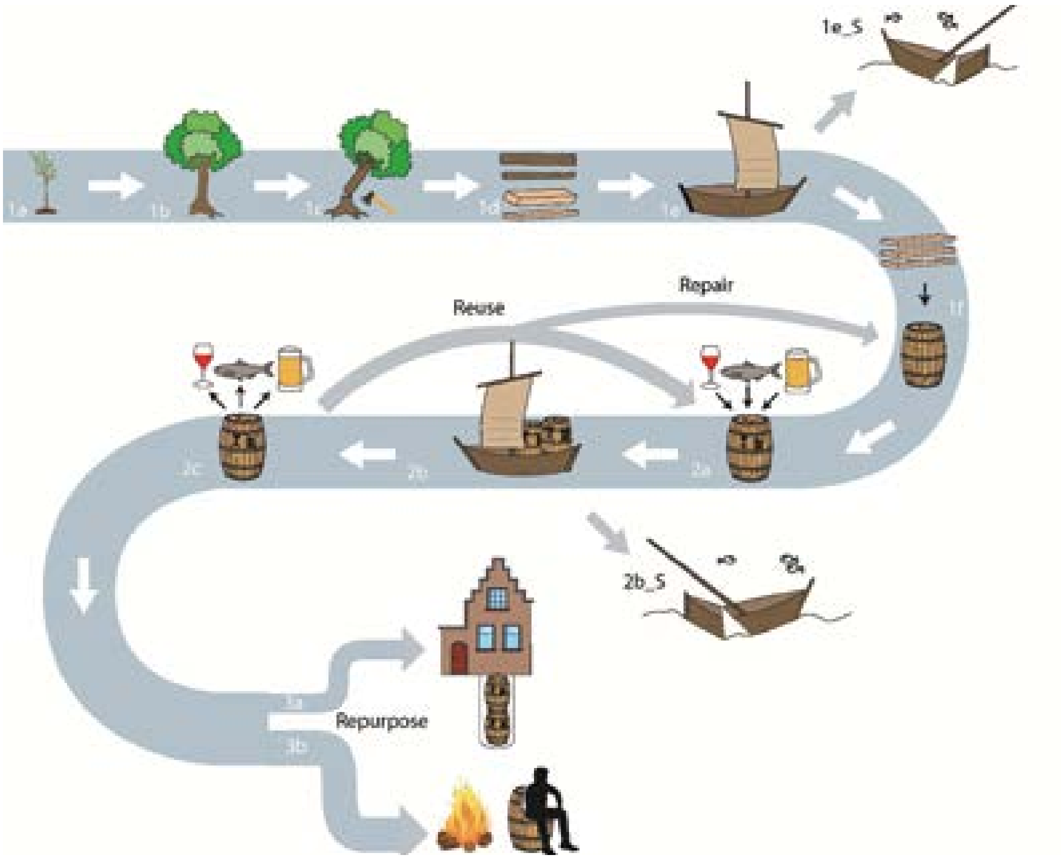

Figure 2.1: Schematic overview of the lifecycle of casks, also indicating the phases at which a ship carrying casks could havesunk.

Production phase

The lifecycle of a cask commences with timber production, which can be traced back to the oldest tree ring in the timber utilized for its construction (Figure 2.1_1a). This production phase concludes when the completed cask has been gauged and is initially employed as a transport container (Figure 2.1_1f).

In Dutch archaeological contexts, the first stage of cask production, timber production, predominantly took place in timber-abundant regions across Northern Europe, including the Rhineland, Meuse Valley, North German Plain, Baltics, Poland, Burgundy/Loire Valley, and northern France.[62]

Dendrochronological analysis of tree rings allows for the dating of timber production. The oldest tree ring among all samples from an individual cask is used to establish the commencement of the casks' lifespan (Figure 2.1_1a). Similarly, the youngest tree ring from all samples of a cask is employed to determine the age of the timber used (Figure 2.1_1b). If sapwood is present, the estimated felling date of the tree used for a cask can also be ascertained (Figure 2.1_1c).

Following felling and processing, the timber required drying and transportation from the timber-producing area to cooperages (Figure 2.1_1e). Timber sourced from the Rhineland or the Meuse Valley likely underwent minimal processing and was primarily transported as logs.[63] Initially, the felled logs were transported to a gathering place with sufficiently wide and deep water. The logs were then bundled into wooden rafts, facilitating their downstream transportation to cooperages. The duration of transportation was contingent upon the distance to be covered.

Timber from the North German Plain, Baltic areas, Poland, the Burgundy/Loire Valley, and northern France was transported by sea. It was first processed into wainscot, planks, or *clapboard* to facilitate shipping (Figure 2.1_1d).[64] During the excavation of the *Copper shipwreck*, examples of wainscot and *clapboard* were discovered. This ship was possibly in transit in the port of Gdańsk when it sank in 1408.[65]

The wainscot found on the *Copper shipwreck* ranged in size from 185 to 252 cm in length and 19 to 31 cm in width. Conversely, the ship's clapboard was significantly smaller, with lengths spanning 54 to 86 cm and widths of 7 to 17 cm (Figure 2.2). This material would have been used to make staves. The term *clapboard*, in Dutch *klaphout*, may have originated from *klepka*, the Polish term for stave. Since a substantial portion of the timber used for casks in Dutch archaeological contexts originated near Gdansk or along the Vistula River within present-day Poland, it is plausible that this term was adopted in the Netherlands.

62 Oosterbaan et al., 2022. 18.

63 Domínguez-Delmás & Berselaar, 2009, 15.

64 Domínguez-Delmás & Berselaar, 2009, 16.

65 Ossowski et al., 2014, 261.

Figure 2.2: Clapboard and wainscot found on the Copper shipwreck (Ossowski et al., 2014).

In the Late Middle Ages and Early Modern period, coopers sought to acquire adequately dried timber, facilitating the ease of splitting while retaining sufficient flexibility for shaping into the desired form. Furthermore, the timber needed to possess stability to ensure the casks' watertight integrity. Although the precise drying duration for coopers' timber during this era remains undetermined, 20th-century coopers' timber with a thickness of 2.5 cm, typically necessitates an average drying period of one year.[66] To eliminate all substances that might impart aroma to the packaged product, a drying period of 36 months is required.[67]

The drying duration for timber used in other applications than cask production provides insights into the drying period for coopers' timber. For ship timber, a minimum period of three years is generally required from the time of felling to ship construction.[68] Timber used in construction typically requires a drying period of

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66 Porter, 2005, 38.

67 Waelput, 2004, 75.

68 Vos, 2019, 121.

two years, as evidenced by architectural historical research conducted on buildings in Amsterdam and Utrecht, among other locations, utilizing dendrochronological data.[69]

Upon acquiring timber, coopers either soaked it in water to remove undesirable substances or laid it out to dry further in their warehouses (Figure 2.3). This additional drying period likely lasted at least six weeks. Archival sources document a mandatory additional drying period of eight weeks in Haarlem[70] and six weeks in Gouda.[71] It is reasonable to assume that cooperies in other cities would have implemented similar mandatory drying periods for their newly acquired timber. Once the timber was partially dried yet retained sufficient flexibility, it could be processed into casks (Figure 2.1_1f). The cask-making process involved numerous steps and required approximately 40 hours to complete.[72] However, this refers to the total production time involved in making a cask, including periods when the staves needed to be soaked, heated, and bent into shape. The actual hands-on labor required for a single cask was likely considerably lower than the 40 hours indicated here.

Figure 2.3: Coopers' timber being dried at the present day Vicard cooperage in Cognac, France (Pineau JL. (2020). Groupe Vicard. Élever la tradition innovation & performance. Retrieved June 17, 2024, from https://www.groupe-vicard.com/files/fr/1591368313.1353/FR_Ctlg_TonnellerieVicard2020-planche.pdf).

69 De Vries, 1994, 379; Van Tussenbroek, 2012, 28.

70 Kuiperskeur, 25 October 1567, published in: Huizinga, 1911, 426.

71 Ordinance of the Coopers, 1490, published in: Rollin Couquerque & Meerkamp van Embden, 1917, 105.

72 Written communication from Cor de Groot, cooper at the Zaans Museum in Zaandam, Netherlands.

Use as transport containers

Upon completion, each cask underwent gauging to ensure adherence to pertinent legislative standards. The specifications of the casks were required to align with the criteria established by provincial or urban authorities, as well as guild regulations.[73] Once approved, officials marked the casks, occasionally including the year of approval, providing a means to date this particular phase in the casks' lifecycle (Figure 2.4). Subsequently, the casks were filled, predominantly with fish, wine, or beer, for transportation to their respective destinations (Figure 2.1_2a–b). Additionally, casks served as containers for other goods such as meat, gunpowder, and spices. The majority of casks were transported via rivers or the sea. However, this transportation was not always successful, particularly in instances where the ships carrying the casks sank (Figure 2.1_2b_S).

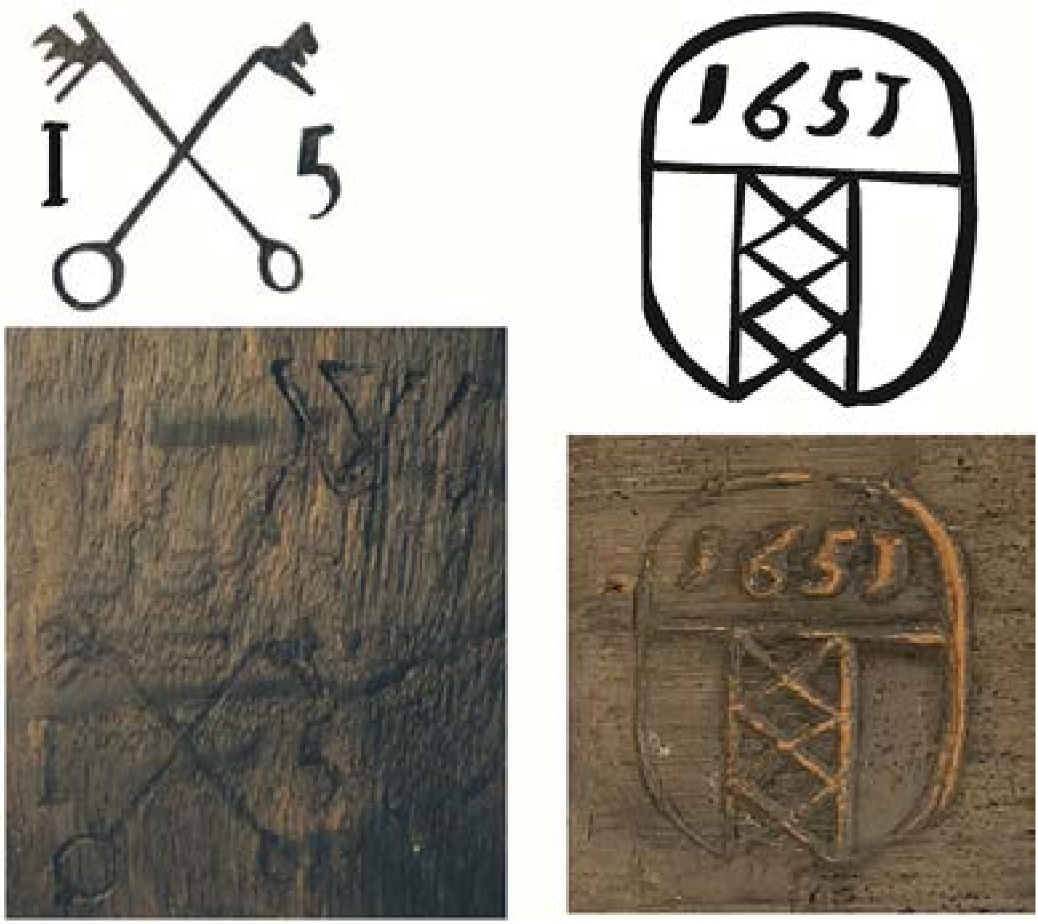

Figure 2.4: Gauge marks with the year of application incorporated in the coat of arms of the city of Leiden (left: Verduin 2019) and Amsterdam (right: author's photo).

73 Yntema, 1992, 218; Oosterbaan, 2023, 105-108.

Casks recovered from shipwrecks facilitate the determination of the interval between the felling of the timber used in their construction and their subsequent utilization as transport containers, contingent upon the known date of the shipwreck. Casks from shipwrecks offer the additional benefit of containing identifiable contents if they held dry merchandise. Conversely, the liquid contents of casks are more challenging to ascertain, as the liquid would have dissipated long before any archaeological research.

Upon reaching their intended destination, casks were typically sold to consumers (Figure 2.1_2c). Once emptied, a cask could be repurposed, returned to the original producer of the product it contained, or, if necessary, taken to a cooperage for repair. In certain cases, casks were dismantled to save space on ships. Casks could also be reused in cities other than their place of origin. In such instances, casks required re-gauging before reuse, with these marks including the year of application, providing a means to date this phase in the lifecycle of a cask.

Repurposing

When casks were no longer required for trade purposes, some were repurposed as shafts for cesspits and water wells (Figure 2.1_3a). However, certain casks, such as those designed for gunpowder and measuring no more than 30 cm in width, were unsuitable for such repurposing due to their small size. Additionally, casks were converted into tables or chairs, as illustrated in iconographic sources (Figure 2.5), or utilized as firewood (Figure 2.1_3b). However, such repurposing is seldom reflected in the archaeological record.

Casks employed as shafts for cesspits and water wells represent the most archaeologically accessible form of repurposed casks. Given that these features are often filled with datable artifacts, the dating results have been incorporated into the dataset to enable a comparison of dates between their production, use as transport containers, and subsequent repurposing.


Figure 2.5: Repurposed casks: Left: shaft of a cesspit or water well (Oosterbaan & Griffioen, 2015); Right: cask used as a table and chair (Smoking and Drinking Peasants in an Interior Setting [Oil on canvas, personal collection], by Egbert van Heemskerck, 1646–1704. Database RKD Netherlands Institute of Art History, n.d., https://rkd.nl/images/203359).

2.4 Results

2.4.1 Production

The first stage involves the cultivation of timber used for coopering, followed by its drying and transformation into wainscot, planks, or clapboards. These materials are subsequently transported to cooperies, where they undergo further drying and are utilized in the construction of casks. A critical component of this phase is the selection of appropriate timber for coopering.

Age of the timber used (Figure 2.1_1a–1c)

Coopers' timber was required to fulfill several criteria, including ease of splitting and flexibility. Oak satisfied these requirements and additionally did not impart an undesirable taste to the contents.[74] Consequently, casks were predominantly constructed from oak, with 97.8% of the casks in the dataset being made from this timber species. The diameter and, thus, the age of the timber were also significant,

74 Waelput, 2004, 52-53, 75.

as trees needed to possess sufficient thickness to allow staves to be cut from quarter-sawn timber (Figure 2.6_A). The dataset indicates that the maximum width of staves in the casks ranged from 6.5 cm to 23 cm, with an average width of 14.2 cm. To cut staves of this average width from a quarter-sawn log, the diameter would have needed to be at least 30 cm. Naturally, trees exceeding a diameter of 30 cm were also utilized for coopers' timber (Figure 2.6_B).

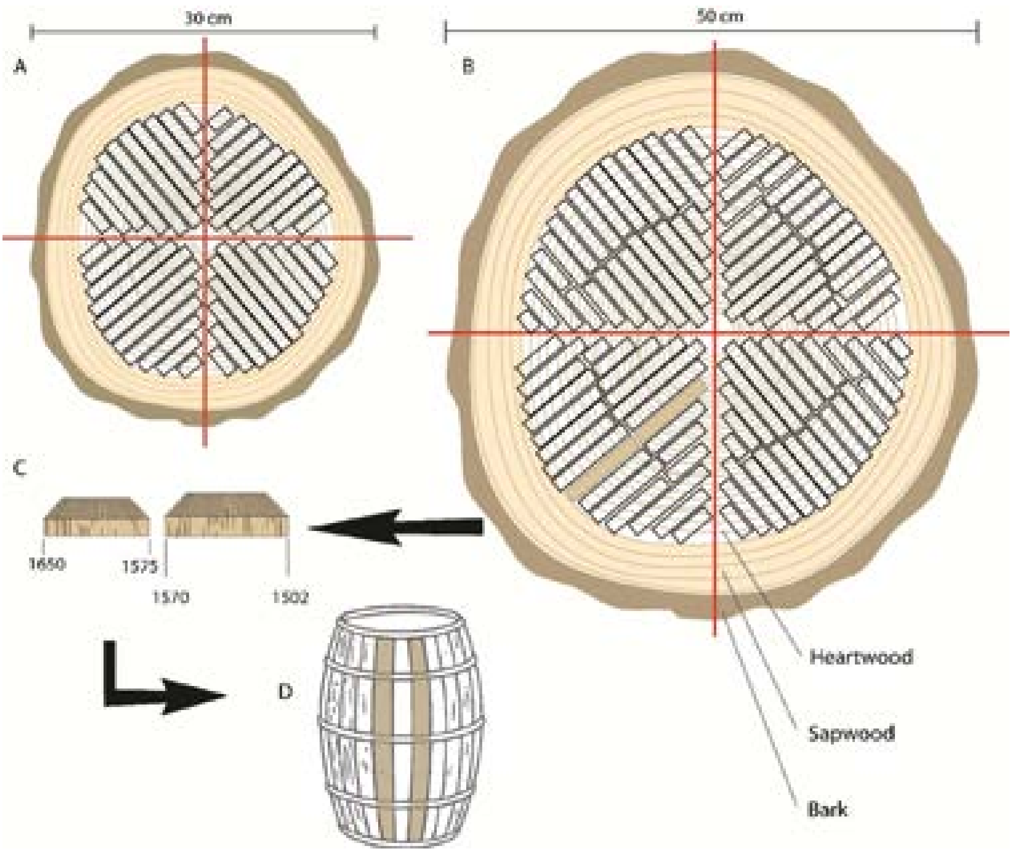

Figure 2.6: The method used to extract staves from quartered oak logs with diameters of 30 cm (A) and 50 cm (B); the placement of staves in casks (C and D).

To examine the age selection of timber used by coopers, several analyzes were employed and subsequently compared to assess consistency and coherence, with the ultimate aim of determining the most probable duration of this phase within the lifespan of casks. First, the oldest and youngest tree rings in individual staves from casks recovered in urban archaeological contexts were examined. This analysis was then repeated at the cask level across the entire dataset. Finally, the cask level analysis was refined by focusing exclusively on those casks for which at least two staves had been subjected to dendrochronological analysis.

First, the oldest and youngest tree rings in individual staves of casks from urban archaeological contexts were analyzed. This analysis, centered on the youngest tree ring, does not ascertain the estimated felling date but rather identifies a year after which the tree was felled (*terminus post quem*), as in many cases estimated missing sapwood rings were not taken into account. This methodology was selected because only 91 of the 1048 samples from urban archaeology contained dendrochronological samples with sapwood. An analysis based on samples with sapwood, which permits an estimated felling date, would have resulted in a limited dataset. The analyses of the oldest and youngest tree rings revealed that staves with between 30 and 274 tree rings were processed. The median of the oldest and youngest tree rings in individual staves was 115 tree rings, with an average of 118 tree rings per stave (Figure 2.7).

Second, an analysis of timber selection was conducted at the cask level, where it is crucial to consider the number of tree rings present in all the staves of a cask. A total of 464 separate casks were analyzed, comprising 1331 dendrochronological samples.[75] The dendrochronological datings of the staves from individual casks were compared, utilizing the oldest and youngest tree rings to determine the period of timber production for the cask. The median of the oldest and youngest tree rings in individual casks was 141 tree rings, with an average of 144 tree rings and a variation of 40 to 330 tree rings in individual casks (Figure 2.7).

The third analysis, focused on the duration of the production phase within the lifespan of casks, was conducted exclusively on casks for which at least two staves had been dendrochronologically analyzed. As shown in Table 2.1, for 221 of the 464 casks in the dataset, only a single stave was analyzed; this analysis therefore concentrated on the remaining 243 casks for which a minimum of two staves had been examined. This revealed a median of 150 tree rings per cask, with a an average of 156 tree rings per cask. Thus, conducting dendrochronological dating on more than one stave increases the average number of tree rings from 144 to 156, representing only an 8% increase. This suggests that several staves within the same casks generally exhibited mostly overlapping tree ring patterns.

In essence, the three-step analysis demonstrates that the initial phase of a cask's lifespan lasted at least 150 years, based on the median number of tree rings in the dataset. This estimate is conservative, as missing sapwood rings in individual casks mean that 150 years represents a minimum duration.

75 In total, sapwood was present in 157 of the 464 casks, representing 34 percent of the assemblage. For these casks, the number of missing sapwood rings was estimated and incorporated into the analysis, using the models proposed by Hollstein (1980) and Wazny (1990).

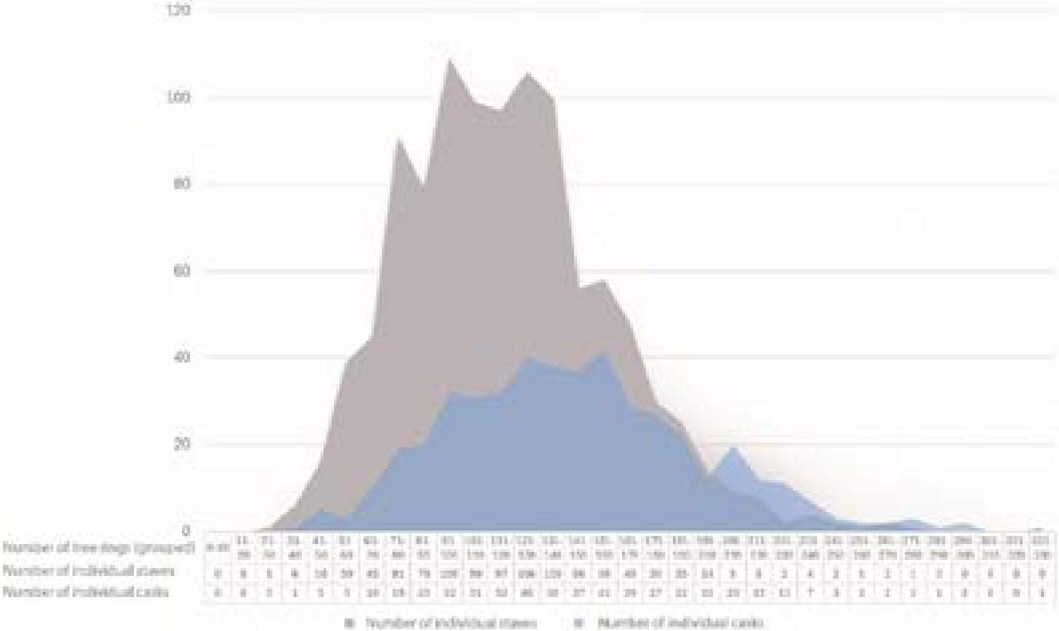

Figure 2.7: Grey: staves (Y-axis) that consisted of the specified number of grouped tree rings (X-axis). Blue: casks (Y-axis) that consisted of the specified number of grouped tree rings (X-axis). When determining the number of tree rings per cask, the difference between the oldest and youngest tree rings in various staves of the same cask is taken into account. For instance, the cask in Figure 2.6 would be placed in the 141–150 group because a difference of 148 tree rings was documented (1502–1650).

Provenance of coopers' timber (Figure 2.1_1a–1c)

The origin of coopers' timber may have influenced the number of tree rings and, consequently, the duration of a casks' production phase. Timber from different regions exhibits distinct characteristics that can affect its suitability for cask production. For instance, timber from the Baltic region was highly valued by artists and shipbuilders due to its slow growth rate, which resulted in a homogeneous, fine grain that ensured stability and durability.[76] This suggests that timber from the Baltic region generally had a higher density of tree rings per centimeter compared to timber from other regions.

To determine whether casks made from timber sourced from different regions exhibit varying numbers of tree rings, an analysis was conducted on timber from various provenances. The sub-study differentiated between casks made from timber transported via river trade routes, specifically the Rhine and Meuse rivers, and those transported via sea trade routes. The sea trade routes were further categorized into southern sea trade from France and northeastern sea trade from

76 Domínguez-Delmás & Berselaar, 2009, 16.

the Baltic region, Poland, and the North German Plain (Figure 2.8). No variation in the number of tree rings per cask was observed across provenances. However, the absence of variation in the number of tree rings per cask across provenances does not permit conclusions about growth-ring density. Determining ring density would require the widths of the individual staves; however, the dataset contains insufficient stave width data to perform this analysis reliably.

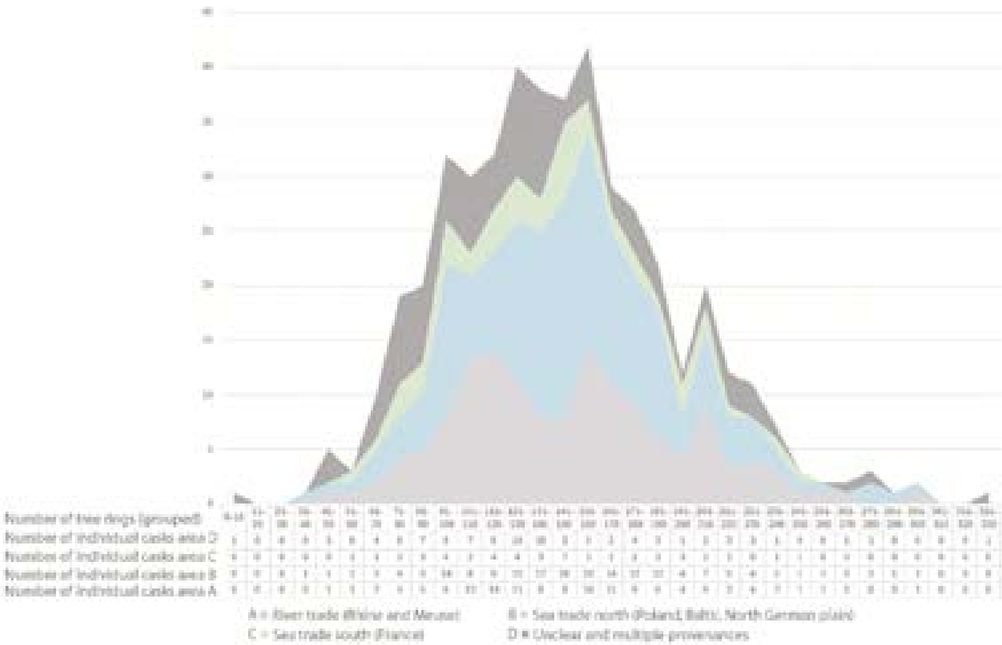

Figure 2.8: The number of casks (Y-axis) that consist of the specified number of grouped tree rings (X-axis), separated by collective provenance area.

Dendrochronological studies frequently demonstrate that staves within a single cask display considerable similarity. Such studies often reveal tree ring tree-ring series with significant similarity, indicating that these staves were sourced from the same provenance area and, potentially, the same tree or even a specific section of a trunk. In the Dutch city of Vlissingen, dendrochronological dating was performed on 14 casks. In 6 of these casks (nearly half), matching tree ring series were observed.[77] The case from Vlissingen represents only one instance of such findings, as similar observations where timber from the same tree was identified within individual casks have been reported in numerous dendrochronological studies.[78] The staves from

77 Doeve, 2021, 11.

78 see Van Daalen, 2012 [Gorinchem, Bluebandhuis]; Van Daalen, 2016 [Venhuizen, Westeinde 15]; Van Daalen, 2019 [Zoutelande – Duinweg]; Van Daalen, 2020 [Veldhoven – Dorpstraat 25]; Van Daalen, 2023 [Utrecht – Gruttersdijk].

these sites, originating from the same tree and utilized in an individual cask, exhibit only minor dating variations of less than 50 years. This suggests that a single radial series of staves was employed from each tree, as depicted in Figure 2.6_A.
Historical sources corroborate a similar preference for selecting timber with consistent properties for cask production. Kilby (1989) and Waelput (2004) assert that 20th-century coopers favored timber with uniform properties for cask construction, which is essential for ensuring a well-crafted cask. Variations in timber properties, such as hardness, could lead to compression and eventual cracking of the softer staves.

The consistent use of timber in casks during the Late Medieval and Early Modern periods was also stipulated in the *Rechtsbronnen* of several Dutch cities.[79] For instance, beer casks in the Dutch cities of Gouda in 1490 and Haarlem in 1567 were mandated to be constructed from high-quality eastern timber, implying the same provenance area. In other instances, such as in the Dutch cities of Dordrecht, Amsterdam, and Leiden, the only requirement was that the timber be of good quality, meaning it had been properly dried and was devoid of sapwood, knots, and wormholes.[80]

Timber processing, drying and shipping (Figure 2.1_1d–1e)

The duration required for the processing, drying, and transportation of coopers' timber remains challenging to ascertain. Nevertheless, the prefabricated staves discovered on the *Copper shipwreck*, located in the bay of Gdańsk, Poland, offer a distinctive opportunity for analysis. Approximately 40 planks originating from Poland were identified on this ship, which is believed to have been intended for cooperages.[81] The staves from this shipwreck are incorporated into the dataset of this sub-study.

Dendrochronological analysis has established that the majority of these planks were felled between 1406 and 1407, with a minority cut as early as 1404. The *Copper shipwreck* is determined to have sunk in 1408, as corroborated by dendrochronological dating and the ceramic assemblage recovered, likely during the spring of that year.[82] This suggests a processing and drying period of 1 to 4 years at the site of the timber producers, aligning with the 36-month drying period for 20th-century coopers' timber (Section 2.3).

79 Oosterbaan, 2023, 106.

80 Oosterbaan, 2023, 106.

81 Ossowski et al., 2014, 257.

82 Ossowski et al,. 2014.

Cask production (Figure 2.1_1f)

As the dataset used in this sub-study does not allow for determining the exact duration of cask production, additional information was obtained through consultation with contemporary coopers employing traditional methods. According to these craftsmen, producing a cask generally requires a total production time of approximately 40 hours, although the actual hands-on labour is likely considerably shorter. They further noted that production time varies substantially depending on the specific type of cask being produced.

In addition, production time was estimated by comparing historical sales prices with average wages. This approach assumes that the total labour hours, combined with material costs and profit margins, would roughly correspond to the selling price of a cask. Based on this calculation, the production of a salted-fish cask was estimated to require approximately 8.75 hours (Section 4.3).

Prior to the actual production process at cooperages, there is an additional drying phase for the coopers' timber. Archival sources indicate that this mandatory drying period lasts for a minimum of six weeks (Section 2.3).

2.4.2 Casks used as transport containers

The examination of the duration of casks as transport containers constitutes a central inquiry in this sub-study. Certain casks were designed for single-use, remaining in service for only a brief period (Figure 2.1_2a–2c). Conversely, other scenarios are conceivable, such as a wine cask filled with local wine in France, which could embark on an extensive maritime journey to the Netherlands. Upon arrival, it might be sold to a tavern, where it would be gradually emptied. Once emptied, the cask could be reused multiple times and potentially sent to a cooperage for repairs. Consequently, the lifespan of such wine casks would differ significantly from that of a herring cask. Though the duration of casks as transport containers can vary, this sub-study aims to estimate their average service life.

In the analysis of the duration of cask usage as transport containers, casks from urban archaeological contexts and those from maritime archaeological contexts are utilized in the dataset. These contexts differ in that the use phase of casks from maritime archaeological contexts as transport containers was abruptly terminated due to the sinking of the ship on which they were transported, whereas the transport-container phase of casks from urban archaeological contexts proceeded to completion.

Additionally, the markings on the casks can offer insights into their duration as transport containers and are therefore also examined.

Casks from urban contexts

This sub-study's analyses concentrated on casks from urban archaeological contexts that had been repurposed as shafts for cesspits and water wells, most of which contained dateable artifacts. The estimated felling date, or the youngest tree ring identified through dendrochronological analysis, was compared with the initial dating of the artifacts found in these cesspits and wells. The interval between these dates represents the duration of a casks' use as a transport container. Of the 345 casks in the dataset from urban archaeological contexts, only 183 possess dendrochronological and artifact-based datings.

Among the 183 casks, 141 were dated using dendrochronological samples that lacked sapwood, which only permitted the determination of the *terminus post quem* for the felling date of the timber used for these casks. For the remaining 42 casks, dendrochronological samples with sapwood were available, allowing for the estimation of the felling date of the timber used for these casks.

The dendrochronological analyses of cask samples without sapwood yielded a median of 9 years (Figure 2.9). The average difference between the *terminus post quem* for the felling date and the initial context dating was 23 years, as the average is significantly influenced by outliers at the extremes of the spectrum. For example, in 8 of the 183 casks, the difference was negative, due to artifacts in the cesspit or water well having an older date than the timber used for the cask. Notably, 23 of the 183 casks exhibited a *terminus post quem* for the felling date and an initial context more than 50 years apart. This discrepancy could potentially be attributed to the use of old casks as the shaft of a cesspit or water well. Alternatively, it could be explained by the fact that the cask was dated based on only a segment of the tree rings from the timber used for the cask. Interestingly, these casks were either wine casks or contained unknown contents. Additionally, there was one cask with a period of 367 years and another with 368 years between the *terminus post quem* for the felling date and the initial context dating. The cesspits containing these casks may have been emptied or filled at a much later period.

The period during which casks were utilized as transport containers can be more precisely determined for those casks with dendrochronological datings based on samples containing sapwood. This is because, for these casks, the discrepancy between the estimated felling date and the initial context dating can be ascertained. The analysis conducted on this subset of the dataset, comprising 42 casks, yielded a median of 9 years and an average of 11 years (Figure 2.10). This finding demonstrates a consistent pattern when compared to the analysis of casks lacking sapwood. The actual duration for which the casks served as transport containers was less than 9 years. Notably, dendrochronological dating does not indicate the commencement of their use as transport containers; the timber must first be processed into casks after being felled and dried, a process that could take 2–4 years. For a substantial number of casks, it is probable that their period of use was approximately 6 years.

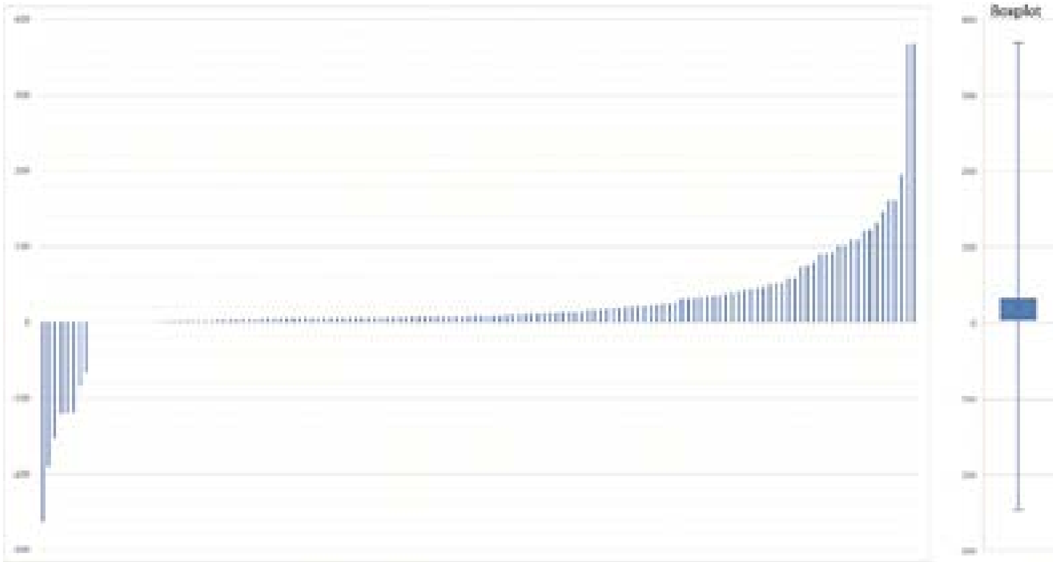

Figure 2.9: The difference of the terminus post quem for the felling date of individual casks and the beginning date of the repurpose phase, of casks from urban contexts (n=141). On the right, the boxplot illustrates, in sequence, the minimum, first quartile, median, mean (denoted by a cross), third quartile, and maximum values.

Figure 2.10: Estimated felling date based on samples with sapwood of individual casks compared to the beginning date of the repurpose phase of casks from urban contexts (n=42). On the right, the boxplot illustrates, in sequence, the minimum, first quartile, median, mean (denoted by a cross), third quartile, and maximum values.

Repurposed casks discovered in urban archaeological contexts were often stacked to function as shafts for cesspits and water wells. Since different casks were put into use simultaneously as shafts, the variation in dating of these individual casks within a single feature can also serve as an indicator of their duration of use as transport containers. A prolonged circulation of casks as transport containers would likely result in greater dating differences. The dataset, however, contains only a limited number of instances where multiple casks from the same cesspit or water well have been subjected to dendrochronological dating. This limitation arises primarily because archaeologists typically aim to date the barrel well itself when collecting dendrochronological samples from casks. Consequently, samples are generally taken from the cask most likely to yield results, while other casks are often not sampled.

Nonetheless, during excavations at Vlissingen Groote Markt and Leiden Aalmarkt, instances of barrel wells were identified where dendrochronological samples from different casks were available. In Vlissingen, the absence of sapwood in the dendrochronological samples from both casks allowed only for a *terminus post quem* dating, resulting in dates of 1582 ± 7 and 1592 ± 7, which are within a decade of each other. It is improbable that these two casks were produced simultaneously, as one was constructed using French timber and the other with Meuse Valley timber.[83] The second example pertains to a barrel well discovered at the Aalmarkt in Leiden, where dendrochronological datings for both casks were identical, each dating to 1518 ± 6.[84]

However, these datings are based on dendrochronological analyses without sapwood, precluding the determination of the exact felling date and leaving it uncertain whether the casks were produced contemporaneously. Nevertheless, the minimal differences in dating do not necessarily contradict a brief circulation period of the casks as transport containers, as evidenced by the analysis of dendrochronological datings in comparison to the initial context datings.

Maritime context

The duration of casks employed as transport containers in maritime contexts can often be precisely determined by correlating the shipwreck date with dendrochronological dating results. This correlation offers insights into the interval between the casks' production (Figure 2.1_1b–1c) and its utilization as a transport container (Figure 2.1_2b-S).

The dataset comprises 62 casks from maritime contexts that have been successfully dated using dendrochronology, with known shipwreck dates. Among these, 21 casks contain sapwood, permitting an estimation of the felling date. The remaining 41 casks lack sapwood, only allowing for the determination of a *terminus post quem* for the felling date.

83 Doeve, 2021, 20.

84 Hoogendijk, 2020, 322.

The 41 casks without sapwood exhibited a median of 17.5 years and an average difference of 30 years between the *terminus post quem* for the felling date and the shipwreck date. However, significant variations exist within this range (Figure 2.11). Some casks demonstrated a difference of merely 1 or 2 years, while the maximum difference was 105 years. It is highly improbable that this cask was used as a transport container for 105 years; the exceptional difference may instead reflect the use of staves cut from the innermost part of the tree, where the rings are considerably older than the outermost growth, or the incorporation of older, repurposed staves used in the repair of the cask.

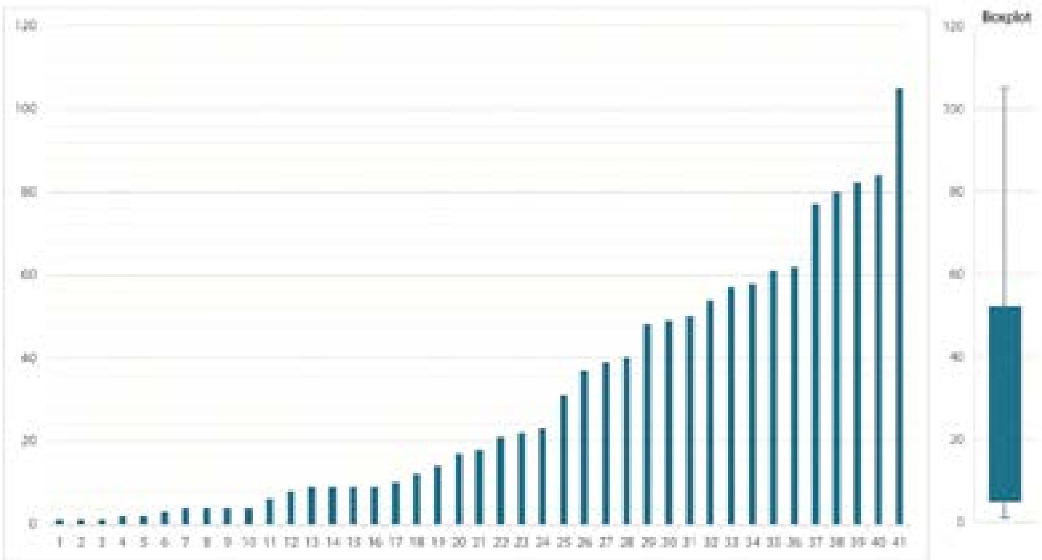

Figure 2.11: Terminus post quem for the felling date of casks from maritime contexts compared to the shipwreck date, in years (n=41). On the right, the boxplot illustrates, in sequence, the minimum, first quartile, median, mean (denoted by a cross), third quartile, and maximum values.

When examining the 21 casks containing sapwood, the median age is merely 8 years, and the average interval between the felling and shipwreck dates is only 15 years. The range also diminishes significantly, spanning from 1 to 51 years (Figure 2.12). However, even with the analysis of casks from maritime archaeological contexts, the median of 8 years cannot be directly equated with the duration of casks being utilized as transport containers. Following the felling of the timber, it required processing, drying, transportation, and fabrication into casks before they could be employed. As demonstrated in section 2.4.1, this process could take 2 to 4 years. Furthermore, these casks had not yet reached the end of their utility as transport containers, as evidenced by the ship carrying them sinking. Nonetheless, the average provides an indication of the period during which casks were employed for transport.

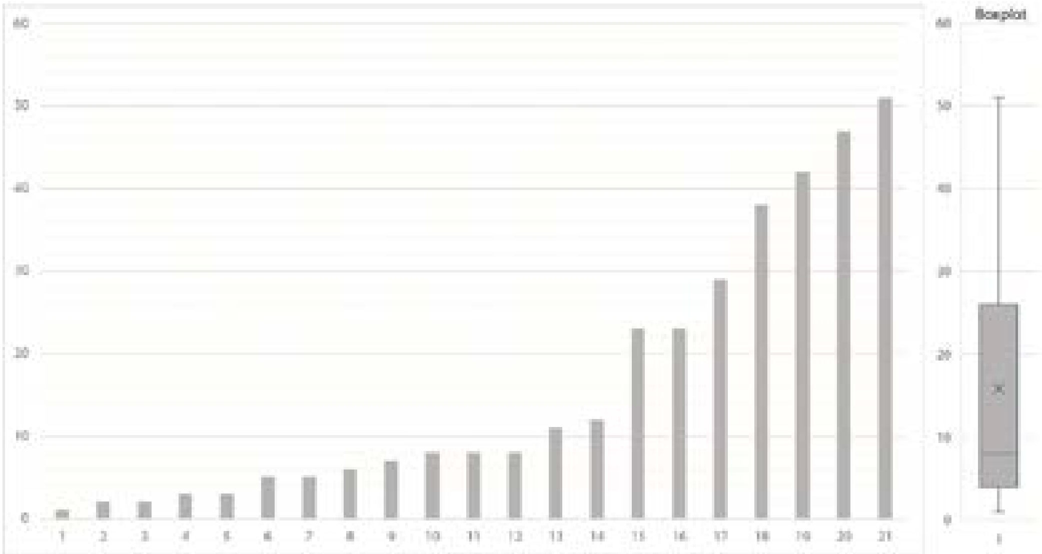

Figure 2.12: Estimated felling dates of casks from maritime contexts based on samples with sapwood compared to the shipwreck date, in years (n=21). On the right, the boxplot illustrates, in sequence, the minimum, first quartile, median, mean (denoted by a cross), third quartile, and maximum values.

The temporal use of casks as transport containers in maritime contexts can be investigated by treating each shipwreck as a find assemblage, which can be associated to a specific period of use. In other words, all casks found on a sunken ships are considered contemporaneous, as they were all present on the same ship. If casks had been utilized for an extended period as transport containers, one would expect a greater variance in the dating of the casks on the same ship. For three ships from Dutch waters, the differences in dating between casks, determined through dendrochronological analysis with sapwood, were investigated. The dating discrepancies range from 4 to 28 years (Table 2.3).

Table 2.3: The dates of casks from three shipwrecks from Dutch waters.

	Kamperkogge	*Burgzand Noord 2*	*Scheurrak SO1*
Oldest cask	1401	1669	1593
Youngest cask	1429	1673	1605
Date difference	28	4	12
Number of casks (with sapwood)	4	3	3

Marks

In certain instances, the duration for which a cask served as a transport container can be ascertained through its markings, particularly if these include dates.

However, dendrochronological or contextual dating is also essential to determine the period of use of the cask as a transport container. Within the dataset, only 2 out of the 464 casks possess such markings, both of which are depicted in Figure 2.4.

The marking “15” on one of the casks is believed to have been inscribed in 1615 (Figure 2.4 left). Dendrochronological analysis revealed that its youngest tree ring dates to 1599. The felling year is estimated to be post-1605, although the precise year remains indeterminate due to the absence of sapwood. Given the brief interval of merely 10 years between the *terminus post quem* and the year marked on the cask, it is plausible that this mark was added shortly after production, possibly at the time of its initial use. Subsequently, the cask was repurposed as a water well shaft, with ceramics discovered within it, dating between 1600 and 1650, indicating a short period of circulation before repurposing.

The other cask bears the year 1651 on its head, discovered in shipwreck OT23 in Flevoland (Figure 2.4 right).[85] Regrettably, no dendrochronological analysis was performed on this cask, but the shipwreck is estimated to have occurred between 1650 and 1675. This suggests that the cask, marked as 1651, also likely did not circulate for an extended period. The limited examples of casks with a year incorporated in the mark further suggest that these casks were likely in use for a brief duration, probably less than a decade. This observation aligns with other methodologies employed to estimate the usage period of casks as transport containers.

2.4.3 Repurposing casks

The repurposing of a cask signifies the commencement of the final phase of its lifecycle. As delineated in section 2.3, casks may be repurposed in various manners, such as being utilized for firewood or transformed into furniture (Figure 2.1_3b). These forms of repurposing present challenges for archaeological detection, as almost no remnants have been discovered. Nevertheless, the repurposing of casks as shafts for cesspits or water wells is documented in urban archaeological research. The dataset comprises 345 repurposed casks, of which 183 have been context dated (Figure 2.1_3a). The dataset indicates an increasing prevalence of these repurposed casks commencing from the 14th century (Table 2.2, Context start date). The duration of this phase is determined by the range of context dating. Repurposed casks employed as shafts for cesspits and water wells typically contain dateable artifacts; the interval between the initial context date and the end context date is considered the duration of the repurposing phase.

Of the 345 casks, the context dating for 183 casks was documented in the archaeological research reports. The analysis of the duration of their repurposing revealed a median of 75 years, with an average of 85 years (Figure 2.13). The

85 Database Maritieme opgravingsdocumentatie, n.d., T23-19, https://doi.org/10.17026/dans-xq9-mgh2.

difference between the initial context date and the end context date ranges from 10 to 325 years. However, context dating is based on the maximum dating range of the artifacts found in the cesspits and water wells. Unlike dendrochronological dating, which provides absolute years or terminus post quem constraints, ceramic dating is based on the production range of specific types of ceramics. This maximum dating range is determined by the production period of the ceramics, which can result in a broader timeframe compared to the repurposing phase of casks. Therefore, the duration of the repurposing phase of the casks must be situated within this range.

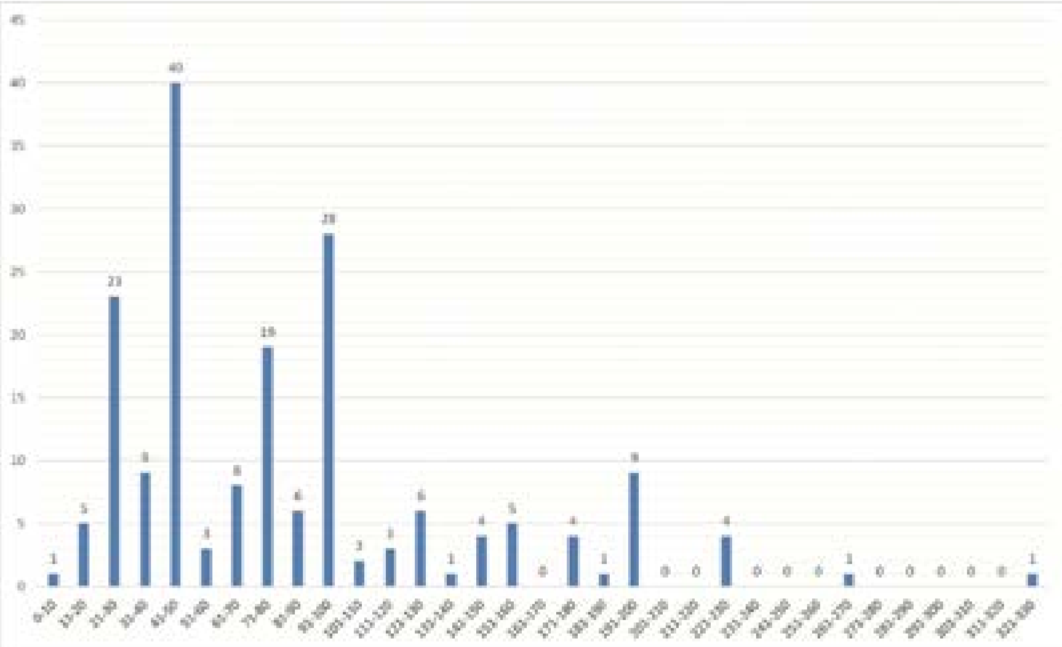

Figure 2.13: Individual casks (Y-axis) with the specified number of grouped duration of repurposing (X-axis) (n=183).

Provenance

The provenance of coopers' timber utilized in cask construction may have influenced the selection of casks for shafts, given that timber characteristics vary by origin. To examine whether this is reflected in the dataset, the dated repurposed casks were categorized according to their provenance and compared with the provenances of the entire dataset, which includes repurposed and non-repurposed casks identified during maritime archaeological research. The comparison is presented in absolute numbers and percentages (Figure 2.14).

The analysis of the repurposed casks and the provenance of the coopers' timber indicates a slight preference for casks made from timber originating from the Rhine and Meuse valleys, with 38% of the repurposed casks sourced from these regions, compared to 31% in the entire dataset. Conversely, the use of casks made from timber from Poland, the Baltic, and the North German Plain appears to be less prevalent, as the percentage from these areas decreases from 40% to 26%.

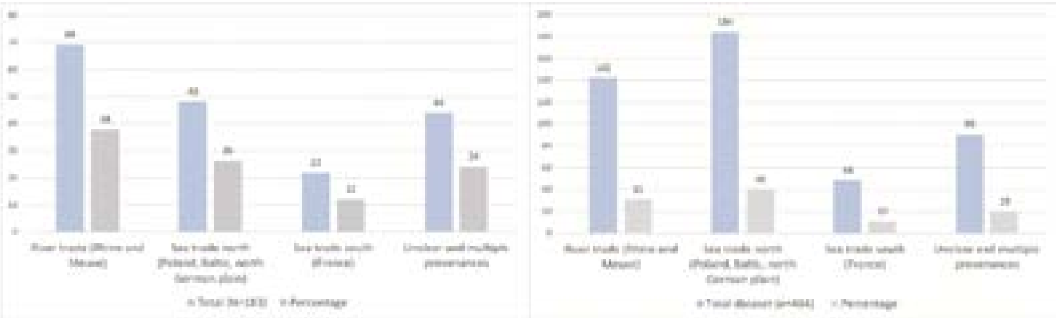

Figure 2.14: Left: Dated repurposed casks from the specified provenances shown in absolute numbers (blue) and percentages (grey) (n=183). Right: Casks in the complete dataset from the specified provenances shown in absolute numbers (blue) and percentages (grey) (n=464).

Associated products (contents)

Not all casks were deemed suitable for repurposing as shafts for cesspits or water wells. Casks with a diameter smaller than 45 cm were generally excluded from such repurposing due to their insufficient capacity for the barrel well.[86] As the size of casks varied according to the products they contained[87], it is plausible that a correlation exists between the products associated with the casks and the likelihood of their selection for repurposing as cesspits or water wells.

The analysis of the repurposed casks and their associated products shows a preference for using wine casks as shafts for cesspits and water wells (Figure 2.15). In total, 11% of the casks in the entire dataset were identified as wine casks, while 22% of the repurposed casks were identified as wine casks. This indicates a preference for repurposing wine casks.

Another notable distinction pertains to casks used for dry goods, such as gunpowder or other merchandise, which constitute 8% of the total 464 casks. These casks were not employed as shafts for cesspits or water wells (Figure 2.15), likely due to their diameter being less than 45 cm. Furthermore, casks for dry goods were often of inferior quality compared to those used for liquids, a factor attributable to the limited thickness of the staves. This lower quality likely represents another significant reason why casks for dry goods were not repurposed as shafts for cesspits and water wells.

86 Oosterbaan et al., 2022, 7.

87 Oosterbaan, 2023.

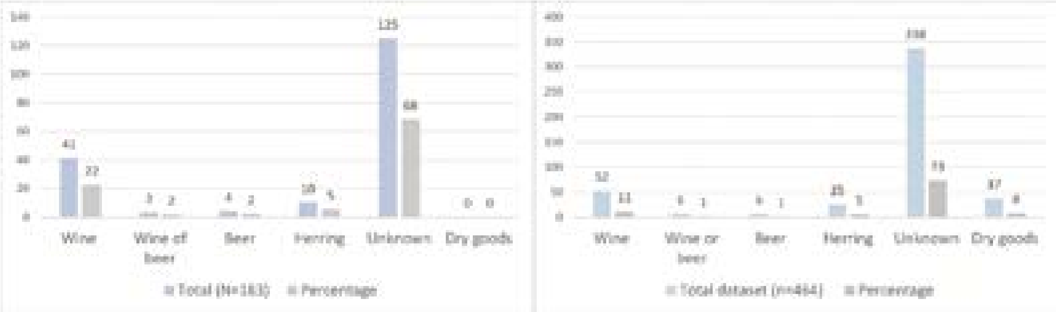

Figure 2.15: Left: Number of dated repurposed casks categorized by their associated product in absolute numbers (blue) and percentages (grey) (n=183). Right: Number of casks in the dataset categorized by their associated product in absolute numbers (blue) and percentages (grey) (n=464).

2.5 Conclusion

Casks are frequently encountered in urban and maritime archaeological excavations of sites dating from the Late Middle Ages and the Early Modern period. Although individual studies occasionally address these transport containers, comprehensive research on casks remains limited. Consequently, fundamental questions regarding casks remain unresolved, such as the nature and duration of a casks' lifespan.

This research seeks to ascertain the lifespan of casks in the Netherlands from the 12th to the 18th centuries. It enhances our understanding of cask utilization and aids in the dating of casks to contextualize their use. For instance, dendrochronological dating of casks can assist in determining the date of a shipwreck or in dating a cesspit or water well where the cask has been repurposed as a shaft.

For this sub-study, a dataset was compiled comprising casks that have been successfully dated through dendrochronological analysis. It includes casks from urban and maritime archaeological contexts. The dataset contains 1,048 dendrochronological samples from 345 casks discovered in urban archaeological contexts in the Netherlands. The maritime component of the dataset consists of 283 dendrochronological samples from 119 casks recovered in Dutch waters and four ships found outside Dutch waters. In total, the dataset comprises 1,331 dendrochronological samples from 464 casks. Specific dates determined through dendrochronological analysis are included in the dataset, such as the oldest and youngest documented tree rings. When sapwood is present, the estimated felling date is also recorded. The provenance of the timber is included if successfully identified through dendrochronological research.

For the casks from a maritime archaeological context, the dataset also includes the shipwreck dates, when available. For the urban archaeological context, dating is provided based on finds deposited in repurposed casks used as shafts for cesspits and water wells, resulting in the beginning and end dates of their repurposing. Additionally, associated products and markings that facilitate the dating of the casks, such as a date incorporated in the mark, are also recorded.

The lifespan of a cask was divided into three distinct phases, production, use as a transport container, and repurposing, to provide a comprehensive picture of the lifespans of casks. While the duration of the lifespan of individual casks may have varied, this research employs the median duration of the different phases, supplemented with information from archival sources, to create a general overview of casks in the Netherlands from the 12th to the 18th centuries.

Table 2.4: Overview of the lifespan of casks based on the median of the 464 casks in the dataset.

Phase	Phase number	Number of years	Number of weeks
Production phase, oldest tree ring till youngest tree ring	1a–1c	>150	>7800
Production phase, timber processing, drying, and shipment	1d–1e	3	156
Production phase, timber processing into casks	1f	0.1	7
Use as transport container	2a–2c	6	312
Repurposing	3a	75	3900
Total lifespan of casks		>234	>12175

Production phase

The analysis of the production phase yielded a comprehensive understanding of the duration of various phases involved, including timber production (Figure 2.1_1a–1c), its processing, drying, and shipment, (Figure 2.1_1d–1e), and the final processing into casks at cooperages (Figure 2.1_1f).

This analysis determined a median duration of at least 150 years for the production of timber used in individual casks, based on the comparison of the youngest and oldest tree rings from various dendrochronological samples of individual casks (Table 2.4). The sub-study also specifically investigated differences in the duration of the timber production process across different provenance areas (Figure 2.8), but no significant patterns were identified. The dataset analysis reveals no evidence suggesting that a cask made from, for instance, French oak contains a different number of tree rings compared to one made from Baltic oak.

The limited evidence for the phase of timber processing, drying, and shipment, between the felling of the tree and its arrival as usable lumber at the cooperages, indicated a duration of approximately three years. Once the coopers' timber arrived at the cooperages, it was dried for an additional six weeks before being processed into casks within a single week by a cooper.

Use as transport containers

The various methodologies employed to ascertain the duration of casks as transport containers consistently yield a coherent picture. For casks originating from urban archaeological contexts, where the youngest tree ring or the estimated felling date (when sapwood was present) was compared with the initial dating based on the casks' contents in the repurposed phase, the median discrepancy was found to be nine years. However, this period must be adjusted by subtracting three years to account for the requisite time for timber processing, drying, and shipment. Consequently, this results in a median usage duration of six years for casks utilized as transport containers (Table 2.4).

Casks from maritime contexts exhibited a median of 8 years between the dendrochronological dating of sapwood samples and the sinking of the ship, indicating a usage duration of five years (Figure 2.12). Notably, the usage period of these casks was prematurely curtailed, as the ship transporting them sank before the casks lost their utility as transport containers.

Alternative methods for evaluating the duration of cask use, such as the analysis of markings with dates and the discrepancies in dating of casks employed in the same cesspit or water well shaft, suggest that casks were typically in use as transport containers for less than a decade. Overall, it can be concluded that casks had a median usage duration of approximately six years during their phase as transport containers.

Repurposing

The repurposing phase exhibits a median duration of 75 years, as determined by the dating of associated artifacts found in cesspits and wells where the casks were utilized (Table 2.4). This phase also involved an examination of whether casks constructed from timber originating from specific regions were favored for repurposing (Figure 2.14). The findings indicate a slight preference for casks made from timber sourced from the Rhine and Meuse valleys, contrary to those made from timber from Poland, the Baltics, or the North German Plain, which were less frequently employed in casks repurposed as shafts in cesspits or wells. Wine casks were the preferred choice when considering the products transported in the casks prior to repurposing, whereas casks used for dry goods were not repurposed as shafts, likely due to their inferior quality and smaller size (Figure 2.15).

The lifespan of casks from the Netherlands during the 12th to 18th centuries is estimated to be at least 234 years, as determined by the median of the individual phases. This lifespan spans from the growth of the oldest tree ring utilized to the final dating based on the contents of cesspits and water wells during the repurposing phase. This research has also elucidated the various phases between these two points, offering a comprehensive account of the production, use as transport containers, and repurposing of casks in the Netherlands during the Late Medieval and Early Modern periods.

Moreover, the sub-study indicates that the examination of casks holds considerable untapped potential. The research presented herein could be further expanded by augmenting the dataset with additional casks, facilitating a more profound investigation into the diachronic developments within this research area. Additionally, this methodology could be applied to a dataset encompassing casks from other countries, such as Germany, Belgium, or other European nations. Furthermore, specific elements of casks, such as cask marks, may contain a wealth of supplementary information that warrants further exploration in future research.

Acknowledgements

The present research builds upon the dataset initially compiled for the article "Provenance and Production"[88], which has since been expanded. The study presented in this chapter benefited from the generous contributions of data from several dendrochronologists: Ing. Petra Doeve MA (BAAC), Ir. Sjoerd van Daalen (BAAC until 2012 and Van Daalen Dendrochronologie from 2013 onwards), the late Em. Prof. Dr. Esther Jansma (formerly Cultural Heritage Agency), and Dr. Marjolein van der Linden (Biax Consult). Throughout the research and the compilation of this article, valuable advice was provided by Dr. Roos van Oosten (Leiden University). Acknowledgment is also extended to Kerry Fast for editing the text. This sub-study constitutes a component of the PhD research conducted by Jeroen Oosterbaan, which is funded by the Dutch Research Council (NWO, Promotiebeurs voor Leraren 2019-I).

88 Oosterbaan et al., 2022.

3. Provenance and production

3. Provenance and production

This chapter discusses the production phase of the coopers' timber within the cask lifecycle (Figure 3.1) and is based on: Oosterbaan, J., Doeve, P., & van Daalen, S. (2022). Provenance and Production: Casks in the Dutch Archaeological Context. International Journal of Wood Culture, 3(1-3), 412-441. https://doi.org/10.1163/27723194-bja10007.

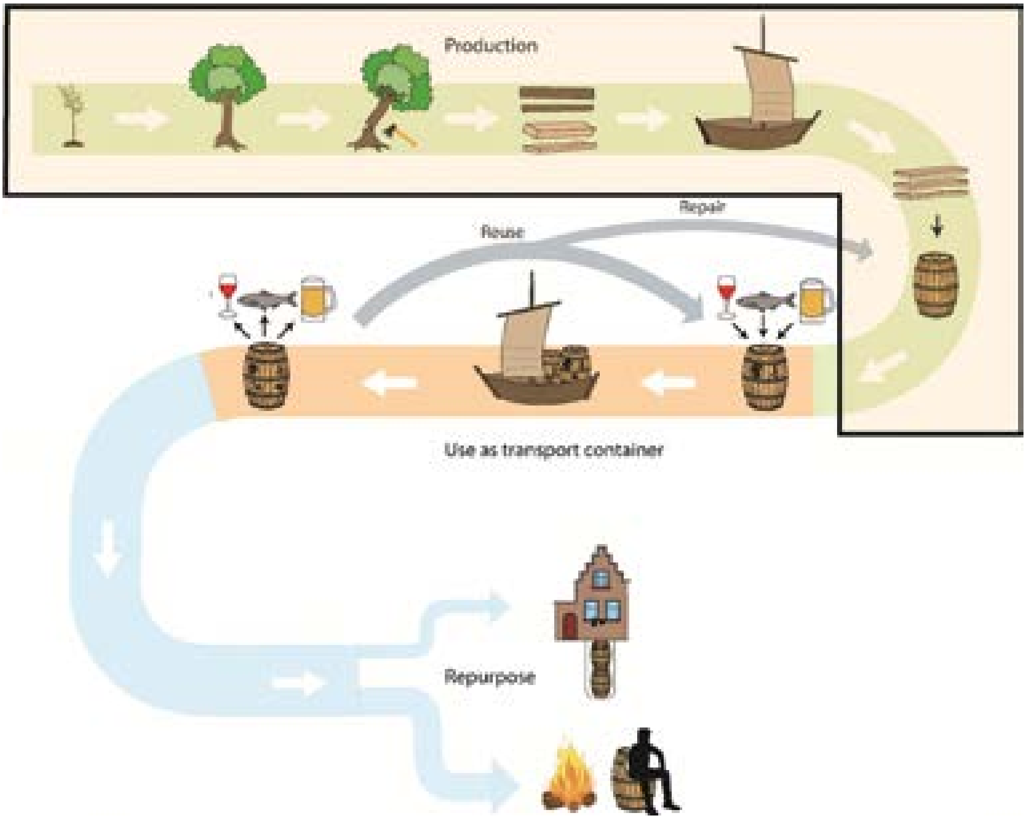

Figure 3.1: Schematic overview of the lifecycle of a cask. Production phase – green; its use as a transport container – orange; repurposing – blue. The frame highlights the part of the casks' lifecycle that is discussed in this chapter.

3.1 Introduction

3.1.1 Casks in archaeological contexts

Casks have often been found in archaeological research in the past several decades. The majority of these casks have been found in urban archaeological context and have been repurposed as shafts for wells or cesspits. Archaeologists study the contents of these casks, often filled with feces and household waste, because much information about the users can be retrieved from them. However, little attention has been paid to the casks themselves. Nevertheless, a study of the wood used in their construction can provide insight into their primary purpose as transport containers for merchandise. The first step to achieve this primary purpose is the production of the casks. This chapter is focused on this first stage in the lifecycle of casks (Figure 3.1).

A striking example is an 18th-century cask repurposed as a well shaft found in the Dutch port city of Vlissingen (Figure 3.2). The VOC (Verenigde Oost-Indische Compagnie, Dutch East India Company) mark on the cask shows that it was related to the Dutch East India Company. In the well, a rare Asian stoneware jar was found. This type of pottery was used as a shipping container and was probably picked up by a sailor or trader as a curiosity. In addition, a wooden toy boat approximately 15 cm long was found in the well. Finds such as these suggest that the youth in Vlissingen were familiar with maritime life. The VOC sign on the cask underlines the maritime connection of the user of the cask. However, because of the lack of research about the cask itself, it remains unclear where this cask was constructed.

In maritime archaeological context, casks serve their fundamental function as containers for transporting goods. The research on these casks provides the opportunity to look into both the casks and the goods that were transported in them. Shipwrecks in Dutch waters have been mapped and partially investigated by the Cultural Heritage Agency.[89] In totality, this inventory includes 218 shipwrecks that date back to the Modern period alone.

Figure 3.2: A barrel well in Vlissingen, Netherlands, and its contents. Left: The well. Top right: VOC etched on staves. Bottom right: An Asian stoneware jar and a wooden toy boat (Oosterbaan & Griffioen, 2015, 434).

89 Database Maritime Stepping Stones (MaSS), 2020.

3.1.2 Lifecycle of casks

Before casks are found by archaeologists, they have already undergone a lengthy lifecycle (Figure 3.1). First, trees are felled and partially dried, after which the raw timber is shipped or cut into planks or boards. The raw timber is suitable to be transported with timber rafts, which is mainly done via rivers. The transport of the planks and boards can also be done on seagoing ships. In the archival sources, boards designated for cask production are registered as *clapboard*, which are small boards of split oak used to make cask staves.

The *clapboard* is then shipped to cooperages, where it is used to make casks. The casks are then filled, most often with fish, wine, or beer, to be transported to their end destination. Other merchandise such as meat, gunpowder and spices were also packed into the casks. Casks were often used as packing material multiple times. Before they were put back into use, the casks often had to be repaired or refitted in the cooperages. When the casks were no longer needed for trade, some were repurposed as shafts of cesspits and wells.

Traces of the different phases are evident in the form of marks left on casks. Coopers marked their casks when they were assembled to quantify their production. When used to transport goods, they were marked to indicate their content, ownership, quality and quantity.

3.1.3 Production of casks

The research of casks in both maritime and urban archaeology can provide insight into the phases of their usage as a container and their repurposing. The production of casks is, however, harder to unravel using archaeological data. The cooperages are hardly ever noted in archaeological research. An overview study of archaeological indicators of artisanal production in Dutch cities from the Late Medieval and Early Modern periods locates only one cooperage in the Netherlands.[90] However, dendrochronological and archaeological data of casks found in urban and maritime archaeology can be used to provide insights into the production phase of casks.

3.1.4 Research questions and design

This chapter is focused on the production of casks excavated in Dutch archaeology. To gain insight into this specific phase of the lifecycle of casks, both dendrochronological and archaeological data were used. Archival sources were used to contextualize and substantiate the interpretation of the archaeological and dendrochronological data but they are not part of the dataset itself. The main objective of this sub-study was to assess whether it

90 *Blonk-van den Bercken et al., 2020, 20.*

is possible to distinguish casks produced in the Netherlands from imported casks. To address the main objective, two sub-questions were considered:

- Which provenance areas can be detected in the timber used to produce the casks identified in the Dutch archaeological context?
- What diachronic patterns can be detected in the provenance areas of the coopers' timber?

3.2 Dataset

Source material

To better understand the production of casks, both archaeological and dendrochronological data were used. The first step in this sub-study consisted of identifying the parts of the casks, such as staves and headboards, found in Dutch archaeological studies that could be dated from the 12th to 18th centuries. Only headboards and staves that had been dendrochronologically analyzed were incorporated into the dataset.

This resulted in a dataset of 946 dated tree-ring series. A tree-ring series represents an individual stave or a headboard. For each tree-ring series, the following items were provided (if available): the timber species; total number of rings; the number of sapwood rings and the dates of the oldest and youngest ring, corresponding to the Student's t-values[91]; the percentage of Parallel Variation or Gleichlaufigkeit (%PV); the overlap between the reference data and the tree series (OL); the deduction of the felling year (*terminus post quem* if only heartwood was present or an estimated felling year based on sapwood calculations) and an established provenance of the timber.

The estimated felling years in the reports were used. If these were unavailable, the calculation of the sapwood statistics of Hollstein (1980) or Wazny (1990) was used. The dataset of the final list of 946 dated tree-ring series consists of dendrochronological data contributed by four dendrochronologists: Ing. Petra Doeve MA (BAAC), Ir. Sjoerd van Daalen (Van Daalen Dendrochronologie), the late Em. prof. dr. Esther Jansma (formerly Cultural Heritage Agency) and Dr. Marjolein van der Linden (Biax Consult).

These data were supplemented with data from archaeological project reports. The archaeological data on the casks' parts consisted of length, width, thickness, holes, marks, date of the contents and find location.

91 Hollstein, 1980.

From tree-ring series to casks

To identify individual casks, the staves and headboards were then matched to one another. Of the 946 records 357 casks could be identified. The archaeological data was predominantly used in this matter because it determined which headboards and staves were found together.

Dating accuracy

The individual casks were then dated using the dendrochronological dates of the tree-ring series. Either the estimated felling interval (if sapwood was present) or the earliest estimated felling date (if sapwood was absent) was used for this. Of the 357 individual casks, only 57 casks (16%) contained at least one tree-ring series with sapwood. For comparative reasons, the estimated felling date and earliest possible felling date were merged and grouped into time periods. The presence or absence of sapwood likely had only a limited impact on the dating results, since Van Daalen's study shows that in many cases the tree-ring series of the staves extend up to the sapwood.[92] However, this needs to be acknowledged when interpreting the data.

Provenance

To determine the provenance of individual casks, the data from the records of the individual staves and headboards were used. When analyzing the dataset, only the provenance areas to which more than five casks could be linked were included. Therefore, the casks made with timber from western Austria, southern England and southern Scandinavia were disregarded because less than five casks contained tree-ring series, indicating a provenance from these areas. The number of casks connected to these provenance regions was too low to execute a reliable analysis.

Timber species

The individual casks were mostly made of headboards and staves of a single timber species. The coopers mostly used oak for the production of casks, in the dataset, 97.8% of the tree-ring series consisted of oak (Table 3.1). In only 16 out of 357 casks, species other than oak were identified. Thus, this sub-study focused only on oak.

Table 3.1: The timber species of the coopers' timber..

Timber species	Number of tree-ring series	Percentage
Oak (*Quercus spp.*)	925	97.8%
Silver fir (*Abies alba Mill.*)	9	1.0%

92 Van Daalen, 2021.

Timber species	Number of tree-ring series	Percentage
Spruce (*Picea abies Karst.*)	7	0.7%
Scots pine (*Pinus sylvestris L.*)	5	0.5%
Total	946	100%

Sample size

The dataset consisted of 357 casks from Dutch archaeological context dating from the 12th to the 18th century. Even though general patterns can be extracted from this dataset, the dataset represents a relatively small number of the total number of casks that were circulating during this period.

In addition, it is important to realize that a large part of the dataset consists of casks that were repurposed for use as well as cesspit shafts. The data showed that only casks with a diameter of more than 45 cm were repurposed this way. This means that not all casks circulating between the 12th and 18th centuries were included in this dataset because smaller casks were not suitable for this type of repurposing.

3.3 Results

The results of the sub-study are presented in the following three sections. The first and second sections address the two sub-questions, focusing on the diversity of the provenance and the diachronic patterns of the wood. The main objective is to assess whether it is possible to distinguish locally produced casks from imported casks used in trade. This research question will be addressed in the final section.
Archival sources were used to contextualize and substantiate the interpretation of the archaeological and dendrochronological data with regard to the research questions. The relevant archival sources will be addressed in each section separately.

3.3.1 Provenance of coopers' timber in Dutch archaeological contexts

Of the 357 individual casks, the provenance of 288 could be established using dendrochronological data. To this end, seven frequently recurring provenance areas were assigned (Figure 3.3). The extent of the provenance areas was determined by combining the provenance analysis of the timber with the catchment areas of the rivers the timber was transported along, either as (semi) raw material or completed casks.

The outlines in Figure 3.3 are estimated boundaries. Adjacent areas may share tree ring characteristics that make a distinction between them arduous and even the boundaries are not well-defined. Especially the Meuse and Rhine valleys, and to a lesser extent adjacent Germany, can be hard or impossible to distinguish. Additionally, the use of wood from the Netherlands cannot be ruled out but is strenuous to detect due to the relative proximity of major timber-supplying areas, such as the North German Plain, Rhineland and Mease valley.

Figure 3.3: The provenance areas of cask timber (n = 288) projected onto a map of present-day Europe with the main rivers used for timber transportation. Only frequently detected provenance areas are mapped.

The seven frequently recurring provenance areas of coopers' timber are Rhineland, Meuse valley, north German plain, Baltic region, Poland, France Burgundy/Loire valley and France. These provenance regions are also known for Late Medieval and Early Modern periods timber imports to the Netherlands for buildings, infrastructure, ships, furniture and art objects.[93]

However, the areas of origin of timber imports for other purposes also include regions that do not occur within the coopers' timber. The most notable absent area is southern Scandinavia. Oak from southern Scandinavia was imported to construct ships, buildings and their foundations[94], however, was rarely used in cooperages. The Scandinavian timber is found in cities along the coast or in cities with good access to waterways, so it could have been available for coopers in

93 *Jansma, 1995; Jansma et al,, 2004; Domínguez-Delmás & Berselaar, 2009; Domínguez-Delmás et al., 2011; Borghaerts, 2021.*

94 *Domínguez-Delmás & Berselaar, 2009, 16-17; Borghaerts, 2021, 43.*

these cities as well. The coopers apparently had a clear preference for wood from specific provenance areas. As such, timber from southern Scandinavia either did not meet their preferences or was unavailable to them.

The seven frequently recurring provenance areas can be divided into two main categories, those that were connected to the Netherlands by either river trade or by sea trade. Timber with a provenance in the Meuse valley and Rhineland (Figure 3.3 areas 1–2) was often used for the production of casks (Table 3.3). These areas were connected to the Netherlands by river trade and could have supplied the coopers' timber or complete casks with merchandise. Timber from these areas was also used for other purposes, such as both buildings and, to a lesser extent though, also for furniture or art objects from the Late Medieval period onwards.[95]

Since the Late Medieval period the Netherlands also relied on timber imports by sea trade, from areas such as the north German plain, Poland and the Baltic region (Figure 3.3 areas 3–5). However, timber for construction was mostly imported from the north German plain[96], but apparently, casks made of this timber are rare, the dataset showed only 15 casks of timber that could be connected to this area.

The Baltic region is the most common provenance among the sea trade import (58 casks, Figure 3.4). Studies showed that in the Netherlands timber from the Baltic region was used for shipbuilding, panels, sculptures, altarpieces and other wooden works of art.[97] The timber from these areas had specific characteristics, which made it popular among artists and shipbuilders. Its slow growth led to a homogeneous, fine grain, which ensured that the timber remained stable.[98] Baltic timber was also used in other European countries because of these specific characteristics. In England, timber from this region was popular for panel paintings.[99]

The provenance areas of oak for casks and oak used for other purposes do not overlap completely. The provenance areas within the current boundaries of France (Figure 3.3 areas 6–7) do not appear in the dendrochronological studies of oak used for other purposes, based on the experience of dendrochronologists in the Netherlands. This suggests that there was no large-scale trade of French oak in the Netherlands.

While the provenance of the oak used for casks can be determined from Dutch archaeological sources, this does not directly provide insight into where the oak was processed into casks. The timber could have been made into casks in the provenance area or elsewhere before it got shipped to the Netherlands in the

95 Domínguez-Delmás & Berselaar, 2009, 15.

96 Adam, 2015, 147.

97 Jansma et al., 2004; Domínguez-Delmás & Berselaar, 2009; Fraiture, 2009.

98 Domínguez-Delmás & Berselaar, 2009, 16.

99 Hillam & Tyers, 1995; Daly & Tyers, 2022.

form of a cask. The timber could also have been transported to the Netherlands as a semi-finished product, that is, *clapboard*, to continue the production of casks in the Netherlands. Thus, archival sources were used to gain insight into the import of timber to be used by coopers specifically.

Provenance areas of the timber used by coopers in archival sources

The large-scale transport of coopers' timber to the Netherlands appears in archival sources in the Late Medieval period. The trade of coopers' timber was recorded in the registers of the toll stations along main rivers in the Netherlands and can therefore account for the timber import from the provenance areas of Rhineland and the Meuse valley (Figure 3.3 areas 1–2). The records of the Lobith toll station along the Rhine, mention the passage of *claphout* (clapboard) on several ships on the Rhine in 1438.[100] However, the number of ships on which *claphout* was registered as cargo is limited in the toll records of stations along the main rivers in the Netherlands. This is probably because of the way the cargo was described in the toll records. Timber was mostly documented as the more generic *Holt* (wood). The size of the timber or why it was being imported cannot be deduced from this term.

Table 3.2: The transport of klapholt as merchandise recorded in the Sound toll register (data derived from Database STR-online, 2017). Klapholt was designated as the Danish translation of clapboard..

Region	Percentage and number of ships passing through the Sound 1497–1634 (region as home port of the captain)	Percentage and number of ships passing through the Sound 1634–1857 (region as destination)
Dutch Republic	80.4% (919)	48.7% (6288)
Great Britain	3.6% (41)	30.3% (3918)
Atlantic coast of France, Spain and Portugal	0.5% (6)	15.8% (2048)
North Sea (German/Danish coast)	5.0% (57)	3.0% (383)
Denmark, Sweden, Norway, Iceland, Greenland	0.5% (6)	1.2% (158)
Baltic region	9.9% (113)	0.8% (101)
Other	0.1% (1)	0.2% (27)
Total	100% (1143)	100% (12923)

100 Weststrate, 2007, 146-148.

In approximately the same period, a document dated 1454, listing tariffs levied on Hanseatic merchants at toll stations in Holland, mentions *clapboard* specifically, which makes it plausible that this product was shipped along river systems to ports in the province of Holland.[101]

The provenance areas that depended on sea trade to import coopers' timber to the Netherlands are also present in archival sources. Timber transported from the Baltic region and Poland (Figure 3.3 areas 4–5) was registered in the Sound toll register. This register recorded the transport of merchandise from the Baltic Sea region to the North Sea from 1497 onwards. The transport of timber used by coopers in the Dutch Republic was also recorded (Table 3.2).

This table shows the percentage and number of ships transporting *clapboard* through the Sound. On these ships, *clapboard* was shipped to different destinations, with the specific purpose of selling it to coopers. In the periods 1497–1634 and 1634–1857, the Dutch Republic was the main destination for coopers' timber.

Archival sources also document the next phase in the transport and trade of coopers' timber, specifically recording the provenance areas. When it arrived in the Netherlands, the timber was sold to coopers. Much of the timber was specifically ordered, but some of it was sold at timber auctions, according to the archival records of the Zaandam timber auctions in the period 1655–1811.[102] The registers specify Rhineland, the port of Hamburg and several ports along the Baltic Sea as the provenance of the coopers' timber (Figure 3.3 areas 1, 3–5).

In the archival sources mentioned above, several provenance areas are documented that have also been identified through dendrochronological research. However, France is the only exception; French timber is not found in dendrochronological studies of oak used for other purposes than casks. This indicates the absence of large-scale transport of oak from France to the Netherlands in the Late Medieval and Early Modern periods. Therefore, casks made of French timber were probably produced in France and contained French products destined for the Netherlands.

3.3.2 Diachronic patterns of the provenance of coopers' timber

Of the 357 casks in the Dutch archaeological records that have been dendrochronologically researched, the provenance area of 288 could be established. The felling interval or earliest possible felling dates have been determined and are organized in 20-year periods in Figure 3.4. Several patterns are evident in the diachronic data of the provenance of the timber used for casks. These patterns show the development of trade networks of which the Netherlands was a part.

101 Weststrate, 2007, 305-324.

102 Schillemans, 1947.

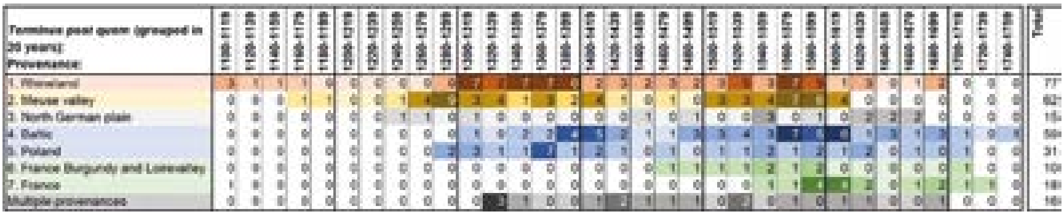

Figure 3.4: The provenance areas of casks in the Dutch archaeological record in 20-year periods.

River trade

Large-scale trade via the major rivers commenced in the High Middle Ages, which was evident in the presence of casks made of timber from the Meuse valley and Rhineland, beginning in the 12th century (Figure 3.4). In the 12th and 13th centuries, these two areas accounted for 81.5% of the provenance areas of casks (Table 3.3).

The river-trade import of timber for other purposes than cask construction to the Netherlands from the Early Medieval period onwards has been demonstrated in several studies based on dendrochronological data.[103] Additionally, in archaeological studies focused on the spatial distribution of artifacts in the Early Medieval period, river trade was demonstrated meticulously. To elaborate, Kemme[104] concluded that the Rhine was the main artery for the timber trade in the Early Medieval period, although, in the 10th and 11th centuries, timber was also transported through the Meuse.

Table 3.3: Overview of provenance areas grouped by river trade and sea trade in 200-year periods.

Date (start)	Date (end)	Oldest tree ring	Youngest tree ring tree ring	Youngest tree ring (sapwood)	Context date (start)
River trade	Meuse valley, Rhine land	81.5% (22)	58.6% (58)	42.2% (57)	137
Sea trade	Baltic region, Poland, north German plain	14.8% (4)	39.4% (39)	41.5% (56)	99
Sea trade	France, France Burgundy_Loire valley	3.7% (1)	2.0% (2)	16.3% (22)	25
	Total	100% (27)	100% (99)	100% (135)	261

103 Jansma et al., 2016, 2017; Van Lanen et al., 2016.

104 Kemme, 2021, 296.

Sea trade

The casks in the Dutch archaeological record provide evidence of the growing importance of the Hanseatic League in the late 13th century. This alliance of trading cities via the Baltic Sea can be connected to the provenance areas of Poland, the Baltic region and the north German plain.[105] Casks made from timber from these areas account for 39.4% (1300–1499) and 41.5% (1500–1699) of the provenance areas in casks found the Dutch archaeological studies (Table 3.3).

The beginning of the import of timber from Poland, the Baltic region and the north German plain is also evident in the provenance analyses of oak used for other purposes. Timber from the Baltic region and Poland was imported to the Netherlands from the 14th century but was of particular importance at the end of the 16th and 17th centuries. This diachronic pattern is also present in the provenance analyses of timber used by coopers.

Casks made of French timber appear in the Dutch archaeological record as early as the late 15th century (Figure 3.4). Their relative share in relation to the total number of casks increases to 16.3% in the period 1500–1699 (Table 3.3). As French timber is uncommon in the Dutch dendrochronological record (Section 4.3.1), it can be identified as entering the Netherlands as complete casks that were used to import French products. This import was predominantly concentrated in the late 16th and early 17th centuries.

Diachronic patterns of the transportation of coopers' timber in archival sources

The timber trade via river is registered in the records of toll stations along the main rivers of the Netherlands, and they show growth in timber transport. The number of rafts of timber registered by the Nijmegen toll station on the Waal in 1550 doubled that of the rafts registered by the Lobith toll station on the Rhine in 1400.[106]

The sea trade in coopers' timber also shows diachronic patterns. The transport of coopers' timber from the provenance areas of Poland and the Baltic region was registered in the Sound toll register (Table 3.2). At the end of the 15th century, the majority of ships carrying *clapboard* were destined for the Dutch Republic. Although the relative share of coopers' timber exported to the Dutch Republic decreased after the second quarter of the 17th century, the absolute number grew exponentially. In the period 1497–1634, a total of 919 ships with *clapboard* cargo and with a Dutch captain passed through the Sound. In the subsequent period 1634–1857, ships carrying *clapboard* with the Dutch Republic as their destination accumulated 6288 record mentions.

105 Gaimster 2001.

106 Weststrate, 2017, 292.

Archival sources also provide insight into the import of timber from the north German plain to the Netherlands. Adam (2015) showed that the earliest mention of the timber trade via the Elbe dates back to 1325. Furthermore, the export of timber from the north German plain gained momentum in the late 17th century and continued until the 18th century. The growing share of the timber import from this provenance area is also reflected in the share of this timber in the timber auctions in Zaandam. The percentage of timber traded through the city of Hamburg, the trading hub for timber from the north German plain, compared to the timber from Rhineland grew considerably. The revenues of the timber from the north German plain grew from 4.7% in 1675–1679 to 51.5% in 1680–1684.[107]

3.3.3 Imported casks or imported coopers' timber

The diversity in the provenance areas of the timber used for casks does not determine where the timber was processed into casks. The timber could have been used to produce casks in the provenance area or it could have been transported to another location where the casks were produced. The casks showing multiple provenances (Figure 3.4 bottom row) shows us something about the transport of the coopers' timber. In these cases, imported timber from several provenance areas was either mixed during transport or at the cooperages before it was used to produce casks.

Of only 16 of the 357 casks, different provenances in one cask were detected. This accounts for only 4.5% of the casks, but several factors need to be considered. First, the dendrochronological research was conducted on more than one stave of a cask in only 182 of the 357 casks. Hence, in 175 cases, only one tree-ring series was analyzed, which makes it impossible to determine whether the timber in those casks came from multiple provenance areas. The relatively small number of staves that have been dendrochronologically analyzed, is caused by archaeologists are usually interested in dating the cesspits and water wells for which the casks has been repurposed. To achieve this, often only one stave was selected to be dated dendrochronologically.

Second, provenance was identified in only 288 of the 357 casks. In the timber used for the other 69 casks, no provenance could be detected, which also makes it impossible to determine whether the timber in those casks came from multiple provenance areas.

The third factor to take into account are the repairs made to casks, which could account for the multiple provenance areas detected in a cask (Figure 3.5 left). In some cases, a broken stave could have been replaced by a new one, though this is less likely when multiple provenance areas are detected in multiple staves of one cask (Figure 3.5 right).

When the first two factors are taken into account, the average occurrence of multiple provenance areas in a cask resulted to be 12.7% (Table 3.4). This table shows the cases in which multiple provenance areas were detected in at least

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107 Schillemans, 1947, 260-279.

one stave. When seven or more parts (headboards and staves) of a single cask were dendrochronologically analyzed, the percentage of casks with multiple provenances was over 18%.

As stated, it is important to note that many of the casks could have been repaired or refitted. The same calculation was executed to analyze multiple provenance areas in multiple parts (headboards and staves); the average occurrence was 9.7% (Table 3.5). The percentage of casks also increased considerably when seven or more parts (headboards of staves) were dendrochronologically analyzed.

The average occurrences in both cases suggest that at least 9.7% of the casks were made with imported timber. This is considerably higher than the 4.5% (16 out of 357 casks) accounted for. The mixing of different timber shipments by coopers is not only reflected in a diversity of provenance areas but also in the non-matching felling intervals of the timber within one cask suggesting that several timber shipments were stockpiled before assembly. In Van Daalen's (2021) study, a control group of 117 staves of 13 casks was dendrochronologically analyzed, of which 20% consisted of casks with non-matching felling intervals.

The casks with multiple provenance areas show that some of the timber was transported before assembly. The actual portion of the casks made with imported timber is probably much higher than the casks with multiple provenance areas account for as locally produced casks were also made from imported timber with matching provenance areas.

It is uncertain where the casks with timber from multiple provenance areas were made, but it is clear that these casks date back to the 14th century (Figure 3.5). This coincides with the growing demand for timber import to the Netherlands, which is also reflected in the establishment of cooperages in the Netherlands (Figure 3.6), as corroborated by archival sources.

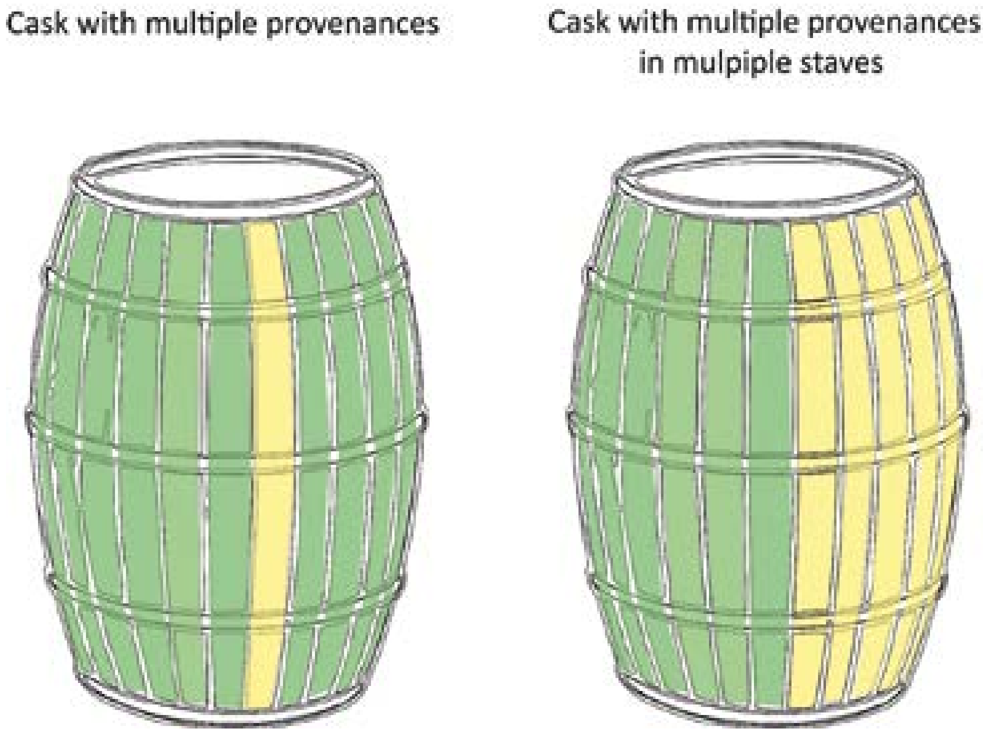

Figure 3.5: Casks made of timber from multiple provenance areas. (Left) A cask with timber from several provenance areas, where at least one stave is from a different provenance area than the rest. (Right) A cask with multiple staves from different provenance areas. The yellow and green colors indicate timber from different provenance areas.

Table 3.4: Occurrence of multiple provenance areas in a cask, with at least one stave per area (Figure 4 4, left)..

Number of cask parts dendrochronologically analyzed	**Number of casks whose provenance could be established**	**Number of casks with multiple provenances with at least one stave per area**	**Percentage**
1 or more	288	16	5.6%
2 or more	157	16	10.2%
3 or more	92	9	11.1%
4 or more	65	7	10.8%
5 of more	57	7	12.3%
6 or more	45	7	15.6%
7 or more	33	6	18.2%
8 or more	25	4	16.0%
9 or more	21	3	14.3%
10 or more	18	2	11.1%
11 or more	14	2	14.3%
12 or more	8	1	12.5%
		Average	**12.7%**

Table 3.5: Occurrence of multiple provenance areas in a cask, in multiple staves per cask (Figure 4 4, right).

Number of cask parts dendrochronologically analyzed	**Number of casks whose provenance could be established**	**Number of casks with multiple provenances in more than one stave**	**Percentage**
1 or more	288	4	1.4%
2 or more	157	4	2.5%
3 or more	92	4	4.3%
4 or more	65	4	6.2%
5 of more	57	4	7.0%
6 or more	45	4	8.9%
7 or more	33	4	12.1%
8 or more	25	4	16.0%
9 or more	21	3	14.3%
10 or more	18	3	16.7%
11 or more	14	2	14.3%
12 or more	8	1	12.5%
		Average	**9.7%**

Production of casks in the Netherlands in archival sources

The production of casks in the Netherlands and the demand for imported oak are evident. The provinces of Zeeland and Holland began to develop prosperous commodity markets in the Late Medieval period.[108] Other provinces within the current boundaries of the Netherlands also began to develop commodity markets but were unable to correspond to the pace of the growth of the commodity market of 16th and 17th-century Amsterdam, in particular.

The merchandise of these markets, such as herring and beer, got shipped in casks that were locally made. The production of casks in these provinces is represented in the establishment of coopers' guilds, beginning in the late 14th century (Figure 3.6). These coopers' guilds were mostly concentrated in the coastal provinces of the Netherlands, with the highest density in the province of Holland, where 18 of the 38 coopers' guilds were established.

It is safe to assume that at least some of the transported coopers' timber was shipped to the Netherlands because the production of casks in the Netherlands depended on timber import. After the Late Middle Ages, the local supply of timber was too scarce to meet the Dutch demand.[109] The import of specific timber used by coopers would not have been an exception to this and was probably

108 Dijkman, 2011, 171.

109 Domínguez-Delmás & Berselaar, 2009, 14.

imported along the same trade networks as other shipped timber. The casks with multiple provenance areas found in Dutch archaeological records date back to the 14th century. This coincides with the establishment of coopers' guilds in the Netherlands, which makes it plausible that these casks were produced in the Netherlands.

A second argument for casks with multiple provenance areas being produced in the Netherlands is based on the specific detected provenance areas. Of the 15 casks with multiple provenance areas, nine were made of at least one stave of Baltic or Polish timber. The trade of timber in these areas is noted in the Sound toll register (Table 3.2), which shows that the Dutch Republic was the main consumer of timber from these areas.

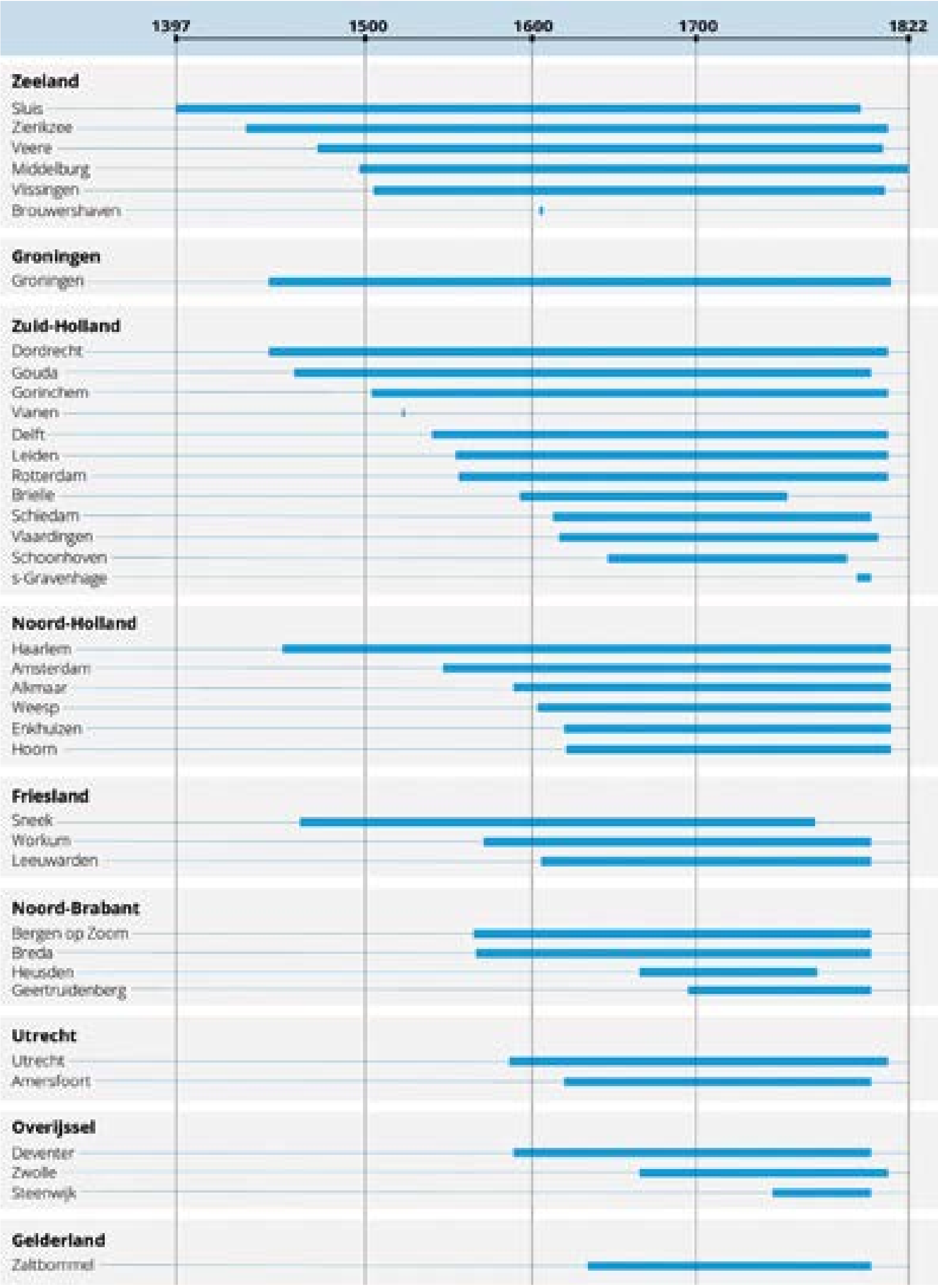

Figure 3.6: Date ranges from the earliest mention to the abolishment of coopers' guilds in the Netherlands by present-day provinces of the Netherlands (Data derived from Database Dutch Craft Guilds, 2012).

3

3.4. Conclusion

This sub-study is focused on the casks in the Dutch archaeological record from the 12th to 18th centuries. These casks had a lengthy lifecycle before any archaeologist documented them (Figure 2.1). This chapter is focused on the production of the casks and the specifics of the timber that was used for this purpose.
The main objective was to assess whether it was possible to distinguish Netherlands's casks from imported casks. To this end, two preliminary topics were addressed: first, the provenance areas of the casks detected dendrochronologically in Dutch archaeological records from the 12th to 18th centuries; second, the diachronic pattern of the Coopers' timber. The dataset used for these purposes consisted of 946 records with samples of dated tree-ring series, among which 357 individual casks could be identified.

3.4.1 Provenance of the casks' timber

In the dataset, casks were found that were made from the timber of nine different provenance areas. For some of these provenance areas, namely western Austria, southern England and southern Scandinavia, only a few casks could be identified. The analyses focused only on the provenance areas to which five or more casks could be linked (Figure 3.3). Based on these findings, the casks were divided into two groups: casks used in river trade and casks used in sea trade. The casks that were used in river trade were composed of timber from the Meuse valley and Rhineland. The timber in casks used in sea trade originated from the north German plain, the Baltic region and Poland. Notably, casks constructed with wood from present-day France were also transported to the Netherlands by sea.

The transport of coopers' timber in the Netherlands in the Late Medieval and Early Modern periods also finds mention in archival sources. The shipment of *clapboard*, which was used by coopers to produce staves, was found registered in the records of toll stations along the main rivers in the Netherlands in the Late Medieval period. The sea trade of coopers' timber was documented in, for instance, the Sound toll register, where the shipments of *clapboard* from Poland and the Baltic region were also recorded. The different archival sources account for all the provenance areas detected in the casks dendrochronologically. The only provenance area within present-day France is absent in the archival sources, which might indicate the absence of a large-scale trade in coopers' timber from France to the Netherlands.

3.4.2 Diachronic patterns of the provenance of the casks' timber

The diachronic patterns of specific provenance areas of the casks show the development of trade networks, of which the Netherlands was a part. Trade via the Meuse and Rhine is evident from the 12th century onwards, since casks made of timber from the corresponding provenance areas were found in Dutch archaeological records of this period (Figure 3.4). The trade on the Baltic Sea by the Hanseatic League is evident in the provenance of the timber of casks since the 14th century. This is complemented by the trade in casks made with French timber after the 15th century (Figure 3.4 and Table 3.3).

3.4.3 Imported casks or imported casks' timber?

The main objective of this sub-study was to assess whether it is possible to distinguish locally produced casks from imported casks used in trade. For this, dendrochronological data were studied in combination with archival material. In some cases, this led to a plausible result. Casks made of French timber containing French merchandise would have been transported to the Netherlands after the assembly. This conclusion is based on the absence of imported French timber in dendrochronological analyses conducted on timber used for purposes other than casks and the absence of French imported coopers' timber in archival material.

The dataset of dendrochronologically analyzed casks also showed that the timber used by coopers was shipped prior to production. Some analyzed casks showed multiple provenances in the same cask, which makes it plausible to assume that the original timber came from several locations (Figure 3.4 and Table 3.3). Archival sources were used to assess the location of the production of these casks. The casks made with timber from multiple locations date back to the 14th century. This coincides with the establishment of coopers' guilds in the Netherlands (Figure 3.6). In addition, 60% of these casks contained timber from either Poland or the Baltic region. This timber was transported through the Sound, after which it was registered in the Sound toll register (Table 3.2). The register shows that the timber that passed through the Sound was mainly destined for the Netherlands.

This sub-study shows that the dendrochronological analysis of casks provides insight into the production of casks. This insight is supplemented by an analysis of data in combination with archaeological data and archival sources. The dataset of dendrochronologically analyzed casks is, however, limited. Hopefully, this sub-study will encourage archaeologists to pay more attention to the dendrochronological analysis of casks. In particular, the analysis of multiple staves from one cask should be encouraged because of the additional information this can provide about their provenance, production and lifecycle.

Acknowledgements

This research could only be carried out with the help of several dendrochronologists. The following dendrochronologists generously shared their data: Ing. Petra Doeve MA (BAAC) provided 124 dated tree-ring series from 21 projects; Ir. Sjoerd van Daalen (BAAC, till 2012) provided 162 dated tree-ring series from 25 projects; Ir. Sjoerd van Daalen (Van Daalen Dendrochronologie, from 2013 onwards) provided 478 dated tree-ring series from 86 projects; the late Em. prof. dr. Esther Jansma (formerly Cultural Heritage Agency) provided 163 dated tree-ring series from 44 projects; Dr. Marjolein van der Linden (Biax Consult) provided 19 dated tree-ring series from 4 projects. In addition, Dr. Roos van Oosten (Leiden University) provided advice on the direction of the study and the usable sources while also commenting on different versions of this sub-study. The archival sources were interpreted with help from the workgroup *Paleografie in Zeeland* (PaiZ), Dr. Ferry Zwaan and Leendert van Prooije. Our kind gratitude is also extended to Kerry Fast, who edited the text, and Jenny Poelen of Blinq communicatie, who designed Figures 2 and 6. The sub-study is part of the Ph.D. research of Jeroen Oosterbaan. This research is funded by the Dutch Research Council (NWO, Promotiebeurs voor leraren 2019-I). Part of the dendrochronological research has been made possible by a grant from the province of Zeeland in the context of the Provincial research agenda Archaeology Zeeland (12576).

4. Production of casks in the Netherlands

4. Production of casks in the Netherlands

4.1 Introduction

This chapter investigates the multifaceted history of cask production in the Netherlands in the Late Middle Ages and Early Modern period (Figure 4.1). It examines the development of this artisanal craft in relation to broad urban, economic, and technological transformations. Through an analysis of guild structures, production processes, and pricing mechanisms, the diachronic development of cask production and its shifting role within urban economies is explored.

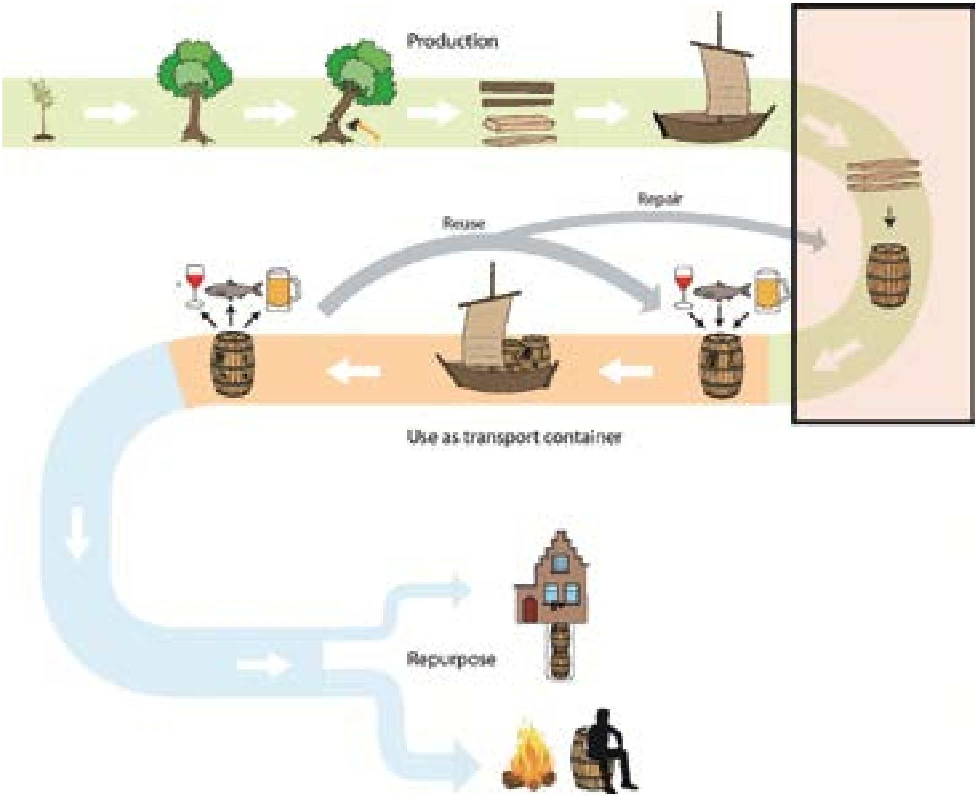

Figure 4.1: Schematic overview of the lifecycle of a cask. Production phase – green; its use as a transport container – orange; repurposing – blue. The frame highlights the part of the casks' lifecycle that is discussed in this chapter.

An examination of the rise of craft guilds shows how they served not only as regulatory bodies for standardization and membership but also signaled an increasing urban economic maturity. This development paralleled a significant shift in economic dominance, from Flanders to Brabant in the High Middle Ages, and by the Early Modern period, to Zeeland and finally Holland.

As economic activity gradually shifted northward, the coopers' trade also expanded as it adapted to the needs and structures of emerging urban centres. The formation of coopers' guilds in these regions not only met the practical demand for standardized and high-quality casks but also indicated where there was significant need for casks, used as they were to store important local products such as herring and beer. This chapter also focusses on the internal structure of coopers' guilds, with their roles of apprentice, journeyman, and master, which is significant for an understanding of cask production.

This chapter also investigates the processes of cask production. Detailed descriptions of traditional cooperage methods exist from the second half of the 20th century, while informative, though less detailed, accounts exist from the 19th century. However, documentation of production methods dating from the Late Middle Ages and Early Modern period is lacking. What does survive from these earlier periods is iconographic material, such as depictions of working cooperages, which offer insight into practices in these periods.

To investigate the development of cask production, a series of 3D scans was made of casks from different periods. The tool marks and general evidence of construction techniques visible on these artifacts can potentially identify diachronic changes in production methods that are not recorded in written sources.

Knowing how casks were priced helps to understand the economic role of cooperage. Pricing is closely related to the relationships between raw material costs, labour, and profit margins. In this chapter, archival sources are used to trace the evolution of cask prices over time and across regions, revealing the commercial positioning of coopers and the economic pressures that shaped their craft.

Bringing these several strands together, this chapter addresses the question: how cask production in the Netherlands developed diachronically in terms of organization, production technique, and pricing in the Late Middle Ages and Early Modern period. By combining data from written sources, archaeology, and 3D scans, a comprehensive understanding of cask production in pre-industrial Europe emerges.

4.2 Craft guilds

The function of craft guilds in the Low Countries

Between 1300 and 1800, there were approximately 2,000 craft guilds in the Low Countries.[110] These institutions emerged as formal associations of crafters within a particular trade or craft, with the approval and oversight of urban authorities. The primary objective of these guilds was the protection and promotion of the collective economic interests of their members.[111] In addition, guilds played a crucial role in structuring and preserving the transmission of craft knowledge and technical skills. This was facilitated through a standardized hierarchical framework consisting of apprentices, journeymen, and masters, within which expertise and practices were passed on through regulated training and professional competence.

Besides their economic function, craft guilds were of considerable social and civic importance. They often served as semi-public institutions that mediated between urban populations and local governments. In many towns and cities, guild members had political influence, particularly in matters of taxation, urban finance, and policy formation.[112] Furthermore, guilds frequently took on responsibilities in areas of public welfare and urban order, for example, contributing to fire prevention, dispute resolution, care for the poor, and even the defense of city walls in times of conflict.

Older and well-established guilds, particularly those founded before c. 1400, often had substantial political influence in addition to their economic authority. In contrast, guilds established in later periods, particularly after the rise of the Burgundian state, operated within a context of an increasing power of central authorities that limited their capacity for political leverage. Thus, the nature and influence of guilds varied considerably over time due to broad shifts in governance and state formation across the Low Countries in the Late Middle Ages and Early Modern period.[113]

The beginnings of craft guilds

Craft guilds began to emerge in the Low Countries in the second half of the 13th century.[114] Their appearance is closely linked to the growth of the trade economy during this period, which led to increased demand for specialized goods. The resulting occupational diversification and the increase of artisans made the formation of craft guilds viable and beneficial. The emergence of guilds correlates

110 Lourens & Lucassen, 1997, 44; De Munck et al., 2006.

111 Lourens & Lucassen, 1997, 43.

112 Blonk-van der Bercken, 2020, 237.

113 Lourens & Lucassen, 1997.

114 De Waard, 2002, 14.

strongly with the increase of urbanization in certain regions; there was a marked development of guild activity in Northern Italy, Switzerland, Southern Germany, the Rhineland, and the Low Countries.[115]

In the Low Countries, the founding dates of craft guilds in cities[116] are recorded in the Database Dutch Craft Guilds.[117] For the area of present-day Netherlands, this inventory was compiled under the direction of Jan Lucassen and Piet Lourens. It was first published in the early 1990s[118] and was later expanded. The database contains information on guilds from their foundation until their abolition in 1798 and is an important resource for studying the institutional, economic, and social roles of guilds in pre-industrial society.

This database shows that in economically dominant Flanders, 149 guilds were founded between 1100 and 1399, more than in any other region (Table 4.1). Between 1400 and 1559, Brabant became more prominent, with 120 new guilds established. From 1400 onwards, the northern Low Countries rose in prominence with 478 guilds founded (1400–1559). During this period, the regions of Zeeland and Holland became prominent, with Holland holding a dominant economic position in the Low Countries by the end of the 16th century. This shift is clearly reflected in the distribution of craft guilds established during the period, with 776 out of a total of 1,374 founded in what is now the Netherlands, forming a large cluster of guilds in the whole of the region.

Table 4.1: Overview of the founding period of craft guilds in the Low Countries, by region (data derived from Database Dutch Craft Guilds, 2012).

Region	**1100-1399**	**1400-1559**	**1560-1669**	**1670-1784**	**unknown**	**total**
Flanders	149	86	43	40	>95	413
Brabant	129	120	24	19	>64	356
Total	**278**	**206**	**67**	**59**	**159**	**769**
% of total number of Belgian guilds	**36%**	**27%**	**9%**	**8%**	**20%**	**100%**
North Brabant and Limburg	31	87	56	31	3	208
Holland and Zeeland	41	272	324	138	1	776
Overijssel, Gelderland, and Utrecht	33	85	121	24	0	263

115 Lis & Soly, 2006, 30.

116 The term cities refers to settlements with more than 2,500 inhabitants in the year 1784.

117 Database Dutch Craft Guilds, 2012.

118 Lourens & Lucassen, 1994.

Region	1100-1399	1400-1559	1560-1669	1670-1784	unknown	total
Groningen, Drenthe, and Friesland	4	34	60	29	0	127
Total	**109**	**478**	**561**	**222**	**4**	**1374**
% of total number of Dutch guilds	**8%**	**35%**	**41%**	**16%**	**>1%**	**100%**

4.3 Coopers' guilds

Function of coopers' guilds in the Netherlands

Like other craft guilds, coopers' guilds were officially sanctioned by local authorities and served as associations of crafters who joined forces primarily to promote their shared economic interests, while also taking the public good into account.[119] Over time, these guilds evolved into formal institutions that regulated the trade of relevant goods, set standards for craftsmanship, provided training in cooperage, controlled access to the craft, and safeguarded the economic position of their members.[120]

The foundation of a guild was typically formalized through a *gildebrief* (guild charter), issued by local authorities. The *gildebrief* granted a monopoly to the guild within city limits, and it also codified the rules, governance, and functions of the guild. The *gildebrief* of Amsterdam coopers (1542) detailed the structure of the guild leadership, outlined a *meesterproef* (rules for the masters' examination), penalties for violations, procedures for quality inspection, and mutual aid practices, such as mandatory attendance at the funerals of deceased members.[121] Article one of the *gildebrief* ensured the guilds' monopoly; only *burghurs* (residents) of the city who had passed the masters' exam and were members of the guild were allowed to manufacture or assemble casks.[122]

The production of casks was most likely centered in urban areas. Cooperage, like other forms of artisanal labour, was typically regulated through city-based coopers' guilds.[123] These guilds functioned as urban institutions and, in addition to organizing trade, they protected their members from external competition. This was possible because urban jurisdiction extended beyond the immediate city boundaries, and because the trade in specific products was conducted in urban markets, thereby placing it firmly within the city's legal domain. Thus, guilds can be viewed as a mechanism to safeguard their members from the growing economic activity in the surrounding countryside.[124] No evidence has survived documenting

119 Tump, 2012, 35.

120 De Kerf, 2013, 21.

121 De Waard, 2002, 15.

122 Van Dillen, 1929, 152.

123 Remmerswaal, 2006, 12.

124 Remmerswaal, 2006, 22.

cooperages outside urban centres. Little is known about the production and repair of casks in rural settings during this period.

The founding and location of coopers' guilds

In total, 38 coopers' guilds were established within the present-day borders of the Netherlands (Figure 3.6). These guilds were predominantly located in the coastal zone, with a notable concentration in Zeeland (six guilds).The majority of coastal zone guilds, however, were founded in Holland, which accounts for 18 guilds in total (Figure 4.2).

Figure 4.2: The location of coopers' guilds within present-day Netherlands, organized by century of their founding (projected on the Nieuwe kaart van de XVII Nederlandsche Provincien, 1715–1737. Vrije Universiteit Amsterdam, The Netherlands, https://digitalecollecties.vu.nl/digital/collection/krt/id/2592/).

A clear diachronic pattern can be seen in the establishment of coopers' guilds, corresponding closely to geographic location. The earliest guilds were founded in the proximity of the dominant economic centres of the time, with a noticeable northward expansion over the centuries. The earliest known coopers' guild was established in Sluis in 1397, near the key commercial hubs of Flanders.
During the fifteenth century, most coopers' guilds were established on the island of Walcheren or in other Zeeland towns, with the key commercial hubs of Brabant located in their immediate hinterland. In the same period, guilds were also

established in some of Holland's most prominent cities. In Dordrecht, for example, a coopers' guild was founded in 1437. Other cities where the booming beer industry created a strong demand for casks followed suit, for example, Gouda, in which a guild was established in 1453.[125]

In the 16th century there was a further expansion of guilds across major urban centres in Holland: Delft (1536), Leiden (1549), and Rotterdam (1553). Amsterdam joined this trend in 1542. During this period, the guild system also began to take form outside the coastal zone. Inland towns with access to major waterways, essential for trade and transport, also established coopers' guilds, for example, Breda in 1561 and Deventer in 1585.

By the 17th and 18th centuries, the spread of coopers' guilds expanded, with new guilds begun in the southern and northern parts of Holland. In the south, guilds were founded in Schiedam (1607) and Vlaardingen (1613), and the northern cities of Enkhuizen (1614) and Hoorn (1617) soon thereafter. In this period, guilds were also founded further inland, including in Leeuwarden (1601), Amersfoort (1617), Zaltbommel (1631), and Zwolle (1661).

Coopers' guilds and associated crafts

In many instances, coopers' guilds did not originate as independent organizations. Instead, they developed out of broader craft guilds encompassing multiple crafts, which, as cities expanded, were increasingly divided along occupational lines. Once the number of artisans in a specific trade, such as coopering, reached a sufficient scale, the establishment of a separate guild became viable.[126] The process of guild formation was thus closely tied to urban growth and the evolving structure of local economies.

In the cities of Dordrecht, Amersfoort, and Breda, coopers' guilds emerged from *timmerlieden* (carpenters') guilds. The co-existence of carpenters and coopers in one guild is understandable since the trades have woodworking in common. In Zierikzee, c. 1600, the St. Matthias Guild comprised coopers, *barbiers* (barbers), *wagenmakers* (cartwrights), and *viswijven* (fishwives),[127] the several crafts sharing a common patron saint, which may well have been the reason they formed a single guild. Even after the Reformation in the northern part of the Low Countries, many craft guilds that had formed around a patron saint retained their saint. In time, however, the significance of the patron saint gradually diminished, both socially and symbolically.[128] In Goes, several crafts were organized as a single guild, including *metselaars* (masons), *schrijnwerkers* (joiners), coopers, cartwrights, and

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125 Yntema, 1992, 52.

126 Lourens & Lucassen, 1997, 127–128.

127 Remmerswaal, 2006, 31.

128 Lis & Soly, 2006, 28.

scheeps- en huistimmerlieden (ship and house builders).[129] Unlike in other cities, however, the coopers in Goes never established their own guild.

In other cities, coopers were not grouped on the basis of the materials they used or their craft techniques but rather according to the types of goods their product serviced. In Amsterdam, for example, the coopers' guild was established in 1542, following a split from the blacksmiths' guild (St. Eloy's Guild). However, the Amsterdam coopers kept their association with the wine merchants in the *kuipers- en wijnverlatersgilde* (Coopers' and Wine Merchants' Guild, Figure 5.4). This combined guild had exclusive rights to transfer wine between casks and to handle the loading and unloading of wet goods.[130]

The association of several trades in one guild may also have offered members certain economic advantages. Some wine merchants, for example, became master coopers, thus avoiding the cost of hiring an independent master cooper by employing a journeyman at a lower cost.[131] As a result, wine traders who were members of the Coopers' and Wine Merchants' Guild could reduce expenses and gain greater control over the production, maintenance, and inventory of casks, essential aspects of their business.

The production of casks was not necessarily tied within craft guilds but rather to the urban markets they serviced. High-volume goods like beer and herring, which were stored in casks, generated substantial demand. Between 1543 and 1545 alone, the nine major beer-producing cities in Holland, including Delft, Gouda, and Haarlem, used approximately 950,000 beer casks. In the early 17th century, casks used in herring ports like Rotterdam, Brielle, and Enkhuizen accounted for a yearly demand of 350,000 casks (Section 1.2).

A major hub of the herring fishery was located in Zeeland, but the primary hub was in Holland.[132] Beer production was based primarily in Holland,[133] although nearby cities such as Utrecht and Amersfoort also played important roles in brewing.[134] The distribution of coopers' guilds shows a concentration of guilds in both Zeeland and Holland (Figure 4.2). Looking at guilds specifically in beer production or fisheries, and the trades related to them, a notable correlation can be observed between these guilds and the presence of coopers' guilds in the same cities.
Of the 175 Dutch towns and cities inventoried in the Database Dutch Craft Guilds, 38 (21.7%) had a coopers' guild. A comparison with guilds related to the production or trade of beer shows that it was relatively common for a coopers'

129 Remmerswaal, 2006, 31.

130 De Waard, 2002, 36.

131 De Kerf, 2013, 34.

132 Van Bochove, 2004.

133 Yntema, 1992, 3.

134 Alberts, 2017.

guilds to be present in the same city. Thus, there were brewers' guilds in 62.1% of the cities that had coopers' guilds, and beer traders' guilds in 50% (Table 4.2).

Additionally, 40% of all fishermens' guilds were located in cities with coopers' guilds, and in more than half of these cases, a fishmongers' guild was also present, suggesting a moderate overlap between these trades. Similarly, shipmasters' guilds were found in 29, that is, 34.1%, of the 85 cities where coopers' guilds existed (Table 4.2). In other words, about one-third of the shipmasters' guilds were in the vicinity of coopers' guilds, indicating a notable, though somewhat weaker, association compared to some of the beer-related guilds.

Table 4.2: Overview of the number of guilds related to beer production or trade, and guilds related to fisheries and their commerce, in the 38 Dutch cities where coopers' guilds existed (Database Craft Guild, 2012).

Name of guild	Name of guild (Dutch)	Number of guilds in cities with a coopers' guild	Number of guilds in the 175 Dutch cities inventoried for guild presence	% presence in city with coopers' guild
Brewers' guild	*Brouwersgilde*	18	29	62.1%
Beer traders' guild	*Bierstekersgilde*	2	4	50.0%
Fishermens' guild	*Vissersgilde*	10	25	40.0%
Fishmongers' guild	*Viskopersgilde*	8	15	53.3%
Shipmasters' guild	*(Groot) Schippers-gilde*	29	85	34.1%

Membership numbers of coopers' guilds

The number of members in a coopers' guild varied between different cities, within individual guilds, and over time. For 21 of the 38 coopers' guilds that existed within the present-day borders of the Netherlands, membership data is available for at least one year. These figures give the number of coopers, masters, and cooperages, but exclude additional personnel such as apprentices and labourers. The data provides a focused view of the formally recognized members within the guild structure rather than a picture of all individuals involved in the craft.

For several coopers' guilds, most notably the one in Gouda, membership numbers have been preserved for a relatively short but continuous period (1632 to 1745). For this period, the guild records reveal a relatively stable number of members. From 1632 to 1720, the guilds' membership remained especially constant, with only minor fluctuations. Beginning in 1732, however, there was a downward trend in membership numbers. It is likely that the number of coopers in Gouda was significantly higher during the Late Middle Ages and the early sixteenth century. The decline is probably linked to the collapse of their primary market, the city's beer breweries. Between 1518 and 1616, the number of breweries in Gouda plummeted from 154 to just 14.[135] The sharp decrease in demand for casks undoubtedly contributed to the decline of the coopers' trade in the city.

A particularly noteworthy case of a high number of members is the Amsterdam coopers' guild. In 1688 it had an exceptionally high number of members, 362 individuals, all officially registered as masters.[136] Unlike in most other cities, the coopers in Amsterdam were part of a joint guild with the city's wine merchants, officially known as the Coopers' and Wine Merchants' Guild. Because this arrangement did not exist in other cities, the list may have included people engaged in wine trading or related activities thus inflating the apparent number of coopers. Even taking this into account, a membership of 362 is, nevertheless, much higher than that of other urban coopers' guilds. In fact, of the guilds for which membership data is available, the Amsterdam guild was larger than all other 17th-century coopers' guilds within the present-day border of the Netherlands combined (Table 4.3).

Labor force of the cooperage sector in the Netherlands

To estimate the total labor force within the cooperage sector in the Netherlands, key production figures were used as benchmarks. Between 1543 and 1545, the nine major beer-producing cities required approximately 950,000 beer casks, averaging around 315,000 per year. [137] In the early seventeenth century, annual demand for herring casks was roughly 350,000.[138] For the purposes of this analysis, an average production figure of 350,000 casks is used.

Labor requirements per cask are estimated at 8.75 hours, based on the cost calculation for salted-fish casks presented in Figure 4.11. Using this benchmark, producing 70 casks required a total labor cost of *f* 51"18"0, equivalent to 1,038 *stuivers*, or roughly 14.83 *stuivers* per cask. Given a daily wage of 18 *stuivers* for an unskilled laborer[139], this translates to approximately 8.75 hours of labor per cask.

Extrapolating to the production of 350,000 casks, each requiring 8.75 hours of labor, yields a total labor requirement of 3,062,500 hours. Assuming an annual work contribution of 2,500 hours per cooper[140], this implies a workforce of approximately 1,225 coopers. It is important to note that this figure refers exclusively to the production of casks for a single product, such as beer or herring. Including casks for other goods, as well as repairs of existing casks, would substantially increase the total labor requirement.

135 Abels et al., 2002, 343.

136 De Waard, 2002, 25.

137 Yntema, 1992, 61.

138 Oosterbaan, 2023, 104.

139 De Vries, 1984, 155; Van Zanden, 1991, 565–566.

140 This calculation assumes a workday of 10 hours, over approximately 250 working days per year.

When compared with recorded membership of cooper guilds in the Netherlands during 1601–1700 (Table 4.3), the total number of coopers amounted to only 656 members. This number of members includes only one entry per city and covers merely 8 of the 38 existing cooper guilds for which membership data are available. The total number of active members of cooper guilds in the Netherlands was likely substantially higher than the recorded figure of 656.

These benchmarks also allow estimation of the maximum production capacity of individual cooper guilds. For example, the Amsterdam Coopers' and Wine Merchants' Guild had 362 members in 1688. Assuming full engagement in cask production, this workforce could collectively contribute 905,000 work hours per year, theoretically producing up to 103,500 casks annually. By contrast, the cooper guild in Veere, with only nine members in 1660, could produce a maximum of approximately 2,500 casks per year.

Table 4.3: Overview of the number of members (master coopers) and cooperages in coopers' guilds, with corresponding year, by city and century (Database Dutch Craft Guilds, 2012).

Location	1300-1400	1401-1500	1501-1600	1601-1700	1701-1800	1801-1900
Alkmaar						11 (1811)
Amsterdam			150 (1570)	362 (1688)	220 (1750)	202 (1811)
Breda					6 (1752) 4 (1798)	
Dordrecht			63 (1558)	80 (1661)		14 (1811)
Enkhuizen					54 (1788)	17 (1811)
Gorinchem						4 (1811)
Gouda				39 (1632) 46 (1641) 58 (1647) 57 (1654) 49 (1669) 39 (1699)	42 (1715) 40 (1716) 32 (1717) 42 (1720) 32 (1732) 20 (1744) 22 (1745)	
Groningen						24 (1811)
Haarlem						16 (1811)
Hoorn						8 (1811)
Leiden		28 (1498)	37 (1581)		19 (1749) 25 (1788)	46 (1811)
Rotterdam			17 (1600)	24 (1643)		138 (1811)
's-Gravenhage			128 (1587)		15 (1796)	
Sluis	21 (1394)				2 (1794)	
Utrecht				52 (1650)		14 (1811)

Location	1300-1400	1401-1500	1501-1600	1601-1700	1701-1800	1801-1900
Veere				27 (1620) 21 (1640) 9 (1660)	11 (1798)	
Vlaardingen					98 (1798)	
Vlissingen					16 (1780)	
Weesp					5 (1798)	3 (1810) 4 (1811)
Zierikzee				33 (1640) 50 (1660)		15 (1803)
Zwolle				18 (1639)	14 (1747) 14 (1748) 16 (1785) 13 (1795)	15 (1806) 19 (1811)

4

Organizational structure of coopers' guilds

Little is known about the organizational structure of coopers' guilds in the Netherlands before the 16th century. Written sources are scarce for that period, but this changes for the 16th century. Thus, in 1542 the organizational structure of the Amsterdam coopers' guild is detailed in its charter, issued by urban authorities. The charter includes the composition of the guilds' masters, the administration of the required masters' exam, as well as a code of conduct and inspection guidelines to ensure the quality of the casks.

The organizational structures of coopers' guilds within the region under study were uniform and stable, with a hierarchy in which roles and functions were clearly defined. The organizational structure of the Amsterdam coopers' guild remained unchanged until its dissolution in 1811,[141] and this stability was mirrored in other coopers' guilds, for example, in Haarlem and Rotterdam.[142] Even significant political changes had little effect on guild governance. When the coastal cities of the Netherlands joined the Republic at the end of the 16th century, the authority of the sovereign was replaced by that of the *Staten Generaal*. However, the cities retained a high degree of autonomy, including control over local institutions like craft guilds, allowing coopers' guilds to continue operating under their established internal regulations.[143]

Guild masters

The board of a coopers' guild typically consisted of four members, known as *overlieden* or *dekens* (guild masters). In Amsterdam, the Coopers and Wine

141 De Waard, 2002, 15.

142 Tump, 2012.

143 Tump, 2012, 40, 46.

Merchants' Guild was governed by four *overlieden* (Figure 5.4), appointed for two-year terms. They were selected by the urban authorities from a list of qualified candidates nominated by the guild board.[144] Despite these parameters, in practice the office appears to have been open to a select group. Between 1704 and 1794, only 44 individuals held the position, averaging over four terms each, suggesting an elite and recurring leadership circle.[145]

The guild masters were responsible for a wide range of duties. They managed the guilds' finances and registers, collected dues, enforced rules, in some cases oversaw the master examinations, mediated disputes, and represented the guild in petitions or consultations with the urban authorities.[146] The composition and organization of a coopers' guild board varied slightly between cities. In Vlissingen (1545), the coopers' guild was led by an *overdeken*, two *kerkdekens* (administrators), and two *straatdekens* (members who attended to technical matters).[147] In Rotterdam, the coopers' guild had a rotating board of four members from at least 1585, increased to five by 1666.[148]

Inspectors

The board of guild masters typically appointed *keurmeesters* or *proefmeesters* (inspectors) who supervised and evaluated the masterpiece crafted by candidates to qualify as a master cooper. These inspectors focused primarily on workshop practices, while other inspectors (*branders*) appointed by the urban authorities assessed whether casks met the required standards. These standards varied depending on the type of cask, for example, for herring or beer, but they also assessed the key components of a cask such as capacity, dimensions, number of staves and headboards, thickness of staves, and whether they were water-tight (Chapter 5). Thus, a system was established by which both the coopers' guild and the urban authorities ensured quality control.
In the mid-16th century, two *keurmeesters* (inspectors) were appointed by the guild masters of Vlissingen.[149] Similarly, two centuries later, the Amsterdam coopers' guild regulations of 1731 and 1772 state that two *keurmeesters* were to be appointed.[150] Records from the Amsterdam guild further show considerable overlap between the board of guild masters and the *keurmeesters*, suggesting an inner circle of recurring leaders.

144 De Waard, 2002, 26.
145 De Waard, 2002, 26.
146 Remmerswaal, 2006, 51.
147 De Ridder, 2004, 66.
148 Remmerswaal, 2006, 57–58.
149 De Ridder, 2004, 65–66.
150 De Waard, 2002, 29–29.

Guild members

For admission as member of a guild, candidates had to meet several requirements. First, there was an admission fee. In the Haarlem coopers' guild in 1607, this fee amounted to *f* 0.60, with *poorters* (city citizens) paying only half of that. From 1693 onwards, the fee increased to *f* 2.00 for non-*poorters* and *f* 1.50 for *poorters*.[151] Secondly, according to the *gildekeuren* (guild regulations), candidates were required to complete a minimum number of years as an apprentice before gaining membership. In the Rotterdam coopers' guild, according to the regulations of 1662 and 1720, this amounted to two years for citizens and four years for non-city citizens (i.e., outsiders). In Haarlem, the 1693 rules required four years of apprenticeship for citizens and six for non-city citizens.[152]

Upon completion of the required apprenticeship, the new journeyman could take the master examination. Passing that test granted him the status of master cooper and allowed him to open a workshop. Opening a workshop required a substantial investment and not every journeyman was able to do that. The journeyman had the option of registering with the coopers' guild as a *knecht* (assistant), for which the above-mentioned registration fee was required.[153]

The form of the master examination varied from city to city. Generally, the cooperage work required for the examination consisted of executing local practices of the craft. In other words, the casks made for the examination were to be used for local products. The coopers' guild of Amsterdam, from 1542 onwards, offered two possibilities for the master exam, one for *groot werck* (big work) and one for *cleyn werck* (small work). For the *cleyn werck* test, the candidate had to make a white-sealed meat tub, a herring cask, and a wine half-*aem* (a type of cask). For the *groot werck* test, the required pieces were a full quarter cask, an oil half-pipe, and a *sester* (specific types of casks).[154]

After successfully completing the master examination, a candidate could establish a cooperage and register as a master cooper with the coopers' guild in the city where the examination had taken place. As proof of membership, a *gildepenning* (guild token) was issued (Figure 4.3). In the northern regions of the Low Countries, the token was issued mainly to masters, although *knechten* (journeymen) did occasionally receive one.[155] The token served as proof of registration and compliance with guild requirements, and it could also be used as identification to confirm attendance at guild meetings or funerals.[156]

151 Tump, 2012, 84.

152 Tump, 2012, 88.

153 Tump, 2012, 90–91.

154 De Waard, 2002, 16.

155 Teulings, 2019, 358.

156 Teulings, 2019, 46. The guild tokens from the 17th and 18th centuries in the Northern Netherlands have been collected in the Gildepenningen database, accessible here: https://hdl.handle.net/10622/RS4FYJ

Figure 4.3: Guild token of the Amsterdam coopers' guild from 1779, issued to master cooper Jean Chevalier Durege (Guild token of the Amsterdam coopers' guild, [Inv. no. 021877], 1779. Zuiderzee museum, Enkhuizen, The Netherlands.

Apprentices and journeymen

In cooperages, the master cooper was assisted by apprentices (*gezel*) and journeymen (*knechten*), the distinction being that apprentices were still in training, whereas journeymen were fully skilled craftsmen, though not yet masters. These two roles formed a flexible workforce, enabling cooperies to adjust labor allocation in response to year to year fluctuations in demand, depending on the demand for casks of the relevant sectors. For example, the collapse of the beer-brewing craft in Gouda between 1518 and 1616—the number of breweries dropped from 154 to just 14—significantly reduced the need for beer casks. If demand for casks was high, additional workers could be hired. The register of journeymen and apprentices from the coopers' guild in Haarlem shows a notable increase in numbers around 1685, which coincides with a time period of economic growth in Holland.[157]

Cask production was also affected by seasonal fluctuations. The supply of coopering wood and the demand for casks varied within a given year. The herring season, for example, lasted only four months, from June to September (Section 7.7.3). Cooperages could adjust their number of workers to meet seasonal needs.

157 Tump, 2012, 86.

As described above, the nature of the cooper trade made for a fluctuating workforce. In Vlissingen, for example, records from 1780 mention 16 master coopers employing a total of 150 journeymen.[158] Similar numbers are seen in Rotterdam; in 1843, 29 coopers employed 172 workers in total.[159] These ratios, however, varied significantly over time and from place to place. The guild employment records of Veere for 1618 listed 27 coopers who employed only eight apprentices. By 1659, the number of master coopers had declined to fewer than 10 in Veere, with just one apprentice remaining.[160] In Haarlem, the coopers' guild registered 428 apprentices and journeymen between 1649 and 1669.[161] While the exact number of cooperages for that period is not known, there were 16 in 1811 (Table 4.3), which would be an average of 1.3 apprentices or journeymen per cooper over the two decades. However, the numbers in coopers' guild registers may be understated, as registration was primarily intended for those who needed to document their apprenticeship years in order to qualify for the masters' examination[162] and thus not all workers in cooperages would have been recorded in the registers.

4.4 Production process

The production of casks in cooperages between 1300 and 1800 is described in various written sources, focusing on pre-industrial methods. Information from these sources is essential for our understanding of production at that time because in the Netherlands today there are very few cooperages left, and cooperages using pre-industrial methods no longer exist in the Netherlands, making the craft extinct in practice. There are, however, some cooperages in museum contexts that demonstrate pre-industrial techniques, for example, at the Zaans Museum, the Zuiderzee Museum (Figure 4.4 right), and at the workshop Kuiperij Meester in Amersfoort (Figure 4.4 left).

In what follows, the traditional process of cask making is examined step by step, relying on documents that describe artisanal techniques as they persisted into the 20th century (Section 4.4.1). To determine whether this production process reflects casks from archaeological contexts, 3D scans were made of four casks dating from the 15th to the 20th century (Table 4.4). These scans reveal tool marks and construction features as well as changes in cooperage practices over time. The findings are presented in section 4.4.2.

158 De Ridder, 2004, 69.

159 Database Dutch Craft Guilds, 2012, https://doi.org/10.34894/WYQO0Z

160 Remmerwaal, 2006, 82.

161 Tump, 2012, 84.

162 Tump, 2012, 83.

Figure 4.4: Left: the workshop of the coopery Meester, Amersfoort, right: the workshop of the coopery in the Zuiderzee Museum, Enkhuizen (author's photos).

4.4.1 Production process in written and iconographical sources

After the required wood was purchased, the staves were prepared by splitting them as efficiently as possible from logs or beams using a curved froe (*kloofmes*), usually across the grain (Figure 4.5_1). In doing so, the desired length, width, and thickness of the staves were carefully taken into account. From the 18th century onwards, splitting gradually gave way to sawing. This was faster and made more efficient use of the wood.[163] Staves made by splitting can be identified by their long, rough edges and scratch marks, which result from wedges being driven downward through the wood, unless these traces were removed during the finishing of the staves.[164] The split or sawn staves were then further dried at the cooperage, typically for a six-week period (Section 2.5).

The staves were then tapered at both ends so they could be bent to the required cur*vat*ure (Figure 4.5_2). In the 20th century, this was done with a lathe but during the research period, a coopers' axe was used. To ensure a tight fit against the hoops that would later bind the cask, the exterior of each stave was rounded (Figure 4.5_3). This was traditionally done with a hollow plane (*haalmes*). The interior surfaces of the staves, on the other hand, were hollowed using a plane with a different concave profile (*holmes*) in order to facilitate the bending of the stave.[165]

Next, the edges of the staves were shaped so they would fit together seamlessly, a process known as jointing (Figure 4.5_4). For standardized cask types that were produced in large numbers, a jointing mold was used to determine the correct bevel. In other cases, the angle was set manually using a bevel gauge. During the

163 Waelput, 2004, 69–70.

164 Manders, 1996, 18.

165 Manders, 1996, 19; Waelput, 2004, 103.

research period, the jointing was primarily done with a jointer plane or a traditional bench plane. In the 20th century, a lathe was used.[166]

The staves were then laid out side by side on a workbench to check whether the required cask circumference would be met and to determine their optimal arrangement. Small imperfections, such as knots or minor tooling errors, were interspersed among the other staves so the imperfections would not be in staves adjacent to each other. Variation in stave widths was also taken into account; wider staves were alternated with narrower ones.[167] To ensure a precise fit, a closing stave was often needed, typically a relatively narrow piece that ensured the staves were of the desired circumference. The presence of such a stave is a key distinction between handcrafted casks from the pre-industrial period and late 20th-century machine-made casks that have staves of uniform width.[168] After this step, the staves were ready to be raised into a cask.

The raising of the cask involved placing the staves into a temporary setting hoop, typically a ring made of thick metal or ash wood (Figure 4.5_7). Once all the staves were inserted, a second hoop was added, drawing the staves together at the bilge and at one end, forming a half-closed cask. At the opposite end, the staves remained splayed and had to be bent inward. To achieve this, the half-finished cask was placed over a brazier. The inner surfaces of the staves were heated and dried by the fire, while the outer surfaces remained moist or were kept wet. The difference in moisture caused the staves to bend inward. A windlass or rope clamp was then used to pull the staves further together (Figure 4.5_8). If the desired cur*vat*ure was not yet reached, the process was repeated. Finally, the head hoop was driven onto the cask, bringing the staves into a tightly bound cylindrical form.

Casks intended for certain types of products were sometimes charred, depending on the buyers' requirements. Waelput notes this practice in the 20th century for casks used in the herring industry or meat transport, to reduce the effects of wood moisture and natural acids. Charring was also done with casks for alcoholic beverages, with the aim of neutralizing acids and to enhance aromas, for example, vanilla.[169] It is not known, however, if this practice was also employed during the research period.

166 Manders, 1996, 20–21; Waelput, 2004, 114–115.

167 Waelput, 2004, 122.

168 De Groot personal communication, January 24, 2025.

169 Waelput, 2004, 143.

Figure 4.5: The assembly of casks in an 18th-century French cooperage. Figs. 1–3: Reducing and shaping the staves, Fig. 4: Jointing; Figs. 5–6: Assembling the heads, Figs. 7–8: Raising the cask. Fig. 9: Cutting the croze (Fougeroux de Bondaroy, 1777; Plate V).

Figure 4.6: Finishing casks in an 18th-century French cooperage. Fig. 1: Measuring the headboards; Figs. 2–4: Placement of the hoops; Fig. 5: Driving hoops; Figs. 6–7: Drilling holes (Fougeroux de Bondaroy, 1777; Plate VI).

The next steps were to work on the bottom rim. First, the chime was formed using an adze. An inward sloping bevel was fashioned along the lower edge of each stave (Figure 4.7). The purpose was to reduce surface contact of the cask with the ground, thereby minimizing the risk of moisture being drawn up from below. The ends were then topped to create an even surface. This was followed by chiving, a process by which the inner edges of the staves were hollowed out to provide sufficient space for inserting the cask heads into the body of the cask. The final step was to cut the croze, a groove into which the heads would be fitted (Figure 4.7).

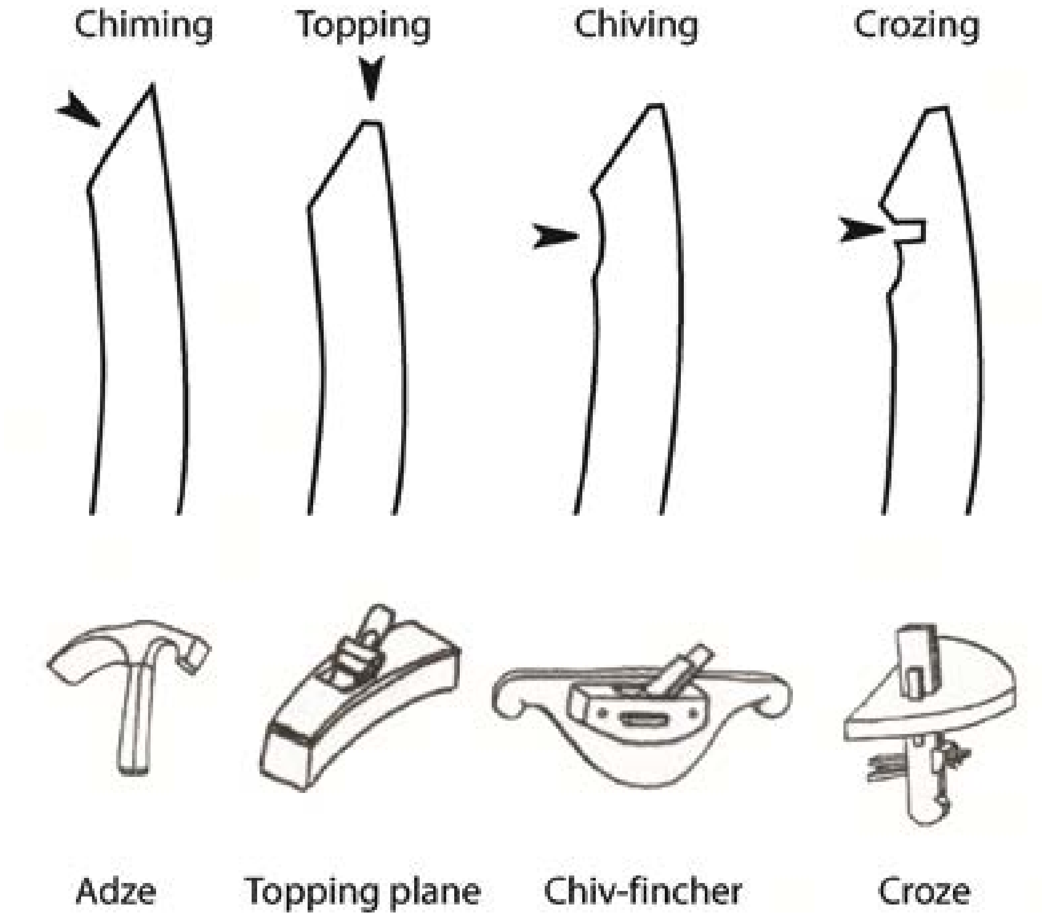


Figure 4.7: Schematic overview of the shaping techniques of the casks' bottom rim with the corresponding tools (Waelput, 2004, 149).

Heads were then made to close the cask. A compass was stepped six times around the casks' interior (Figure 4.5_5), and the required diameter was transferred onto a set of headboards. Depending on that diameter, a head could have from one to seven pieces. To prevent leakage at the joints, flax, hemp, or rushes were packed between the headboards. The head was sawn out with a bow-saw and joined with wooden pegs. The perimeter was then trued with a hollow plane. The inner edge was beveled more sharply than the outer, allowing the head to sit easily in the croze.[170] Because heads were not always perfectly round, their rotational position inside the cask mattered for a watertight seal. Matching marks on both the head and the cask rim ensured the heads' correct orientation.

The heads were typically inserted from the inside of the cask outward into the croze. As the bilge was the widest part of the cask, this allowed the most space for maneuvering. First, the waist hoop was temporarily loosened or removed to create enough clearance for fitting the heads into the croze at both ends. Once the heads were properly positioned, the end hoops were driven back into place to secure the assemblage.

After that, the temporary hoops could be replaced with the hoops intended for the finished cask (Figure 4.6_3-5). In Dutch cooperages, these were primarily made of willow withies. Iron hoops, standard by the 20th century, were already in use during the Early Modern period. Exca*vat*ions at the Behouden Huys on Nova Zembla show that metal hoops were used as early as the late 16th century.[171] Since the expedition to Nova Zembla expected harsh conditions, it is likely that the crew favoured casks bound with iron hoops. Nevertheless, throughout the Late Middle Ages and Early Modern period, willow was the most commonly used material for cask hoops.

The final step in the process was to finish the exterior of the cask by planing away surface irregularities and drilling the necessary holes (Figure 4.6_7). Depending on the intended contents, these might be a bung hole (*bomgat,* for filling and emptying the cask), a tap hole (*tapgat*, for drawing off liquid), or a vent hole (*zwikgat*, to allow air in during tapping), which were bored into the bilge or the heads. Lastly, the cask was marked by the cooper responsible for its production.

4.4.2 Production process of casks from archaeological contexts

To assess whether there are observable differences in the production process between the 15th and 20th centuries, a total of four casks were 3D scanned (Table 4.4). From an analysis of these scans, data and traces of the production process can be identified. Particular attention was given to three key aspects of production: the variation in stave width, the presence of wedge marks, and traces of hoop placement. The findings are presented below.

170 Manders, 1996, 29–30.

171 Manders, 1996, 44.

Table 4.4: The specifications of the cask found in the city of Amersfoort that were 3d scanned.

Context	Date	Height (cm)	Maximum diameter (cm)	Link to 3d data
Coopery Meester (Amersfoort)	20th century	41	26	[172]
MW'18	18-19th century	75	40	[173]
HA 4-18	16th century	105	61	[174]
Sto'16	15th century	73	53	[175]

Initial analysis focused on variation in stave width. As described in section 4.4.1, a hand-made cask, according to contemporary coopers, can be identified by the presence of a relatively narrow stave used to close the cask, the closing stave. In machine-made casks, stave widths are consistent, allowing the cask to be completed without the need for a specially fashioned narrow closing stave.

Of the 3D-scanned casks, only the example from the 20th century showed a practically uniform stave width and thus there was no clearly distinguishable closing stave. The other three casks, however, had a visible, narrow closing stave (marked with an arrow in Figure 4.8). It is likely that such a stave was added after the cooper had laid out all the staves on the workbench to see whether they formed the intended circumference. In many cases, this did not result in a perfect fit. An additional narrow closing stave was a practical solution.

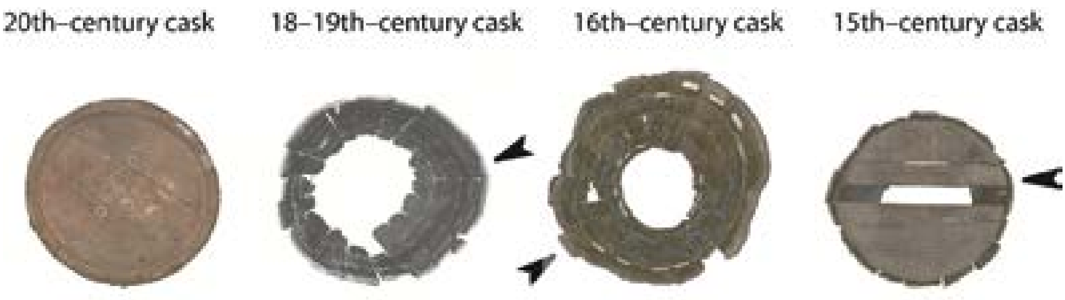


Figure 4.8: Top view of the 3D-scanned casks. Arrows mark the potential presence of a narrow, closing stave.

172 https://sketchfab.com/3d-models/20th-century-barrel-e09bc4cd466843a69c71d37a1968267d.

173 https://sketchfab.com/3d-models/ton-mw18-01512dd5409e4842857ea43b7da94fd3.

174 https://sketchfab.com/3d-models/ton-ha-4-18-358b57d7abf541049f2c129cfbe03f93.

175 https://sketchfab.com/3d-models/ton-sto16-binnenzijde-170b2a296ab54c4d86749d203fb3dfa7.

The 3D scans were also examined for signs of split or sawn staves. As noted by Waelput, sawing became the predominant method from the 18th century onwards. Earlier cooperages favoured splitting the wood with wedges, and this procedure left short and transverse impressions (Section 4.4.1). The presence of wedge marks, therefore, is indicative of splitting.[176]

Only the 15th- and 16th-century casks show such wedge marks. They are visible on the inner surfaces of the staves as lines running perpendicular to the grain, usually no wider than 5 cm, appearing in multiple locations (Figure 4.9). Exterior traces may have been removed during finishing. The absence of wedge marks on 18th-, 19th-, and 20th-century casks does not conclusively indicate sawing, since any traces of splitting could have been removed in the finishing process. While this evidence agrees with a historical shift from splitting to sawing, it is not conclusive.

Figure 4.9: Interior view of two casks, showing traces of the wedges used to split the wood.

Many of the tool marks visible on the exterior of the casks can be linked to the placement of hoops (Figure 4.10). These traces typically appear as transverse lines running perpendicular to the stave grain, often spanning the full stave width and recurring at consistent heights across adjacent staves. In three of the four 3D-scans, the hoops themselves are no longer preserved, preventing definitive identification of the materials used. However, based on comparative data from 15th- and 16th-century casks, willow hoops were most likely used, as they were common in this period.

The marks may originate from several phases of the cooperage process: from the initial application and removal of setting hoops to the installation of permanent hoops. Alternatively, they may reflect later repairs, such as the replacement of hoops during the casks' lifespan, which could leave minor damage or pressure

176 Manders, 1996, 18.

marks. The 3D-scan data, however, does not allow for a clear distinction between production-related and use-related traces of hoop placement.

Figure 4.10: Traces of hoop placement on the exterior of the 3D-scanned casks.

4.5 Pricing of casks

To provide an overview of the prices for cooperage work, a few examples of selling prices from the mid-17th century to the end of the 18th century are presented here. Records of prices have been preserved in the archives of the coopers' guild of Dordrecht that include cask lists from between 1635 and 1640. These lists include deliveries to breweries, such as the brewery in 't Cruijs in Dordrecht, which in 1635 purchased a last of half-barrels (*halfvaten*) for 10 guilders.[177] These half-barrels, generally holding around 70 liters, were common in the beer trade.[178] Since a last typically comprised 12 barrels, the price of one half-barrel would be approximately 16 *stuivers* (*f* 0:16:1).

In another order, a last of barrels to be delivered to the brewery Den Dissel cost 18 guilders, which amounts to 1 guilder and 10 *stuivers* per barrel (*f* 1:10:0).[179] The beer casks to which this entry refers were likely larger, possibly exceeding 130 liters (Chapter 5). In the following years, the selling price of half-barrels fluctuated slightly, for example, in January, 1639, a last of half-barrels was sold for 10 guilders and 10 *stuivers* (*f* 10:10:0).[180]

Another type of cask, the half-*ankers* and *ankers*, are documented in the records of the coopers' guild of Veere in 1768 with their prices. A half-*anker* was a relatively small cask, typically holding approximately 37 or 38 liters, and was commonly used for products such as wine, vinegar, and distilled spirits.[181] The price of an empty half-*anker* is mentioned on several occasions, indicating minor fluctuations, generally between 11 and 13 *stuivers* per unit.[182] Full *ankers* were priced higher at 18 to 22 *stuivers*.[183]

177 RAD, GC, No. 505, April 18, 1635.

178 Database De oude Nederlandse maten en gewichten, n.d., https://mgw.meertens.knaw.nl/maat/304

179 RAD, GC, No. 505, November 29, 1635.

180 RAD, GC, No. 505, January 4, 1639.

181 Database De oude Nederlandse maten en gewichten, n.d., https://mgw.meertens.knaw.nl/maat/36

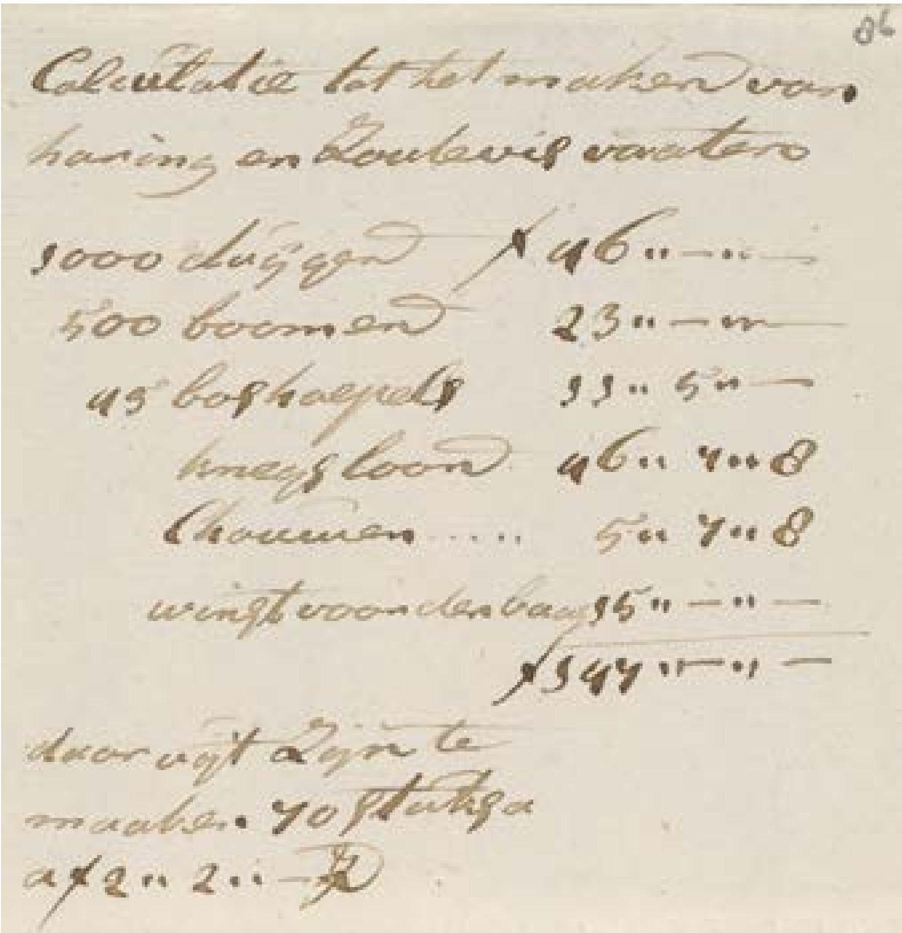
182 ZA, SV, No. 1901, June 18–August 12, 1768.

183 ZA, SV, No. 1901, April 10–May 26, 1773.

The value of these casks can be estimated by comparing the selling price with the typical wages of the time. In Holland between 1650 and 1805, the average daily wage was 18 *stuivers* for unskilled labour and 25 *stuivers* for skilled labour.[184] This means that an unskilled laborer could buy a half-*anker* with about a day's wages. A beer cask would cost almost two days' wages.

Calculating the selling price

In calculating the selling price of a cask, the cost of timber and hoops, labour, and profit margins were considered. The minutes and appendices of the coopers' guild archive in Vlissingen (1775–1808) include a detailed cost calculation for producing casks intended for salted fish (Figure 4.11). The document is not directly associated with any specific entry in the archival minutes and appendices of the coopers' guild, making it impossible to determine its exact date within the period 1775–1808.


86

Calculatie tot het maken van
haring en bouluvis vaaten

1000 duygen f 46 .. - .. -
500 boomen 23 .. - .. -
45 bos hoepels 11 .. 5 .. -
knegs loon 46 .. 4 .. 8
Ch... .... 5 .. 7 .. 8
winst voor den baas 15 .. - .. -
f 147 .. - .. -

daer uyt dinte te
maken 70 stukjes
a f 2 .. 2 .. -

Figure 4.11: The calculation of the selling price of a cask of salted fish, found in the minutes and appendices dated between 1775 and 1808 of the archives of the coopers' guild in Vlissingen (ZA, GtV 99, folio 86).

184 De Vries, 1984, 155; Van Zanden, 1991, 565–566.

The document shown in Figure 4.11 lists the following amounts:[185]

1000 *duijgen* (staves)	*f* 46″0″0
500 *boomen* (headboards)	*f* 23″0″0
45 *bos hoepels* (bundles of hoops)	*f* 11″5″0
knegtsloon (journeyman wages)	*f* 46″7″8
Shouwen (carrying)	*f* 5″7″8
Winst voor den baas (Profit for the boss)	*f* 15″0″0
	f 147″0″0

Daarvan zijn te maaken 70 stuks á f 2″2″0 t stuk (With that, 70 casks can be made at *f* 2:2:0 each)

The calculation sheet shows that 70 casks for packing salted fish could be produced at a total cost of *f* 147:0:0, with each cask costing *f* 2:2:0. The timber and hoops alone accounted for *f* 80:5:0, roughly 55% of the total cost.[186] Hoops accounted for 16.7% of the raw material costs. This is striking since lower costs for hoops might be expected in that hoops were often locally produced from willow, in regions like the Biesbosch. The timber, on the other hand, had to be imported from the Baltic region, Poland, or the North German Plain (Chapter 3).

The labour costs related to making casks, including journeyman wages and carrying, amounted to a total of *f* 52:5:6, that is, 35% of the selling price. Interestingly, the labour costs are only those of the journeyman, not the master cooper. It is possible that the master cooper was not directly involved in the manual making of the 70 casks, and the term *den baas* (the boss) is likely a reference to the master cooper, for whom a profit margin of *f* 15:0:0 is allotted, that is, 10% of the selling price.

To estimate the value of an empty cask for salted fish, its selling price of *f* 2:2:0 can be compared to the typical daily wage of an unskilled laborer during this period, which was 18 *stuivers*. Thus the cost of a one cask was equivalent to $2\,^{1}/_{3}$ days of work.

4.6 Conclusion

This chapter investigates how cask production in the Netherlands evolved from the Late Middle Ages into the Early Modern period, examining the organization in craft guilds, production process, and pricing. Through this diachronic investigation, significant economic, social, and technological developments that shaped the production of casks are highlighted. The sub-study explores how the role of craft guilds, the methods of cask production, and market strategies were adapted in response to broad urban and economic shifts. Drawing on a wide range of sources, archival documents, iconographic materials, archaeological findings, and 3D scans

185 The amounts are listed in gulden, stuivers, and oorden (1 gulden = 20 stuivers, 1 stuiver = 4 oorden).

186 Duijgen f 46″0″0 + boomen f 23″0″0 + boshoepels f 11″5″0 = f 80″5″0.

of casks, new insights are offered towards a better understanding of the changing nature of this essential craft Late Middle Ages into the Early Modern period.

The emergence of craft guilds in the Low Countries is a crucial lens through which the socioeconomic dynamics of the period can be better understood. As formal institutions that regulated artisanal production within specific crafts and advocated for the collective interests of their members, guilds played a crucial role in defining the operations of specific crafts.

The establishment of craft guilds is symbolic of the shift in economic dominance during the transition from the late medieval to the early modern urban economy. Most urban craft guilds in the Low Countries were founded from the 12th to the 16th century. In Flanders, the majority of guilds emerged from the 12th to the 14th century, while in the Duchy of Brabant, guild formation intensified during the 15th and 16th centuries.

During this period, the provinces of Zeeland and Holland emerged as important centres of economic activity, with Holland in particular becoming the dominant center of the Low Countries by the late 16th century. This growing prominence is evident in the geographic distribution of craft guilds. Of the 1,374 registered guilds within the present-day borders of the Netherlands, 776 were established in Zeeland and Holland, underscoring the region’s central position in the development of urban artisanal practice.

An investigation of the founding dates of coopers’ guilds reveals a similar pattern. The earliest guilds were established near prominent economic centres, followed by a gradual northward expansion in the following centuries. The oldest known coopers’ guild was founded in Sluis in 1397. Subsequent guilds were established in the rest of Zeeland and then in Holland. It was only near the end of the 16th century that coopers’ guilds were founded further inland, particularly in port towns on major rivers, such as Breda (1561) and Deventer (1585).

The interaction between craft guilds and related sectors (e.g., beer brewing and the herring fishery) took place within a network of economic interdependence that was vital to the survival and development of the cooperage trade. The establishment of coopers’ guilds in cities with active brewing and fishing sectors suggests a symbiotic relationship, in which the consistent demand for casks sustained the coopers’ profession, stimulated specialization, and ensured its long-term viability.

The organizational structure of coopers’ guilds remained relatively consistent over time. They were typically organized hierarchically, serving to implement good governance and trade regulations, and to ensure internal discipline. Concrete evidence of this structure, however, only emerges in the Early Modern period, as no written records detailing guild organization have survived from the Late Middle Ages. In surviving documentation, there is evidence that roles were clearly delineated; guild masters provided leadership, inspectors enforced quality standards, and regular members carried out production. This structured division of responsibilities was essential in maintaining trade standards and institutional coherence.

The knowledge of the cask production process in the Netherlands during the research period cannot be drawn from still-active cooperages, as very few remain today. The few surviving coopers work primarily in museum settings. Consequently, our understanding of traditional cask-making relies mainly on written descriptions and on production marks found on casks recovered from archaeological contexts.

Crafting a cask was a complex, multi-step procedure designed to ensure functionality, durability, and watertightness. The staves were shaped by chiming, topping, chiving, and crozing. The heads were constructed by joining several headboards, beveling their edges, and fitting them into the body of the cask, a step that required temporarily loosening the hoops to allow proper placement. Once the heads were inserted, the hoops were repositioned and secured in place. Finally, the exterior surface was smoothed, bung and tap holes cut, and the coopers' mark applied.

To analyze production marks on casks, four archaeological specimens were selected and investigated. This was done with the help of 3D-scans of the casks. Each cask is of a different period, and collectively they span from the 15th to the 20th century. The analysis focused on three key aspects: variation in stave width, the presence of wedge marks, and traces of hoop placement.

Of the four casks, only the 20th-century one had a largely uniform stave width, indicating mechanized production. In contrast, the casks dating from the 15th to the 19th centuries all had at least one significantly narrower stave, typically used to seal the cask. This feature is characteristic of hand-crafted casks, confirming that these earlier examples were produced entirely with manual techniques.

The presence of wedge marks on staves has been interpreted as indicative of wood splitting. In contrast, the absence of wedge marks on staves is believed to indicate sawing, a method that likely predominated from the 18th century onwards. In the 15th- and 16th-century casks, wedge marks were observed on the inner surfaces of the staves, supporting the hypothesis of a historically earlier splitting method. The most common production traces found on the casks, however, are those resulting from the placement and removal of hoops. These marks were consistently identified diachronically on the exterior surfaces of the staves.

Pricing materials and labour illustrate the economic factors that influenced cask production. An examination of archival sources revealed the particulars of raw material costs, labour, and profit margins. Fluctuations in pricing reflect economic health in the coopers' trade and highlight the interdependence between coopers and the sectors they served. The large demand for casks in the brewing and fishing sectors underscores the vital role that coopers played in supporting these burgeoning industries.

In conclusion, this sub-study of cask production offers a nuanced understanding of the interplay between craft, economy, and society during a transformative period in the history of the Netherlands. The evolution of coopers' guilds, production techniques, and pricing mechanisms reveals a dynamic landscape shaped by urbanization, economic shifts, and technological advancements. The investigation and analysis of written sources, casks from archaeological contexts, and 3D scans, enriches our understanding of the cooperage trade and contributes to the discourse on pre-industrial craft production in Europe.

5. Identifying content through casks

5. Identifying content through casks

This chapter discusses the use as transport container within the cask lifecycle (Figure 5.1) and is based on: Oosterbaan, J. (2023). Identifying Content through Casks. Skyliss: Journal of Maritime and Limnetic Archaeology and Cultural History (23), 103-116.

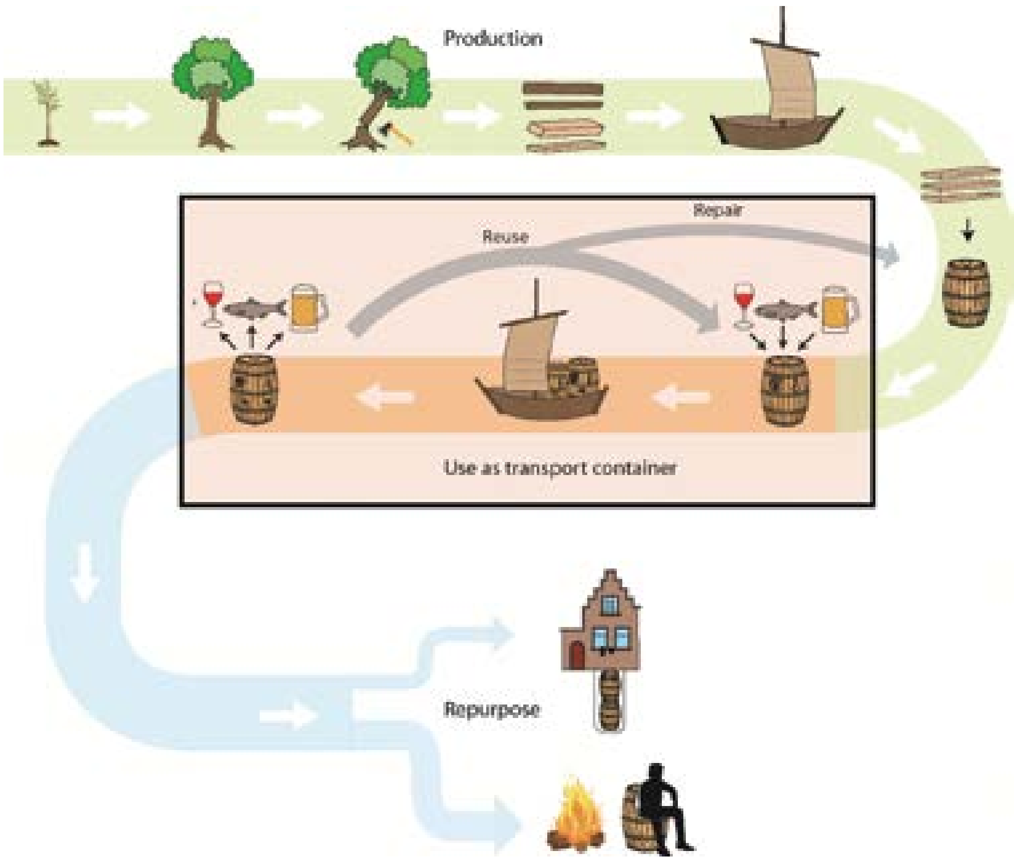


Figure 5.1: Schematic overview of the lifecycle of a cask. Production phase – green; its use as a transport container – orange; repurposing – blue. The frame highlights the part of the casks' lifecycle that is discussed in this chapter.

5.1 Introduction

Casks, the precursors of modern day shipping containers, played a vital role in the transportation of goods during the pre-industrial era. Regions specializing in trade, such as the coastal area of the Low Countries, witnessed an increasing demand for casks beginning in the Late Medieval period. Cooperies in the Low Countries catered to this demand by manufacturing a wide variety of casks, intended for storage and transportation of various products.

These products included:

- dry merchandise like grains, seeds, and spices,
- foodstuffs such as dairy products, meat, and fish, as well as water,
- alcoholic beverages like beer, wine, and spirits.

Given their ubiquity, casks are frequently discovered in urban archaeological sites throughout the Netherlands. However, despite their prevalence, determining the original contents of these casks remains a challenge, making it difficult to link the users of the casks to specific products and their trade networks. To address this issue, this sub-study examines the specifications of casks used for the two most important export products from the coastal regions of the Netherlands: beer and herring.

The brewing industry was primarily concentrated in the province of Holland and reached its peak during the period 1450–1650.[187] Archival sources show that during the mid-15th century, in various cities of Holland, including Amsterdam, Haarlem, and Leiden, the taxation on beer constituted as much as 50% of the cities' total revenue.[188] The number of beer casks that circulated can also be calculated based on archival sources. The archives of the states of Holland show that during the period 1543–1545, approximately 950,000 beer casks were used in the nine major beer-producing cities in Holland.[189]

The second most significant export product of the coastal region of the Netherlands in the Late Medieval and Early Modern periods was herring. In the 1300s, most herring were caught in the narrow waterway between the Danish mainland and islands. By a twist of nature, herring shoals moved from this narrow waterway to the North Sea in the Late Middle Ages, creating favorable conditions for herring fisheries in the provinces of Flanders, Zeeland, and Holland.[190]

However, even within these provinces, the center of the herring industry shifted. During the Late Middle Ages, the primary cities of importance were situated in Flanders, evidenced by the fact that it had a larger fleet of herring fishing vessels in operation than Zeeland and Holland.[191]

Beginning in the 16th century, cities in Zeeland and Holland progressively assumed a more significant role in the herring industry. Their combined herring fleets totaled approximately 1000 ships at the peak of the industry.[192] Holland's

187 Yntema, 1992, 25-28; Unger, 2001, 69.

188 Yntema, 1992, 30-53; Unger, 2001, 70; Alberts, 2010, 120.

189 Yntema, 1992, 61.

190 Unger, 1978, 337; Poulsen, 2008, 40.

191 Van Vliet, 2005, 28.

192 Van Bochove, 2004, 4; Poulsen, 2008, 46.

cities, in particular, emerged as the dominant force in the herring fishery.[193] Rotterdam, Brielle, Delfshaven, and Maassluis, situated in the Meuse estuary, and Enkhuizen, in the northern regions of Holland, collectively brought in an annual catch averaging around 25,000 last at the peak of the herring industry, in the first half of the 17th century.[194]

This information enables the quantification of the demand for herring casks by the Dutch herring fishery during the specified timeframe. According to historical sources, during the Late Medieval and Early Modern periods, one last of herring corresponded to 12–14 casks.[195] In this period, the standard equivalency is estimated to be 14 casks per last.[196] In other words, the annual demand for casks used by the Dutch herring fishery totaled approximately 350,000 casks.

In both the beer industry and the herring fishery, there was a significant demand for casks in coastal regions of the Netherlands in the Late Medieval and Early Modern periods. Local cooperies began to specialize in the production of casks specifically tailored for these products. To ensure consistency, various levels of authority (urban councils, provincial authorities, Habsburg rulers, etc.) issued legislation that mandated the specifications for beer and herring casks (e.g., height, number of staves, number of hoops). This legislation, preserved in archival sources, together with museum artefacts and casks from archaeological sites and depicted in paintings from the Low Countries shed light on the research question: how can Dutch herring and beer casks that were produced in the 15th till 18th centuries be identified?

5.2 Sources and methods

To help identify Dutch herring and beer casks built in the 15th to 18th centuries, various sources are used. These include legislation, its enforcement, and production and use of beer and herring casks.

Archival sources comprising legislation passed by various jurisdictions (urban, provincial and larger jurisdictions such as the Habsburg Empire) prescribe the specifications of beer and herring casks (size, capacity, number of staves, headboards, etc.) that were produced in the coastal regions of the Netherlands.

Monitoring the specifications of herring and beer casks, that is, ensuring compliance with legislation, was crucial for the industries, and was carried out by urban and guild councils. Amsterdam Museum contains gauge instruments that were used for this purpose, and they too are a data source for identifying casks.

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193 Van Vliet, 1994, 30.

194 Van Bochove, 2004, 4.

195 Harland, 2009, 2; Dijkman, 2011, 113.

196 Unger, 1980, 260. Each of these herring casks contained approximately 500 herrings.

Paintings of the Low Countries from the 15th to 18th centuries depicting beer and herring casks are another source used in this sub-study. Only artwork produced by artists from the Low Countries within the designated research period were analyzed. The paintings were accessed through the online database of RKD.[197]

Casks retrieved from maritime archaeology sites, that is, shipwrecks, proved most suitable for this sub-study because their original contents could have been preserved. Conversely, repurposed casks recovered in urban archaeology were not suitable because their original contents cannot be identified. Only casks found at shipwrecks in Dutch waters are included in this sub-study, as they can be directly linked to production activities in the Netherlands and consequently the corresponding legislation and enforcement in the region. The database of the Maritime Archaeological Depot of the Netherlands was consulted as a resource for this research.[198]

5.3 Cask specifications

Cooperies in the Netherlands produced casks for a wide variety of products. As stated, beer and herring casks were in highest demand. The specifications of casks differed depending on their purpose, and they also changed over time and varied from city to city. But in what manner did the casks for specific products differ from one another?

The capacity, and therefore the dimensions of casks, varied according to the product they were made for. The dimensions also impacted the number of staves in a cask. Finally, the number of parts comprising the head of a cask also varied (Figure 5.2).

Achieving a watertight seal was critical in cask construction. However, this was more important when the contents exerted pressure on the casks. The thickness of the staves, the number of hoops used, and the quality of the timber used were all factors that contributed to a watertight fit. These specifications varied depending on the products for which the casks were intended.

Access to the contents of the casks was essential. Usually large bungholes were made in the bilge of the casks, facilitating filling and emptying, as well as cleaning of the interior. Typically, the cask heads were not removed for filling, as both heads were fitted into the crozes of the staves and could only be taken out by loosening the hoops, which caused the staves to separate and open up the cask.

In casks designed to contain liquid, taps were fitted in tapholes to facilitate the extraction of the liquid. In most casks with tap holes, a small additional hole was

197 Database RKD Netherlands Institute of Art History, n.d.

198 Database Maritieme Opgravingsdocumentatie n.d.

made to allow air to enter while the liquid was being drawn. Occasionally, smaller holes were made for the purpose of sampling the liquid.

In summary, the following specifications varied in casks depending on the product it was designed for:

- Capacity
- Dimensions
- Number of staves
- Number of headboards
- Thickness of staves
- Hoop sets
- Timber used
- Type of hole

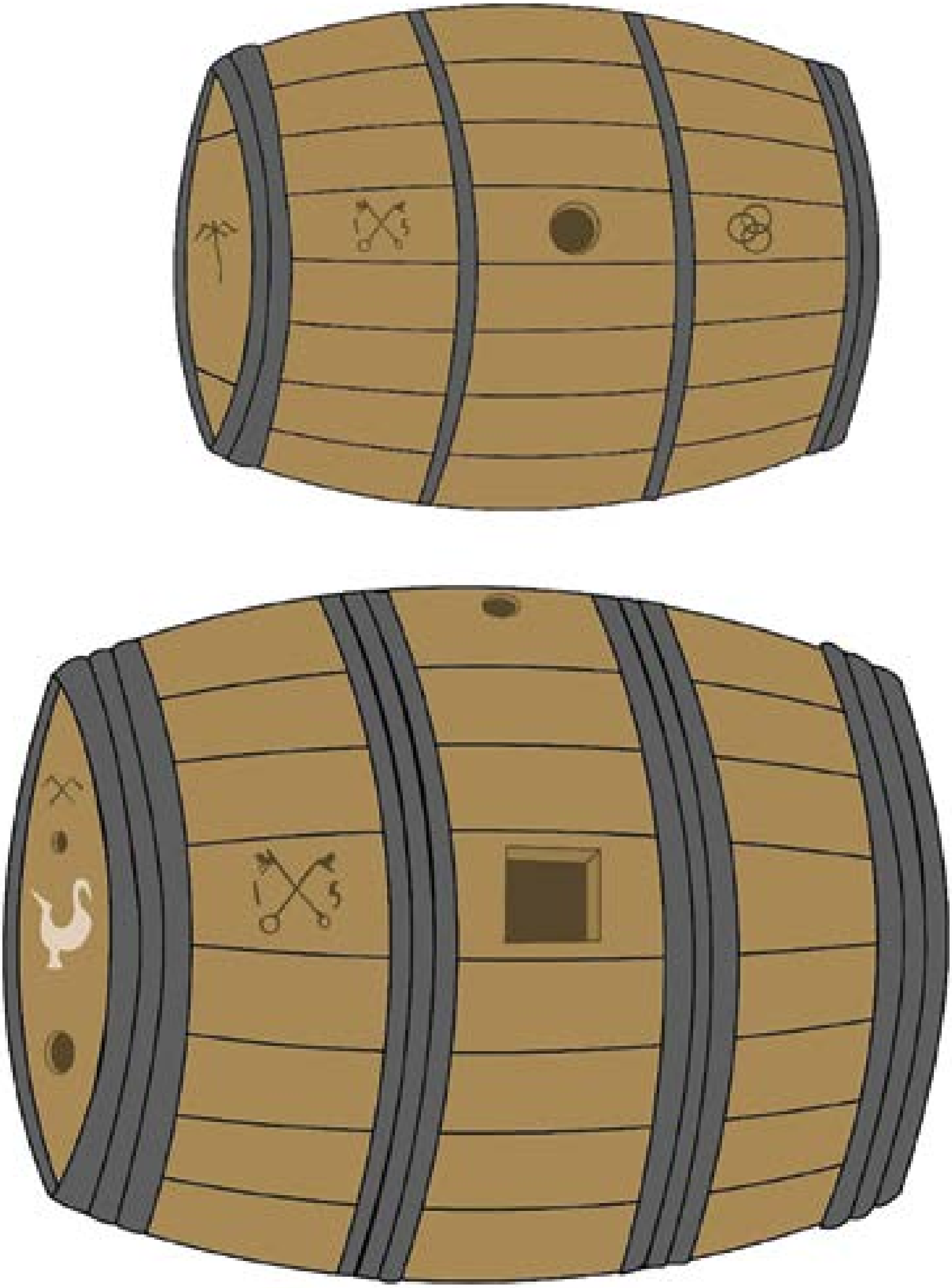

Figure 5.2: Artist impression of a herring cask (top) and a beer cask (bottom) in the Early Modern period.

5.4 Results

5.4.1 Legislated cask specifications

Legislation concerning beer and herring casks was enacted by various levels of authority. Each level of authority had its own legislative jurisdiction and formulated legislation accordingly. Urban authorities consisted of local government bodies and craft guild councils. They typically oversaw specific issues concerning cask construction, such as the thickness of the staves and the number of staves and headboards in a cask.

Provincial authorities also involved themselves in matters related to cask production. For example, Holland prescribed the capacity of casks in certain instances. Additionally, urban craft guilds that produced the same product sometimes joined forces to pursue common interests. The beer brewers of Holland formed the Generale Brouwers van Holland (General Brewers of Holland), while craft guilds in Zeeland and Holland specializing in the herring fishery established the College van de Grote Visserij (College of the Big Fishery).

Legislation of larger jurisdictions, such as the Habsburg Empire and the union of seven northern provinces following the Dutch revolt, dealt with matters affecting the entire region and was aimed at primary issues. In the case of beer and herring casks, these jurisdictions ruled on matters such as cask capacity and granted provinces and cities the right to collect taxes.

Beer casks

In the early 16th century, the beer industry in the coastal region of the Netherlands was regulated by both the Habsburg Empire and provincial authorities. According to a 1531 ordinance issued by the Habsburgs, new breweries were required to be located within city walls, transforming it into an urban industry from a rural one.[199]

Beginning in 1580, the province of Holland sought to gain influence over this significant industry by issuing ordinances targeting the brewing sector. However, Holland's efforts were frustrated when the Habsburg Empire granted certain privileges to brewing cities. For instance, Charles V granted privileges to the cities of Gouda and Haarlem concerning excise and other tax collection related to beer production.[200]

These privileges provided both cities with a considerable degree of autonomy in regulating their brewing industries, and both the brewers and urban authorities defended these privileges vigorously because of the potential income the industry

199 Yntema, 1992, 221.

200 Yntema, 1992, 221.

promised. However, urban brewers went beyond safeguarding their privileges and endeavored to influence decisions at the provincial level by establishing the Generale Brouwers van Holland in 1660, a lobbying group that remained active until 1811.[201]

Due to the efforts of this group and other initiatives by beer-producing cities, regulating how beer casks were produced remained primarily an urban concern.[202] This led to significant regional differences in legislation on beer casks and hence differences in their specifications.

The variation in urban legislation that affected beer casks, usually in the form of ordinances issued by city councils, is most notable in regulations about the capacity of casks. This is illustrated in Figure 5.3, which depicts prescribed beer cask sizes and how this changed over the course of two centuries. As the figure shows, the prescribed capacity of beer casks differed significantly across cities. For instance, in 1550, the specified beer cask capacity in Amersfoort was 131 L, in Amsterdam it was 155 L, and in Breda, 148.2 L. Additionally, the figure shows a trend of increasing beer cask size across cities beginning in the 15th century. This trend likely reflects urban preferences for larger beer casks, as these allowed for more accurate measurement of their contents, reduced the number of casks that needed to be checked, and made fraudulent practices harder to carry out.

Other aspects of beer casks were mostly regulated by craft guilds (Table 5.1). This legislation guided coopers to ensure beer casks met regulations and also facilitated officials in verifying that casks had been constructed according to the required specifications. In most instances, beer casks were required to be constructed with 15 staves with a minimum thickness of 1.4 cm each. Additionally, the use of newly crafted hoops was required, which meant old hoops could not be reused.

201 Timmer, 1918; Bakker et al., 1992, 178.

202 Yntema, 1992, 219.

Table 5.1: Specifications of beer casks from guild archives of various cities in the Netherlands.

	Gouda (1490)	Haarlem (1567)	Dordrecht (1606)	Amsterdam (1609)	Leiden (1743)
Capacity	Same size as Hamburg's casks	Prescribed size in ordinance of Haarlem	Reference to the correct sizes as ordered by the city council	Same size as Dordrecht's beer casks: 76 *stopen* (2.4 L x 76=182.4 L); 1/2 cask: 40 *stopen* (2.4 x 40=96.l L)	Same size as Dordrecht's beer casks
Number of staves	Not mentioned	Minimum of 14 staves	Minimum of 15 staves; 1/2 cask: 13 staves	Minimum of 15 staves; 1/2 cask: 14 staves	Minimum of 15 staves; 1/2 cask: 13 staves
Width of staves	Not mentioned	Not mentioned	Staves of equal width	Not mentioned	Not wider that 5 *duymen* (12.9 cm)
Thickness of staves	Not mentioned	Not mentioned	2/3 *duym* (1.71 cm)	Not mentioned	Minimum of 1.4 cm
Number of headboards	Not mentioned	Not mentioned	Maximum of 3 headboards	Not mentioned	Maximum of 3 headboards
Thickness of head	So thick that it cannot be bent by hand	Not mentioned	1/2 *duym* (1.3 cm)	Not mentioned	Not mentioned
Timber used	Good Prussian timber	Eastern timber of good quality, without sapwood	Dry timber without sapwood, knots or wormholes	Dry timber without sapwood, knots or wormholes	Dried oak without wormholes, bad knots or sapwood
Hoops	Simultaneously made hoops	Not mentioned	Simultaneously made hoops	12 simultaneously made hoops	16 simultaneously made hoops
Holes	Not mentioned	Not mentioned	Not mentioned	Bunghole must be made	Taphole and bunghole must be made
Source	Ordinance of the Coopers, 1490[203]	Kuiperskeur, 25 October 1567[204]	RAD, GC, No. 563/6 Ordonnantie op het maken van biertonnen, 1606.	Willekeuren van de Kuypers en Wijn-verlaters No. 11, 22 July 1609.[205]	Reglement Brander van de Biertonnen, 1743 [206]

203 Published in: Rollin Couquerque & Meerkamp van Embden, 1917, 105-106.

204 Published in: Huizinga, 1911, 426-431.

205 Published in: Smient & Smient, 1663, 497-498.

206 Published in: Luchtmans, 1743, 1 – 20.

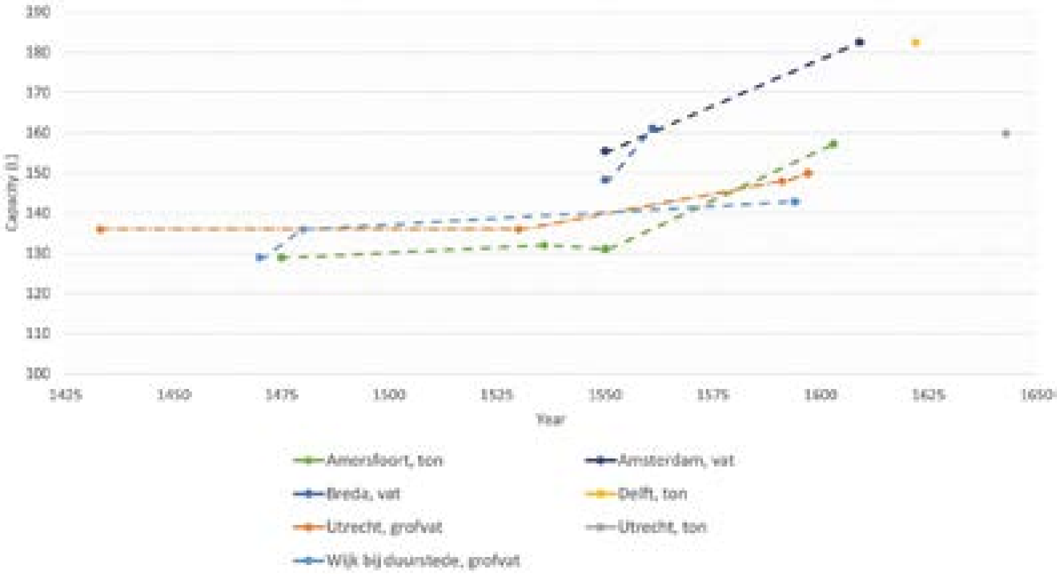

Figure 5.3: Diachronic change of beer cask capacity in cities in the Netherlands (sources: Alberts, 2010; Unger, 2001; Verhoeff, 1983).

Herring casks

During the Late Medieval period, rulers began standardizing herring casks in the provinces of Zeeland and Holland. For example, Duke Willem VI of Holland issued an ordinance in 1423 that mandated the size of casks in Brielle,[207] although the exact dimensions of these casks are not known. Despite measures being taken to protect the quality of herring by Holland and Zeeland, complaints about herring persisted in various cities during the mid-15th century. To address these concerns, new ordinances were introduced in the late 15th century, establishing the Dordrecht cask with a capacity of 120 L as the standard herring cask.[208]

At the beginning of the 16th century, the competition between the herring industries of Flanders and Holland reached its peak. To level the playing field, the Habsburg ruler issued an ordinance standardizing the size of herring casks that applied to both counties.[209]

As the 16th century drew to a close, Holland dominated the herring industry. To safeguard this position, several cities with significant herring industries formed the College van de Grote Visserij in 1567.[210] This organization served as a lobbying group dedicated to protecting the interests of Holland's and Zeeland's collective herring fishery. Through its efforts, the capacity of herring casks remained at 120 L.

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207 Beaujon, 1885, 7-8; Dijkman, 2011, 194.

208 Dijkman, 2011, 194.

209 Beaujon, 1885, 21.

210 Unger, 1980, 261.

Table 5.2: Specifications of herring casks in the ordinances of Holland and West Friesland.

	Holland and West Friesland (1619)	Holland and West Friesland (1699)
Capacity	Not mentioned	Not mentioned
Number of staves	Minimum of 13 staves	Minimum of 12 staves
Width of staves	Staves of equal width, minimum of 2 *duym* (5.1 cm), maximum of 5 *duym* (12.8 cm)	Staves of equal width, minimum of 2 *duym* (5.1 cm), maximum of 5 *duym* (12.8 cm)
Thickness of staves	minimum of 1/2 *duym* (1.3 cm) at the ends; 1/3 *duym* (0.9 cm) at the bilge	minimum of 1/2 *duym* (1.3 cm) at the ends; 1/3 *duym* (0.9 cm) at the bilge
Number of headboards	Maximum of 3 headboards	Maximum of 3 headboards
Thickness of head	Not mentioned	Not mentioned
Timber used	Good timber	Good timber
Hoops	Simultaneously made hoops	Simultaneously made hoops
Holes	Not mentioned	Not mentioned
Source	Placcaet ende Ordonnantie, beroerende het maken, keuren ende branden van de Haring-tonnen, 1619[211]	Placcaet ende Ordonnantie, beroerende het maecken, keuren ende branden van de Haring-Tonnen, 1699[212]

Other specifications of herring casks were mostly regulated by provincial authorities (Table 5.2). Urban craft guilds had less authority to prescribe the specifications of herring casks than they did of beer casks; coopers in various cities in Holland and West Friesland that were connected to the herring fishery had to comply with provincial specifications. Herring casks, in the main, were required to have at least 12 or 13 staves. The staves of herring casks were, with a minimum width of 0.9 cm, narrower than the staves used in beer casks by more than 1.4 cm. Additionally, new hoops had to be used, and reusing old hoops was mostly prohibited.

5.4.2 Enforcing cask specifications

Urban and guild councils were responsible for overseeing the enforcement of legislation concerning beer and herring casks. To this end, they used various instruments to measure the dimensions of casks, new and used, at weighing houses located in the coastal cities of the Netherlands. Several gauge instruments used to check casks appear in the painting *Amsterdam Coopers and Wine Merchants' Guild with Coopers*, shown lying on the floor (Figure 5.4).

211 Published in: Jacobs, 1619, 1 – 20.

212 Published in: Beman, 1699, 1 – 26.

Figure 5.4: Gauge set showing the bracket and ring on the floor in front of the table and the caliper behind the cask (The governors of the Amsterdam coopers and wine merchants' guild [Oil on canvas, Inv. no. SB 5402], by Gerbrend van den Eeckhout, 1673. Amsterdam Museum, The Netherlands.

The artefact collection at the Amsterdam Museum includes gauge instruments that were used in Amsterdam's weighing house. These instruments can be categorized into three distinct types (Figure 5.5):

- Gauge set. It consists of a ring, bracket and calipers that were used to measure the diameter of the cask at the top and at the bilge, as well as the height of the cask and the correct position of the heads within the staves.
- Croze gauge. This instrument is specifically designed to gauge the diameter of the top of the cask and its height.
- Gauge plank. The cask was placed on the plank horizontally and vertically to gauge the height of the cask and the diameter of the bottom of the cask, respectively.

Figure 5.5: Left: Gauge caliper, middle: croze gauge, right: gauge plank (left: Schuif el for herring cask [inv. no. KA 9532], 1722. Amsterdam Museum, Amsterdam, The Netherlands; middle: Kroos el for herring cask [inv. no. KA 9533], 1722. Amsterdam Museum, Amsterdam, The Netherlands; right: Measuring plank for herring cask [inv. no. KA 9972], Unknown date. Amsterdam Museum, Amsterdam, The Netherlands; The casks used in all of the three examples: Half herring cask [inv. no. KA 9921], unknown date. Amsterdam Museum, Amsterdam, The Netherlands).

Beer casks

The gauge instruments from the Amsterdam Museum provide insight into how the required specifications of beer casks were checked to ensure compliance during construction. The cask type for which the instrument was designed and the year and city in which it was commissioned are etched into the tool. It is notable that on the gauge instruments for beer, the city is etched next to the type of cask. This underlines the possibility that beer casks from different cities differed in size. However, the gauge instruments in the Amsterdam Museum's collection were used to monitor beer casks made by the specifications of the city of Dordrecht, and consequently, a comprehensive comparison between cities based on these gauge instruments is not possible. The specifications of casks from Dordrecht can be traced diachronically from 1658 to 1801. The cask specifications were consistent throughout this period. For instance, the lengths of beer cask staves show only minor variation, measuring 82.1 cm in 1658 and 82.6 cm in 1801 (Table 5.3).

Table 5.3: Specifications of Dordrecht beer casks calculated using the gauge instruments from the Amsterdam Museum. The capacity was calculated using the formula for the calculation of a cylinder: π x r2 x h. To incorporate the height of the cask, the distance between the crozes was included in the formula. To account for the curvature of the cask, the averages of the maximum and minimum radiuses were used. The inventory numbers of the instruments are those of the Amsterdam Museum.

Type of cask	Year	Text on gauge instrument	Length of staves	Croze distance	Max. Ø (cm)	Min. Ø (cm)	Capacity (L)	Inv. No.
Beer cask	1658	A:1658 XXX DORTSE BIER TON BESLAAT 15 DUYGEN	82.1	71.1	58	56	56	KA9500, KA9501, KA9508
1/2 beer cask	1658	A: 1658 XXX DORTSE BIER 1/2 VADT	68.8	61.5	45.5	43	43	KA9502, KA9503, KA9508
1/4 beer cask	1658	A: 1658 XXX DORTSE BIER 1/4	57.0	49.5	35.5	34	34	KA9504, KA9505, KA9508
1/8 beer cask	1658	….TSE BIER 1/8 TON	48.4	40.9	27.7	26	26	KA9899, KA9508
1/8 beer cask	1769	XXX A1769 Dort-se bier 1/8 ton	42.8	40.8	27.8	25.5	25.5	KA9506, KA9507, KA9509
Beer cask	1801	A 1801 Dortse bier el	82.6	71.5				KA9964
1/2 beer cask	1801	A 1801 Dortse bier el	68.3	61.0				KA9964
1/4 beer cask	1801	A 1801 Dortse bier el	55.0	46.5				KA9964
1/8 beer cask	1801	A 1801 Dortse bier el	41.8	37.5				KA9964

Herring casks

The gauge instruments at the Amsterdam Museum also provide insight into the specifications of herring casks from 1658 until the 19th century (Table 5.4). Additionally, the museum's collection includes three intact herring casks[213], which likely served as the standard by which herring casks were measured at the weighing house in Amsterdam. Unlike the gauge instruments used for beer casks, the ones used for herring casks do not bear inscriptions indicating the city in which they were used. This suggests that the dimensions of herring casks measured in Amsterdam were widely adopted.

213 Amsterdam museum, KA 9920, KA 9921, and KA 9922.

The oldest gauge instrument that enables the calculation of cask capacity dates from 1722.[214] Its capacity of 120.7 L closely aligns with the prescribed capacity for herring casks mentioned in archival sources. The inclusion of an intact 19th-century herring cask[215] in the collection, with a capacity of 119.9 L, suggests that the capacity measure remained consistent in the 18th and 19th centuries.

Table 5.4: The specifications of herring casks in Amsterdam calculated using the gauge instruments from the Amsterdam Museum. The capacity was calculated using the formula for the calculation of a cylinder: ϖ x r2 x h. To incorporate the height of the cask, the distance between the crozes was included in the formula. To account for the curvature of the cask, the averages of the maximum and minimum radiuses were used. The inventory numbers of the instruments refer to the Amsterdam Museum.

Type of cask	Year	Text on gauge instrument	Length of staves	Croze distance	Max. Ø (cm)	Min. Ø (cm)	Capacity (L)	Inv. No.
Herring cask	1658	B XXX 1658 HARING TON			51.7	49.1		KA9524, KA9525
1/2 herring cask	1658	1658 1/2 HA-RING VADT			40.5			KA9903
1/2 herring cask	1658	1658 1/2 HA-RING VADT			40.5			KA9527
1/8 herring cask	1658	B 1658 HARING 1/8				24.5		KA9530
1/8 herring cask	1658	B1658 XXX HA-RING 1/8				26.6		KA9531
Herring cask	1722	17 XXX 22 HA-RING EL	71.4	65.1	49.6	47.6	120.7	KA9533
1/2 herring cask	1722	17 XXX 22 HA-RING EL	57	50.5	40.1	38.6	61.4	KA9533
1/4 herring cask	1722	17 XXX 22 HA-RING EL	44	39.5	29.9	28.5	26.4	KA9533
1/8 herring cask	1722	17 XXX 22 HA-RING EL	35.5	30.5	24.4	23.2	13.5	KA9533
1/4 herring cask	1722	B 1722 XXX HARING 1/4						KA9528, KA9529, KA9532
Herring cask	1770	B 1770 XXX HARING EL	70.4					KA9965
1/2 herring cask	1770	B 1770 XXX HARING EL	55.5					KA9965
1/4 herring cask	1770	B 1770 XXX HARING EL	44.8					KA9965

214 Amsterdam museum, KA 9533.

215 Amsterdam museum, KA 9920.

Type of cask	Year	Text on gauge instrument	Length of staves	Croze distance	Max. Ø (cm)	Min. Ø (cm)	Capacity (L)	Inv. No.
1/8 herring cask	1770	B 1770 XXX HARING EL	36.5					KA9965
Herring cask	1800–1900		69.5	63.6	51	47	119.9	KA9920
1/2 herring cask	1800–1900		54.5	51.5	40	37.2	60.2	KA9921
1/8 herring cask	1800–1900		33.5	29.5	24	22.5	12.5	KA9922

5.4.3 Cask specifications in paintings

An important source for determining cask specifications are paintings from the Late Medieval and Early Modern periods. They shed light on certain characteristics that are absent in archival sources, such as the number and size of holes and the number of hoops per cask. Furthermore, paintings provide information on cask characteristics that are also documented in archival sources, and can thus be considered supplementary, such as the number of staves and headboards.

Using RKD's online dataset to analyze paintings containing casks, 105 beer casks and 44 herring casks were identified.[216] They were identified as either beer or herring casks based on their visible contents or the context in which they are situated in the paintings, such as an inn or a fish market. An example of features of both a beer cask and a herring cask (with the herring still visible) can be seen in an early 17th-century painting of the Battle between Carnival and Lent (Figure 5.6). The analyzed paintings date from 1554 to 1896 and exhibit specifications that can be cross-referenced with the legislation in archival sources.

216 *Database RKD Netherlands Institute of Art History, n.d. Images. The permalink for each of the following items consists of https://rkd.nl/explore/images/ followed by the item number. Beer: 69302; 283908: 4458; 213986; 229649; 278577; 4668; 4668; 11802; 225869; 117159; 233053; 265643; 57218; 57218; 290228; 290228; 239904; 298401; 217593; 60070; 37837; 199782; 259744; 199199; 199211; 5478; 203680; 8050; 19140; 199804; 199842; 199848; 199775; 199789; 213653; 214299; 186007; 232082; 53928; 102799; 45693; 121195; 105198; 110347; 35163; 102521; 276157; 276158; 276160; 275614; 306258; 191422; 69843; 274171; 56366; 196863; 241341; 281224; 67551; 27097; 193487; 286178; 228311; 201979; 209910; 242323; 193431; 102368; 59859; 290440; 241087; 305300; 263211; 231964; 290108; 6076; 69481; 303256; 301495; 224450; 62856; 107370; 247498; 276174; 285154; 260773; 205041; 303537; 6528; 6383; 24844; 1042; 227955; 19426; 308253; 257026; 206615. Herring: 103056; 121618; 106892; 30922; 253392; 114259 ; 202737; 102090; 69302; 105742; 25489; 270017; 281776; 246652; 246844; 308190; 107794; 203737; 60266; 239117; 239117; 239117; 239117; 252144; 254827; 254827; 227828; 253392; 114149; 246844; 233603; 107169; 246785; 258013.*

Figure 5.6: On the left, a beer cask, identified as such because of its association with meat and waffles, is part of Carnival. On the right, a herring cask, along with ecclesiastical figures, is illustrative of Lent, a period of fasting (The Battle between Carnival and Lent [Oil on panel, private collection], by unknown artist, follower of Pieter Bruegel, 1600–1625. Database RKD Netherlands Institute of Art History, n.d., https://rkd.nl/explore/images/69302).

Of the 105 beer casks identified in the paintings, 48 were visible in such a way that 40% of the cask could be seen. This resulted in an average number of 5.9 visible staves per beer cask (Table 5.5). The average number of visible staves of herring casks was 5.7 (on 20 out of 44 casks identified in the paintings). These findings align with the 1606 legislation on beer casks in Dordrecht, which specified that a beer cask should consist of a minimum of 15 staves (Table 5.1). It should be noted that since the casks in the paintings are depicted from a single perspective, only 40% of the staves are visible. The same legislation from Dordrecht prohibited a head of more than three components (Table 5.1). The beer casks in the paintings were in compliance with this legislation in most cases. Only three beer casks had heads of more than three components.

The presence of holes in casks, often absent in archival sources, can be considered a distinguishing feature of casks intended for specific products. Among the 105 beer casks depicted in paintings, a total of 96 holes were shown. Similarly, among the 44 herring casks depicted, 29 holes were visible. These holes can be categorized as bungholes, tap holes, ventilation holes and sampling holes (Figure 5.7).

Table 5.5: Number of stave and headboards of casks in paintings.

Number of staves	**Beer (105 casks)**	**Herring (44 casks)**
Number of casks on which one side of the casks is completely visible	48	20
5 staves	21	13
6 staves	16	2
7 staves	8	4
8 staves	3	1
Average number of staves	5.9	5.7
Number of headboards		
Number of casks of which at least one head was visible	13	2
1 headboard	7	0
2 headboards	1	0
3 headboards	2	1
4 headboards	1	1
5 headboards	2	0
Average number of headboards	2.2	3.5

Both herring and beer casks had bungholes. These holes were used to fill and empty the cask, and they also provided access to the cask for cleaning the interior. In herring casks, 87% of the bungholes were round. In beer casks, about equal numbers of holes were square or round (Table 5.6). There was no specific period in which either round or square bungholes were used in beer casks; they both appear continuously throughout the Modern period.

The relatively higher occurrence of square bungholes in beer casks may be linked to differences in functional demands and maintenance practices compared to herring casks. Beer casks were likely reused more frequently, requiring more intensive internal cleaning to maintain hygiene and product quality. The larger, square openings may therefore have facilitated easier access for cleaning, scraping, and inspection of the cask interior than round bungholes. Although this hypothesis is plausible, it has not been specifically investigated within the present doctoral research.

Both beer and herring casks generally exhibited sets of the same number of hoops, with both types having, on average, four sets of hoops binding the staves. However, a notable difference between the two is the presence of markings on the casks. The paintings showed 13 marks on beer casks, while herring casks only displayed 3 marks (Table 5.6).

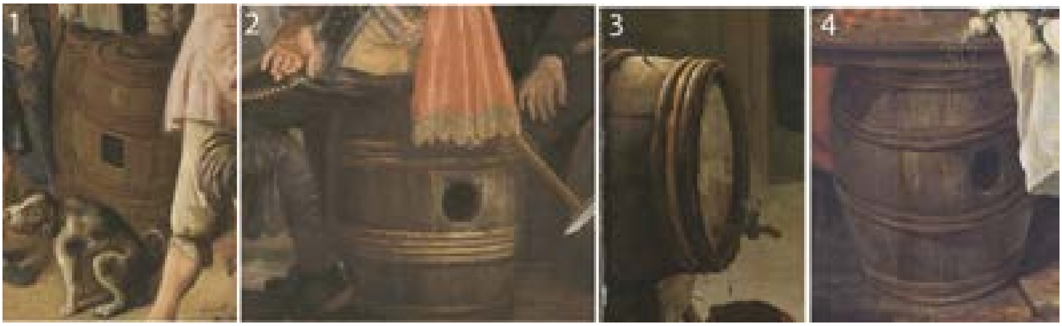


Figure 5.7: Paintings of casks with holes. 1. Square bunghole in beer cask, 2. Round bunghole in beer cask, 3. Taphole and ventilation hole in beer cask, 4. Round bunghole in herring cask. Sources: 1. Folk singers selling their songs [Oil on canvas, private collection], Jan Miense Molenaer, first half of 1630s. Database RKD Netherlands Institute of Art History, n.d., https://rkd.nl/explore/images/217593; 2. Banner of captain Roelof Bicker and lieutenant Jan Michelsz. Blaeuw at the brewery 'De Haan' on the corner of the Lastage (corner Geldersekade and Boomsloot) in Amsterdam [Oil on canvas, inv./cat.nr. SK-C-375], by Bartholomeus van der Helst, c. 1640-1643. Rijksmuseum, Amsterdam, The Netherlands; 3. Peasant inn [Oil on canvas, inv. no. S527], by Frans van Mieris (de Oude), c. 1655. Museum de Lakenhal, Leiden, The Netherlands; 4. An Old Woman Selling Fish [Oil on canvas, inv. no. P234], by Gabriel Metsu, 1657-1662. Wallace collection. London, United Kingdom).

Table 5.6: Holes, hoops and marks of casks in paintings.

Holes in casks	**Beer (105 casks)**	**Herring (44 casks)**
Number of holes	96	29
Bunghole (round)	37	13
Bunghole (square)	36	2
Tap hole	21	0
Ventilation hole	2	0
Sampling hole	0	0
Number of hoops per set		
Number of casks on which all hoops are visible	65	24
2 sets of hoops	2	1
3 sets of hoops	9	2
4 sets of hoops	53	19
5 sets of hoops	0	1
6 sets of hoops	1	1
Average number of hoops per set	3.8	4
Marks on casks		
Number of marks	13	3
Marks on heads	10	0
Marks on staves	3	3

5.4.4 Casks in maritime archaeological context

Casks are common artefacts in the excavation of shipwrecks. They served as containers for merchandise, ship equipment and crew provisions. This explains why casks are found not only on merchant ships but also on fishing vessels and warships.

It might be expected that casks containing either beer or herring would be frequently discovered during shipwreck excavations in Dutch waters given the importance of these industries. However, the opposite is true. In the case of Dutch shipwrecks, only three casks can be confidently identified as having contained herring, based on the presence of herring residue inside them.[217] No beer casks have been found in this way during maritime archaeological investigations, which is not surprising given that beer would have dispersed after the ship sank.

A possible explanation for the paucity of beer and herring casks in Dutch maritime archaeology is that a significant number of casks were found disassembled, making it difficult to ascertain their original contents. Furthermore, not all content leaves detectable residue in casks. While the herring can be identified by the presence of fish bones, the remnants of liquids such as beer or wine are not easily traceable.

On the 16th-century shipwreck OM11, also known as the *Biddinghuizer Colfschip* because of the discovery of 16 remarkably well-preserved golf clubs on board, three casks containing herring bones were recovered (Figure 5.8; Table 5.7). One is a full herring cask and two are quarter casks. Based on archival legislation and the gauge instruments used for monitoring, we know that the prescribed capacity of a full herring cask was 120 L, which coincides with the capacity of the herring cask found on the *Biddinghuizer Colfschip*.

Figure 5.8: Herring cask OOM11_1 from the Biddinghuizer Colfschip (Lauwerier & Laarman, 2008).

217 *Database Maritieme opgravingsdocumentatie, n.d.*

Table 5.7: Specifications of beer and herring casks recovered from the Biddinghuizer Colfschip.

Ship-wreck	Cask identi-fication	Cask type	Date of wreck	Height of cask (cm)	Max. Ø (cm)	Min. Ø (cm)	Thickness of staves (cm)	Capaci-ty (L)
OM11	OOM11_1	1/4 her-ring cask	16th century	41.5	31	28	1.1	24.6
OM11	OOM11_2	Herring cask	16th century	73	51	44	1.1	119
OM11	OOM11_3	1/4 her-ring cask	16th century	42	31	28	1.1	24.6

5.5 Conclusion

Studying the source types used in this chapter in tandem provided insight into the identification of 15th–18th-century beer and herring casks. Data concerning cask construction was derived from archival legislative sources produced by authorities ranging from the Habsburg Empire to provincial authorities to urban councils. Gauge instruments from the Amsterdam Museum were used to create the dataset on the monitoring of specifications of casks. Beer and herring casks depicted in paintings and recovered at maritime archaeology sites were studied in order to gain insight into casks that were being used. Each type of source offered valuable insights into casks from specific timeframes within the research period, and a unique set of cask specifications was derived from each source type (Table 5.8).

The data on cask specifications garnered from legislation, museum artefacts, and artwork and shipwrecks corroborate each other for the most part. For example, a capacity of 120 L for herring casks was consistently documented in archival sources from the Late Medieval period throughout the Early Modern period. The standard 120-L capacity for herring casks was first instituted in the 15th century in the coastal region of the Netherlands and remained in place for several centuries. This capacity measure was also verified by one of the 1722 gauge instruments from the Amsterdam Museum (Table 5.4).[218] Additionally, the only full herring cask discovered in the *Biddinghuizer Colfschip* also had a capacity of 120 L (Table 5.7, OOM11_2). Unlike herring casks, beer casks from the coastal region of the Netherlands varied in volume throughout the Late Medieval and Early Modern periods.

There are several explanations for this disparity. Herring from Zeeland and Holland were marketed collectively; consumers bought herring from a province and not from a specific city such as Enkhuizen or Rotterdam. As a result, herring producers were more amenable to standardization. Conversely, a beer's reputation remained closely tied to the city or brewery of origin, much like it is today.

218 Amsterdam Museum, inv. no. KA9533.

Additionally, there was a broader array of beer types, such as *kuit* beer, *hop* beer, and *gruit* beer, each associated with specialized breweries. This diversity in beer types prevented interregional and national standardization of beer casks.

Table 5.8: Types of sources used to determine timeframe and specifications of beer and herring casks.

	Legislation: Archival sources from large, regional jurisdictions	**Legislation: Archival provincial sources**	**Legislation: Archival urban sources**	**Enforcement: Museum artefacts**	**Casks in use: Paintings**	**Casks in use: Archaeology**
Timeframe	1423–1900	1481–1900	1392–1900	1658–1900	1554–1900	1500–1900
Capacity	X	X		X		X
Number of staves		X	X	X	X	X
Width of staves		X	X			X
Thickness of staves		X	X			X
Number of headboards			X		X	X
Thickness of head		X	X			X
Timber used		X	X			X
Hoops		X	X		X	X
Holes			X		X	X

Another contributing factor is financial in nature. Herring played a smaller role than beer in the economies of provinces like Holland. Urban income relied heavily on tax revenue from beer, leading local authorities to fiercely protect their tax collection privileges. As a result, regulations concerning beer often remained the jurisdiction of urban authorities rather than that of larger administrative bodies.

This sub-study offers valuable insights into the specifications of beer and herring casks. Some of the specifications were more useful than others in identifying casks (Table 5.9). Other specifications, such as the width of staves, number of headboards, thickness of the head, and the type of timber and hoops used were found to be widespread and were of limited value in the identification process.

Table 5.9: The most distinctive features of beer and herring casks.

	Beer casks	Herring casks
Capacity	Capacity of casks differed, depending on the city of origin. Beer casks mostly had a larger capacity (>130 l) than herring casks.	120 L from the late 15th to 18th century.
Number of staves	Minimum of 14/15 staves for a full beer cask and 13/14 staves for a 1-2 beer cask.	Minimum of 12/13 staves for a full herring cask.
Thickness of staves	Minimum of 1.4 cm.	Minimum of 0.9 cm.
Holes	A round or square bunghole in the bilge of beer casks, a round taphole in the head and sometimes a round ventilation hole in the extremity of a stave or the head.	Only a bunghole in the bilge of the cask; mostly round.

A variety of source types offers valuable insights into the characteristics of beer and herring casks from the coastal regions of the Netherlands during the Late Medieval and Early Modern periods. It successfully identified several distinct features of these casks. Hopefully, this research will inspire archaeologists and historians to collect additional data on beer casks, herring casks, and casks used for other products, further enriching our understanding of their contents.

Acknowledgements

The archival sources were carefully interpreted, assisted by the Paleography workgroup in Zeeland (PaiZ), with heartfelt appreciation to Dr. Ferry Zwaan, whose invaluable insights greatly enriched the analysis. Furthermore, Dr. Roos van Oosten from Leiden University provided valuable guidance in shaping the study and identifying relevant sources, along with valuable feedback on various drafts of this sub-study. Gratitude is also extended to Kerry Fast for her expert editing of the text and to Jenny Poelen of Blinq communicatie for designing Figure 5.2.

6. Repurpose of casks

6. Repurpose of casks

6.1 Introduction

This chapter examines the repurposing of casks in the Netherlands during the Late Middle Ages and Early Modern period, the last phase in the lifecycle of casks (Figure 6.1). Although casks were originally produced for the storage and transport of goods, they continued to serve a wide variety of purposes long after their primary function had ended. Their sturdy wooden construction made them suitable for a wide range of secondary uses. The following sections first discuss the different ways in which casks were repurposed, after which the research design of this case study is presented, focusing on their repurpose as cesspits and water wells in the Dutch town of Vlissingen.

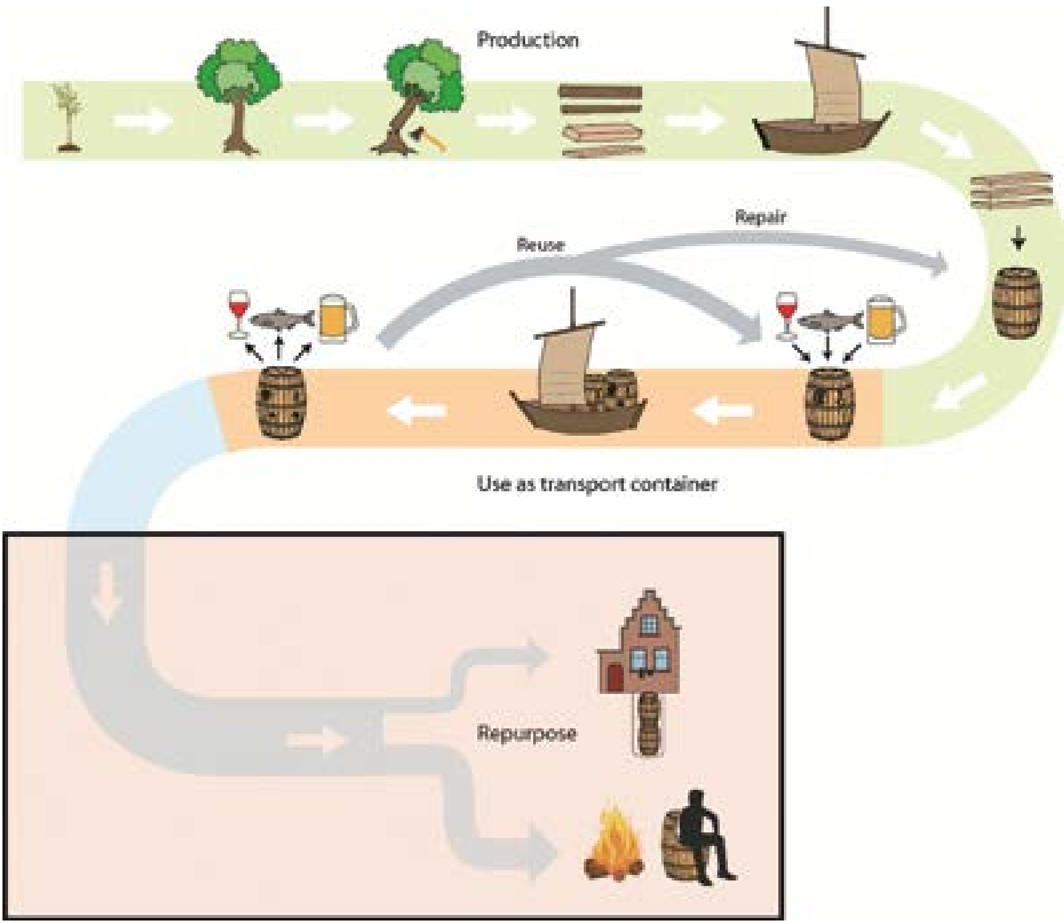


Figure 6.1: Schematic overview of the lifecycle of a cask. Production phase – green; its use as a transport container – orange; repurposing – blue. The frame highlights the part of the casks' lifecycle that is discussed in this chapter.

6.1.1 Repurpose practices of casks

Casks were employed in a broad variety of repurpose practices. They were, for instance, transformed into household furniture such as chairs and tables (Figure 6.2_1, 2) and frequently served as storage containers in homes. Beyond domestic settings, casks were also repurposed in maritime contexts, as buoys to mark underwater hazards or navigational routes critical to shipping and trade. In the fishing industry, casks served as effective flotation devices for fishing nets, a technique common especially in the operation of herring fleets (Figure 6.2_3). Through the wide range of repurposing possibilities, casks became a common feature in the streetscape of the Late Middle Ages and Early Modern period.
Even if casks were dismantled, their individual parts were not discarded. Staves were repurposed for various purposes in urban environments, for example, for frameworks for fences or flooring (Figure 6.2_4). Eventually, when no other use was viable, the wooden remnants of casks could be used for firewood.

Figure 6.2: Examples of repurposed casks: 1. A cask used as a table; 2. Casks used as chairs; 3. Casks used as flotation devices for fishing nets; 4. Staves repurposed as flooring. Sources: 1. Merry company of peasants playing music, smoking and drinking [Oil on canvas, private collection], by Bartholomeus Molenaer, 1640–1650. Database RKD Netherlands Institute of Art History, https://rkd.nl/images/298401; 2. Company drinking and smoking in an interior [Oil on canvas, private collection], by Jan Molenaer, 1669–1702. Database RKD Netherlands Institute of Art History, https://rkd.nl/images/259744); 3. Shipping in calm waters [Oil on canvas, private collection], by Willem Van Diest, 1629–1668. Database RKD Netherlands Institute of Art History, https://rkd.nl/images/257584); 4. Oosterbaan & Griffioen, 2015, 85.

The best-known repurposing of casks in archaeology is their use as shafts of cesspits and water wells (Figure 6.3). The heads of the casks were removed, and then the casks were stacked vertically to form the shaft. In this way, casks took on a structural function as part of a construction technique. During installation, the casks also functioned as a temporary casing; digging was done from inside the cask, thus gradually the cask shaft was sunk deeper into the ground, and more casks were added vertically during the process. The shaft could thus be dug to the required depth with minimal surface disturbance and significantly reducing the risk of collapse during digging. Archaeological remains of cask shafts often exhibit only a narrow cut in the soil, significantly smaller than the wide pits associated with brick-lined cesspits and water wells.[219] Due to the favourable soil conditions in the Netherlands, typically waterlogged, these wooden structures have been well preserved and have been systematically recorded by archaeologists.

Figure 6.3: An example of three repurposed casks that form a cesspit, Vlissingen, dated between 1425 and 1525. Left: the exterior view of the casks; right, the contents of the cesspit (Oosterbaan & Griffioen, 2015, 355).

219 Van Oosten, 2015, 85.

6.1.2 Research design

Although considerable research has been conducted on cesspits and wells,[220] no systematic comparison between cask-lined shafts and their brick-lined counterparts has been undertaken in the Netherlands. As a result, the factors that influenced the choice between the two types of lining remain unclear.

Van Oosten, in a comprehensive study focused on cesspits, put forward several preliminary hypotheses.[221] One key consideration may have been financial. Repurposed wooden casks likely involved lower material costs and, since installation took less time, labour costs would have been less as well.[222] Additionally, soil conditions likely played a role. In areas with unstable or marshy subsoil, cask-lined shafts would have provided a safer working environment because of the reduced risk of the soil collapsing. Another plausible explanation for the choice of cask lining is the ready availability of discarded casks that could be repurposed. In cities where such casks were abundant, this option may have been favoured due to convenience and lower cost.

In this chapter, a case study approach is taken in an examination of the construction of cesspit and water well shafts. The case study is focused on the city of Vlissingen. Three key factors are examined: soil conditions, economic considerations, and availability of material. The research question asks what factors determined the choice between bricks and repurposed casks in the construction of cesspits and water wells in urban Vlissingen during the Late Middle Ages and Early Modern period.

This study was carried out as a single-city case study to eliminate confounding effects from differences in construction practices, regulations, and environmental conditions between cities. Van Oosten's study demonstrated that urban authorities issued specific regulations regarding the management of waste and human excrement, for example, Haarlem's regulations aimed at protecting urban waterways.[223] Construction practices also varied between cities. In 's-Hertogenbosch and Dordrecht, for example, cesspits and cellars were often designed to serve multiple households living on one parcel of land, where large, rectangular pits or cellars were constructed.[224] In addition, relatively few cesspits have been found in inland cities compared to coastal cities. This may be because human waste held greater economic value for farmers in the areas around inland cities. Differences in subsoil conditions, ranging from stable sandy soils to marshy clay or peat, could also have significantly impacted how cesspits were built. By limiting the scope of research to one city, a more controlled analysis is possible.

220 Baart, 1982, 1983; Baart et al., 1986; Bartels, 1999; Sarfatij, 1999, 2007; Thijssen, 1985; Van Oosten, 2015.

221 Van Oosten, 2015.

222 Van Oosten, 2015, 83–84.

223 Van Oosten, 2015, 130.

224 Van Oosten, 2015, 326.

Vlissingen was chosen because of its economic and material conditions. As a major trading port with a thriving herring fishery and active coopers' guild, and playing a key role in the distribution of goods to Antwerp, Vlissingen had an abundance of casks. This is reflected in a relatively high number of both brick-lined and cask-lined cesspits and water wells that have been uncovered in Vlissingen. The combination of socioeconomic context and diverse archaeological evidence makes Vlissingen a good place to explore the repurposing of casks in an urban setting.

In recent decades, three large-scale archaeological excavations have been carried out in different parts of Vlissingen's historic city centre from which well-documented data is available. The excavations are known by the toponyms Groote Markt,[225] Spuistraat,[226] and Dokkershaven.[227] The excavations were done in various areas of the city and include several phases of the city's expansion. This ensures that the dataset is balanced. Finally, an investigation of several locations makes it possible to examine small but significant differences in soil conditions across Vlissingen.

Dataset

The dataset consists of all features identified as *beerput* (cesspits), *waterput* (water wells), and *tonput* (barrel wells) from the excavations at Groote Markt, Spuistraat, and Dokkershaven (Table 6.1), but only features with a circular shape were selected for this case study. For each feature, the dataset includes the exact location of the feature, extracted from the excavation data such as trench and feature number; height data, specifying the highest and lowest documented levels; and a date, based on the dating of the artefact assemblage found in the feature.

The identification, whether cesspit or water well, is also recorded. Features initially classified as "barrel well" in the dataset have been reassigned either to the cesspit or water-well category for this case study, based on excavation and contextual data. The construction material, whether cask or brick, is also noted for each shaft. In some cases, hybrid constructions were observed where the upper part of the shaft was made of brick and the lower segment with one or more casks.

For features with cask linings, the dataset also includes detailed measurements of the individual casks used, height, maximum diameter, and minimum diameter. The final dataset comprises 226 entries. The following table shows the number of records related to each excavation.

225 *Oosterbaan & Griffioen, 2015.*

226 *De Boer et al., 2010.*

227 *Claeys et al., 2010.*

Table 6.1: Number of cesspits and water wells per excavation.

Toponyms excavation	Number cesspits	Number of water wells	Total	Surface excavated
Vlissingen Groote Markt	72	51	123	5705 m2
Vlissingen Spuistraat	15	10	25	2851 m2
Vlissingen Dokkershaven	31	47	78	10000 m2
Total	**118**	**108**	**226**	**18556 m2**

Vlissingen Groote Markt

The excavation at Groote Markt was carried out by Archaeological Research and Consultancy (ARC BV) in two phases in 2011 and 2012. The research area was divided into three areas, identified as areas A, C, and E with a combined excavation area of 5,705 m² (Figure 6.4).

These areas are located in the western part of Vlissingen's historic city centre. The southernmost area (C) lies directly along the Groote Markt and was first developed for residential use in the 14th century. The other two areas (A and E) are situated near the outer edge of late medieval Vlissingen and were not settled until the 16th century.

For many of the land parcels excavated, tax records are available from registers dating from 1580. These records show that property owners of areas A and E were taxed 1% of the assessed value, offering valuable insight into the relative value of the properties at that time.[228]

Vlissingen Spuistraat

The excavation Spuistraat was conducted by ADC ArcheoProjecten in several phases between November 2004 and February 2005. In total, 2,851 m² of surface area was investigated (Figure 6.4).

The excavation took place in the heart of the historic city centre. Remains of residential structures were uncovered dating back to the early 15th century, as well as remains of Vlissingen's former harbor and the Sint-Jacobskerk and adjacent cemetery.[229]

228 Oosterbaan & Griffioen, 2015, 52. Details of the Vlissingen Groote Markt excavation are from Oosterbaan & Griffioen, 2015.

229 De Boer et al., 2010, 242. Details of the Vlissingen Spuistraat excavation are taken from De Boer et al., 2010.

Vlissingen Dokkershaven

The excavation Dokkershaven was carried out by ADC ArcheoProjecten during the winter of 2007–2008, near the Dokhaven. It was by far the largest of the three investigations, covering a total area of approximately 10,000 m² (Figure 6.4).

This excavation was conducted outside of the 16th-century city centre. The area only became part of Vlissingen following the eastward expansion of the city at the end of the 16th century. Most of the buildings within the excavation area were constructed between 1609 and 1614, when a new harbor (Dokhaven) was developed on the east side of the city.[230] The excavation uncovered parts of the dock lock and adjacent warehouses. In addition, remnants of three churches with graveyards were found. The site also revealed building remains dating from the 17th century onwards, both worker housing and residences of prominent citizens.[231]

Figure 6.4: Excavation sites projected onto a current topographic map of Vlissingen.

230 Claeys et al., 2010, 37.

231 Details of the Vlissingen Dokkershave excavation are taken from Claeys et al., 2010.

Chronology of dataset

Of the 226 cesspits and water wells investigated, 180 could be dated, primarily based on datable finds recovered from the features (Table 6.2). In some instances, relative dating methods were also applied, relying on the spatial relationship between the feature in question and other dated features. This information was used to establish a detailed chronology, which has been incorporated in the dataset.

In the other 46 records, no detailed chronology could be established due to several reasons. In some cases, no datable finds were available because the features had been emptied at some point. This practice occurred relatively frequently in Vlissingen, where in particular cesspits, attracted the attention of people outside the archaeological community hoping to find items of value. In addition, it is possible that certain features received less attention from archaeologists due to the sheer volume of features and materials uncovered. In the selection process, these features were excluded from thorough investigation.

The following table presents an overview of the initial dating of cesspits and water wells from the dataset, grouped into half centuries. The focus is on the starting date, as this case study aims to investigate the factors that influenced decisions to construct cesspits and wells.

Table 6.2: Number of cesspits and water wells, by construction date.

Context dates	Number of cesspits and water wells
1300–1349	1
1350–1399	0
1400–1449	7
1450–1499	6
1500–1549	40
1550–1599	42
1600–1649	54
1650–1699	6
1700–1749	4
1750–1799	2
1800–1849	13
1850–1900	5
No context date	46
Total	**226**

Source criticism

The combined area of the three Vlissingen excavations is only a small portion of the historic city centre. Of the area within the earlier city limits of Vlissingen in 1550, in which the Groote Markt and Spuistraat are located, approximately 5.5% has been excavated. Within the later city limits, expanded in the late 16th and early 17th centuries, within which Dokkershaven is located, the overall percentage of area excavated is about the same (5.4%). The relatively small area in the historic city that is under investigation ensures a selective dataset, excluding features from the parts of the city that were not excavated.

Vlissingen's strategic location in the maritime landscape makes it a particularly suitable city for this case study. Due to its maritime and strategic location on the Western Scheldt, Vlissingen maintained strong trade links with Antwerp. This likely meant that residents of Vlissingen had easier access to discarded casks than those of inland cities. Additionally, the soil conditions in Vlissingen differ markedly from those in many other cities. Marine sediment created a relatively unstable subsoil, which may have encouraged the use of cask shafts, which could be quickly installed, rather than labor-intensive brick.

Vlissingen presents a rich opportunity for study because it has a relatively high number of cask-lined shafts compared to other urban sites. This abundance allows for a meaningful comparison between cesspits and water wells with cask-lining and those with brick-lining within a single urban context.

6.2 Vlissingen

This section provides a brief overview of the relevant soil conditions in Vlissingen, after which the city's historical development is briefly sketched.

6.2.1 Soil conditions in Vlissingen

The soil composition of the historic city centre of Vlissingen was formed by sediment deposits during four geological periods. The sediments are not uniformly distributed across the wider area and occur at varying depths, resulting in variations in soil conditions in the historic centre and the excavation sites.

During the Pleistocene era, sand was deposited at what is now Vlissingen. At the beginning the Holocene era the land surface was significantly lower, with the coastline far to the west, beneath what is now the North Sea. As sea levels rose throughout the Holocene era, coastal margins became submerged, increasing groundwater saturation. This gradual saturation fostered optimal conditions for peat development, known as *basisveen*, in the low-lying areas.[232]
A second layer of sediment began forming around 5500 BCE, when the upper

232 Silkens & Meijlink, 2023, 10.

Pleistocene sands, sometimes overlain by *basisveen*, were eroded by tidal channels and marine flooding. The resulting marine sediment, are classified as the *Laagpakket van Wormer*, and ceased forming around 2000 BCE.

The third layer consists of peat that accumulated after the coastline formed around 2000 BCE, reducing marine effects. During the subsequent 1,500 years, the *Hollandveen Laagpakket* developed over a large area.[233]

From the Roman period onwards, the sea again exerted its forces on the area that would later be the historic centre of Vlissingen. This was due to two reasons: subsidence of the land surface caused by drainage and a gradual rise in sea level. The landscape evolved into a tidal environment where channels repeatedly cut into the terrain and eroded existing peat layers. These successive sedimentary phases are classified as the Laagpakket van Walcheren.[234] Over time, these creeks were filled with sandy sediment, which was less compacted than the surrounding peat-rich soils. As a result, the former creek beds formed slightly elevated ridges in the landscape, making them attractive locations for early human settlement.[235]

A series of these former creek beds extends in a north-south direction bordering what would later become the western part of Vlissingen's historic city centre (Figure 6.5 creek beds). This geomorphological feature may have played a significant role in the establishment of the early settlement that eventually developed into the town of Vlissingen. After the creek had filled with relatively sandy sediments, the location provided a slight elevation and more stable ground conditions, making it especially favourable for early habitation and construction.

A channel was probably still open during the Late Middle Ages and played an important role in the emergence of Vlissingen. It ran in a north-south direction through the western part of the historic city centre (Figure 6.5 channel). At the end of the Late Middle Ages, it was filled in to prepare ground for the urban expansion of Vlissingen. Initially, it silted up naturally and later it was further levelled off anthropogenically with backfill.

As a result of both natural and anthropogenic processes, the soil conditions in Vlissingen's historic city centre vary. The three archaeological excavations are located across these differing sub-strata. In the eastern sector, Dokkershaven and Spuistraat lie within a peat-rich area. The southern part of Groote Markt is located within a former tidal channel, artificially filled in, causing a less stable sub-strata. The northern trenches of the same site are situated on former creek beds with relatively sandy, and thus more stable soil (Figure 6.5).

233 *Formatie van Nieuwkoop, Vos & Van Heeringen, 1997; Silkens & Meijlink, 2023, 10.*

234 *Formatie van Naaldwijk, Vos & Van Heeringen, 1997.*

235 *Silkens, 2008, 10.*

Figure 6.5: Soil conditions in and around the historic city centre of Vlissingen.

6.2.2 Development of Vlissingen

The earliest traces of medieval settlement in Vlissingen are in an area north of the current city centre, on the eastern side of a creek bed that was filled with water until the Late Middle Ages. The area, known as Oud-Vlissingen, likely developed around a natural harbor. As ship sizes increased and the natural harbor silted up, the creek became less navigable, prompting the growth of a new settlement further south, later known as Nieuw-Vlissingen, or simply Vlissingen.

The development of Vlissingen is linked to Count Floris V who visited the area in 1290 and purchased the land in 1294.[236] The area attracted settlers because of the possibility of peat exploitation and herring fishing, both important for the town's early economy.[237] In the 14th and 15th centuries, the town expanded, the Sint-Jacobskerk was built, and dikes and harbors (e.g., Koopmanshaven and Achterhaven) were constructed. By 1417, the town had around 500 inhabitants (Figure 6.6).[238]

236 Dommisse, 1910, 55–63.

237 De Boer et al., 2010, 36.

238 Brusse & Mijnhardt, 2012, 216.

Figure 6.6: Three excavations placed in the 1550 map of Vlissingen (projected on: map of Vlissingen by Jacob van Deventer, dated 1550, ZA, ZI, 364).

From the late 15th to the 16th century, Vlissingen benefited from trade with Antwerp and Bruges. A third of Antwerp's goods passed through Walcheren, and thus Vlissingen's deep harbor proved to be a key logistical advantage for transportation. The 1530 storm surge improved navigability via the Westerschelde, which further boosted the town's economic role. In response, Fort Rammekens was built nearby in 1547.[239] Vlissingen's population continued to increase; in 1500 it had around 1,000 inhabitants, and by 1550 this number had tripled to 3,000.[240]

Political shifts also affected Vlissingen positively. In 1571, Spanish forces occupied the town and began building a citadel, but they were expelled in 1572 by the local population. William of Orange rewarded this rebellion by lifting trade restrictions and allowing harbor expansion.[241] Major urban changes followed, including fortifications and new harbor infrastructure.

The fall of Antwerp in 1585 brought wealthy Protestant refugees to Vlissingen, along with trade links and economic activity. That same year Vlissingen was

239 Brusse & Mijnhardt, 2012, 240.

240 Druenen, 2015, 171.

241 De Ridder, 2004, 14–15.

pledged to England as a strategic ally, and an English garrison was stationed in the city.[242] Control over the Westerschelde gave Zeeland control over regional trade routes.

At the beginning of the 17th century, the city expanded significantly to the east. During the Twelve Years' Truce (1609–1621), fortifications were reinforced and new harbors were constructed (e.g., Dokhaven), doubling the size of Vlissingen (Figure 6.7).[243] By this time, the population had increased to 7,000. But from the second quarter of the 17th century onwards, the city's growth began to stagnate. The fishing industry declined, but pri*vat*eering increased. In the years that followed, ongoing maritime conflicts and foreign wars further stymied Vlissingen's development.

Figure 6.7: Three excavations placed on the 1648 map of Vlissingen (projected on: map of Vlissingen by Willem Janszoon Blaeu, dated 1648, ZA, ZI, 379).

The French Revolution at the end of the 18th century had a profound impact on Dutch society, and its effects in Vlissingen were acute. In 1795, France was granted the right to station a garrison in the city. By 1804, a French fleet was based in Vlissingen's harbors, in preparation for an invasion of England. In response, a

242 Claeys et al., 2010, 36.

243 Claeys et al., 2010, 36.

British expedition bombarded the city in 1809, destroying much of its historic centre.[244] This marked the end of Vlissingen's prominence in the Early Modern period.

6.3 Results

In what follows, the results of this case study of repurposed casks are presented in four sections. First, the use of casks versus bricks as lining for cesspits and water wells is discussed. Then the three key factors are addressed: economic considerations, soil conditions, and the availability of construction material.

6.3.1 The chronological distribution of cesspits and water wells

An initial overview of the dataset of the exca*vat*ion sites revealed that out of a total of 226 features, 118 were interpreted as cesspits and 108 as water wells (Table 6.3).

The features were also examined chronologically, beginning with the start date of their context dating. These dates were grouped into 50-year periods, which shows that the majority of features were constructed between 1500 and 1649. During this period, 136 (76%) of the 180 dated features were built (Table 6.3). This time period corresponds to the period during which Vlissingen was thriving, that is, from the late 15th century to the second quarter of the 17th century (Section 6.2.2).

The relatively limited occurrence of cesspits during the Late Middle Ages has also been observed in other Dutch cities. Van Oosten demonstrated that in cities such as 's-Hertogenbosch and smaller emerging towns in the Netherlands, the widespread use of cesspits did not begin until the Early Modern period.[245]

The increase in the number of cesspits in the Early Modern period, which is also evident in the Vlissingen dataset, is commonly attributed to rising population levels and population density. Haarlem, for example, grew significantly in the first half of the 16th century, and the number of cesspits increased accordingly.[246] A similar correlation is evident between population growth and the number of water wells. In the late medieval fishing village of Raversijde (Belgium), for example, archaeological research uncovered a large number of cask-lined water wells, most of which date to the period of prosperity in the first half of the 15th century.[247] The data from Vlissingen also indicates a correlation between the rise in the number of cesspits and water wells and an increase in population.
Beginning in the second half of the 17th century, the rate of new cesspits and water wells being constructed in Vlissingen declined significantly. Only 30 of the

244 Brusse & Mijnhardt, 2012, 240.

245 Van Oosten, 2015, 189.

246 Van Oosten, 2015, 160, 162.

247 Houbrechts & Pieters, 1996, 254–255.

180 dated features, just 17%, were constructed during this period (Table 6.3). The same held true for Leiden.[248] This decline is often attributed to regulatory measures imposed by urban authorities, for example, the construction of a sewer system during the 1659 urban expansion of Leiden.[249] There was likely a comparable development in Vlissingen, related to urban ordinances starting in 1637 that implemented urban consolidation and initiated a shift to brick structures.[250]

Table 6.3: Number of cesspits and water wells, by construction date.

Context dates	**Cesspits**	**Water wells**	**Total**
1300–1349	1	0	1
1350–1399	0	0	0
1400–1449	5	2	7
1450–1499	6	0	6
1500–1549	30	10	40
1550–1599	26	16	42
1600–1649	30	24	54
1650–1699	0	6	6
1700–1749	2	2	4
1750–1799	2	0	2
1800–1849	5	8	13
1850–1900	1	4	5
No context date	12	34	46
Total	**118 (52%)**	**108 (48%)**	**226 (100%)**

The distribution of cesspits and water wells with cask-lining and brick-lining
The dataset includes a total of 118 cesspits, of which 102 (86%) are constructed with casks. The remaining 15 cesspits are built with brick. In one exception, both materials are used, a brick-lined upper section, beneath which at least one cask (perhaps more) had been placed (Table 6.4).

The pattern differs for water wells. Of the 108 water wells only 46 (42%) are cask-lined. The majority of the water wells, 55%, have brick-lining, indicating a preference for bricks. As with cesspits, only a few examples (3%), combine brickwork and casks (Table 6.4).

Table 6.4: Number of cesspits and water wells with brick and cask lining, by construction date.

248 Van Oosten, 2016, 7–8.

249 Van Oosten, 2015, 197.

250 Oosterbaan & Griffioen, 2015, 54.

Context dates	Cesspit, brick-lined	Cesspit, cask-lin-ed	Cesspit, brick and cask-lined	Cesspit total	Water well, brick-lined	Water well, cask-lined	Water well, brick and cask-lined	water well total	Total
1300–1349	1	0	0	1	0	0	0	0	1
1350–1399	0	0	0	0	0	0	0	0	0
1400–1449	0	5	0	5	1	1	0	2	7
1450–1499	1	5	0	6	0	0	0	0	6
1500–1549	4	26	0	30	0	10	0	10	40
1550–1599	0	25	0	25	3	13	0	16	41
1600–1649	5	25	0	30	11	12	1	24	54
1650–1699	0	0	0	0	2	3	1	6	6
1700–1749	1	1	0	2	2	0	0	2	4
1750–1799	1	1	0	2	0	0	0	0	2
1800–1849	1	3	1	5	5	3	0	8	13
1850–1900	1	0	0	1	3	1	0	4	5
No context date	0	11	0	11	32	3	1	36	47
Total	**15**	**102**	**1**	**118**	**59**	**46**	**3**	**108**	**226**

The material used for the construction of cesspits and water wells varies significantly between cities, reflecting distinct regional practices. Van Oosten's research of cesspits reveals notable differences in construction material in both inland and coastal regions, specifically in 's-Hertogenbosch, Deventer, and Amersfoort (inland), and Haarlem, Leiden, Alkmaar, and Dordrecht (coastal).[251]

In the inland city of Amersfoort, the total number of documented cesspits is relatively low. Of these, approximately 80% are constructed with bricks and only

251 Van Oosten, 2015.

20% with wood.[252] A particular feature of Deventer's cesspit record is the presence of roof-tile cesspits in 12% of the excavated examples. The cesspit assemblages of the coastal cities of Haarlem, Leiden, and Alkmaar, however, show a high degree of consistency. Nearly all cesspits are constructed of brick.[253]

Dordrecht deviates markedly from the general coastal pattern. The use of wood as cesspit construction is much more common. In both the 13th–14th and 15th–16th centuries, 72% of the cesspits were constructed with wooden linings.[254] The occurrence of cask-lined cesspits in Vlissingen most closely resembles the situation in Dordrecht. In fact, the percentage is even higher than that of Dordrecht; 86% of all cesspits in the dataset have cask lining. Van Oosten attributes such regional variation to several factors: the local availability of building materials, soil conditions, and the financial means of the property owner.[255] These factors will be addressed in turn in the following sections.

6.3.2 Soil conditions

One of the factors that may have influenced the choice between cask and brick lining is the soil condition. Unstable soil is commonly cited as an explanation for cask lining. In Dordrecht, for example, as mentioned above, a large proportion of cesspit linings were casks. The shafts there were often dug into layers of filled and disturbed soil, several meters thick, resting on peat-rich sediments.[256]

The soil conditions in Vlissingen are similar to those in Dordrecht. This may help to explain the widespread use of cask-lined cesspits (86%) and water wells (42%) in the city. Vlissingen, however, provides an opportunity to investigate the influence of soil conditions in more detail, as there are notable variations in the soil conditions within the historical city centre.

As shown in Figure 6.5, three zones with distinct soil conditions can be identified. The first zone is in the western part of the historic city centre, where archaeological excavations at Groote Markt have revealed sediments that were deposited in former creek beds (Figure 6.5). The resultant sandy subsoil has a greater stability and load-bearing capacity than soil in other parts of the city. A relatively high amount of brick lining might be expected there. The lower risk of subsidence associated with the sub-strata did, in fact, would have made brick lining feasible despite its longer construction time.
The second zone is characterized by the soil of a former channel that ran through the city centre until the Late Middle Ages (Figure 6.5). The channel was likely filled in toward the end of that period to make way for Vlissingen's urban development,

252 *Van Oosten, 2015, 67.*

253 *Van Oosten, 2015, 65.*

254 *Van Oosten, 2015, 71.*

255 *Van Oosten, 2015, 72.*

256 *Van Oosten, 2015, 71; Sarfatij, 2007, 47–93.*

during which the harbor facilities were relocated (Section 6.2.2). The archaeological excavation at Groote Markt revealed unstable soil conditions in this zone, which leads to the expectation of a higher concentration of cask-lined cesspits and water wells.

The third zone is located in the eastern half of the historic city centre, where Spuistraat and Dokkershaven are located (Figure 6.5). In these excavations, peat-rich sediments were encountered. The stability and load-bearing capacity of this subsoil can be considered average compared to the other two zones. The distribution of cask-lined and brick-lined cesspits and water wells was, therefore, expected to be close to the citywide average.

Although a lower than average occurrence of cask-lined cesspits was expected in the creek-bed zones, the opposite is the case. In that zone, 94% of the cesspits have cask linings, compared to the citywide average of 86% (Figure 6.8). Similarly, the peat-rich region in the eastern part of the historic city centre shows higher-than-average numbers, with 96% of cesspits having cask lining. In contrast, the area of the former channel that was filled in, with its unstable soils and low load-bearing capacity, which led to an expectation of a high number of cask-lined cesspits, actually has a lower than average number of cask-lined cesspits, just 77%.

This distribution, deviating from initial expectations, may indicate that the differences in soil conditions did not in any major way affect the choice of cask or brick lining. It is possible that the variations in the local subsoil of Vlissingen, compared to other cities, were relatively minor and that factors such as availability of construction material, construction traditions, and economic considerations had a greater influence on the construction of cesspits.

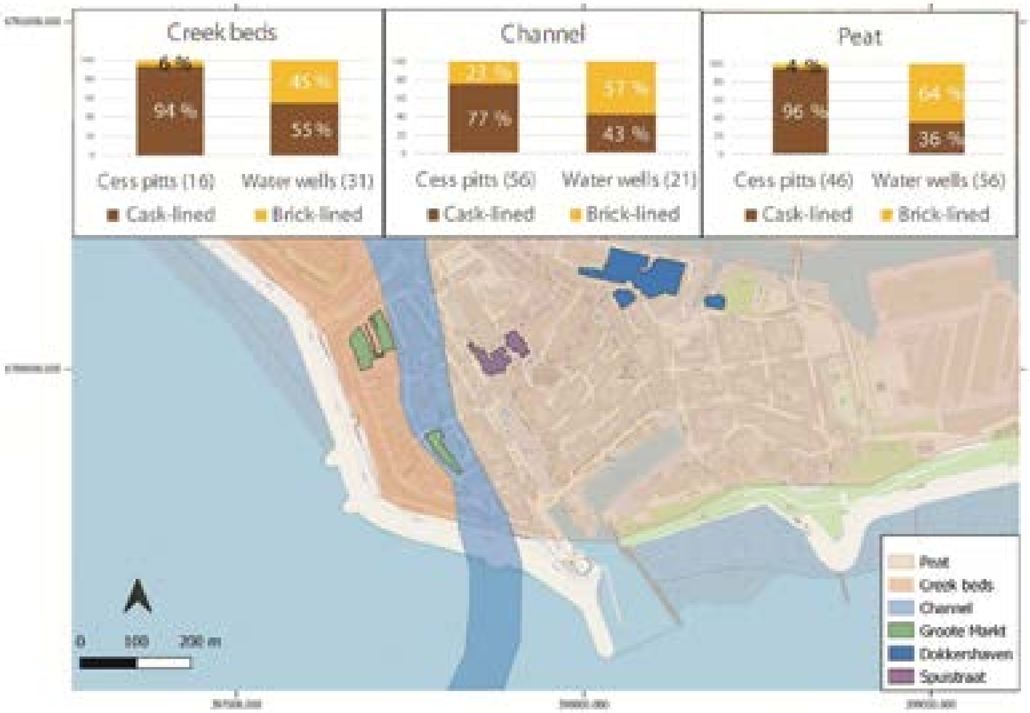


Figure 6.8: Percentages of cask-lined cesspits and water wells in the region with creek beds, former channel, and peat area projected onto a map of soil conditions in and around the historic city centre of Vlissingen.

The distribution of cask-lined and brick-lined water wells in the dataset does not align with initial expectations either (Figure 6.8). In the creek-bed sediment, relatively stable soil with a high load-bearing capacity, cask-lined wells make up 55% of the total, well above the citywide average of 43%. In the unstable fill of the former channel, the percentage of cask-lined water wells is similar to the city average. Interestingly, although it was in the peat-rich sediments that a higher-than-average use of cask-lined wells was expected, only 36% of the wells had cask lining.

Regional variations in soil conditions may also have affected the groundwater level, a crucial factor in the construction of water wells. To investigate this, the average depth of the wells in the three zones were compared. Notably, the average maximum depth of wells in the creek-bed sediment and the peat-rich subsoil are similar, approximately 0.5 m and 0.4 m below NAP (*Normaal Amsterdam Peil*). In contrast, wells in the channel zone (fill) reach an average depth of 1.1 m below NAP, up to 0.7 m deeper. The fact that the channel was filled in at the end of the Late Middle Ages could mean that the soil had become more water permeable, resulting in a significantly lower groundwater table. It seems likely that the required depth of a well would have influenced the construction method and the choice of material used.

In conclusion, neither the percentage of cesspits with cask lining nor that of water wells with cask lining in the dataset reveal any clear patterns related to soil conditions. Neither does the distribution of cesspits and water wells across the zones present a consistent picture. In the peat-rich region in the eastern part of the historic city centre, cask-lined shafts were expected to be similar to the citywide average. However, the number of cesspits exceeds this average while the cask-lined water wells occur less frequently than expected. This may indicate that soil conditions in Vlissingen had only a limited influence on the choice of construction materials for cesspits and wells and that other factors played a more significant role.

6.3.3 Economic considerations

Certainly one important factor in the choice of lining would have been the financial means of the property owner. If construction was to be undertaken, a financial investment was required. Choice of material would be closely tied to the owner's resources.

Studies of Dordrecht have observed that cask-lined cesspits and water wells are common in the outskirts whereas in the city centre, brick-lined shafts were constructed in greater number. One explanation for this is relative financial means. In the poorer districts of Dordrecht, there appears to have been a preference for the more economical cask lining.[257]

Written sources rarely provide detailed information on the cost of constructing wells. One exception is the will of Bommenee (c. 1685–1757), who was the head of public works in the town of Veere, about 15 kilometers from Vlissingen.[258] In his will, he noted detailed information about water-well construction costs, based on first-hand experience and direct observation. His notes provide a rare and valuable insight into the materials and cost involved in building freshwater wells during this period (Table 6.5).

257 Bartels, 1999, 27; Van Oosten, 2015, 72.

258 Van Oosten, 2015, 84.

Table 6.5: Construction costs of a water well, taken from the will of Bommenee (c. 1685–1757) from Veere..

Building material of water well	Building material of water well (Dutch)	Diameter (m)	Depth (m)	Cost (*f*)	Cost of extending
3,400 new IJssel bricks and trass with Doornik lime	*3400 nieuwe IJs-selsteen en tras en Doornikse kalk*	1.04	3.55	43.20	+ 1.78 m costs *f* 54.30
825 half-size grey bricks, lime, and trass	*825 halve grauwe mopsteen, kalk en tras*	0.89	3.55	25.35	Cask 5, *f* 3.00, Cask 6, *f* 3.60, Cask 7, *f* 4.20, Cask 8, *f* 4.80
975 repurposed bricks, along with lime and coal ash	*975 oude moppen + kalk en koolas*	1.04	3.55	14.85	
4 wooden casks (hogsheads of 222 liters each)	*4 houten tonnen (oxhoofden à 222 l)*	1.04	3.55	16.80	

This list of the costs reveals a significant difference in expenses depending on the construction material used. A brick-lined water well cost 43.20 guilders, approximately two and a half times more than a water well constructed entirely from casks, which costs only 16.80 guilders. The document also records a hybrid well, built using both bricks and casks, which cost 25.35 guilders, approximately halfway between the two. The cost estimate is specifically for 18th-century Veere. Notwithstanding diachronic and regional variations, the list provides a general indication of the relative cost that might be expected. It is clear that the choice of building material had a substantial impact on overall construction costs. This disparity is likely not only related to the investment in materials but also reflects differences in labor costs and the time required for construction. A cask-lined well would have been significantly quicker and easier to construct than a brick-lined one.

Certain items in Bommenee's will are labeled as repurposed or new, such as "975 old bricks" or "3,400 new IJssel bricks" (Table 6.5). Though it is not explicitly stated, it seems likely that the casks he listed were repurposed and not specifically made to be used as shaft linings. This is also evident from the marks frequently found on casks that were used as lining. Besides the coopers' mark, there would be no reason to mark a cask as specifically produced as shaft lining material.

To determine whether financial means influenced the choice of lining, the dataset from Vlissingen proved useful. An initial question is which parcels of land in Vlissingen were owned by relatively wealthy residents and whether they had a preference for brick lining or repurposed casks. A logical step would be to analyze the spatial distribution of cesspits and water wells across the wealthier and poorer neighborhoods of Vlissingen. However, there was relatively little social segregation in Vlissingen during the research period; wealthy and poor residents often lived side by side,[259] with no clearly defined rich or poor neighborhoods. Comparison of construction materials across the several excavations offers limited insight into the choice of lining in relation to financial means. The intermingling of social classes within the same area makes it difficult to draw meaningful conclusions about the spatial distribution of features across the three excavation sites.

In order to draw a reliable picture of financial means, only data from Groote Markt was used because of the availability of useful data. For the period 1575–1625, detailed data on financial means is available from archaeological findings and historical records, including tax assessments from 1580[260] and mortgage information for some parcels.[261] These three sources of information were used to classify the financial means of the residents of parcels excavated at the Groote Markt.[262] The 1824 cadastral map was used as a reference for the spatial layout, which has remained largely unchanged since the late 16th century.[263]

Cesspits and water wells dating between 1575 and 1625 were identified based on the initial dating of the artefacts recovered from them (Table 6.6). Only features from between those dates were included in the analysis because specific data on the financial means of the parcel owners are available for this period. In order to examine the spatial distribution of these features in relation to the financial classification of the associated properties, they were plotted onto the corresponding parcels (Figure 6.9, Figure 6.10).

Table 6.6: Number of cesspits and water wells (1575–1625) uncovered at the Groote Markt in Vlissingen, by lining type.

Feature type	**Cask**	**Brick**	**Combined**	**Total**
Cesspits	19	5	0	24
Water wells	14	10	1	25
Total	**33**	**15**	**1**	**49**

259 Brusse & Mijnhardt, 2012, 11.

260 In 1580, taxes of 1% were levied based on the assessed values of real estate to finance government expenditures, which during this phase of the Eighty Years' War were likely directed toward war-related costs. In Vlissingen, real estate was assessed using a system of predefined categories; parcels were not individually valued but assigned to specific classifications. ZA DOMM: Afschrift van het "Quohier" van taxatie van de 100en penning van de huizen en de erven binnen der stede van Vlissingen (Toeg. 71 invnr 4).

261 ZA, RAZE No. 118/750, 1610–1808. https://www.zeeuwsarchief.nl/onderzoek-het-zelf/archief/?mivast=239&mizig=435&miadt=239&milang=nl&mif1=3306614547&mizk_alle=Venisstrate

262 Oosterbaan & Griffioen, 2015, 59. A total of 49 parcels were examined during the excavation, which have been categorized as below average (n=30), average (n=13), or above average (n=5) in terms of financial means.

263 Oosterbaan & Griffioen, 2015, 59.

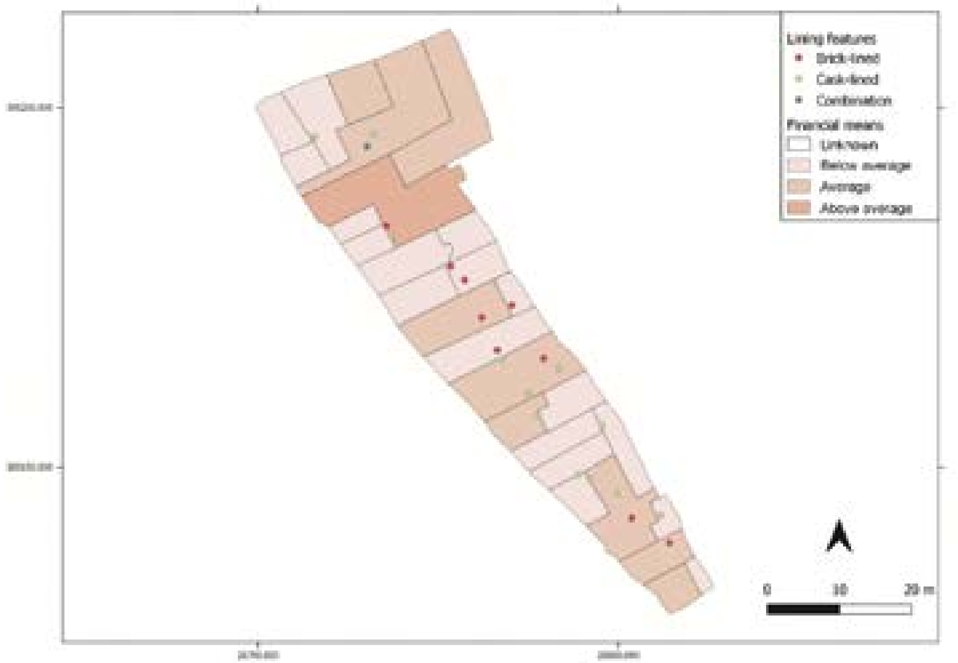


Figure 6.9: Distribution of cask and brick lining of cesspits and water wells in the southern part of the Groote Markt excavation in Vlissingen mapped onto the parcels in which they were found.

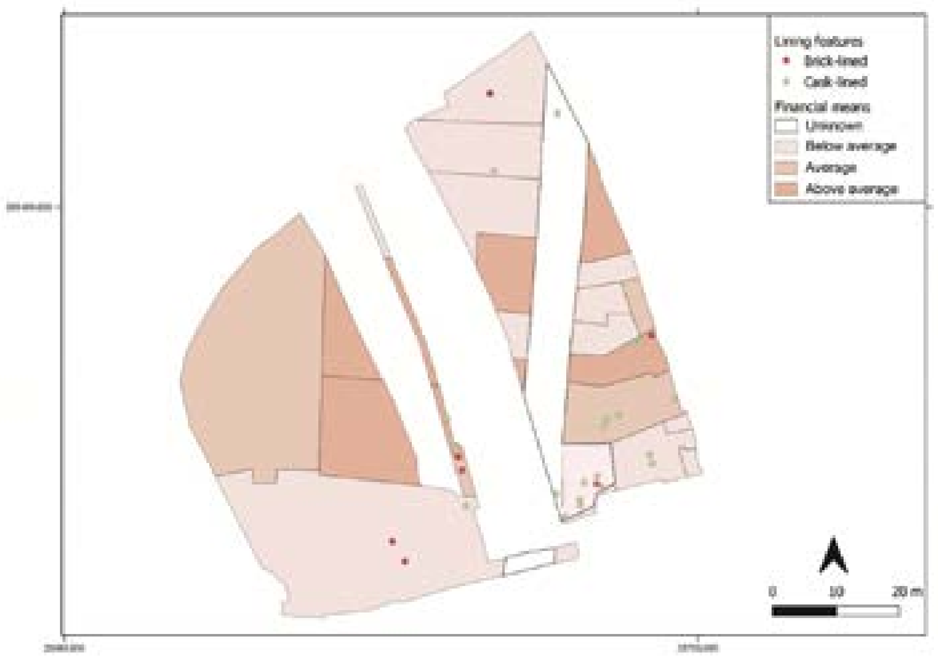


Figure 6.10: Distribution of brick and cask lining of cesspits and water wells in the northern part of the Groote Markt excavation in Vlissingen, mapped onto the parcels in which they were found.

The spatial distribution of cask lining versus brick lining in the period 1575–1625 across different areas of Groote Markt shows that cesspits and water wells were installed on 25 out of 49 plots. The only partial coverage may be explained by the fact that cesspits and water wells were often shared by the inhabitants of multiple plots. Many of these features have also been found along plot boundaries. In addition, not all plots were fully excavated, which means that some of these features were not documented.

The analysis further reveals a clear correlation between lower financial means and a preference for cask lining. Of the features found on parcels belonging to residents with below-average financial means, 90% (17 out of 19) had cask linings, whereas this was the case for only 50% (5 out of 10) of the parcels owned by individuals with above-average financial means (see Table 6.7). This suggests that economic considerations played a significant role for residents in deciding whether to use brick or casks as lining in their cesspit or water well.

Table 6.7: Number of cask and brick features, 1575–1625, uncovered at the Groote Markt in Vlissingen, by financial means of the parcel owners.

Financial means of parcel owners	**Cask**	**Brick**	**Combined**	**Total**
Below average	17	2	0	19
Average	9	7	1	17
Above average	5	5	0	10
Unknown	2	1	0	3
Total	**33**	**15**	**1**	**49**

Though the cost of constructing cesspits or wells with brick lining was higher than using casks, the brick versions were probably more durable. For each of the 49 features, an estimated lifespan was calculated based on contextual dating, primarily derived from the finds recovered within the features. This analysis revealed an average lifespan of 180 years for cesspits and wells with brick lining, compared to an average of 91 years for cask-lined ones. Brick lining lasted about twice as long as a cask lining.

6.3.4 Availability of construction material

The availability of repurposed casks that had fulfilled their original function as containers probably contributed to the development of cask-lined shafts. In urban settings, discarded casks were readily available and therefore relatively inexpensive, and so were probably favoured for practical reasons.[264] This led to a prevalence of cask-lined cesspits and water wells rather than the more costly and labor-intensive brick lining.

264 Van Oosten, 2015, 72.

In this section, the existence of coopers' guilds is initially examined and used as an indicator of the availability of discarded casks that could be repurposed (Table 6.8). In cities where coopers' guilds existed, there would have been sufficient demand to sustain a cooperage, and this implies that these cities were involved in considerable trade in goods transported in casks. Examples of this include the herring trade in Vlissingen and the beer trade in Haarlem.[265] In addition to producing new casks, cooperages associated with the guilds would also have repaired casks. Once a cask could no longer be repaired, it would have been discarded, but with the possibility of being repurposed.

Table 6.8: Founding year of coopers' guilds in the cities included in the dataset of Van Oosten's dissertation.

City	Founding year of the coopers' guild
Vlissingen	1499
Haarlem	1443
Leiden	1549
Alkmaar	1584
Dordrecht	1437
's-Hertogenbosch	No urban coopers' guild
Deventer	1585
Amersfoort	No urban coopers' guild

The existence of a coopers' guild does not directly indicate the actual number of casks circulating in a city. The scale and nature of production associated with these guilds could vary considerably from one urban centre to another. One indicator of the extent of this variation is the number of coopers registered with each guild. In 1688, for instance, the coopers' guild in Amsterdam had 362 registered members, while the guild in Veere had only nine members in 1660 (Table 4.3). Such a range suggests significant differences in the scale of coopering activities, both production and repair. Consequently, the local availability of used casks suitable for repurposing would also have varied markedly between cities that had coopers' guilds.

Furthermore, the establishment of a coopers' guild should not be viewed in isolation from broader developments in trade networks or patterns of urban expansion. These socioeconomic shifts were often accompanied by demands for increased infrastructure, including a rise in the number of cesspits and water wells. In addition, in order to assess the prevalence of features with cask lining, the relative availability of alternative building materials must be considered as that might have influenced construction choices. For example, in Deventer roof tiles

265 Yntema, 1992; Brusse & Mijnhardt, 2012, 72.

were commonly repurposed for cesspit lining.[266] In Leiden, the presence of large-scale local brick production probably facilitated the use of bricks.[267]

To assess the impact of the local availability of casks, while considering the presence of coopers' guilds as a factor, only cesspits in Vlissingen are examined. The cesspits have been arranged chronologically in 50-year periods and categorized according to lining type, casks or bricks (Table 6.9). As previously noted, the data reveals a strong preference for cask lining, a trend that accelerated significantly after 1500. A comparison of this preference with the founding date of the coopers' guild, 1499, shows that the use of casks began very soon after the guild was founded.

Table 6.9: Type of cesspit lining by construction date in Vlissingen.

Context dates	Brick (N)	Cask (N)	Total
1300–1349	1	0	1
1350–1399	0	0	0
1400–1449	0	5	5
1450–1499	1	5	6
1500–1549	4	26	30
1550–1599	0	25	25
1600–1649	5	25	30
1650–1699	0	0	0
1700–1749	1	1	2
1750–1799	1	1	2
1800–1849	2	3	5
1850–1900	1	0	1
No context date	0	11	11
Total	**16**	**102**	**118**

To assess more carefully whether there is a correlation between the establishment of a coopers' guild in Vlissingen and the frequent occurrence of cask-lined cesspits, data from other cities can usefully be compared. For this purpose, the dataset compiled in Van Oosten's dissertation, which represents cesspit research up to the year 2013, has been used.[268] Only cesspits with a reliable start date and dated between 1300 and 1900 were selected. In addition, the analysis was limited to circular cesspits with brick, roof tile, or cask lining, which excludes refuse pits and cesspit cellars. The cities included in the analysis are Dordrecht, Haarlem, Leiden, Alkmaar, 'sHertogenbosch, Deventer, and Amersfoort (Table 6.10).

266 Van Oosten, 2015, 72.

267 Hollestelle, 1961.

268 Van Oosten, 2015.

Table 6.10: Number of cesspits by construction date in Dordrecht, Haarlem, Leiden, Alkmaar, 's-Hertogenbosch, Deventer, and Amersfoort.

	Dordrecht			**Haarlem**			**Leiden**			**Alkmaar**			**'s-Hertogen-bosch**			**Deventer**			**Amersfoort**		
con-text dat es	Briick- lined	Cask- lined	Total	Brick- lined	Cask- lined	Total	Brick- lined	Cask- lined	Total	Brick- lined	Cask- lined	Total	Brick- lined	Cask- lined	Total	Brick- lined	Cask- lined	Total	Brick- lined	Cask- lined	Total
1300-1349	6	10	16	4	3	7	0	0	0	0	0	0	0	5	5	3	0	3	0	0	0
1350-1399	11	12	23	7	2	9	10	2	12	6	0	6	4	2	6	2	1	3	0	0	0
1400-1449	9	3	12	24	2	26	29	1	30	17	0	17	3	1	4	10	0	10	2	0	2
1450-1499	3	3	6	9	0	9	20	0	20	8	0	8	9	2	11	2	0	2	0	0	0
1500-1549	9	6	15	18	0	18	10	0	10	5	0	5	30	1	31	9	0	9	3	0	3
1550-1599	16	3	19	21	0	21	12	2	14	35	0	35	0	0	0	3	0	3	0	0	0
1600-1649	7	3	10	82	1	83	7	1	8	42	2	44	16	1	17	1	0	1	2	3	5
1650-1699	3	1	4	24	0	24	1	0	1	9	1	10	5	0	5	5	0	5	0	0	0
1700-1749	3	4	7	24	2	26	1	0	1	5	0	5	10	1	11	8	0	8	2	1	3
1750-1799	2	0	2	1	0	1	0	0	0	5	0	5	1	0	1	2	1	3	0	0	0
1800-1849	2	0	2	4	0	4	1	0	1	1	0	1	6	1	7	3	0	3	0	0	0
1850-1900	0	2	2	2	0	2	0	0	0	1	0	1	6	0	6	5	0	5	4	0	4
Total	**71**	**47**	**118**	**220**	**10**	**230**	**91**	**6**	**97**	**134**	**3**	**137**	**90**	**14**	**104**	**53**	**2**	**55**	**13**	**4**	**17**

Note: Green fields indicate the time period during which a coopers' guild was established in the city in question.

This overview shows no correlation between the establishment of a coopers' guild and an increase in the proportion of cask-lined cesspits. In Dordrecht, for example, where both the absolute and relative number of cask-lined cesspits is highest compared to brick-lined cesspits, at least 22 out of the 47 documented cask-lined cesspits were constructed prior to the founding of the coopers' guild in 1437 (Table 6.10).

Another notable observation is that there is a limited number of cask-lined cesspits found in the cities of Haarlem, Leiden, Alkmaar, 'sHertogenbosch, Deventer, and Amersfoort. Combined, these cities account for only 39 cask-lined cesspits out of a total of 640, a mere 6%. In contrast, Dordrecht, like Vlissingen, exhibits a relatively high number of cask-lined cesspits. The comparison between Dordrecht and Vlissingen is particularly relevant given that both cities have unstable soil conditions (Section 6.3.2).

Another factor shared by Vlissingen and Dordrecht may be the availability of discarded casks, which, however, need not be directly associated with a coopers' guild. Both cities functioned as trans-shipment ports in the Late Middle Ages and Early Modern period.[269] The availability of casks in these cities likely relates less to local cask production than to casks having outlived their use as transport containers. In trans-shipment ports, casks were not only transferred from ship to ship. For some products, for example, beer and wine, the contents were also poured into different casks before being traded further.[270] This undoubtedly led to many casks becoming obsolete as transport containers.

To test the hypothesis that the availability of casks and their subsequent repurposing as lining is related to the presence of a trans-shipment port, a focused analysis was conducted on cesspits and water wells in Vlissingen. The city is historically known for its herring trade, and the dimensions of herring casks are known (Chapter 5). By comparing the dimensions of herring casks with the sizes of casks used as lining, it should be possible to determine whether only herring casks or other cask types were repurposed. Evidence of a wide variety of cask sizes, and therefore a diverse range of goods, would suggest that the available casks in trans-shipment ports were used as lining.

Herring casks produced in the provinces of Holland and Zeeland in the Early Modern period onward were standardized, which remained largely consistent over time. Due to the importance of maintaining a collective reputation for both the quantity and quality of herring exports, the use of well-constructed, uniform casks was essential. As a result, broad regional agreements were established to standardize casks. The official specifications for whole herring casks required a certain minimum number of staves, typically 12 or 13, a stave thickness of at least 0.9 cm, and, most importantly, a capacity of 120 liters (Chapter 5). This standardized volume requires a cask height of 69–73 cm and a bilge diameter (the widest measurement of a cask) of 49–51 cm.

For the 106 casks used as lining for cesspits and water wells in Vlissingen, both height and bilge diameter were recorded and grouped in 5 cm ranges (Table 6.11). Based on these dimensions, only 14 casks (13%) match the standard height of herring casks, and 18 (19%) fall within the expected diameter range. This suggests that the majority were not originally used for herring but for storing other goods. This supports the interpretation that in trans-shipment ports like Vlissingen and

269 Dordrecht: Unger, 1915, 971–972; Havers, 1996; Van Herwaarden et al., 1996, 185–189; Stenvert & Van Tussenbroek, 2007, 73; Vlissingen: Brusse & Mijnhardt, 2012, 82–87.

270 Twede, 2005.

Dordrecht, casks for repurposing were primarily surplus transport containers circulating in the port, rather than locally coopered casks. Availability thus appears to correlate more strongly with a city's logistics than with its manufacturing output.

Table 6.11: Height and bilge diameter of cesspits and water wells in Vlissingen.

Cask height (cm)	N	Bilge diameter (cm)	N
55-59	1	40-44	3
60-64	2	45-49	4
65-69	4	50-54	14
70-74	10	55-59	13
75-79	11	60-64	29
80-84	18	65-69	12
85-89	17	70-74	22
90-94	19	75-79	4
95-99	2	80-85	2
100-104	9	86-89	1
105-109	1	90-94	2
110-114	2		
115-119	3		
120-124	5		
125-129	0		
130-134	1		
135-139	1		
Total	**106**	**Total**	**106**

Note: The dimensions of standardized herring casks are marked in red.

Conclusion

Casks retained residual value and were frequently repurposed for a variety of uses once they had served their primary purpose as containers for traded goods. Repurposed casks served domestic purposes such as being used for furniture or were dismantled into individual staves to be used as building material or firewood. Among the many ways of repurposing casks, one in particular stands out in the archaeological record, the use of casks as lining for cesspits and water wells.

Those who commissioned the construction of cesspits or wells could choose repurposed casks as lining or the more permanent brick. This choice may have been influenced by at least three factors, soil conditions, economic considerations, and the availability of material. While such factors have been proposed as hypotheses in previous archaeological studies, the extent to which they played a role, and how they intersected with one another has not previously been examined in a focused and systematic manner. In this chapter that gap has been addressed. The question is what factors determined the choice of brick or repurposed cask as lining in the construction of cesspits and water wells in urban Vlissingen during the Late Middle Ages and Early Modern period.

The study of this chapter is based on a dataset comprising 226 features, 118 cesspits and 108 water wells, each with either a brick or cask lining. These features were uncovered in three large-scale archaeological excavations carried out in the city of Vlissingen—Groote Markt, Spuistraat, and Dokkershaven. The excavations yielded a relatively large number of well-preserved and thoroughly documented features, with construction dates ranging from 1300 to 1900. As a major trading port with a thriving herring industry, an active coopers' guild, and a central role in the distribution of goods to Antwerp, Vlissingen had abundant access to casks. This archaeological and historical data makes Vlissingen a suitable case study for investigating factors that shaped the choice of brick or repurposed casks.

The first striking pattern observed in the dataset is the high proportion of cask-lined features in Vlissingen; 86% of cesspits and 55% of water wells were constructed using repurposed casks. These proportions are significantly higher than those of inland cities such as Amersfoort, 's-Hertogenbosch, and Deventer, where features with cask lining rarely exceed 15%. Only in Dordrecht has a similarly high proportion of cask-lined features been identified, making it one of the few urban contexts comparable to Vlissingen (Table 6.10).

The high occurrence of features with cask lining in Vlissingen and Dordrecht is best explained by the availability of discarded casks. Both cities functioned as trans-shipment ports where goods such as beer and wine were not only transferred from one ship to another, but often decanted into new casks, rendering the old casks redundant (Section 6.3.4). This would have resulted in a surplus of casks that could be repurposed. A trans-shipment port could be expected to handle a diversity of cask types of various origin, function, and size. The archaeological records of Vlissingen cesspits and wells show that the repurposed casks used in the construction of these features were of a wide variety of sizes, corresponding to what could be expected in a trans-shipment port city (Table 6.11).

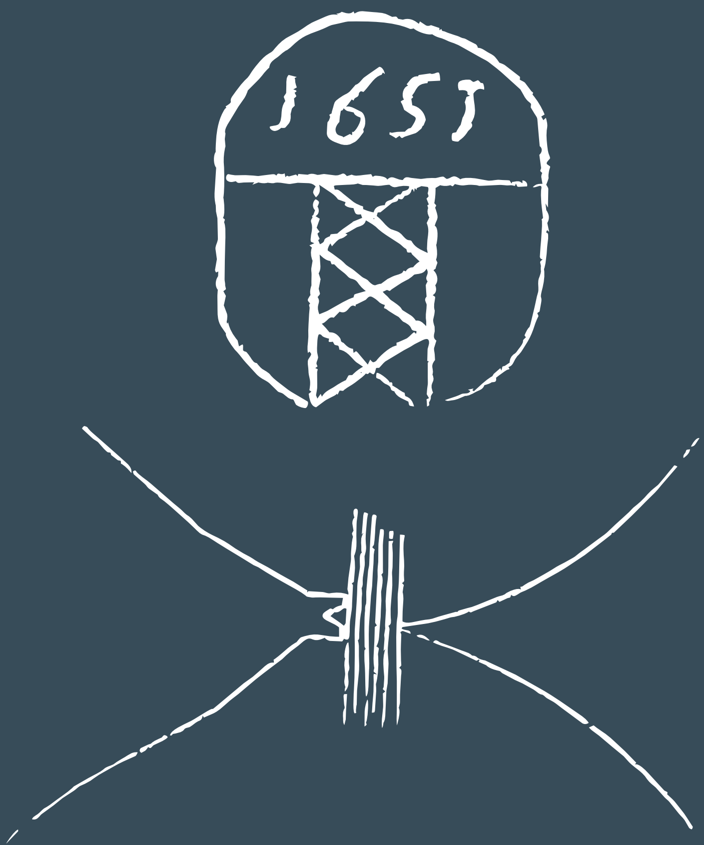
The hypothesis that local cask production influenced the number of cask-lined features is not supported by the data. No clear correlation was found between the establishment of coopers' guilds, as a proxy for organized cask production, and the frequency of cask repurposing in urban construction. This supports the idea that the availability of discarded casks through commercial circulation was decisive rather than local production.

The second key factor was the financial means of the property owner. The construction of cesspits and water wells required a significant investment, and affordability likely influenced choices of what material to use. Previous research in Dordrecht determined that cask-lined cesspits appeared more frequently in the city's poorer neighborhoods. This pattern is further supported by the will of Bommenee (Table 6.5), which shows clearly that using cask lining for a water well was considerably cheaper than brick lining. The analysis of the Vlissingen dataset confirms this trend, revealing a clear correlation between the use of cask lining and parcels owned by individuals with below-average financial means (Table 6.7).

A third factor that may have influenced the choice between cask lining and brick lining is local soil conditions. To investigate this, the distribution of cask-lined features was analyzed across various locations in Vlissingen's historic city centre, characterized by their unique subsoil properties. However, no clear correlation was found between unstable soil or soil with a low load-bearing capacity and a higher occurrence of features with cask lining (Figure 6.8). This suggests that subsoil variation in Vlissingen did not play a significant role in determining the construction materials used for cesspits and water wells.

This research shows that the use of casks in cesspits and wells in Vlissingen was mainly driven by availability of material and economic factors. As a trans-shipment port, Vlissingen had a surplus of discarded casks, making them a cheap and readily available alternative to brick. This preference was especially common among lower-income property owners. In contrast, local soil conditions had little influence on construction choices. Together, these findings bring to light how the repurposing of material in urban infrastructure was driven not only by practical constraints but also by broader economic and logistical dynamics characteristic of port cities like Vlissingen.

7. Typology for cask marks



7. Typology for cask marks

7.1 Introduction

Casks frequently appear in archaeological contexts, particularly in urban and maritime settings, often bearing one or multiple marks. In archaeological reports, the documentation of these artifacts is superficial, often limited to descriptions of the casks' marks and dimensions. Yet, the study of cask marks represents a valuable and largely untapped source for understanding the socioeconomic dynamics of trade and consumption in the Netherlands in the Late Middle Ages and Early Modern period (1300–1800). To use cask marks as a source for such a study, it is first necessary to gain insight into their function and usage.

This chapter provides a foundation for such an understanding by presenting a typological classification of cask marks, systematically grouping them according to their function. In contrast to the sub-studies presented in the preceding chapters, this sub-study on cask marks does not focus on a single phase but rather on multiple phases of the cask lifecycle, namely production and their use as transport containers. No cask marks are currently known from the last phase, the repurpose of casks; therefore, this sub-study does not address the last phase of the lifecycle (Figure 7.1).

Cask marks were applied for various purposes, including indicating where and by whom the cask was produced, identifying its owner, recording its contents (quantification), and assessing the quality of both the cask and its contents (qualification). Identifying the reason marks were added to casks can help reconstruct the journey of a cask through the phases of production and use as a transport container. Cask marks can be seen as indicative of the various phases a cask has undergone, revealing the individuals and institutions involved in its trade and, potentially, the goods it contained.

Cask marks are particularly important as they bridge archaeological data and written sources, providing a crucial link between material culture and documentation in written sources (Figure 7.2). Documents such as trade records, shipping manifests, and urban regulations provide valuable context regarding the function and significance of these marks, while archaeological evidence sheds light on their practical use, the locations where marked casks were found, and the cargo contents in contexts such as shipwrecks. This multidisciplinary approach, which integrates archaeological and written sources, enhances the analysis of cask marks and provides a deeper understanding of trade practices in the Late Middle Ages and Early Modern period.

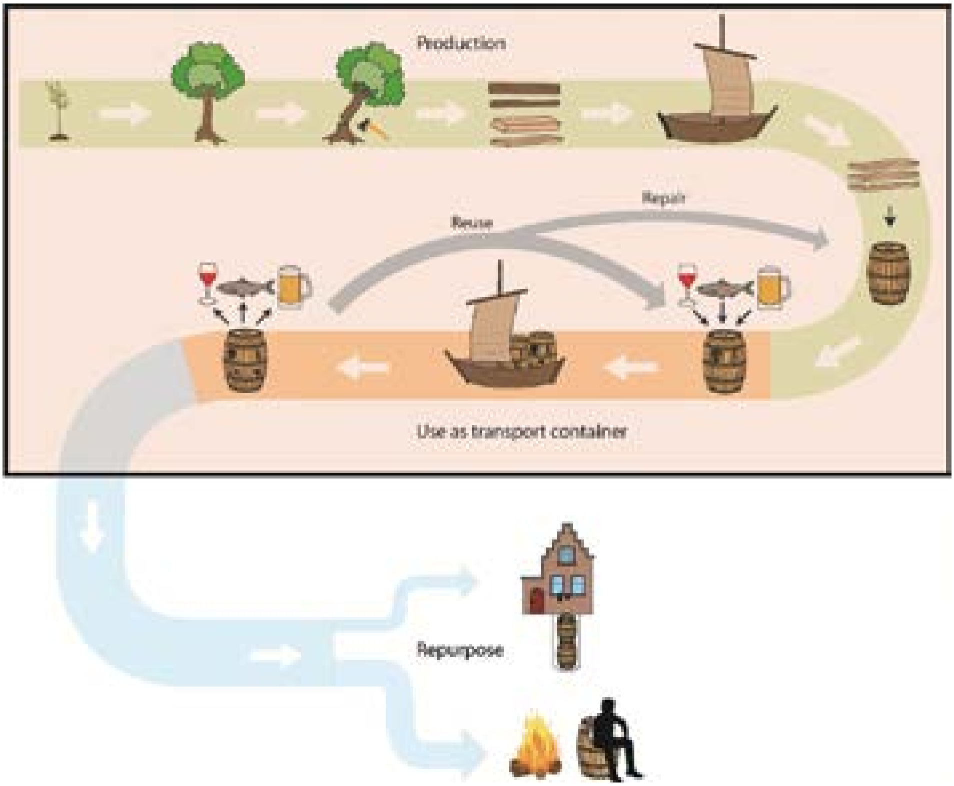


Figure 7.1: Schematic overview of the lifecycle of a cask. Production phase – green; its use as a transport container – orange; repurposing – blue. The frame highlights the part of the casks' lifecycle that is discussed in this chapter.

Figure 7.2: left: The placement of cask marks (Detail of Allegory of Commerce [Print of woodcut, no. PK.OP.20701], by Jost Amman, 1585. Copy at British Museum (England), reproduced under CC BY-NC-SA 4.0; right: cask head with several marks from the Burgzand Noord 4 shipwreck sunk in 1751 (Vos, 2012, 185. ID218).

7.2 Research problem and research question

The valuable data that can be derived from the numerous cask marks found in Dutch archaeological contexts—often uncovered as cargo in shipwrecks or as repurposed barrel-well shafts in urban excavations—remains largely untapped due to the absence of an integrated study on cask marks. Research has been undertaken in various academic disciplines, including archaeology, history, archival studies, and architectural history, but these investigations have only provided partial insights into the use of cask marks. A comprehensive study of their overall functions and characteristics has not yet been carried out.

Studies of cask marks from Dutch archaeological contexts are typically conducted only when large quantities of marks are found at a specific site, making them relatively rare. When these studies are conducted, they are site-specific and focus solely on the cask marks found at that location. Researchers often restrict their analysis to describing the cask marks without interpreting the reason they were applied or placing them within a broader framework, partly due to the lack of overview studies on this subject.

Conversely, research on cask marks using data from architectural history and historical studies tends to focus on why they were applied, although they are usually limited to a specific type of mark, such as wine gaugers' marks.[271] As a result, neither historical studies nor architectural-historical research have provided an overview of the functions of different types of cask marks.

This sub-study aims to address this gap by developing a typology for cask marks found in archaeological contexts, based on their intended function. The establishment of this typology is a crucial step in the systematic analysis and interpretation of cask marks in relation to their function, the merchandise contained in the casks, and broader trade networks. The central objective of this sub-study is to establish a typology for cask marks found in Dutch archaeological contexts from the Late Middle Ages and Early Modern period (1300–1800).

The main research question is

- How can cask marks from Dutch archaeological contexts (1300–1800) be classified into a typology and to what extent is the resulting typology suitable for cask marks from these context?

271 Van Gangelen & Potze, 2017.

In order to address the main research question, the following sub-questions are considered:

- What are the main results of previous studies of cask marks?
- What are the distinguishing features of cask marks that are best suited to classify them into a typology?
- For what reasons were cask marks applied, and how can they be incorporated into a suitable typology for cask marks?

7.3 Research design and dataset

The research was conducted in multiple phases, reflecting the stepwise design of the study presented in this chapter, and is presented below in the chronological order. Each phase, some of which encompassed separate sub-studies, is discussed in detail in section 7.3.1, including their objectives, methodologies, and the specific source materials employed.

A separate section (7.3.2) addresses the compiled dataset, the Database WOODAN Cask Marks. This section provides a comprehensive account of how the dataset was constructed, the procedures used for its assembly, and the limitations of the data.

7.3.1 Research design

Historiography and the features of cask marks (Section 7.4)

The sub-study of the first sub-question, which focuses on previous research on (cask) marks, is presented as a historiography. This section compiles and analyzes the most relevant research findings from various academic disciplines—archaeology, history, and architectural history—to provide a comprehensive overview of existing knowledge on the subject. Based on the combined results of individual studies, insights have been gained into the features of cask marks and the reasons why they were applied.

Features of cask marks (Section 7.5)

The second sub-question focuses on identifying the most distinguishing features of cask marks, which form the basis for their classification. This allowed for initial insight into the range of features that cask marks can exhibit and which of these are most suitable for classification. At this phase of the research, the emphasis was on their features (classification) rather than on their functions (typology).

To answer the second sub-question additional research was conducted on the method of application using photometric stereo techniques on cask marks. Further analysis was carried out by examining descriptions of cask marks found in archaeological research reports from the Netherlands, where a relatively high number of cask marks have been found. These reports provided detailed descriptions of various features, enabling the identification of the full range of features and the most distinctive among them.

Typology for cask marks (Section 7.6)

The third and final sub-question focuses on developing a comprehensive typology based on the function of the different cask marks, encompassing all possible types of cask marks found on casks from Dutch archaeological contexts. Each type is defined by the specific function of the mark.

To understand the reasons why marks were applied, an overview was compiled by assembling cask mark types as identified in previous studies. This analysis incorporated the results of both archaeological investigations and historical studies based on written sources. In addition, the distinguishing features of cask marks identified were taken into account, providing a foundation for classifying marks according to their features before considering their function.

By comparing archaeological investigations and historical studies, an initial overview of the possible functions of cask marks was established. These mark types were subsequently analyzed based on the phases in the lifecycle of casks and the actors involved in their application. This comparative approach provided deeper insights into the significance of cask marks and allowed for the identification of missing types to be incorporated into the typology. This typology of cask marks, along with a discussion of the reasons for defining each type, is presented in section 7.6.

Description of individual cask mark types (Section 7.7)

The individual cask mark types are further described in section 7.7. This analysis of each subtype begins with a discussion of the reasons for application, followed by a description of the source material used, and a description of the types' distinguishing features.
For each subtype, the first step was to examine the available source material from archaeological studies that have, to some extent, explored cask mark functions. Additionally, overview studies of written sources and architectural-historical research were consulted, which are referenced separately in each discussion. In cases where information from these sources did not provide sufficient contextual insight, additional research of primary written sources was conducted.

The additional research into primary written sources focused mainly on sources directly related to the research period (1300–1800). Second, only primary source material originating from the provinces of Holland and Zeeland in the Netherlands was included. This regional focus is supported by the fact that the majority of cask production in the Late Middle Ages and Early Modern period (1300–1800) within present-day Netherlands took place in these provinces. This is confirmed by the significant concentration of coopers' guilds in these regions. Out of the 38 coopers' guilds established in the Netherlands, 24

(63%) were located in the provinces of Zeeland and Holland.[272] These regions showed the greatest potential for finding official regulations concerning cask marks and therefore became the focus. Within these regions, the archives of the coopers' guilds from Vlissingen and Alkmaar were consulted.[273]

To examine the cask marks associated with the next phase in the lifecycle of casks, the use as transport containers, material from the archives of organizations such as the College van de Grote Visserij for herring[274] (advocacy organization for herring industry of Zeeland, Holland and West-Friesland) and the Generale Brouwers van Holland for beer (advocacy organization for beer producers, 1600–1800) was consulted.[275] Furthermore, the *statuutboek* of the Dutch cities of Veere[276] and Delfshaven[277] were consulted for information on herring cask marks and *brandpackers*' registers.[278]

Identification marks played a crucial role use as transport containers, as they indicated the product contained in a cask, the individuals involved in the casks' trade, and corporate entities associated with the cask contents. To investigate these marks, legal sources from 1578–1915, such as wills, contracts, trade agreements, and testimonies, found in the *Oud Notarieel Archief* of Amsterdam were consulted.[279] Legal documents from the cities of Gouda,[280] Haarlem,[281] and Delft,[282] as well as the *Charterboek der Graven van Holland en Zeeland* (Charter Book of the Counts of Holland and Zeeland),[283] were also examined for relevant passages— regulations and ordinances outlining guidelines on mark function, use, and application. Additionally, the archives of the *Middelburgsche Commercie Compagnie*[284] (Middelburg Commercial Company) served as a valuable source for contextualizing cask marks in this phase. The data from the primary written sources were then used to further refine the typology and establish contextual information for each type of cask mark.

272 Oosterbaan et al., 2022.

273 ZA, GtV, Archief Kuipersgilde, 1545–1808; published in: Geest, 1664.

274 NA, ACGV, 1578–1857.

275 Yntema, 1992.

276 ZA, SV, no. 312, Staetuytboeck Veere, 1416–1699.

277 SD, ASD, 1568–1607.

278 A statute book contains the ordinances issued by urban authorities.

279 SAA, ONA, Oud Notarieel Archief, 1578–1915.

280 Published in: Ordinance of the Coopers, 1490; published in: Rollin Couquerque & Meerkamp van Embden, 1917.

281 Published in: Huizinga, 1911.

282 Published in: Soutendam, 1870.

283 Charterboek der Graven van Holland en Zeeland, 1299–1356.

284 ZA, MCC, 1720–1889; Unger, 1951.

Following the research on primary written sources, an assessment was made to determine which types still lacked sufficient contextual information. This was the case for marks applied during construction, for which interviews with present-day coopers were conducted to fill the gaps.

A typology of cask marks from Dutch archaeological contexts (Section 7.8)

In order to address the main research question, the developed typology was applied to cask marks from Dutch archaeological contexts to assess the typology's suitability. In section 7.8, the number of occurrences for each mark type is documented, along with a detailed description of its distinguishing features. These descriptions are compared to those provided in section 7.7, highlighting similarities, differences, and additional insights gleaned from archaeological source material.

The conclusion (Section 7.9)

In the conclusion, the central research question will be addressed by focusing on the suitability of the proposed typology in relation to cask marks from archaeological contexts. The most significant research results will be discussed by highlighting the similarities, differences, and additional insights gained from archaeological data when compared with the regulations concerning, and descriptions of, cask marks found in written sources. Furthermore, this sub-study aims to provide a foundation for further research on cask marks, for which specific recommendations are provided.

7.3.2 Dataset, the Database WOODAN Cask Marks

To apply the developed typology to cask marks from Dutch archaeological contexts, a dataset was compiled containing examples from the period 1300–1800. This dataset was not only used for the this dissertation but has also been made publicly available online, supported by a grant from the Samenwerkende Maritieme Fondsen and in cooperation with the WOODAN Foundation.[285] As a result, the database is referred to as the Database WOODAN Cask Marks.

The first step in developing the Database WOODAN Cask Marks was establishing a framework to systematically organize the relevant data used for describing cask marks. The database is organized into various fields for capturing both contextual and descriptive information. Contextual data fields were used to record details such as the find location, coordinates of find location, and associated archaeological context. Descriptive data fields were used to record the specifics of each cask mark by type, its placement on the cask, and the method of application. They were also

285 For the specific details of these collaborations, see the acknowledgements of this chapter.

used to record the dimensions of the marks and the number of cask components on which the mark appears. Furthermore, the database framework captures dating information, discerning between different dating methods, such as context-based dating, dendrochronological analysis, and dating derived from written sources.

The data included in the Database WOODAN Cask Marks had to meet a number of requirements. First, the cask mark had to originate from a Dutch archaeological context dating between 1300 and 1800. Second, contextual information was required, preferably drawn from a published research report. Third, at least one image of the cask mark had to be available to allow for visual comparison.

The first step in compiling the dataset was to request provincial and municipal archaeologists, as well as archaeological companies, to provide existing studies containing cask marks. The resulting cask marks were included in the dataset and supplemented with search results from the AGNES search engine[286], which proved by far the most effective method of building the dataset. This tool enabled targeted searches across more than 180,000 archaeological documents using specific keywords.

The most effective keywords were *ton* (barrel/cask, n=5208 hits), *tonput* (barrel well, n=1700 hits), *merkteken* (mark, n=1166 hits), and *duig* (stave, n=817 hits). However, not every search result produced a cask mark to add to the database. Therefore, additional targeted searches were conducted using more specific keywords such as *eigendomsmerk* (property mark, n=80 hits), *handelsmerk* (merchants' mark, n=67 hits), (branding mark, n=28 hits), *kuipersmerk* (coopers' mark, n=20 hits), and *ijkmerk* (gauge mark, n=20 hits).
The inventory resulted in the largest dataset of cask marks assembled in the Netherlands, comprising a total of 1,021 cask marks: 405 from maritime archaeological contexts, 527 from urban archaeological contexts, and 89 from rural archaeological contexts. To ensure open access for other interested parties and researchers, the database has been made available online at www.woodancaskmarks.org. In this chapter, the cask marks included in the database are referenced by their ID numbers, as used in the database itself, for example, ID955.

The dataset containing 1,021 cask marks from archaeological contexts has certain limitations. The first concerns uneven regional representation. In regions where relatively little archaeological research has been conducted, representation is limited. This is evident from the fact that 461 out of 616 cask marks (75%) from terrestrial sites originate from the present-day provinces of Noord-Holland, Zuid-Holland, and Zeeland. This is partly due to the fact that a relatively large amount of archaeological research has been conducted in these provinces; between 2020 and 2024, 26.9% of all archaeological investigations in the Netherlands were carried out in the aforementioned three of twelve Dutch provinces.[287] When compared to

286 Agnes: search engine for Dutch archaeology , n.d. (version 3.1). University of Leiden. Available online at: https://agnessearch.nl/. Last accessed on 01 May 2025.

287 Database Erfgoedmonitor, n.d.

the number of archaeological investigations carried out in the five northeastern provinces of the Netherlands (Flevoland, Friesland, Drenthe, Groningen, and Overijssel), which accounted for 19.5% of all archaeological researches during the same period,[288] the disproportionate representation of casks originating from the western coastal provinces becomes evident. Nevertheless, the dataset clearly indicates that the occurrence of casks at terrestrial sites remains a phenomenon observed predominantly in the western coastal provinces.

Another limitation of the dataset concerns the availability of images. Because each cask mark required at least one image in order to be included, many examples discovered before 1990 were excluded. Most cask marks excavated during this period were either documented in reports without accompanying images or have not yet been published at all.

The most significant limitation of the dataset is its quantitative underrepresentation, when compared with the total number of cask marks in use during the research period. This becomes evident when comparing the number of cask marks in the dataset to the 500-year study period (1300–1800), revealing an average of only two cask marks per year. To assess the dataset's quantitative underrepresentation, this average number can be compared to the number of beer and herring casks in use. For example, between 1543 and 1545, approximately 950,000 beer casks were used in the nine major beer-producing cities in Holland, and in the first half of the 17th century, the annual demand for casks in the herring industry totaled approximately 350,000 casks.[289] The dataset of cask marks should therefore not be considered an accurate quantitative reflection of the total number of casks with marks in circulation. However, the dataset can be used to represent the various types of cask marks that were in use during the period covered by this research. This should be taken into consideration when assessing the suitability of the typology for cask marks from archaeological contexts.

7.4 Historiography

As stated in section 7.2, cask marks have been studied across various academic disciplines, yet a comprehensive overview of marks applied to casks in the Netherlands between 1300 and 1800 is lacking.

Studies focusing on cask marks from Dutch archaeological contexts typically examine cask marks only when they are found in large quantities at a specific site, making such findings relatively rare and site-specific. In some cases, studies identify specific types of cask marks, but they are classified according to other features, such as the method of application. Meanwhile, research based on

288 Database Erfgoedmonitor, n.d.

289 Oosterbaan, 2023, 104.

architectural-historical data and written sources primarily focuses on the functions of marks. Studies from these academic disciplines are often limited to a specific type of mark and therefore do not provide a comprehensive view of the range of marks applied to casks.

To provide additional context to the combined research results of the academic disciplines focused on cask marks (historical studies, archaeological studies, and architectural-historical research), international studies have also been included in this historiography, with the criterion that the casks studied were part of a trade network that involved the Netherlands. Below, the relevant research results from studies based on written sources and architectural-historical research are presented, followed by an analysis of research based on archaeological source material.

Historical research based on written sources and architecture

The sub-study of marks based on written sources dates back to the late 19th century when house marks became the subject of several studies.[290] House marks were explicitly linked to Germanic culture, and at times, they were even used as elements of Nazi propaganda.[291] Jenks and Mrozewicz suggested that the interest of Nazi scholars in house marks during World War II may have created obstacles for studies on written sources in the decades that followed.[292] However, the researcher Scherft conducted research in 1950 and 1951, focusing on a different type of mark, specifically, gauge marks and the gauging system in Breda.[293] In the same decade, an architectural-historical study was conducted in 1957 on the Oude Kerk in Amsterdam, focusing on the count marks in the roof structure of the church.[294] After these studies in the 1950s, no significant research on building marks was conducted for several decades.

In the 1990s, research on marks was once again taken up by both Dutch and international scholars. In 1992, a study that focused on the marks of medieval craftsmen was published in German.[295] In the Netherlands, researcher Janse continued the study of marks with an investigation that provided an overview of various house marks used in constructions from the medieval period to the 18th century in different parts of the Netherlands and bordering Dutch-speaking regions.[296]

290 Michelsen, 1853; Homeyer, 1870.

291 Reydon, 1940.

292 Jenks & Wubs-Mrozewicz, 2022.

293 Scherft, 1950/1951.

294 Janse, 2004.

295 Engel, 1992.

296 Janse, 1990.

Research on personal identification marks was revived in 2010 by Zeven, who interpreted these marks as property indicators.[297] In 2017, Van Gangelen and Potze published an article about an examination of marks on casks found in Groningen from different time periods. Although an archaeological discovery served as the starting point of their research, the study was primarily based on written sources and focused on wine gaugers' marks.

In 2022, an extensive study of merchants' marks was conducted by Jenks and Mrozewicz, with 29 letters from the Lübeck Civic Archives serving as the primary source material. Marks, including many merchants' marks found in letters from booty taken in the English Channel in August 1533 by privateers from Lübeck, provided insight into the property of the parties involved.[298] A similar study is currently being conducted as part of the *Zee(uw)post* project, digitizing and transcribing marks from 17th- and 18th-century letters.[299] These letters came from ships captured during the Anglo-Dutch wars, taken by English troops or their allies, and were eventually archived in the National Archives in London. Among them are numerous *cognossementen* (bills of lading) containing marks that are also noted as appearing on casks.

Studies drawing on written sources and those within architectural history share the characteristic of concentrating on a single type of cask mark. This narrow scope is largely a consequence of the nature of the source material, which typically sheds light on only one distinct purpose of cask marking practices. Consequently, the other functions for which marks could have been applied on casks received little or no attention in these studies. As a result, these studies have not yielded a comprehensive understanding of the full spectrum of marks that could appear on casks.

Archaeological research

Studies that focus on cask marks from archaeological contexts are usually confined to specific sites where marks are found in significant numbers, primarily in the research of shipwrecks. Since the number of shipwrecks in Dutch waters that are analyzed is limited, relevant studies on cask marks from shipwrecks outside of Dutch waters have also been included for a more complete historiography.

One of the groundbreaking studies on cask marks was conducted on the casks of the *San Juan* (1565), a shipwreck discovered in Red Bay, Canada, where nearly 200 casks were recovered.[300] When the cask marks from this shipwreck were studied in detail by combining archaeological and historical analysis, the symbols

297 Zeven, 2010.

298 These merchants' marks are publicly available through the Database Merchants Marks, n.d.

299 Database Zee(uw)post, n.d.

300 Ross & Loewen, 1985/2007.

were successfully traced to merchants in France.[301] This study was significant as it used object attributes to deduce the production process and lifecycle of the casks. Loewen, the author of the study, later conducted similar research on *La Belle* (1686), identifying recycled items and rebuilt casks, and linking marks to transported goods.[302] He also challenged Kilby's assumption that markings were always made by the cooper who assembled the cask.[303]

In the 1980s, research on casks from shipwrecks and their marks focused on the wrecks of the *Betsey* (1781)[304] and *William Salthouse* (1841).[305] In research on the latter, cask markings were classified into six types: assembly marks, coopers' inspection marks, shippers' marks, Roman numerals, circular marks, and miscellaneous marks.

Casks from more recently discovered shipwrecks have also been studied, such as those examined by Rodrigues, who analyzed 33 casks from the *Mary Rose* (1545), focusing more on volume, contents, condition, and stowage than on marks.[306] In 2010, Fawsitt analyzed 16 casks from a late 16th-century wreck in Drogheda, Ireland, establishing the reuse of head pieces, though she could not confirm whether they all belonged to the same consignment from France because of unidentified marks. For the *Vasa* (1628), a thorough examination of the casks was conducted, including the development of a typology and comparative research of the marks.[307] However, a more in-depth study of the markings is needed.

In 2014, markings on medieval casks from the *Copper shipwreck* were identified by Ossowski as a merchants' mark belonging to Johann Pilge, a representative of the *Großschäffer* (senior trade administrator) of Königsberg, who traded copper in Bruges and was also active in Gdańsk.[308] However, this is not the only possible interpretation. In an earlier study of merchants' marks from the *Copper shipwreck*, Śledź pointed out that their use was not limited to commercial transactions. He also raised the question of whether these marks signified ownership, identifying either the merchants exporting the goods or those who purchased them. He noted that a single merchant may have used multiple marks rather than just one. Some markings may have indicated quantity, batches of goods, or even quality control of casks.[309]

301 Loewen, 2007.
302 Loewen, 2017.
303 Kilby, 1971.
304 Shackelford, 1988.
305 Staniforth, 1987.
306 Rodrigues, 2005.
307 Ratcliffe, 2012.
308 Ossowski, 2014.
309 Śledź, 1979.

A more recent study on cask marks was conducted by Hansson, Linderson, and Foley on the *Gribshunden* (1495), found near Ekön Island, Sweden. While a thorough analysis was performed on the casks, further investigation is needed to determine the meaning of the markings and, more importantly, to link them to individuals, as they may have been applied in either the Netherlands or the Baltic region.[310]

In the Netherlands, research of casks has been conducted for several decades. Most excavations, both maritime and terrestrial, have focused on describing the casks, only noting the presence of marks without further investigating their function and purpose of application.[311] However, some studies have conducted more in-depth research of cask marks. Manders was among the first to examine cask marks from Dutch archaeological context, offering theories in his thesis about marks on casks from the shipwreck *Scheurrak SO1*, where a classification based on the methods of application was used.[312] Vos has written several sections about casks found in different ships in the Burgzand Noord area in the Dutch Wadden Sea but does not explore the cask marks in detail.[313] The marks on casks found on the *IJsselkogge* were studied by Schoute in 2017, although no ownership or content connections could be confirmed.[314]

Oosterbaan studied 85 casks from the terrestrial site Vlissingen Groote Markt, classifying five mark types based solely on the marks' design.[315] Casks from the Dutch city of Leiden and its surroundings were examined by Hofman in his thesis, in which he proposed a typology distinguishing construction marks, count marks, ownership marks, and gauge marks.[316]

One of the first outcomes of the present dissertation research on cask marks was the identification of the shipwreck *Burgzand Noord 4*. This was made possible by linking the marks on the casks from the wreck to individual merchants and plantations in Suriname. This led to the identification of the wreck as the frigate *'t Hart*, and the study provided specific insights into the trade network in which the ship operated (Chapter 8).[317]

310 *Hansson et al., 2022.*

311 *Function emphasizes the operational or technical use of a mark, describing it as part of a process or mechanism. Example: The function of the cask mark was to indicate the approved volume of beer in the cask. Purpose of application emphasizes the motivation or reason for applying the mark, focusing on the "why" rather than the "how." Example: The purpose of the cask mark was to prevent fraudulent practices and ensure standardization.*

312 *Manders, 1996.*

313 *Vos, 2012.*

314 *Schout, 2017.*

315 *Oosterbaan, 2015.*

316 *Hofman, 2020.*

317 *Tran et al., 2025.*

Site-specific studies in Dutch archaeological contexts of cask marks consistently revealed the absence of a comprehensive analysis of cask marks. To address this gap, the Database WOODAN Cask Marks cataloguing Dutch cask marks was launched by Oosterbaan in 2024 (www.woodancaskmarks.org).[318] This database includes most of the marked casks discovered in archaeological contexts in the Netherlands, as well as a selection of cask marks documented in archival sources, and serves as the dataset for this sub-study.

7.5 Features of cask marks

To develop a comprehensive typology and ensure its effectiveness for cask marks from archaeological contexts, it is crucial to systematically document features of the appearance and application of marks. Three stand out as the most distinctive: the design of the mark, the method used for its application, and its location on the cask. Each feature exhibits its own variations, which are described below.

7.5.1 Design

There is a wide variety in the design of cask marks, ranging from simple scratches to a tally system to monograms with letters. There are also more elaborate cask marks, such as the well-known wine gaugers' marks, cities' coats of arms, and cask marks that consist of figurative shapes (Figure 7.6). The variation in the design of cask marks is their most distinctive feature, and they differ depending on why the mark was applied. For this reason, a detailed description is provided for each type of cask mark in section 7.7.

7.5.2 Method of application

Cask marks were applied using various tools: a timber scribe, knife, branding iron, compass, brush, and strike iron (Figure 7.3). It is highly likely that during the Late Middle Ages and Early Modern period, casks were also marked with chalk or charcoal, but these have not been preserved in the archaeological record. The method of application can serve as an indicator for classifying a cask mark, as most types can be distinguished by their cross-sectional shape. For example, a cask mark carved with a knife exhibits a V-shaped cross-sectional indentation, whereas a mark applied with a brush has been applied on the surface of the cask (Figure 7.3).

318 *Database WOODAN Cask Marks, n.d.*

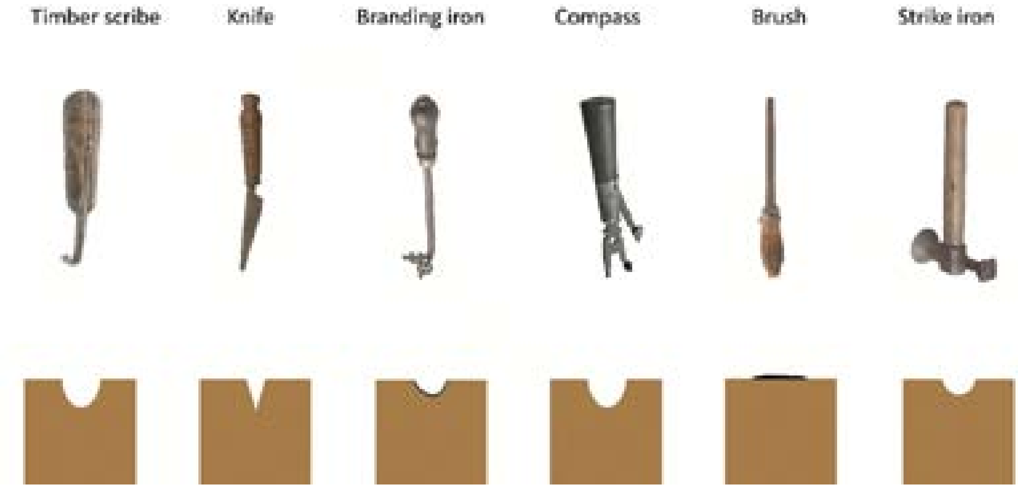


Figure 7.3: An overview of methods of cask mark application: Tools used and a schematic representation of their cross-sectional shapes. Sources: Timber scribe: Scribe for rejection during the gauging of casks [Tool, inv. no. 5708], unknown date. Museum de Lakenhal, Leiden, The Netherlands; Knife: Knife and fork with wooden handle [Tool, inv. no. 4280], unknown date. Museum de Lakenhal, Leiden, The Netherlands; Branding iron: Brand VOC [Branding iron, no. NG-1987-14-1], Rijksmuseum, Amsterdam, The Netherlands; Compass: Scribe and compass [Compass, no. 357.087], Collectie Looij, Nieuwenhoorn. Fotocollectie Rijksdienst van Cultureel Erfgoed, Amersfoort, The Netherlands, reproduced under CC BYSA 3.0. Brush: Brush [Tool, inv. no. NH49-141]. Unknown data. Museum Batavialand, Lelystad, The Netherlands, reproduced under CC BYSA 3.0; Strike iron: Strik iron with number 43 [Tool, no. NG-2013-22-5], Rijksmuseum, Amsterdam, The Netherlands.

Cask marks applied with a timber scribe, branding iron, compass, or strike iron generally appear as U-shaped indentations. The depth of these indentations helps determine the tool used. Those applied with a timber scribe or compass are generally deeper than those made with a branding iron or strike iron (Figure 7.3). The maximum depth of cask marks made with a timber scribe or compass from the archaeological excavation at Vlissingen Groote Markt is 6 mm, whereas those made with a strike iron or branding iron have a maximum depth of only 3 mm.[319]
To investigate whether this distinction also applies to other sites, photometric stereo technique recordings were made of cask marks from the shipwreck *Scheurrak SO1*, which were applied with a timber scribe or branding iron (Figure 7.4). This sub-study confirmed the pattern, with a depth of 6 mm for cask marks made with a timber scribe and 4 mm for those applied with a branding iron. Additionally, this sub-study showed the clear distinction of the V-shaped cross section of a cask mark inscribed with a knife (Figure 7.4).

319 The measurement data comes from the documentation of the Vlissingen Groote Markt excavation.

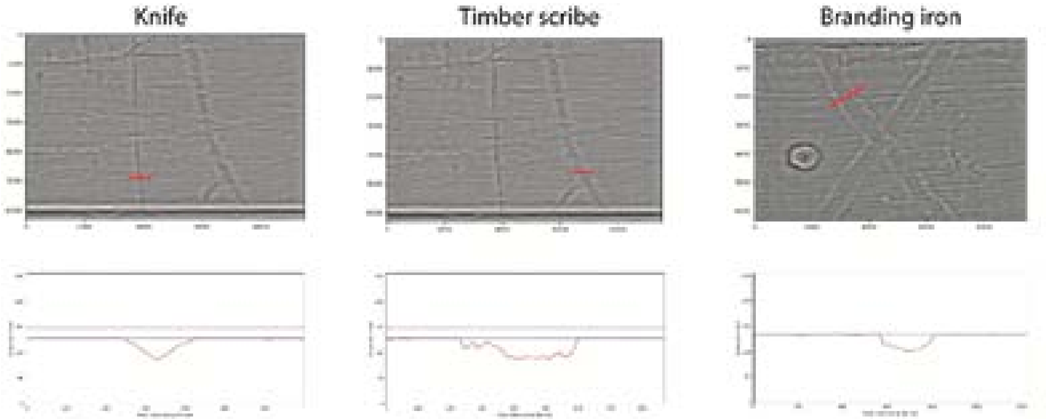


Figure 7.4: Cross sections of cask marks from the Scheurrak SO1 shipwreck using the photometric stereo technique, where the deeper areas of the cask marks are shown in progressively darker grey tones, allowing a cross section to be generated using grayscale values. Left: knife (Manders, 1996, find no. SO1658); middle: timber scribe (Manders, 1996, find no. SO1658); right: branding iron (Manders, 1996, find no. SO7992a).

The deep cask marks made with a timber scribe or compass can be distinguished from each other by their shape: those made with a compass have a circular form from a top view, while those made with a timber scribe vary in appearance. On the other hand, the shallow marks—applied with either a strike iron or a branding iron—can be distinguished by the presence of charred residue, which is only found on marks made with a branding iron (Table 7.1).

Table 7.1: Overview of the characteristics of the different methods of application of cask marks.

Method of application (tool used)	Cross-sectional shape	Depth	Charred residue?
Timber scribe	U-shaped	Relatively deep (ca. 6 mm)	No
Knife	V-shaped	Relatively deep (ca. 6 mm)	No
Branding iron	U-shaped	Relatively shallow (ca. 3–4 mm)	Yes
Compass	U-shaped	Relatively deep (ca. 6 mm)	No
Brush	Superficial	On the wood	No
Strike iron	U-shaped	Relatively shallow (ca. 3–4 mm)	No

7

7.5.3 Location of marks on casks

The location of a mark on a cask can also be used for its classification. Marks have been found on exterior and interior of heads, the bilge bottom, the bilge centre, and the bilge near the hole (Figure 7.5). The placement of a cask mark can help identify the actor who applied it. A mark on the interior of a casks' head, for instance, is considered a coopers' mark. Marks at this location could only have been made during the production phase before they were filled. In some cases, specific regulations also applied to the placement of marks, which is discussed further in section 7.7.

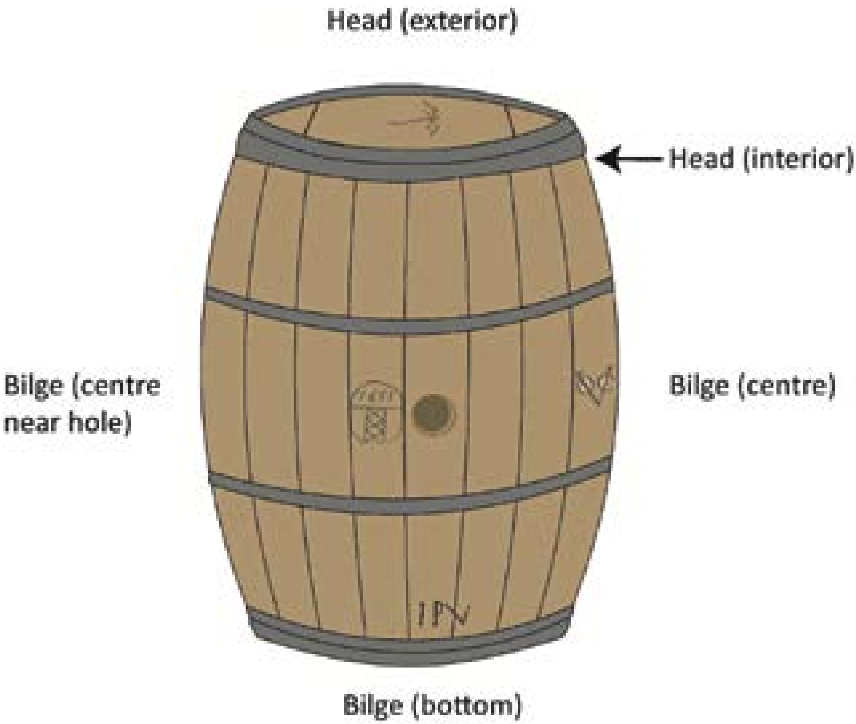


Figure 7.5: Locations of cask marks.

7.6 Typology of cask marks

The typology of cask marks is defined by the functions these marks fulfilled during the first and second phase of a casks' lifecycle, namely production and subsequent use as a transport container. For the purposes of this sub-study, these phases have been further subdivided into specific phases, each representing a step in the lifecycle during which cask marks could be applied. The precise phase in which a mark was applied was therefore integrated as a structuring element of the typology.

In addition, the actors responsible for applying the marks were taken into account. Because different actors, such as coopers, merchants, inspectors, or municipal officials, possessed distinct roles and responsibilities, the actor involved had a direct impact on both the functioning and purpose of application of a cask mark.

Finally, the typology also considers the trade networks in which casks circulated. These networks could vary considerably depending on the product being traded, with some casks restricted to local or regional markets, while others were part of international distribution systems. Such variation had a significant influence on the presence, type, and function of cask marks.

The various functions of cask marks that were identified, together with the aforementioned characteristics, were analyzed and formed the basis for the typology presented below (Figure 7.6).

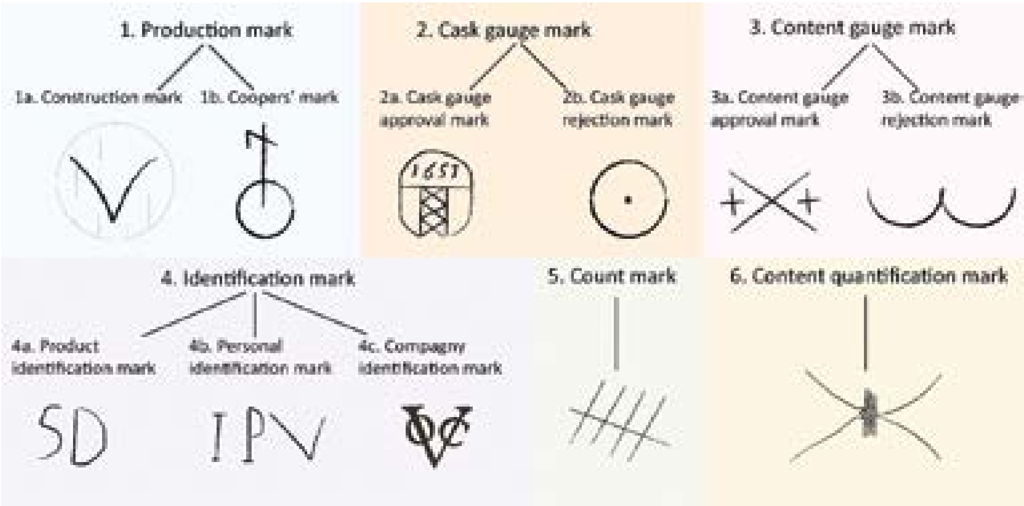


Figure 7.6: Typology of cask marks, including examples of mark designs.

The typology of cask marks used in this sub-study includes six main types, four of which are further divided into subtypes, bringing the total number of types to eleven (Figure 7.6). The typology is structured hierarchically into main types and subtypes, as some types show a great deal of similarity, despite serving a different function. This applies, for example, to the approval and rejection marks of both the casks and their contents. The hierarchical setup of the typology allows cask marks to be assigned as a main type if a subtype cannot be determined. This is particularly relevant for identification marks, as the features of subtypes often show strong similarities, making them indistinguishable in some cases.

Each of the individual mark types fulfils a distinct function and therefore carries a specific purpose. A marks' function is best understood when determined in tandem with the lifecycle of the cask in question (Figure 7.7). The lifecycle of a cask can be divided into three main phases: production, use as a transport container, and repurposing. In the present sub-study, the repurposing phase has been deliberately excluded, as no evidence currently exists regarding the functions of cask marks applied during this phase.

To further understand the function of cask marks, it is also important to consider the individuals who applied them to the casks. For many of the mark types, specific actors were responsible for marking the casks, such as inspectors appointed by urban authorities, who were the only ones authorized to apply certain cask marks (Table 7.2). The sequence in which marks were applied to a cask is described below. In section 7.7, a detailed description is provided for each subtype, including the marks' function, the corresponding phases in the lifecycle of a cask, and the actors responsible for its application. In section 7.7, the defining features of each subtype are described, including appearance, method of application, and location on the cask.

The chronological sequence of cask mark application

Production marks were applied in the first phase of the lifecycle of a cask (Figure 7.7_1a, 1b). This main type is subdivided into construction marks and coopers' marks (Figure 7.6). A cooper, when assembling a cask, applied marks related to the construction of the cask, such as matching marks that indicated the correct assembly order of the cask's components. The final task of a cooper during the construction of a cask was to place his coopers' mark, indicating that he as the craftsman, had assembled the cask (Table 7.2).

Casks that had been approved could then be filled, initiating the second phase of their lifecycle: use as a transport container (Figure 7.7, 3a, 3b). For various product groups that were packaged and transported in casks, the gauging process was also carried out to ensure that the contents of the casks met the required specifications. For this purpose, inspectors appointed by the urban authorities were also employed, who concluded the content gauging process by placing a content gauge approval or rejection mark on the casks (Figure 7.6, Table 7.2).

When casks had been filled and were ready for transportation, further identification marks and count marks were applied. Identification marks might indicate the products packed in the casks or the persons or companies associated with the casks and their contents (see Figure 7.6 for these subtypes). There is a greater variety of actors who applied identification marks compared to the previously mentioned types of cask marks (Table 7.2). However, all identification marks were applied exclusively during the second phase of a casks' lifecycle (Figure 7.7_4, 5).

Count marks were applied once casks were in transit (Figure 7.6, Figure 7.7_5), and it is likely that count marks were applied by parties involved in the trading business (Table 7.2).

This type of mark was used to indicate the quantity of merchandise in the cask and was applied, for instance, to casks on ships when they passed through toll stations.

Upon a cask's arrival at its intended destination, the contents of certain products were measured (Figure 7.7_6) and a content quantification mark applied (Figure 7.6). In the case of a wine cask, excise duties had to be paid to the local urban authorities, depending on the amount of wine in the cask. To enforce this, inspectors applied this type of cask mark (Table 7.2).

In practice, not every cask was marked with all the marks outlined in the sequence above. Several factors came into play in the application of marks. First, the product for which the casks were made played a crucial role. For products intended for export, such as herring, an extensive gauging process was required for both the casks and the herring (Sections 7.7.2 and 7.7.3). In contrast, for casks intended for the local market, the process was less involved as quality control for these products was generally less stringent; there was no risk of interregional reputational damage, and producers and consumers often dealt with each other directly, making a system of identifying marks unnecessary. Second, both regional and diachronic differences in the regulations governing casks and their contents may have influenced how the casks were marked.

Variation in marks can also be seen on casks from the same city and period and intended for the same type of product, if the lifespan of these casks was interrupted. This is particularly relevant for casks found in shipwrecks, where the sinking of the ship unintentionally brought the lifecycle of the cask to an abrupt end. Although this occurred in only a small segment of the casks that were in use during the research period, it is particularly impactful for this sub-study since 405 out of the 1,012 casks in the dataset originate from shipwreck investigations (Section 7.3).

Equally, marks of the same type could be applied multiple times to an individual cask in the same usage period, if, for example, casks changed hands several times; multiple personal identification marks would then be applied to the same cask.[320] Of course, several of the same type of cask mark on an individual cask could also result from its repeated use as a transport container without changing ownership. After a cask was emptied, it could be returned to the producer of a specific type of merchandise. The producer could then have the cask re-gauged to ensure it still met the required specifications before reusing it for shipping. Over time, this reuse could lead to the repeated application of certain cask marks. To avoid confusion, marks were sometimes removed by scraping them off the cask.

320 As can be seen, for example, on a cask head from the shipwreck Burgzand Noord 4 (Figure 7.2, right), the personal identification mark 'IPV' was applied twice.

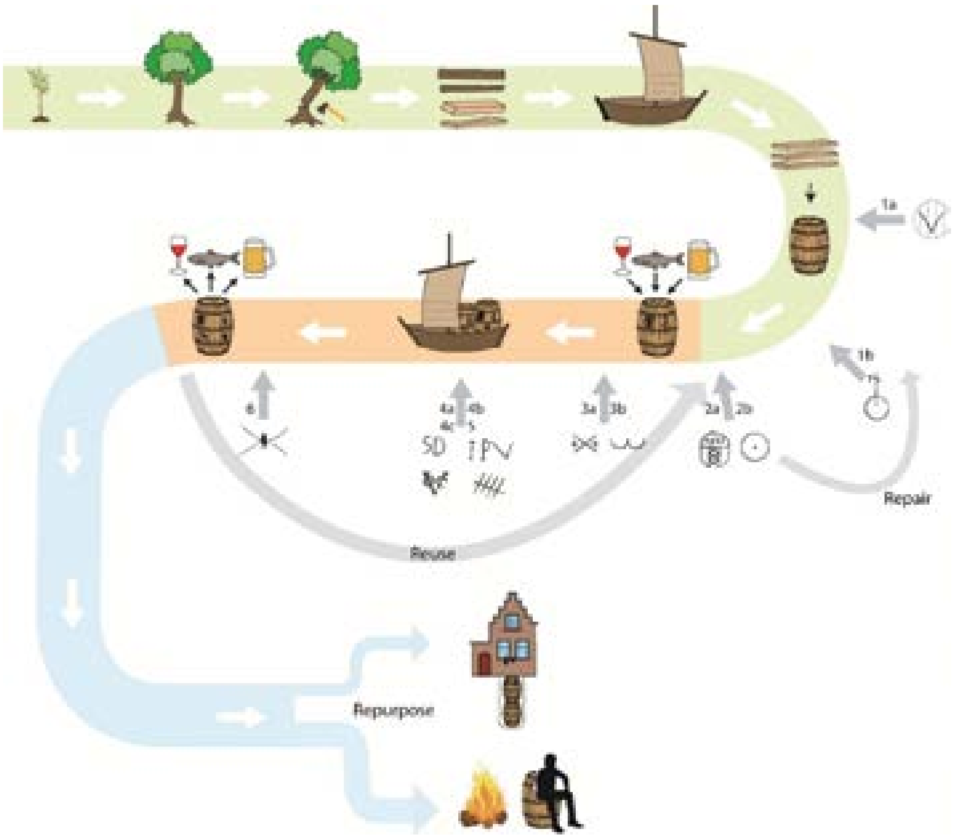


Figure 7.7: Schematic overview of the three phases in the lifecycle of a cask (production phase – green; use as a transport container – orange; repurposing – blue), with the type and the phase at which cask marks were applied.

Table 7.2: Overview of cask mark types. The mark functions are incorporated in the type name, followed by its position in the lifecycle of casks and the actor responsible for applying the mark.

Cask mark type	Phase in lifecycle	Applied by
1. Production mark		
1a. Construction mark	During production phase	Coopers
1b. Coopers' mark	During production phase	Coopers
2. Cask gauge mark		
2a. Cask gauge approval mark	End of production phase	Urban inspectors
2b. Cask gauge rejection mark	End of production phase	Urban inspectors
3. Content gauge mark		
3a. Content gauge approval mark	Beginning of use as transport container	Urban inspectors
3b. Content gauge rejection mark	Beginning of use as transport container	Urban inspectors

4. Identification mark		
4a. Product identification mark	During use as transport container	Producers/merchants
4b. Personal identification mark	During use as transport container	Merchants
4c. Corporate identification mark	During use as transport container	Producers
5. Count mark	During use as transport container	Merchants/toll officers
6. Content quantification mark	End use as transport container	Urban inspector (wine gaugers)

7.7 Cask marks by type

The following description of the individual cask mark types begins with a discussion of cask marks' function, followed by a description of the source material used to identify the mark, a description of its distinguishing features, and a rationale for defining them as a distinct type of cask mark.

7.7.1 Production marks

Production marks were added during the first phase of a casks' lifecycle, known as the production phase, by the coopers who crafted them. These cask marks are divided into construction marks and coopers' marks. Both served a distinct function and have a unique set of features, which are described below.

7.7.1.1 Construction marks

The distinctive function of the construction mark is the primary reason for establishing it as a separate type of cask mark in the typology. Construction marks were applied by coopers to measure, match, or indicate the sequence of the assembly of the staves or headboards. To contextualize the use of construction marks, regulations regarding this type of mark were sought in various written sources. However, no information on this subject was found. This is not surprising, given the practical nature of the mark; coopers had little reason to document this process, which could have ended up in the archives of, for instance, the coopers' guilds.

To gain more insight into the use of construction marks, contemporary coopers who craft casks using traditional methods were consulted. Coopers Cor de Groot (cooper of the Zaans Museum) and Erwin van Berkel (cooper of the Zuiderzee Museum) were consulted regarding the appearance, application method, and placement of marks on casks.

Design

According to De Groot and Van Berkel, construction marks can vary in appearance depending on their function, such as matching headboards, the correct placement of dowels, and the orientation of the heads.[321] For example, matching headboards could be indicated by inscribing V-shaped marks (Figure 7.8_1), while the placement of the dowels could be marked with short, straight lines on the surface of the heads (Figure 7.8_2).

The beveled edges of the heads had to fit seamlessly into the croze, which was cut into the inside ends of the staves. Since a head is typically slightly oval, its orientation is crucial during placement. The correct position of the head could be indicated by concentric (Figure 7.8_3) or X-shaped marks (Figure 7.8_4), which extended across the ends of the staves. If these marks aligned properly, the orientation of the head within the staves was correct, ensuring a watertight construction.

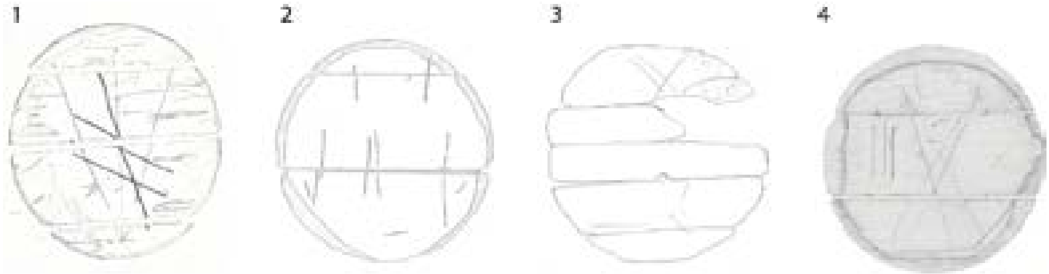


Figure 7.8: Examples of construction marks on heads. 1. Scheurrak SO1; 2. Burgzand Noord 14; 3. Burgzand Noord 4; 4. Scheurrak SO1. Sources: 1. Manders, 1996, 60. ID0059; 2. Vos, 2012, 307. ID0002; 3. Vos, 2012, 184. ID024; 4. Manders, 1996, 59; ID0039.

Another possible construction mark, intended to indicate the correct placement of the staves, consisted of a diagonal line running across multiple staves.[322] This mark would be used during production when the staves had to be temporarily disassembled and submerged in a water bath to make them flexible for bending into the desired curve. Cask marks were used to indicate the correct sequence of the staves and to ensure they were reassembled in the proper order.[323]

Method of application

De Groot stated that construction marks on the bilge were superficial or made with chalk or charcoal that disappeared in time. He also noted that construction marks, particularly on staves, would disappear from the bilge during the finishing process at the end of the construction phase. The bilge, when finished, had a smooth, continuous surface, meaning shallow marks and other production traces had been removed.

321 Personal communication, de Groot, January 24, 2025; personal communication, van Berkel, September 30, 2024.

322 Personal communication, de Groot, January 24, 2025.

323 As shown in Figure 7.17_3.

The construction marks preserved on casks recovered from archaeological contexts were most likely incised using a knife. In instances where circular forms were required (Figure 7.8_3), a compass would have been employed to inscribe the mark.

Mark location on casks

According to both De Groot and Van Berkel, construction marks were mainly applied to the head, where they served various functions, such as marking matching headboards and the position of dowels, and ensuring the proper orientation of the heads. Additionally, De Groot suggested that construction marks on the bilge that indicated the correct sequence of staves may have been removed during the finishing of the casks, making them no longer visible.[324]

7.7.1.2 Coopers' marks

Coopers' marks were applied to finished casks (Figure 7.7). Coopers applied marks to quantify their output, which was important because their wages were determined by the number of casks they produced. Additionally, coopers' marks served to trace the producer of the casks, which was particularly useful in cases where claims were made for damages resulting from a defective cask. The distinctive function of coopers' marks and their unique place in the lifecycle of casks justify the assignment of coopers' marks as a separate type in the typology.

Coopers' marks also played a crucial role in quality control; inspections were conducted immediately after production to verify whether the cask met the required standards. The mark was mandatory; the absence of a coopers' mark would result in the cask being rejected. Therefore, in various coopers' guilds in Dutch cities, the application of a coopers' mark was explicitly mandated, as seen in Haarlem in 1567[325] and Breda in 1561.[326] A resolution by the city of Groningen in 1602 also required the use of coopers' marks, but it applied only to casks intended for exportable contents.[327]

For some products intended for export, such as beer, specific ordinances have been preserved that explicitly state it was mandatory to apply a coopers' mark on casks with specific products. This applied, for example, to the Hoemburg beer casks intended for export, which were produced in Gouda in 1490.[328] Additionally,

324 Personal communication, de Groot, January 24, 2025.

325 Published in: Huizinga, 1911, 114.

326 Scherft, 1950, 137.

327 Van Gangelen & Potze, 2017, 123.

328 Published in: Rollin Couquerque & Meerkamp van Embden, 1917, 105.

the beer casks produced in Haarlem in 1567[329] and those in Amsterdam in 1663[330] had to be marked with a coopers' mark.

Casks intended for herring, another major export product, were also required to have coopers' marks. The herring casks produced in Veere had to be marked on the bilge with a coopers' mark.[331] The College van de Grote Visserij, which provided regulations for many herring towns in Holland and West Friesland, also mandated a coopers' mark on herring casks.[332]

Design

The above-mentioned written sources provide no specific requirements for the design of coopers' marks. However, many examples reveal a design primarily composed of straight lines, with curved lines being the exception (Figure 7.9). This type of cask mark often incorporated a cross (Figure 7.9_2, 3, 5), an arrow cross (Figure 7.9_3, 4), or hash symbol (Figure 7.9_6). Monograms comprising a cooper's initials were used, as is shown in Figure 7.9_8 where "PM" stands for the cooper Pieter Mogghe. Additionally, Christian symbolism, for example, Chi-Rho, may also have been employed by coopers (Figure 7.9_7).

Figure 7.9: Examples of coopers' marks on herring casks in Amsterdam, 1517. The marks are linked to the following coopers: 1. Dirck Roemertsz; 2. Harrick Jansz; 3. Thys Kerstensz; 4. Willem Talinck; 5. Adriaen Imanse (ID1048); 6. Jacob Black (ID1057); 7. Jan Claese (ID1034); 8. Pieter Mogghe (ID1053). Sources: 1–4. SAA, AvB, Archief van de Burgemeesters, no. 5023/275, February 22, 1517; 5–8. ZA, GtZ, no. 5218/138, Lijst van leden kuipersgilde, 1649.

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329 Published in: Huizinga, 1911, 423.

330 Published in: Smient & Smient, 1663.

331 ZA, SV, No. 312/38, January 19, 1566 [scan 42].

332 NA, ACGV, No.74/1, May 12, 1620 [scan 1].

Method of application

The method of application of a coopers' mark is specifically mentioned in several sources. According to a 1521 ordinance regulating a local brewery, the coopers' mark on beer casks produced in Schiedam had to be applied with an adze, making an imprint comparable to that made with a timber scribe.[333] In Veere, a 1672 decree mandated that the coopers' mark be applied using a marking iron, either by striking or branding.[334]

Less permanent marks, such as chalk, charcoal, paint, or ink, were not prescribed. This is likely due to the fact that the coopers' mark had to remain visible until the full cask reached the final consumer. Applying the mark with a timber scribe (or adze) or a marking iron would ensure the marks' durability.

Mark location on cask

Various regulations specified the placement of coopers' marks on casks. Descriptions of 20th-century casks traditionally crafted say that they were placed on the cask heads.[335] This is verified by archaeological explorations of numerous marked casks revealing coopers' marks typically applied on one of the heads.[336]

Written sources from the Netherlands provide similar information for herring casks. For instance, in Veere, a 1479 ordinance mandated that the coopers' mark be placed on the bottom of herring casks.[337] Sources from the 17th century state that the mark should be placed on the *averechtschen bodem*, which likely referred to the interior of the head.[338]

Other written sources, however, mention a placement on the bilge, often specifying that it should be applied to the bung stave (the widest stave). This was the case for beer casks from Gouda in 1490,[339] Haarlem in 1567,[340] and Dordrecht in 1606.[341] The College van de Grote Visserij also mandated the placement of the coopers' mark on the bung stave of herring casks in 1583 and in 1620.[342] An 1583 ordinance not only required its placement on the bung stave but also specified its position between the third and bilge hoop.

333 *Published in: Heeringa, 1904, 300.*

334 *ZA, SV 312/50, December 3, 1672 [scan 55].*

335 *Kilby, 1971, 29; Waelput, 2004, 95.*

336 *Houbrechts & Pieters, 1996, 247; Fawsitt, 2010, 64.*

337 *ZA, SV 311/21, Rood costuumboeck, June 9, 1479 [scan 23].*

338 *ZA, SV 312/50, December 3, 1672 [scan 55].*

339 *Published in: Rollin Couquerque & Meerkamp van Embden, 1917, 216.*

340 *Published in: Huizinga, 1911, 425.*

341 *RAD, GC, No. 563/6, Ordonnantie op het maken van biertonnen, September 17, 1624.*

342 *NA, ACGV, No.73, Placcaaten wegens de Groote Visserije, 1583 [scan 16]; NA, ACGV, No. 74/item 12, 1620.*

Thus, coopers' marks could be applied on the bung staves or on the heads. On the heads it could be applied to either the interior or the exterior. An application on the interior of a head appears to be unique to coopers' marks. It is the only type of mark for which evidence of such placement has been found.

7.7.2 Cask gauge marks

The cask gauge mark was applied to casks at the end of the production phase, in preparation for use as transport containers. This cask mark was part of the gauging process carried out by inspectors (*keurmeesters*, or *branders*) appointed by urban authorities or guild boards. They assessed both the overall quality and the volume capacity of the cask. This inspection was crucial for ensuring the quality of the product being transported.

Casks were required to comply to specific regulations that varied according to their designated use. These regulations mandated the dimensions, the number of staves and hoops, the quality of the timber used, and a watertight construction (Chapter 5). If a cask met all the requirements, it was marked with a cask gauge approval mark. In contrast, casks that failed to meet the required criteria were marked with a cask gauge rejection mark.

The cask gauge mark was not only applied to new casks used for the first time, but it was also required for casks that were being reused. A mandatory annual inspection of old casks could also be ordered, as stated in the archives of the Coopers' Guild of Amsterdam in a 1609 ordinance.[343] Subjecting used casks to the gauging process ensured that they were compliant with the same quality control measures as new casks, maintaining standards for their subsequent use.

The distinctive function of the cask gauge mark for both approval and rejection, their unique function in the lifecycle of casks, and their application by an urban inspector justify assigning them separate subtypes in the typology.

7.7.2.1 Cask gauge approval marks

The cask gauge approval mark was applied to casks by urban inspectors upon confirmation that the cask met all the requirements of the gauging process. The prescribed dimensions, for instance, had to be checked using certain gauge instruments, a ring, bracket, or calipers (Figure 5.5).[344] A cask bearing this type of mark could then be used as a transport container. The cask gauge approval mark communicated to producers, traders, and consumers that the gauging process had been properly carried out. If, however, the cask was found to be defective or insufficient due to poor craftsmanship or an inadequate gauging process, the

343 De Waard, 2002, 21.

344 Oosterbaan, 2023, 108.

mark could be used to trace the city of origin and a compensation claim could be made for any damages incurred damages or other deficiencies.

Cask gauge approval marks are mentioned extensively in written sources, and thus a consistent function can be deduced, both diachronically and geographically. The earliest mention of the use of the cask gauge approval mark dates back to 1490, when it was mandated that the city of Gouda's *brant van de stede* (the city's brand mark) had to be placed on Hoemburg beer casks.[345] This is also the case with beer casks from Schiedam in 1521,[346] herring casks from Vlissingen in 1545,[347] and beer casks from Dordrecht in 1588 and 1606.[348] In these ordinances, the cask gauge approval mark was the city's brand mark, known as the *stede brant* or *stadts segel*. For herring casks, the mark was called the *tonnebrand* (cask brand mark) or stede brand.[349] In the latter part of the research period, in the 18th century, the cask gauge approval mark was still mandatory, for example, a 1743 ordinance from Leiden required a cask mark in the form of the city's coat of arms with the year of application to be placed on herring and beer casks.[350] This type of cask mark appears to have been used on casks for a wide range of products. As mentioned above, both beer and herring casks were required to be marked with the cask gauge approval mark. The same was the case for butter casks, according to the ordinances of the Alkmaar Coopers' Guild in 1664.[351] Additionally, in Breda, casks produced abroad, such as wine casks, had to be inspected annually from 1665 onwards.[352]

Design

In written sources, the cask gauge approval mark is referred to as a city's brand mark. Only in a few cases is the design of the mark depicted in a written source, such as for the city of Breda with its coat of arms (Figure 7.10_2). However, on actual casks uncovered by archaeological research, this type of cask mark can often be recognized by a design of a city's coat of arms, for example, Amsterdam (Figure 7.10_1)–the year is also given–and Leiden, with its crossed keys representing the city (Figure 7.10_3).

Besides a *brand* mark, a city could also be represented by a single letter or a letter combination. In Delft, during the 17th century, the letter "D" was used as an cask

345 Published in: Rollin Couquerque & Meerkamp van Embden, 1917, 105.

346 Published in: Heeringa, 1904, 300.

347 ZA, GtV, No. 9, Minuut-notulen kuipersgilde, 1775–1808.

348 RAD, GC, No.551, Ordonnantie op het branden van tonnen, 1588; RAD, GC, No. 563/item 13, 1620.

349 Beaujon, 1885, 9–10; Dijkman, 2011, 220; Published in: Heeringa, 1904, 306; Houbrechts & Pieters, 1996, 247.

350 Published in: Luchtmans, 1743, 9.

351 Published in: Geest, 1664, item 47.

352 Scherf, 1950, 155.

gauge approval mark,[353] and in Breda, starting in 1587, the cask mark was the letter combination “BRE” (Figure 7.10_5). However, from 1777 onwards, this system was modified[354] and the cask gauge approval mark was replaced with a single letter that changed annually. This meant that the specific year a cask was gauged could be identified directly from the mark, although with the disappearance of an easily recognizable urban coat of arms, required users to have greater familiarity with the marks, which varied annually.[355] For certain products, a simpler design than a coat of arms was used for the cask gauge approval mark. On herring casks in Amsterdam the *tonnebrand*, indicating that certain specifications had been met, consisted of a circle with a cross inside it (Figure 7.10_4).

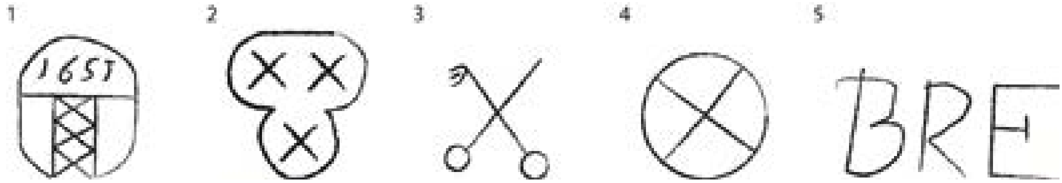

Figure 7.10: Examples of cask gauge approval marks. 1. Cask mark of Amsterdam; 2. Cask mark of Breda; 3. Cask mark of Leiden; 4. The tonnebrand on herring casks from Amsterdam; 5. Cask mark of Breda. Sources: 1. Van Gangelen & Potze, 2017, 125; 2. Scheft, 1951, 61; 3. Verduin, 2019, 255; 4. SAA AvB, No.275, February 22, 1517; 5. Scheft, 1951, 55.

Method of application

The majority of written sources do not provide specific instructions on how the cask gauge approval mark was to be applied. However, the terminology used, such as *stede brand*, suggests the use of a branding iron. Additionally, a design of a city’s coat of arms, which was used frequently, was typically so intricate that etching it with a timber scribe or knife would have been arduous.

The passages in written sources that specify how this type of cask mark had to be applied also mention the use of the branding iron. This was the case for butter casks from Delft, for example, in the first half of the 16th century, which had to be marked with a *gloeiend ijzer* (red-hot iron).[356]

Mark location on cask

The cask gauge approval mark was typically applied on the bilge of the casks.[357] In certain cases, even more specific guidelines were provided: marks had to be

353 Van Gangelen & Potze, 2017, 125.

354 Scherft, 1951, 56; Van Gangelen & Potze, 2017, 125.

355 Scherft, 1951, 56; Van Gangelen & Potze, 2017, 125.

356 Published in: Soutendam, 1870, 194.

357 RAD, GC, No. 551, May 5, 1588; RAD, GC, No. 563, September 17, 1624; Published in: Soutendam, 1870, 194.

applied either on the joints of the staves or, more commonly, on the widest stave. Evidence of this is found in an ordinance from 1583 in the archives of the College van de Grote Visserij concerning herring casks that mandated placement of the mark on the widest stave, positioned between the bilge hoop and the third hoop.[358]

7.7.2.2 Cask gauge rejection marks

If a cask did not meet the requirements for that specific cask, the city inspector would apply the cask gauge rejection mark. Rejected casks could be repaired by a cooper, after which the assessment process would be repeated. When the required repairs were completed, the inspector would replace the cask gauge rejection mark with the cask gauge approval mark and the cask would again be fit for use.[359]

If the same cask was submitted for inspection again without the required repairs or if the cooper had removed the cask gauge rejection mark, the inspector was authorized to remove the casks' *kimmen* (bottom part of the staves) and claim ownership of the cask according to an ordinance of the coopers' guild in Dordrecht in 1602[360] and an ordinance of the College van de Grote Visserij.[361]
Although the cask gauge rejection mark is mentioned less frequently in written sources than the cask gauge approval mark, a consistent pattern of use throughout the research period can be identified. The oldest known reference to this type of cask mark dates back to 1583 and states that rejected herring casks should be marked.[362] This cask mark type is also mentioned in regards to beer casks in Dordrecht in 1606[363] and herring casks in Rotterdam in 1743.[364]

Design

In some of the written sources, the design of the cask gauge rejection mark is mentioned. For example, the cask gauge rejection marks on herring casks from Rotterdam in 1743 came with the following prohibition: *"Sal niemand bestaende Merken nog de circels by de keur-meester op eenige afgekeurde tonnen gesteld uyt te houwen"* (No one shall remove the existing marks or the circles on any rejected casks placed there by the inspector).[365] This implies that a circular design was one of the designs used as cask gauge rejection mark. Similarly, for herring casks from Amsterdam, inspectors in 1579 were requested to inspect and mark

358 NA, ACGV, No.73/16, 1583 [scan 16].

359 NA, ACGV, No.74 /item 17, May 12, 1620 [scan 3].

360 RAD, GC, No. 559, Resolutie van de Staten van Holland, 1663.

361 NA, ACGV, No.74 /item 17, May 12, 1620 [scan 3].

362 NA, ACGV, No.73, 1583 [scan 16].

363 RAD, GC, No. 563, September 17, 1624.

364 Published in: Waesberge, 1734, item 40.

365 Published in: Waesberge, 1734, item 58.

the casks with circles (*"te keuren ende circulene"*), which suggests that approval or rejection marks were circular in design.[366]

Method of application

No sources have been found that prescribe the method of applying cask gauge rejection marks. However, given a circular design, it is very likely that a compass or a similar tool was used.

Mark location on cask

The location of the cask gauge rejection mark was sometimes specified, with instructions to place it on the bilge of the cask, as was the case with beer casks in Leiden in 1743.[367] In an ordinance issued by the College van de Grote Visserij, not only was the bilge indicated as the location of the mark, it also had to be applied at the midpoint between the third hoop and the *hals hope* (chime hoop).[368]

7.7.3 Content gauge marks

Content gauge marks were applied during a casks' use as a transport container, initiating the second phase of a casks' lifecycle. Certain products had to be inspected by officials and had to meet specific quality standards, as was customary with herring where inspectors checked the quality of the fish and ensured it had been properly packing and salted. If the contents of a cask met all regulations, they were approved and the cask was marked with a content gauge approval mark. Conversely, contents that failed to meet the required criteria were rejected and the cask marked with a content gauge rejection mark.

The content gauge marks differ from the cask gauge marks in that they apply to the contents rather than the cask itself. Furthermore, content gauge marks were applied at a later phase than cask gauge marks. Another example of a cask mark similar to the content gauge mark is the product identification mark, though it was applied by the producers of the merchandise or someone affiliated with them, and did not require inspection.

The distinctive function of content gauge marks for both approval and rejection, their unique function in the lifecycle of casks, and their application by a city inspector, warrant assigning them separate subtypes in the typology.

366 Published in: Smient & Smient, 1663, 466.

367 Published in: Luchtmans, 1743, 15.

368 NA, ACGV, No.73, 1583.

7.7.3.1 Content gauge approval marks

The content gauge approval mark was applied to casks by inspectors upon confirmation that the contents met all the prescribed requirements of the gauging process. A cask bearing this type of mark could then be transported or traded. The content gauge approval mark assured producers, traders, and consumers that the gauging process had been successfully completed.

This type of cask mark was primarily used for products exported from the coastal regions of the Netherlands in the Late Middle Ages and Early Modern period, with products such as beer, herring, and dairy products, for example, butter.[369] Specific regulation of the content gauge approval mark have predominantly been documented in written sources in the context of herring casks. The following discussion therefore focuses on the cask marks for herring only.

Dutch herring was exported not only throughout Europe but also beyond, where Dutch herring was regarded highly for its quality. To maintain this reputation, gauge regulations were established to ensure quality control and to safeguard the prominent position of Dutch herring in the international herring trade.[370]
The first historical reference to regulations for the Dutch herring fishery is an ordinance of 1519, which applied to Holland and Flanders.[371] The ordinance was established to create a level playing field for these two regions, to minimize differences, and to prevent disputes. The 1519 ordinance prescribed that any herring deviating from the required standard must be packed in separate casks. This applied to herring that was classified as *ydel* (herring without fat or roe), *kuitziek* (herring with underdeveloped roe), and or *wrack* (herring with defects). Casks containing inferior herring could have the *backbrand* applied, but that was considered optional. The authorities of cities where herring was packed were, in other words, free to implement their own regulations for deviation from the standard.[372]

Veere, in Zeeland, was one of the cities in the 16th century that decided on an optional inspection and appointed inspectors to oversee quality control of its herring export. The *Staetuytboeck Veere*, issued in 1544, stated that inspectors were required to removed herring with defects.[373] The following distinctions were made: *ydelen* (lean herring, without fat or roe), *hoofdeloosen* (headless herring, possibly improperly processed), *kuitsieken* (herring with underdeveloped roe), *verloosen* (herring with defects, e.g., missing fins or tail), *velloosen* (herring without skin, possibly due to spoilage or improper processing), and *wammelosen* (soft,

369 Yntema, 1992, 3; Unger, 2001; Dijkman, 2011, 222–22.

370 Dijkman, 2011, 353.

371 Beaujon, 1885, 9; Dijkman, 2011, 222.

372 Beaujon, 1885, 9.

373 ZA, SV, No. 312/80, August 4, 1568.

limp herring, likely of poor quality or spoiled). In some cases, the mark indicating these deficiency classifications has been preserved, such as for *kuitsieken* (Figure 7.11_1) and *wammelosen* herring (Figure 7.11_2). In Veere a further distinction was made for *wracken* herring, the lowest quality grade, with its own symbol (Figure 7.11_3).

At the end of the 16th century, several factors affected the quality control of herring. Fishing as such was curtailed by the Eighty Years' War because sea warfare created unsafe conditions for fishermen.[374] At the same time, ongoing concerns about quality control led to adjustments in the gauging process. Whereas in the early 16th century herring had been inspected after being packed into transport casks, by the late 16th century the sorting process was carried out aboard the herring busses by the crew.[375] This change of method affected the way quality control was conducted, as recorded in a series of ordinances from the 1580s.[376] These ordinances stated that, after sorting, the herring was brought ashore in *zeetonnen* (sea casks) after which inspectors verified whether the sorting had been done properly. The shipmasters were required to place their personal mark on the *zeetonnen* to ensure the traceability of the person responsible for the sorting.

Upon a successful inspection of the sorting, the herring could be packed into casks for transport. This process was done by packers sworn-in by the city. They were responsible for properly salting the herring and filling the casks. Each packer had a unique mark that had to be placed on the full herring cask and recorded in an official register. Such registers from the city of Veere have been preserved and include lists of packers between 1540 to 1615.[377] The lists are organized by function: *keurmeesters* (inspectors), *brandpackers* (responsible for packing the herring in the casks), *hoogers* (responsible for topping up the casks with herring after they had been compacted), and *souters* (responsible for salting the herring). Individual marks were consistently recorded only for the *brandpackers*, and from this period onwards these marks functioned as content gauge approval marks on herring casks (Figure 7.11_4, 5).

The ordinances from the 1580s proved insufficient in the early 17th century to prevent new malpractices from in the herring fishery. Much of the herring caught in the North Sea was transported directly to foreign ports by Dutch fishermen, thus evading the official quality control process.[378] To address this issue, several proclamations were issued between 1604 and 1621 that required various marks to be applied to herring casks in Dutch harbors, depending on the time of year

374 Van Bochove, 2004, 3–4.

375 Beaujon, 1885, 40.

376 Beaujon, 1885, 41.

377 ZA, SV, No. 1898, Registre roerende den cupers, 1540–1638.

378 Beaujon, 1885, 47.

the herring was caught and on the destination country or city.[379] For the main regions of export, distinct marks had to be applied to the casks to differentiate destinations, such as the *Roaanse brand* for export to France and Flanders (Figure 7.11_6) and the *Keulsche brand* for exports to the Cologne region.[380]

Additionally, the period in which the herring was caught had to be indicated with a mark on the cask. This also served as a quality mark, as the herring varied in quality throughout the fishing season due to fluctuations in fat content and the development of roe (*hom*) and milt (*kuit*). The herring fishing season had three periods determined by the development phases of herring: young herring caught before the spawning period, during the spawning period, and post-spawning. In Rotterdam's 1743 classification, for example, marks corresponded with these three seasons:[381]

- *Jacobi brand* for herring caught after July 25, marked with a "J";
- *Bartholomeus brand* for herring caught after August 24, marked with a "B";
- *Kruys brand* or *Grote brand* for herring caught after September 14, marked with an "X."

Just nine years later, this threefold classification also appeared in *Het Algemeen Kunstwoordenboek der Wetenschappen* with distinct terminology and corresponding marks for herring originating from Holland:[382]

- *Maatjes* herring, caught early in the herring season, was very tender in flesh and fat, with few or no entrails. Based on their quality, they could be classified as maatjes herring (Figure 7.11_7), *maatjes* wrak herring (Figure 7.11_8), or *maatjes wrak-wrak* herring (Figure 7.11_9).
- *Volle* herring, caught around St. Bartholomew's Day (August 24), had fully developed roe or milt. Depending on their quality, they were categorized as *volle* herring (Figure 7.11_10), *volle wrak herring* (Figure 7.11_11), or *volle wrak-wrak herring* (Figure 7.11_12).
- *Brand* herring, caught in the latter part of the herring season, were assigned a mark consisting of the city's coat of arms alongside a double circle (Figure 7.11_13). No further identification mark was prescribed for this category.[383]

It is unclear whether the classification of 1743 replaced the one of 1734 or if both were used simultaneously. What remained consistent, however, was the requirement that marks indicating both the period of catch and the destination were mandatory on herring casks destined for export.

379 Beaujon, 1885, 48.

380 Beaujon, 1885, 47.

381 Published in: Waesberge, 1734, item 29.

382 Westerhovius, 1743, 354–355.

383 Westerhovius, 1743, 354–355.

7

Design

The design of content gauge approval marks varied depending on their significance, but simple designs were generally preferred. This type of cask mark has only been found in the herring fishery, and thus information on its design applies only on content gauge approval marks for this product.

Some examples of simple quality-related marks are shown in Figure 7.11_1–3. Likewise, marks indicating the period in which the herring was caught were usually simple, often consisting of a single letter referring to a religious feast day that occurred around the period of the herring season when the fish was caught, such as the letter “J” (*Jacobi brand*), “B” (*Bartholomeus brand*), and “X” (*Kruys brand*). The method used from 1743 onwards to indicate the catch period of herring was also a simple marking system. Each fishing period was assigned a classification in which the number of elements in the mark also conveyed the quality of the herring (Figure 7.11_7–13). For example, the mark for high-quality young herring consisted of two half circles, and the mark for lower-quality young herring was a single half circle (Figure 7.11_7, 8). In contrast, the *brandpacker’s* mark, which functioned as a content gauge approval mark, was generally more intricate. These marks varied in design but often featured geometric patterns similar to those of coopers’ marks.

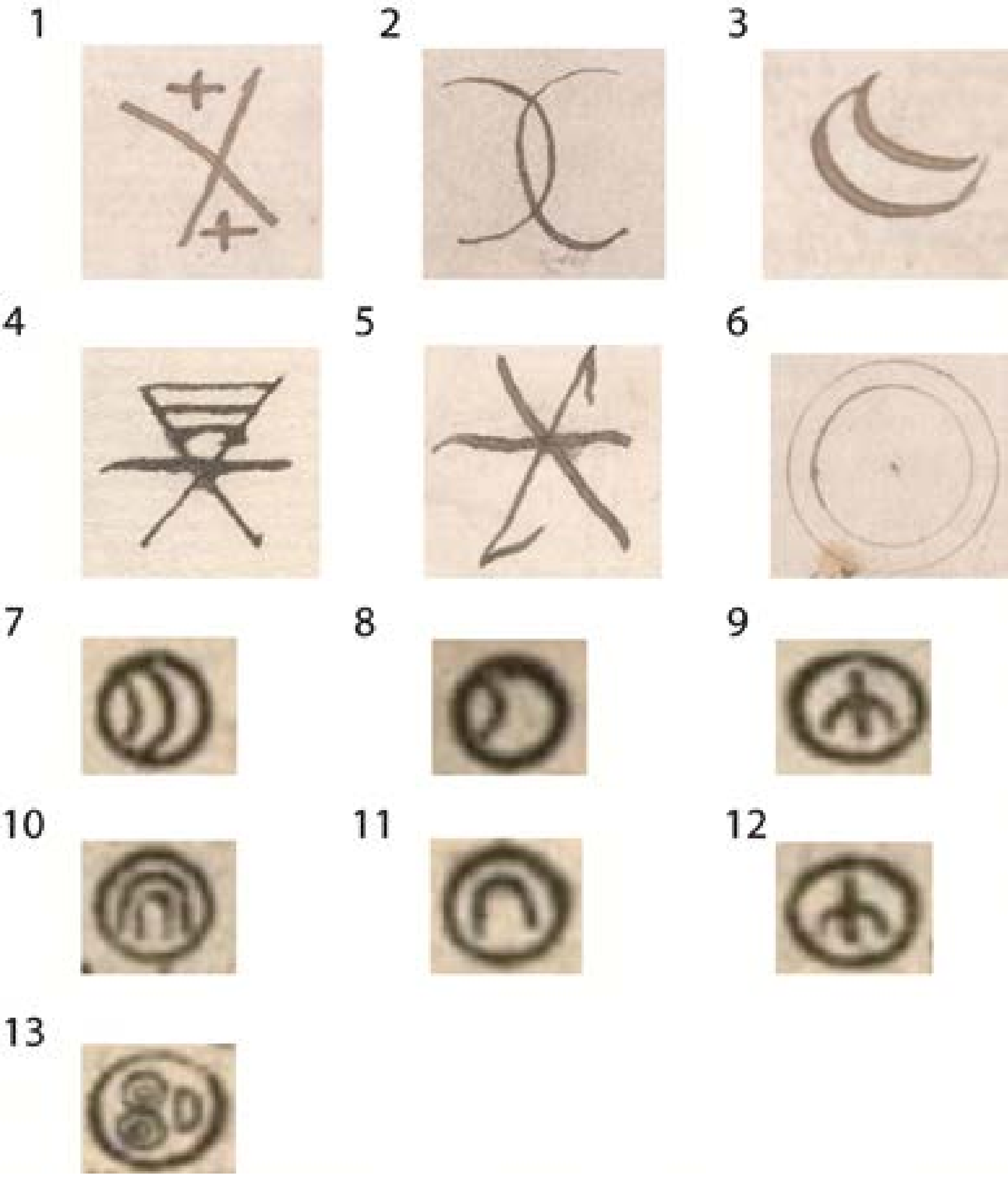

Figure 7.11: Examples of content gauge approval marks from written sources. 1. Mark of the kuitsieken herring (herring with underdeveloped or poorly developed roe); 2. Mark of the wammelosen herring (soft, limp herring, likely of poor quality or spoiled); 3. Mark of the wracken herring (of the lowest quality); 4. Mark of the brandpacker Andries Stevenssen in Veere in 1540; 5. Mark of the brandpacker Anthuenis Falquier in Veere in 1577; 6. Mark of the Rooner herring (to be exported to France and Flanders; 7. Mark of the maatjes herring; 8. Mark of the maatjes wrak herring; 9. Mark of the maatjes wrak-wrak herring; 10. Mark of the volle herring; 11. Mark of the volle wrak herring; 12. Mark of the volle wrak-wrak herring; 13. Mark of the brand Herring. Sources: 1. ZA, SV, No. 312/80, August 4, 156. ID1022; 2. ZA, SV, No. 312/80, August 4, 1568. ID1024; 3. ZA, SV, No. 312/80, August 4, 1568. ID1022; 4. ZA, SV No. 1898/1, 1540–1550. ID1222; 5. ZA, SV, No. 1898/1, 1540–1550. ID1299; 6. (ZA, SV, No. 312/80, August 4, 1568. ID1022; 7-12. Westerhovius, 1743, 354–355.

Method of application

No sources have been found that prescribe regulations for the method of applying content gauge approval marks. Given their function of indicating a successful gauging process, it was essential that these marks were clearly visible and durable and so the use of a timber scribe, branding iron, and strike iron is a likely method of application.

Mark location on cask

Various sources from different periods stipulate where the content gauge approval mark was to be applied. Both the bilge and the heads are mentioned as mark locations, suggesting a chronological shift in marking practices.

In the earliest ordinances, marks were to be applied on the bilge, with additional specifications stating that they should be placed between the belly hoop and the third hoop.[384] However, beginning in the 18th century, placement on a head became mandatory.[385] The marks for *volle* herring (Figure 7.11_7–13) are all positioned on the cask head. The large outer circles of the designs represent the outline of the cask heads.

7.7.3.2 Content gauge rejection marks

Inspectors applied the content gauge rejection mark to casks whose contents failed to meet the required standards during the gauging process. As discussed in section 7.7.3.1, written records refer to content gauge marks mainly in relation to herring. The classification system differentiated several levels of quality, with the lowest grade designated as *wrack*. [386] In the case of herring, marks that indicate *wrack* are interpreted as content gauge rejection marks, whereas for other products, the meaning may differ.

Design

Various written sources describe or depict the design of the content gauge rejection mark, revealing variations over time. In Veere, the mark used in 1544 consisted of a double circle placed on the bottom of the cask.[387] By 1663, Amsterdam had adopted a different design, featuring a double half-circle.[388] By 1743, herring of the lowest quality, classified as *wrak-wrak*, consistently bore the same mark regardless of the catch period. The design was of a half-circle with a line transversing it (Figure 7.11_9, 12).

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384 Beaujon, 1885, 48.

385 Westerhovius, 1743, 354–355.

386 Published in: Smient & Smient, 1663; Beaujon, 1885, 11; ZA, SV no. 312/88, August 4, 1568.

387 ZA, SV no. 312/88, August 4, 1544.

388 Published in: Smient & Smient, 1663, 471.

Method of application

No written sources have been found that prescribe the method of applying cask gauge rejection marks. Given their function of indicating a unsuccessful content gauging process, it was essential that these marks were clearly visible and durable and so the use of a timber scribe, branding iron, or strike iron are the likely methods of application.

Mark location on the cask

Similar to the placement of content gauge approval marks, written sources indicate that rejection marks were initially applied to the bilge and later to the head of the cask.

7.7.4 Identification marks

Casks were marked for identification purposes during the second phase of their lifecycle, as transport containers. In some cases, it may have been necessary to label the product in the casks. For cask marks with this function, type 4a has been added to the typology. For instance, in 1692 ships of the Verenigde Oost-Indische Compagnie (VOC) encountered problems because casks containing tar and vinegar closely resembled those used for storing food and drink.[389] To prevent confusion, products were required to be clearly labeled in ink.[390]

Cask marks also served to identify the persons or companies associated with the casks and their contents. These cask marks could indicate ownership of the casks but could also indicate commercial agents or entities who were transporting or trading the products. Cask marks could also be associated with and bear the logo of companies such as the VOC or a brewery.[391] Hence, for personal identification marks, type 4b has been added to the typology, while type 4c pertains to corporate identification marks.

A common element of the three subtypes of identification marks (4a, b, and c) is that they were all applied to the cask as a transport container and were applied in the process of filling, trading, or transport. These identification marks indicated to transporters, traders, and owners what the contents of the cask were as well as the person or corporation associated with it, which removed the need to open the cask. Identification marks were applied by owners, shippers, transporters or traders and thus are distinguished from cask or content gauge marks, which were applied by urban inspectors. While gauge marks are typically found in sources of an institutional nature (e.g., city regulations), identification marks are more varied and

389 NA, VOC, No. 192–194, March 26, 1692.

390 Lekkerkerk, 1992, 58.

391 Gaastra, 1991; Lekkerkerk, 1992, 60.

can be found in the archives of trade organizations, bills of lading, and personal correspondence.

7.7.4.1 Product identification marks

The product identification mark was applied to casks to describe the product it was carrying, and was placed on the casks by the producers of the merchandise. As previously mentioned, the contexts in which this type of mark is referenced in written sources vary. To better understand the function and features of this type of cask mark a few examples from written sources are discussed below.

The product identification mark was particularly useful when a casks' contents were not easily distinguishable from the contents of other casks because the external characteristics of the casks were similar. An example is the similar looking casks on VOC ships that contained tar and vinegar, or food and drink, mentioned above.[392]

Product identification marks indicated not only the type of product but also its origin. The archives of the Sociëteit van Suriname list marks on casks filled with coffee beans and information on the plantations from which the coffee beans originated (Chapter 8).[393] The casks were transported on the frigate *'t Hart*, which sank in 1751 near the Dutch island of Texel. The coffee beans had been grown on various plantations owned by Jan Pietersz Visser.[394] The casks were marked not only with the owner's personal identification mark, "IPV," but also with a mark identifying the contents. The mark "SD" was used for Sardam plantation (Figure 7.12_1), "OB" referred to the Ornamibo plantation, and "RR" to the Rorac plantation (Figure 7.12_2). A fourth plantation, Claverblad, was identified by a *klaverblad* (three-leafed clover) symbol as its cask mark (Figure 7.12_3).

Design

The product identification marks mentioned in written sources indicate a wide variation in design. Since the people who applied the cask marks typically had the freedom to determine the design themselves, such variation was bound to occur. The examples below show designs ranging from letter combinations (Figure 7.12_1, 2) to geometric figures (Figure 7.12_3).

392 Lekkerkerk, 1992, 58.

393 NA, SvS, No. 280/316 (OBP), October 24, 1747.

394 Tran et al., 2025.

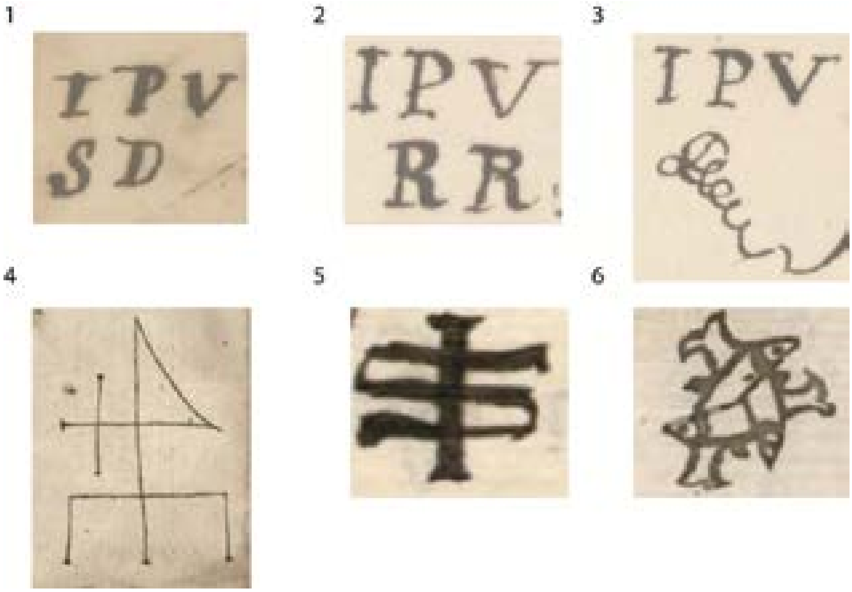

Figure 7.12: Examples of product and personal identification marks from written sources. 1. Mark of Jan Pietersz Visser and the plantation Sardam; 2. Mark of Jan Pietersz Visser and the plantation Rorac; 3. Mark of Jan Pietersz Visser and the plantation Claverblad; 4. Mark associated with Dietrich Hoerner and Heinrich Schelt; 5. Mark associated with William Gresham and Adrian Johnson; 6. Mark associated with Rychard Rede and William Gresham and his wife. Sources: 1-3. NA, SvS, No. 280/316 (OBP), October 24, 1747; 4. Jenks & Wubs-Mrozewicz, 2022, 116; 5. Jenks & Wubs-Mrozewicz, 2022, 143; 6. Jenks & Wubs-Mrozewicz, 2022, 106–107.

Method of application

The written sources do not contain information on how the product identification mark was to be applied on casks. But cask marks of this type found in archaeological contexts can provide clarification (Section 7.8.4).

7

Mark location on the cask

Neither do the written sources specify the location on the cask where this type of cask mark was to be applied, examples from archaeological contexts can provide clarification (Section 7.8.4).

7.7.4.2 Personal identification marks

Personal identification marks, in contrast to product and corporate identification marks, have received more attention in the investigation of written sources.[395] This type of mark is referred to as a merchants' mark or a household mark, but as Jenks and Mrozewicz point out, they were not used exclusively by individual merchants or households.[396]

395 Girling, 1964; Bermond-Picot, 2020; Jenks & Wubs-Mrozewicz, 2022.

396 Jenks & Wubs-Mrozewicz, 2022, 61–62.

This type of mark was used in the same way as signatures functioned in the Late Middle Ages and Early Modern period.[397] The marks, thus, are found in a wide range of contexts, for example, on gravestones and house facades, and in personal letters and legal documents.[398]

Written sources also mention personal identification marks on casks, identifying the traders involved and the merchandise they contained. In many cases, the mark of the owner of the goods was also applied. This was particularly important when the parties in the trade agreement were not involved in the shipping of the casks. To formalize trade agreements and allow the carrier or commercial agent to handle the transport and the transaction, a *cognossement* (bill of lading) could be used. In Figure 7.13 shows an example of a *cognossement* describing the trading of several marked casks in which the captain of the ship was responsible for completing the transaction between seller and buyer. The mark in the margin is a monogram of the letters "I" and "B," referring to Isaq de Brito, the selling party, that is, the owner of the goods who was selling them.

Figure 7.13: An example of a cognossement (bill of lading), indicating that Isaq de Brito had oxheads (specific type of casks) with brandy and sugar, among other things, transported to Vlissingen in 1672 on the ship Bycoref with Captain Jacob Suteligh from Flesingen. The casks were intended for Francisco de Medina, who, based on this bill of lading and after transferring the agreed upon payment, would be able to claim the casks by the mark displayed in the margin (TNA, HCA, No. 223, August 25, 1672; Database Zee(uw)post, n.d., https://digitaal.dezb.nl/zeeuwpost/book/023e137d-56c9-5a3b-d083-6f5a58246e15/1).

As mentioned earlier, personal identification marks did not function only as an identification of the owner or an affiliated merchant. They could also refer to the claimants of the goods (i.e., the buyer) or an intermediary commercial agent.[399]

397 Jenks & Wubs-Mrozewicz, 2022, 65.

398 Girling, 1964, 17; Zeven, 2010, 4.

399 Jenks & Wubs-Mrozewicz, 2022, 61.

Additionally, sources show that personal identification marks referred to people other than the owner. For example, Jan Pietersz Visser, who purchased the Surinamese plantation Sardam in 1745 (Figure 7.12_1–3), used the mark “FLW,” the personal mark of the former plantation owner Frans Lorens Wriedt until 1747, at which he began using “IPV” as a cask mark.[400]

The main function of the mark, however, remained the same. It allowed those involved in the shipping and trading of the cask to easily recognize it. That this type of mark fulfilled its function is shown in the research of Jenks and Mrozewicz who analyzed communications related to merchandise transported in 1533–1534. The unmarked casks were described in more detail than the marked ones, which indicates that cask marks functioned effectively as a shorthand for identification.[401]

Design

The product identification marks found in written sources exhibit significant diversity in their design. This variation exists because the people who applied the marks were free to design the marks themselves. Designs ranged from a combination of strokes (Figure 7.12_4), to simple combinations of letters (Figure 7.12_5), to more complex representation (Figure 7.12_6).

Method of application

The written sources do not stipulate how the product identification mark was to be applied to casks. However, many personal identification marks remained consistent because they were linked to a specific individual. This consistency made it worthwhile to invest in a branding iron or strike iron for marking casks. Alternatively, marks could also be applied using a timber scribe or ink. Examples of this type of cask mark found in archaeological contexts help clarify these application methods (Section 7.8.4).

Mark location on the cask

The written sources do not indicate a specific location where on the cask this type of mark was to be applied, so the preferred location of personal identification marks on casks remains unknown. Examples from archaeological contexts can provide valuable insights into these practices, helping to determine common patterns in mark placement and their possible significance (Section 7.8.4).

7.7.4.3 Corporate identification marks

Corporate identification marks were applied by a specific corporate entity and were used to identify the owner of a cask and its contents by that company, or to

400 Tran et al., 2025.

401 Jenks & Wubs-Mrozewicz, 2022.

indicate that the contents of the cask were produced by a specific corporate entity. An example of a corporate identification mark was found on the VOC ship *De Amsterdam*, which sank near Hastings, England, in 1749, and which bore a VOC mark of ownership.[402]

Corporate identification marks also functioned as indicators of origin and quality.[403] This is particularly relevant for beer casks, for which examples of marks are known. No specific regulations have been found in written sources, but paintings illustrate this practice. Several Dutch paintings from the research period that probably depict breweries, show beer casks with marks visible on the heads of the casks (Figure 7.14). These corporate identification marks made it easy to identify the origin of the beer when, for example, it was tapped and served in a tavern.

Design

The examples of corporate identification marks discovered show company logos. In the case of the VOC, this involved a combination of letters, but for breweries, logos usually consisted of complex representations. Examples of this include a lion (Figure 7.14_1), a goat (Figure 7.14_2), and a crowned horseshoe (Figure 7.14_3).

Figure 7.14: Examples of corporate identification marks from iconographical sources. Sources: 1. Peasants inn [Oil on canvas, no. S 527], by Frans van Mieris (de Oude), c. 1655. Museum de Lakenhal, Leiden, The Netherlands; 2. The Old drinker [Oil on canvas, inv. no. SK-A-250], by Gabriël Metsu, 1661–1663. Rijksmuseum, Amsterdam, The Netherlands; 3. Beer carrier [Etching, no. RP-P-1896-A-19368-1631], by Jan Luyken, 1711. Rijksmuseum, Amsterdam, The Netherlands.

Method of application

The examples of corporate identification marks in artistic contexts consist of marks made with ink or paint. Given the frequency with which this type of cask mark would have been applied, the use of a branding iron or strike iron is also considered a possibility, although no references to this method have been found in written sources or paintings.

402 Lekkerkerk, 1992, 60.

403 Jenks & Wubs-Mrozewicz, 2022, 65.

Mark location on the cask

Notably, corporate identification marks on beer casks in paintings are exclusively depicted on the heads of casks. This is likely related to the horizontal position of the beer casks, such as those found in taverns, from which beer was tapped (Figure 7.14_1, 2). The marks applied to the heads were therefore clearly visible to those in the tavern. Other examples, such as the VOC mark found on the ship *De Amsterdam*, were applied centrally on the bilge. In summary, corporate identification marks were applied on the bilge of casks, though it can be argued they were also applied on the heads.

7.7.5 Count marks

Count marks were used to indicate the quantity of goods contained in the casks that were being shipped. The application of these marks was likely carried out by various parties involved in the trading process, whether merchants, consumers, or people responsible for facilitating trade, such as toll collectors. These marks were a practical way of quantifying goods for those who handled them or managed their transport.

In written sources there are no records or regulations describing the use of count marks on casks. This absence may be due to the fact that count marks were not applied in an institutional framework or formalized context in which they functioned. Unlike other types of marks that were linked to specific gauging jurisdictions, count marks were often used informally and on a day-to-day basis by various parties. Tally systems and other forms of quantification were widely used in trade and commerce, and the practice of marking casks with numerical quantities was likely so commonplace and intuitive that it did not require further explanation or institutionalization.

This type of mark, however, has been found on casks in archaeological contexts and has already been identified as a separate type of cask mark,[404] warranting its inclusion in the typology. Since research on written sources does not provide information about count marks, the study of count marks in architectural-historical research has provided insight into their characteristics (see further below).[405]

Design

The design of the count mark is distinctive. It functioned as a tally system that was traditionally employed to represent numbers, particularly in contexts requiring quantification. These marks are of significant interest in architectural-historical research, as they are commonly found on wooden roof structures and stone materials used in buildings. Janse has carefully analyzed the tally system and

404 Schoute, 2017; Hofman, 2020.

405 Janse, 1990; Zeven, 2010.

traced its use back to the 13th century.[406] This system represented each number with a unique symbol or combination of symbols. For example, the number 5 was typically represented by "^" and the number 10 by "X." The exact numerical value was denoted by varying numbers of crossbars or notches (Figure 7.15).

In time, especially after the 13th century, the tally system became more refined. Count marks appeared in several forms, including Arabic numerals, Roman numerals, and tally marks. There were also regional and chronological variations in the design of count marks. The design of the count marks is, however, always related to numbers, whether in the Arabic system, the Roman system, or the tally system.

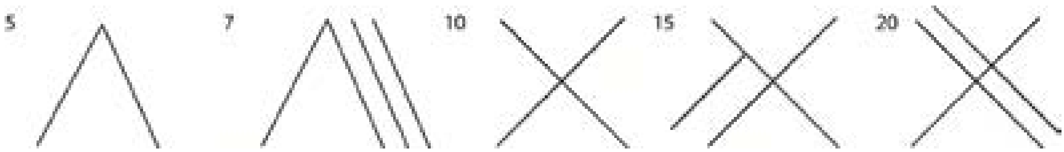

Figure 7.15: Examples of the tally system used in the Netherlands during the Late Middle Ages (based on Janse, 1990).

Method of application

The examples of count marks from archaeological contexts were applied using a timber scribe or knife.[407] Given the functional nature of count marks and their practical role in transactions, tools such as a scribe or knife would have been the expected instruments for applying them. Furthermore, examples from architectural-historical research reveal applications made with a timber scribe or knife.[408]

Mark location on the cask

The absence of regulations regarding the placement of count marks allowed for flexibility in their application, and so they can be found on various locations on the cask. This type of cask mark can thus be expected to appear on either the bilge or on the heads of casks.

7.7.6 Content quantification marks

Content quantification marks were applied to casks after they arrived at their destination, where the contents were quantified by officials appointed especially for this task. Quantification was necessary because merchants were required to pay market tolls or excise duties to the urban authorities or to those who had leased

406 Janse, 1989, 1990.

407 Schoute, 2017; Hofman, 2020.

408 Janse, 1990.

the excise rights from them, and these tolls were based on quantity.[409] The content quantification marks indicated officially measured contents from which was used to calculate the amount of excise duties required, based on applicable rates.

The best-known example of the content quantification mark is the *wijnroeiersmerk* (wine gaugers' mark), which has received considerable scholarly attention. A substantial amount of written source material makes reference to this type of cask mark. This is not surprising given its function and significance, and the fact that it was used in a wide range of institutional contexts of wine quantification. In cities with a staple rights on wine, for example, Dordrecht (granted in 1299)[410] and Utrecht (granted in 1375),[411] quantification generated significant revenue for the city and was therefore closely supervised. For instance, in late medieval Utrecht, revenue from wine excise duties was the largest source of income after beer excise duties.[412]

Excise duty on beer was the largest source of urban revenue for many cities in Holland and in the Sticht region, such as Amersfoort and Utrecht.[413] The amount of excise duty on beer was based on quantity and so establishing the volume of beer being sold or purchased was important. However, the quantities of incoming beer was determined by the number of casks, not by actual content, as with wine.[414] This difference is likely due to the fact that beer, unlike wine, was pressurized inside the cask because of the fermentation process and so opening the cask to measure its contents would have caused the beer to spill. This explains why no content quantification marks have been found on beer casks.

Design

The only visual evidence of content quantification marks is that of the wine gaugers' mark. The following discussion of this type of cask mark will, therefore, focus exclusively on wine gaugers' marks. The design of the wine gaugers' mark followed a consistent pattern, which makes it easy to distinguish from other types of marks, despite the variation of the wine gaugers' marks design of different cities.

The design consists of two elements. First, quantity is represented by a series of horizontal, vertical, or diagonal strokes (Figure 7.16). Of course, wine gaugers' marks differ from one another because the contents varied from cask to cask. The second element is a cross or multiple crosses placed next to the quantity symbol. A cross stroke was the gaugers' way of ensuring additional marks would not be added after the wine gauger had marked the cask. This was intended to prevent the fraudulent inflation of the quantity of wine in the cask.[415]

409 Beukers, 2007, 24; Weststrate, 2007, 69; Van Gangelen & Potze, 2017, 129.

410 Van Gangelen & Potze, 2017, 132.

411 Van Gangelen & Potze, 2017, 133.

412 Beukers, 2007, 24.

413 Alberts, 2017, 356–361; Beukers, 2007, 24.

414 Yntema, 1992, 950; Alberts, 2017, 36.

415 Van Gangelen & Potze, 2017, 140.

The elaborate designs of wine gaugers' marks mean they are relatively large compared to other marks. They typically extend across at least two, and often three, staves of a cask.

As mentioned above, designs varied from city to city. The wine gaugers' mark was used in cities with staple rights on wine in Holland and the Stichtse region, but this right was also held by cities in neighboring regions, such as Cologne, Bruges, and Antwerp. In these latter cities, different measurement units were used to quantify the volume of wine, and this variation affected the design of the wine gaugers' mark (Figure 7.16). For example, in Cologne, measured volume was represented by a series of horizontal strokes, each stroke representing one *ohm* (a standard volume unit). Smaller vertical or diagonal strokes were used to denote the *viertel* (a smaller volume unit of measurement). The largest unit, the *fuder*, which was equivalent to a large cask, was represented by a triangle (Figure 7.16_1). These markings provided clear indications of the amount of wine in a cask, and the specific design of each mark served to identify the city and its system of measurement.

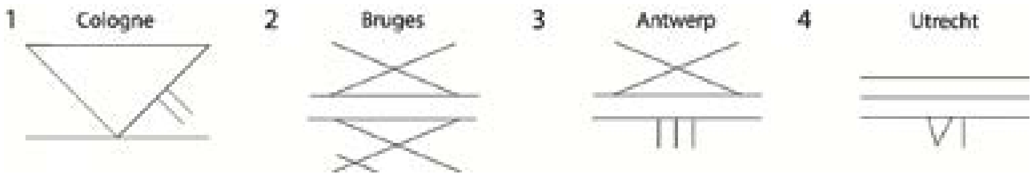

Figure 7.16: Examples of wine gauge marks from various Northwest European cities (based on Van Gangelen & Potze, 2017).

Method of application

Applying the wine gaugers' mark was known as *ritsingen*, which refers to the use of a *ritsmes* (timber scribe). References to regulations for how this type of cask mark was to be applied explicitly state that only the timber scribe was to be used as application tool.[416] Given the function of this type of cask mark, it needed to be visible and durable. The timber scribe was particularly useful in that it afforded flexibility in adapting the design to the cask contents, which varied from cask to cask.

Mark location on the cask

Written sources that refer to the location of the wine gaugers' mark indicate that it was placed on the bilge of the cask, next to the bung hole.[417]

7.8 The typology applied to cask marks from archaeological contexts

To assess the suitability of the typology for cask marks, it was projected on cask marks from Dutch archaeological contexts. For this purpose, a dataset was created containing 1,021 cask marks from archaeological Dutch contexts, of which 902 (88%) could be assigned to a specific type (Table 7.3).

416 Beukers, 2007, 36; Weststrate, 2007, 694; Van Gangelen & Potze, 2017, 13.

417 Van Gangelen & Potze, 2017, 134–137.

Each mark was identified as specifically as possible in the typology. If there was a further division into subtypes within a main type, the marks were assigned to the corresponding subtype. However, for 33 identification marks, there was insufficient data available to make a reliable assignment, so they were only labeled as the main type "4. Identification mark."

Table 7.3: Number of cask marks, by type.

Cask mark type	Number of cask marks	Percentage of cask marks
1. Production mark	0	0%
1a. Construction mark	77	7.5%
1b. Coopers' mark	27	2.6%
2. Cask gauge mark	0	0%
2a. Cask gauge approval mark	30	2.9%
2b. Cask gauge rejection mark	15	1.5%
3. Content gauge mark	0	0%
3a. Content gauge approval mark	81	7.9%
3b. Content gauge rejection mark	8	0.8%
4. Identification mark	33	3.2%
4a. Product identification mark	16	1.6%
4b. Personal identification mark	437	42.8%
4c. Corporate identification mark	3	0.3%
5. Count mark	125	12.4%
6. Content quantification mark	50	4.9%
Unknown	119	11.6%
Total	1021	100%

The following sections discuss the features of each type, focusing on the most common and notable designs, the type of context in which the mark was found, the method of application, and the marks' location on the cask.

7.8.1 Production marks

The production marks are subdivided into construction marks and coopers' marks. Both marks were applied during the first phase of the lifecycle of a cask by the cooper who crafted them. Figure 7.17 shows the most notable examples of production marks; Table 7.4 presents features of the cask marks.

Figure 7.17: Examples of production marks: 1. Construction mark for measuring headboards; 2. Construction mark for pairing headboards; 3. Construction marks indicating the sequence of staves; 4. Coopers' mark on interior head; 5. Coopers' mark on interior head; 6. Coopers' mark on exterior head. Sources: 1. Vos, 2012, 184. ID186; 2. Verminnen, n.d. ID428; 3. Hemert & Huijsmans, 2022, 81; 4. Manders, 1996, 61. ID955; 5. Tump, 2014, 29. ID467; 6. Gerritsen, 2013, 207. ID477.

Table 7.4: Number of production marks (construction marks and coopers' marks) by mark feature.

Context type	Number of construction marks	Number of coopers' marks
Maritime	68	13
Urban	7	13
Rural	2	1
Total	77	27
Application tool		
Timber scribe	7	20
Knife	38	2
Timber scribe or knife	7	1
Compass	25	0
Branding iron	0	3
Unknown	0	1
Total	77	27
Location on task		
Head (exterior)	47	6
Head (interior)	27	21
Bilge (centre)	3	0
Total	77	27

7.8.1.1 Construction marks

The construction marks in the dataset of cask marks from archaeological contexts were primarily identified by the method of application, the location of the mark on the cask, and, most importantly, by their design. The design and its associated function have been described by present-day coopers, as detailed in section 7.7.1. Based on these features, a total of 77 construction marks were identified in the Database WOODAN Cask Marks. The construction marks from maritime contexts represent the vast majority of this type of cask mark—68 out of the 77 examples (Table 7.4).

In the dataset, 25 examples of cask marks of concentric lines were found (Figure 7.17_1), which were, according to present-day coopers used to indicate the correct orientation of the head in the cask (Section 7.7.1). The examples from archaeological contexts provided the opportunity to examine these cask marks in detail, allowing for the identification of an additional function for this type of mark. Notably, the diameter of the concentric shape of the cask mark is almost identical to that of the head on which it is placed, and the concentric lines consistently intersect exactly above and below the centre of the heads. These two features suggest that this concentrically shaped cask mark was applied during the measurement of the heads.

After the headboards were sawn to length, they needed to be assembled correctly, which was facilitated by V-shaped marks on the heads (n=7; Figure 7.17_2). In the example shown, it is notable that the V-shaped mark is partially covered by a clamp, a structural element used to reinforce the head of the cask. Because of the placement of the clamp, the mark would have been largely invisible during the casks' use as a transport container, confirming the interpretation of this cask mark as a construction mark. The assembly of the headboards required the use of dowels, whose positions could also be marked on the headboards, typically represented by a double straight line (n=22).

In some cases, construction marks were also intended to ensure that casks could be correctly reassembled after initial use and temporary disassembly. An example of such a series of cask marks was found on a cask repurposed as a 17th-century water well shaft in Mierlo (n=1; Figure 7.17_3).[418] Each stave was marked with a numerical cask mark, allowing the staves to be reassembled in the correct order.
Given the often-temporary nature of construction marks, which were important during the assembly of casks, it is not surprising that most of these marks were shallow, indicating that they were inscribed with a compass (n=25) or knife (n=38; Table 7.4). This method accounts for 82% of the documented cask marks.
In contrast, construction marks intended for reassembly were inscribed more deeply using a timber scribe.

418 Hemert & Huijsmans, 2022, 81.

The vast majority of construction marks, 96%, were found on the heads of the casks (n=74), with 27 (35%) located on the interior of the heads (Table 7.4). The relatively low number of construction marks on the bilge of casks may be linked to the finishing process at the end of the construction phase when both the interior and exterior surfaces of the casks were smoothed to create a seamless finish, which likely removed any shallow construction marks.

7.8.1.2 Coopers' marks

In the Database WOODAN Cask Marks, a total of 27 coopers' marks have been identified based on the features listed in the typology (Table 7.4). The design of this type of cask mark shows considerable variation and exhibits similarities in design with identification marks. When distinguishing between these two types of cask marks, the location of the coopers' mark on the interior of the heads was of crucial importance.

The size of coopers' marks varied; some are quite small, appearing on only one head piece, while others are large, spanning several pieces. The design typically consists of a series of straight lines intersecting at right angles (Figure 7.17_4–6), sometimes combined with circles. Some coopers' marks also include letters (Figure 7.17_5) or, in some cases, Christian symbols such as the Chi-Rho.

Coopers' marks display distinct features in terms of both their method of application and location on the cask. The majority of the marks (n=20, 74%) were applied with a timber scribe (Table 7.4). This typical coopers' tool was readily available to coopers and was thus used for most of the marks. The location of the marks also follows a clear pattern. All of the coopers' marks were on the heads, either on the interior (n=21) or exterior (n=6; Table 7.4). The higher frequency of marks on the interior is understandable, as newly made casks would not yet be filled with merchandise, leaving the exterior free for other marks.

7.8.2 Cask gauge marks

The cask gauge marks are subdivided into cask gauge approval and rejection marks. Both types were applied to casks by urban inspectors as the final step of the production phase, the first phase of the casks' lifespan. Figure 7.18 shows notable examples of cask gauge marks from archaeological contexts; Table 7.5 presents relevant features of casks.

Figure 7.18: Examples of cask gauge marks: 1. Cask gauge approval mark with coat of arms of the city of Amsterdam and the year 1651; 2. Cask gauge approval mark with a simplified version of the coat of arms of Leiden with a "W"; 3. Cask gauge approval mark with the year 1755; 4. Cask gauge approval mark consisting of the numbers 6 and 4; 5. Cask gauge rejection mark consisting of one circle. Sources: 1. Database DANS Data Station Archaeology, n.d., https://archaeology.datastations.nl/dataset.xhtml?persistentId=doi:10.17026/DANS-XQ9-MGH2, licensed by CC BY 4.0; 2. Verduin, 2019, 255. ID417; 3. Unpublished. ID948; 4. Van der Laan, 2023, 54. ID848; 5. Oosterbaan & Griffioen, 2015, 571. ID573.

Table 7.5: Number of cask gauge marks (approval and rejection marks) by mark feature.

Context type	**Number of cask gauge approval marks**	**Number of cask gauge rejection marks**
Maritime	4	1
Urban	19	14
Rural	7	0
Total	30	15
Application tool		
Timber scribe	18	8
Timber scribe or knife	4	1
Compass	2	6
Branding iron	4	0
Strike iron	2	0
Total	30	15

Context type	Number of cask gauge approval marks	Number of cask gauge rejection marks
Location on task		
Head (exterior)	4	0
Bilge (centre)	19	11
Bilge (bottom)	1	3
Bilge (centre near hole)	3	1
Unknown	3	0
Total	30	15

7.8.2.1 Cask gauge approval marks

In the Database WOODAN Cask Marks, 30 cask gauge approval marks were identified, primarily based on the design of the cask mark, which ranges from the coat of arms of a city (Figure 7.18_1) to a series of numbers indicating the year the cask was gauged (Figure 7.18_1, 4). In some cases, the cask gauge approval process was concluded with multiple marks. In addition to a coat of arms or a date, the inspectors' mark was also be applied occasionally, as seen in the "W" next to the coat of arms of Leiden in Figure 7.18_2. The majority of this type of cask mark was applied with a timber scribe (n=18). However, the use of a branding or strike iron was also an option. Most of the cask gauge approval marks are found at the centre of the bilge (n=19; Table 7.5).

7.8.2.2 Cask gauge rejection marks

A total of 15 cask gauge rejection marks were identified in the dataset, mostly based on their design (Table 7.5). All but one of these examples originated from an urban archaeological context. The casks on which these marks were found were likely not repaired by a cooper after being rejected, but they were not discarded. They could still be repurposed as the shaft of a barrel well, which served as a cesspit or water well.[419]

The design of the cask gauge rejection marks found in archaeological contexts is uniform. All are circular with a central point, but in some cases, multiple circles appear together (Figure 7.18_5). Thus, the design of the cask gauge rejection marks presented in the typology (Section 7.7.2) is also present in archaeological contexts.

Given the circular design, it is not surprising that a significant number of the cask gauge rejection marks were made using a compass (n=6). The cask gauge rejection marks in the dataset were applied exclusively to the bilge, with the majority found at the centre of the bilge (n=11; Table 7.5).

419 Van Oosten, 2015, 84.

7.8.3 Content gauge marks

The content gauge marks are also subdivided into approval and rejection marks. Both types of cask marks were applied by urban inspectors after they had inspected the merchandise in the casks. The application of a content gauge mark indicated the completion of the gauging. Figure 7.19 shows the most notable examples of cask gauge marks from archaeological contexts, while Table 7.6 presents relevant features of cask marks.

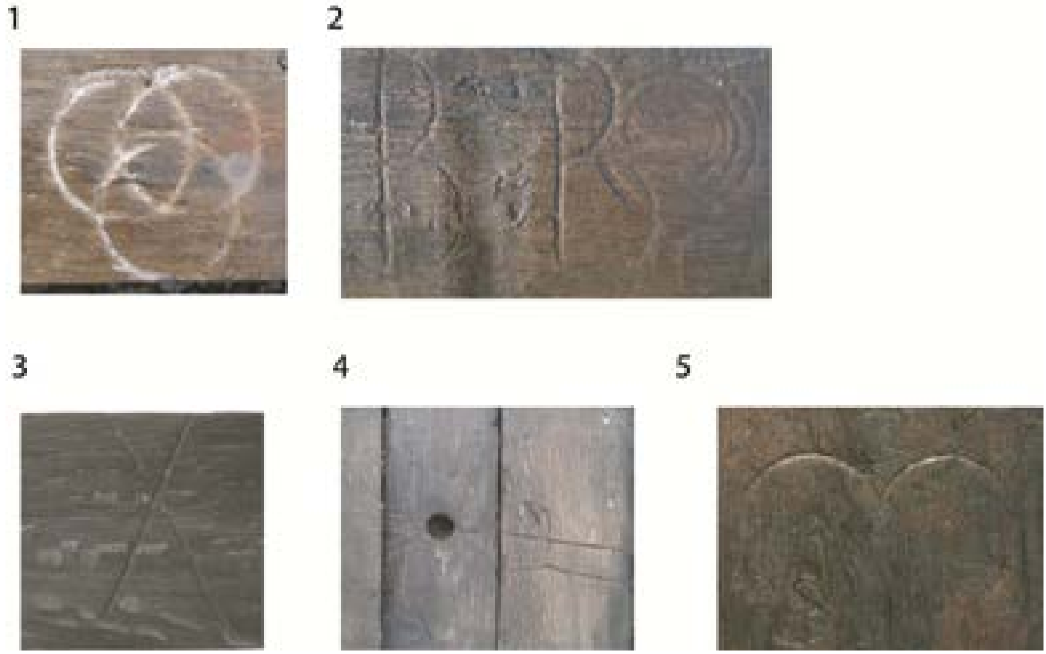

Figure 7.19: Examples of content gauge marks: 1. Content gauge approval mark consisting of three circles; 2. Content gauge approval mark consisting of two circles and two "B"s; 3. Content gauge approval mark consisting of a cross; 4. Content gauge approval mark consisting of two circles over a hole; 5. Content gauge rejection mark consisting of two half circles. Sources: 1. Duijn & Schrickx, 2011, 40. ID538; 2. Duijn & Schrickx, 2011, 43. ID542; 3. Oosterbaan & Griffioen, 2015, 570. ID591; 4. Duijn & Schrickx, 2016, 478. ID518; 5. Van Haaster et al., 2020, 23. ID345.

7

Table 7.6: Number of content gauge marks (approval and rejection marks) by mark feature.

Context type	Number of content gauge approval marks	Number of content gauge rejection marks
Maritime	7	2
Urban	60	4
Rural	14	2
Total	81	8
Application tool		
Timber scribe	43	3
Timber scribe or knife	12	2
Compass	20	3
Branding iron	3	0
Strike iron	3	0
Total	81	8
Location on task		
Head (exterior)	11	1
Bilge (centre)	42	4
Bilge (bottom)	3	3
Bilge (centre near hole)	25	0
Total	81	8

7.8.3.1 Content gauge approval marks

The Database WOODAN Cask Marks contains 81 content gauge approval marks, primarily identified by their distinctive design. As mentioned in section 7.7.3, content gauge approval marks were extensively described in written sources in relation to herring casks. Their design was typically simple and related to a quality designation or the specific time of year during which the herring was caught.

The prescribed design of this type of mark is also found on casks from archaeological contexts. These marks, for example, consist of a combination of circles, which were likely applied by an inspector to the herring cask at three times to confirm that the filling process had been done correctly—filled, topped off, and the herring salted (Figure 7.19_1, 4).

The design of cask marks consisting of circles also featured multiple, concentric circles (Figure 7.19_2). This design is identical to the prescribed form of the mark for *Rooner* herring, which was exported to France or Flanders (Figure 7.11_6). In addition to this circular mark, the letter “B” was also applied twice, possibly indicating the *Bartholomeus brand*. This herring was caught after August 24, in the middle of the herring season, when the fish carried fully developed roe or milt. The "X" found on various herring casks from archaeological contexts is likely to be interpreted as the *Kruys brand* (Figure 7.19_3). This herring was caught after September 14, at the end of the herring season.

Written sources from the early part of the research period regarding the location of content gauge approval marks on herring casks stipulate that they were to be placed on the bilge of the casks. In the 18th century, placement on heads became mandatory (Section 7.7.3). The examples of this type of cask mark from the dataset show that the majority were found at the centre of the bilge (n=42; Table 7.6) or at the centre of the bilge near the bunghole (n=25), while only 11 were found on heads. No clear chronological pattern was observed in the placement of content gauge approval marks, suggesting that their application was more flexible than the prescribed regulations suggest.

No regulations regarding the method of applying content gauge approval marks have been found in written sources. However, examples from archaeological contexts provide an opportunity to provide this information. These examples indicate that the majority of marks were applied with a timber scribe (n=43; Table 7.6) or a compass (n=20). Given the various designs (Figure 7.11), a branding or strike iron would have been an obvious tool to use, yet these methods of application were observed in only six out of 81 cases. Apparently a timber scribe was precise enough to accurately apply the design to the casks. Additionally, the use of a compass for content gauge approval marks appears practical, considering the many circular elements in the prescribed designs of this type of cask mark.

7.8.3.2 Content gauge rejection marks

Only eight examples of content gauge rejection marks have been identified in the Database WOODAN Cask Marks (Table 7.6). All were identified based on their circular shape, which aligns with descriptions of this type of cask mark in written sources (Section 7.7.3). One example, consisting of two half circles (Figure 7.19_5), perfectly matches the prescribed design for this type of cask mark on herring casks, as stipulated in Amsterdam in 1663.

The distribution of content gauge rejection marks in terms of their location on the cask shows a pattern closely resembling that of content gauge approval marks. The majority were found at the centre of the bilge (n=4) or at the centre of the bilge near the bunghole (n=3). Only one example of this type of cask mark was applied to a head. The content gauge rejection marks were exclusively applied using either a compass or a timber scribe (or knife) (Table 7.6).

7.8.4 Identification marks

Identification marks are subdivided into product, personal, and corporate identification marks. These types of cask marks were applied by producers of the merchandise or merchants. The institutional context in which identification marks were applied varied, resulting in a range of features for this type of cask mark, which archaeological examples help clarify. Figure 7.20 presents notable examples of identification marks, while Table 7.7 displays the numbers per subtype and lists their features. It also shows that 33 cask marks could only be identified as the main type identification marks, a more specific assignment by subtype was not possible.

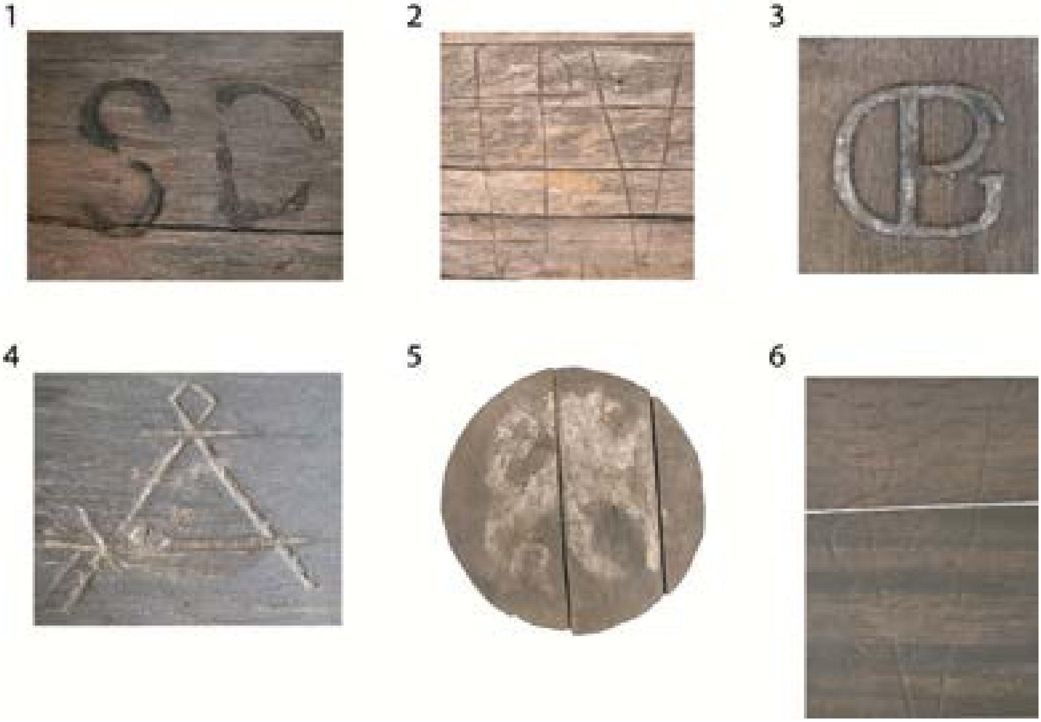

Figure 7.20: Examples of identification marks: 1. Product identification mark "SD"; 2. Personal identification mark "IPV"; 3. Personal identification mark "GP"; 4. Personal identification mark; 5. Corporate identification mark of a lion; Corporate identification mark "VOC". Sources: 1. Vos, 2012, 184. ID010; 2. Tran et al., in 2025. ID216; 3. Duijn & Schrickx, 2011, 35. ID530; 4. Verduin, 2019, 245. ID404; 5. Van Veen, 2012, 186. ID361; 6. Oosterbaan & Griffioen, 2015, 567. ID581.

Table 7.7: Number of identification marks (product, personal and corporate identification marks and identification marks unassigned to a subtype) by mark characteristic.

Context type	**Identification marks**	**Product identification marks**	**Personal identification marks**	**Corporate identification marks**
Maritime	18	16	158	0
Urban	14	0	248	3
Rural	1	0	27	0
Unknown	0	0	4	0
Total	33	16	437	3
Application tool				
Timber scribe	7	8	350	1
Knife	0	0	6	0
Timber scribe or knife	0	0	30	0
Compass	1	0	3	0
Branding iron	18	5	37	0
Strike iron	3	0	0	0
Brush	4	3	6	2
Unknown	0	0	5	0
Total	33	16	437	3
Location on cask				
Head (exterior)	12	9	140	2
Head (interior)	0	0	1	0
Bilge (centre)	17	3	211	1
Bilge (bottom)	1	4	48	0
Bilge (centre near hole)	2	0	21	0
Unknown	1	0	16	0
Total	33	16	437	3

7.8.4.1 Product identification marks

The 16 product identification marks in the Database WOODAN Cask Marks all originate from a single shipwreck, the *Burgzand Noord 4*. The design of the cask marks found on this shipwreck consists of the letter combination "SD" (Figure 7.20_1). These cask marks could be identified as product identification marks thanks to extensive research of written sources, which provided insight into the meaning of the cask marks discovered on the shipwreck.[420] It should be noted

420 Tran et al., 2025.

that extensive research was necessary to confidently interpret these cask marks as product identification marks. Without this research, the analysis of these identification marks would not have been conclusive.

The *Burgzand Noord 4* shipwreck has been identified as the frigate *'t Hart*, which sank near Texel in 1751.[421] As stated in section 7.7.4, casks containing coffee beans were found on this ship, originating from the Surinamese plantation Sardam, owned by Jan Pietersz Visser. These casks were marked with the personal identification mark "IPV" and the product identification mark "SD," clearly identifying the product as originating from the plantation Sardam.

Despite the fact that only 16 product identification marks were found among the 1,021 marks recorded in the Database WOODAN Cask Marks, this set still represents one of the largest find complexes. Namely, all these cask marks were discovered on the same ship, meaning they were used within the same timeframe and the cask marks of "SD" all originated from the same location. Because all the cask marks were found on the same ship, the formal agreements regarding the trade transaction of the casks bearing the product identification marks are also likely to have been the same.

Despite these 16 marks originating from the same find complex and their design being consistent, they still show variation in both the method of application and their location on the casks. They were applied using a timber scribe (n=8), a branding iron (n=5), and a brush (n=3). Additionally, the marks' placements on the casks vary, with marks documented on the head (n=9) and the bilge (n=7; Table 7.7). This variation is present not only within the find complex but also on individual casks. On cask H, the mark "SD" was found three times, variously applied with a brush, timber scribe, and branding iron. Possibly, the cask was reused multiple times to transport products from the Sardam plantation, with a different mark being applied each time. However, it remains unclear why three identical product identification marks, applied using three different methods, were placed on the same cask.

7.8.4.2 Personal identification marks

Personal identification marks account for 43% (437 out of 1,021) of all marks in the Database WOODAN Casks Marks, making this type by far the most frequent cask mark to appear (Table 7.7). This type of cask mark is also extensively described in written sources and has received relatively much academic attention. In these studies, personal identification marks were compared to signatures, and they also provided insights into their features (Section 7.7.4).

The personal identification marks found in written sources exhibit significant diversity in their design, ranging from combinations of strokes and simple letter combinations to more complex representations (Section 7.7.4). This significant

421 *Tran et al., 2025.*

diversity in design also appears in archaeological contexts. Marks consisting of initials were found on casks in archaeological contexts, such as the "IPV" mark that can be linked to plantation owner Jan Pietersz Visser (Figure 7.20_2). Initials were also combined into monograms, an example of which is the branded mark "GP" (Figure 7.20_3). In total, letter combinations—whether or not formed into monograms—account for 31% (137 out of 437) of the cask marks identified as personal identification marks in the database.

The remaining 69% (300 out of 437) primarily consist of a combination of strokes or geometric shapes. These marks can also be linked to individuals associated with the trade of the respective casks, an example of which is shown in Figure 7.20_4.

Written sources contained no regulations about how personal identification marks were to be applied (Section 7.4). It would make sense for an individual to invest in a branding iron or strike iron, as this type of cask mark would be used regularly and there would be no need to alter the mark over an extended period of time. However, in total, 80% (350 out of 437; Table 7.7) of the personal identification marks were applied using a timber scribe (Figure 7.20_2, 4), while only 8% (37 out of 437) were made with a branding iron, as seen in the example in Figure 7.20_3. Likely, using a timber scribe was more practical because it did not require heating, as did a branding iron.

The lack of specific regulations regarding the location of personal identification marks on casks allowed for variation in placement (Section 7.7.4). This is reflected in the Database WOODAN Cask Marks, where this type of cask mark is found in various locations on the casks. In total, 32% (141 out of 437) of the marks were applied to the heads, 64% (280 out of 437) to the bilge, and the location of 4% is unknown (Table 7.7). The examples of personal identification marks from archaeological contexts also show that there was no standard location for the placement on casks.

7.8.4.3 Corporate identification marks

The Database WOODAN Cask Marks holds only three corporate identification marks from archaeological contexts (Table 7.7), two of which are shown in Figure 7.20_5, 6. No specific regulations for this type have been found in written sources, but examples from archaeological and iconographical contexts are provided in section 7.7.4.

In an archaeological context, one example of a corporate identification mark closely resembles the examples from iconographical contexts of this type of cask mark (Figure 7.14). Both cask marks are painted and applied to the head, featuring a representational element in which a lion can be recognized. These marks are interpreted as a corporate identification mark of a beer brewery. This interpretation is based on the context in which these marks appear in iconographical sources, where casks of beer are depicted in taverns. Of course, these could also represent casks of other beverages, but the characteristics of the casks depicted in the paintings align with those of beer casks, such as their size and the number of staves and headboards.[422]

Another example of a corporate identification mark was applied to the bilge of a cask (Figure 7.20_6), where the VOC logo can be recognized. This mark originates from an urban archaeological context, where the cask was repurposed as a shaft for a cesspit. This cask was likely owned by the VOC, of which an example was also found on the VOC ship *De Amsterdam* (Section 7.7.4).

Of all the types of cask marks, the corporate identification mark is the least frequently encountered, accounting for only 0.3% (3 out of 1,021) in the Database WOODAN Cask Marks (Table 7.7). This is due to several factors. First, a cask mark of this type can only be identified as the logo of the respective corporate entity if the logo of that entity is known, as is the case with the VOC mark.

Second, there is a twofold explanation for the relatively rare occurrence of painted marks on the heads of casks linked to breweries. A large portion of the casks with marks found in the database come from urban archaeological contexts, where they had been repurposed as shafts for cesspits or wells. In many cases, the heads of the casks used in this manner were removed to create a cylinder by stacking the casks on top of each other. Naturally, the cask marks on the heads were also lost. Additionally, it is expected that the painted marks, which appear on casks from maritime archaeological contexts, are less well-preserved in the archaeological record compared to marks that were applied in other ways.

Third, there is a possibility that casks with corporate identification marks remained in the possession of the corporate entity in question, even when sold with their contents to establishments like taverns. In this case, an equivalent of a deposit system may have been in use. Casks would have been returned to the corporate entity once emptied, and as a result, would not have been repurposed as shafts for cesspits or wells.

7.8.5 Count marks

In the Database WOODAN Cask Marks, 125 count marks have been registered (Table 7.8). Due to the paucity of information from written sources on count marks on casks, their features are derived from architectural-historical research, which focusses on count marks from structural elements of buildings (Section 7.7.5). From this research, a design of the count mark emerges that typically consists of Roman or Arabic numerals or tally systems or their late medieval or early modern equivalents. The variation in count marks has also been observed in examples from archaeological contexts. An example of a tally system, representing the number 4,

422 Oosterbaan, 2023.

is shown in Figure 7.21_1. The example in Figure 7.21_2 possibly represents the number 25, where the two longer diagonal lines indicate tens, and the single short diagonal line represents five.[423] The count marks that consist of tally systems are by far the most common in archaeological contexts, with 111 out of the 125 count marks. The use of Roman numerals (Figure 7.21_3; n=12) and Arabic numerals (Figure 7.21_4; n=1) as count marks on casks from archaeological contexts has also been encountered but is much less common.

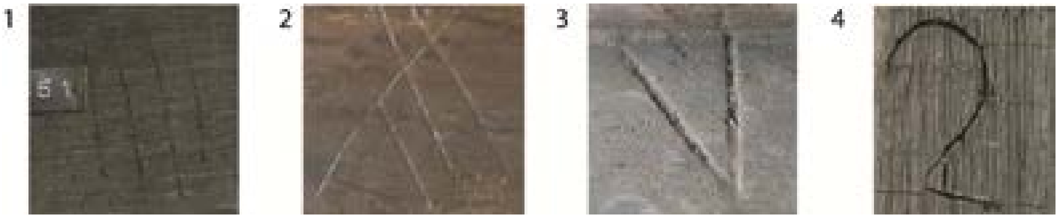

Figure 7.21: Examples of count marks: 1. Count mark, tally system; 2. Count mark, medieval tally system; 3. Count mark, Roman numerals; 4. Count mark, Arabic numerals. Sources: 1. Manders, 199. ID969; 2. Vernimmen, n.d., 1. ID413; 3. Verduin, 2019, 245. ID410; 4. Manders, 1996. ID919.

Table 7.8: Number of count marks, by mark characteristic.

Context type	**Number of count marks**
Maritime	42
Urban	68
Rural	15
Total	125
Application tool	
Timber scribe	67
Knife or timber scribe	8
Strike iron	1
Knife	48
Unknown	1
Total	125
Location on cask	
Head (interior)	2
Head (exterior)	27
Bilge (centre)	57
Context type	**Number of count marks**
Bilge (centre near hole)	10

423 Janse, 1990, 5.

Bilge (bottom)	20
Unknown	9
Total	125

The research based on written sources and that based on architectural-historical research has not provided meaningful insights into the method of application of count marks on casks. However, architectural-historical research has shown that count marks were applied with either a timber scribe or knife on structural elements of buildings (Section 7.7.5). The count marks on casks from archaeological contexts show the same methods of application; 123 out of 125 count marks were applied with either a timber scribe or knife (Table 7.8).

Count marks were applied at various locations on the casks (Table 7.8). The most common locations were the centre of the bilge (n=57), the bottom of the bilge (n=21), and the exterior of the head (n=27). This variation is likely not as closely related to regulations as may be the case for other types of cask marks; practicality may be the reason. For example, when casks were stacked, whether on a ship or elsewhere, not all parts were accessible for placing a count mark.

7.8.6 Content quantification marks

Content quantification marks are identified 50 times in the Database WOODAN Cask Marks. Most of these were discovered in urban archaeological contexts (n=36; Table 7.9). These marks are primarily identified by their distinctive design, consisting of a series of horizontal lines, sometimes combined with smaller vertical lines and crosses, as described in written sources (Section 7.7.6).

All the content quantification marks in the database have been labeled as wine gaugers' marks, indicating that the casks were used to transport wine. The examples from archaeological contexts, sharing the features described in written sources, consist of a series of horizontal and vertical lines (Figure 7.22). In some cases, a half-oval was also used to indicate the contents (Figure 7.22_1). Many examples of this type of cask mark are relatively large and extend across multiple staves (Figure 7.22_1, 2).

The characteristic cross of the wine gaugers' mark has also been found on many casks from archaeological contexts. In most cases, the marks consist of a single cross placed directly adjacent to the series of lines that indicate the contents (Figure 7.22_1, 2, 4). This indicated a final tally and made it more difficult to add lines, which would fraudulently increase the marked volume after the wine gauger had completed his work. A smaller cross could also be placed above and/or below the marked content to ensure no more lines could be added (Figure 7.22_3).
According to researchers Potze and Van Gangelen, the presence or absence of the single large cross may be an indication of the city or region where the cask mark was applied. They state that the wine gaugers' mark from Cologne did not include

a large cross, which would ensure no more lines could be added.[424] To analyze whether this pattern also appears in examples from archaeological contexts, casks with a provenance established through dendrochronological analysis were compared with the presence or absence of a large cross. The wine casks made from wood from the Rhine region were also likely filled with wine from this area and transported though Cologne to export markets.

In total, the origin of only 10 out of 50 wine gaugers' marks was successfully determined using dendrochronological analysis. Of these, two wine casks with a wine gaugers' mark were made from wood originating from Rhineland. One of these marks does not contain a large cross, while the other one does (Figure 7.22_4). For now, no clear correlation can be determined between the design of the wine gaugers' mark and the provenance of the timber used.

It is also noteworthy that there are multiple examples of casks featuring more than one wine gaugers' mark. Figure 7.22_1 presents an example of this, where a mark with a large cross is visible directly below the bunghole. Below this cross, a smaller wine gaugers' mark has been applied that does not use the large cross but instead has a smaller cross (to ensure no more lines could be added) above tally lines that indicated the quantity of the wine.

The presence of multiple wine gaugers' marks on the same cask suggests that the cask had been reused as a wine cask and that the presence of a previous wine gaugers' mark was not necessarily a problem. Furthermore, this particular cask features two marks of different design. These may have been applied in different cities, suggesting that the wine cask was traded through different cities and along different trade networks.

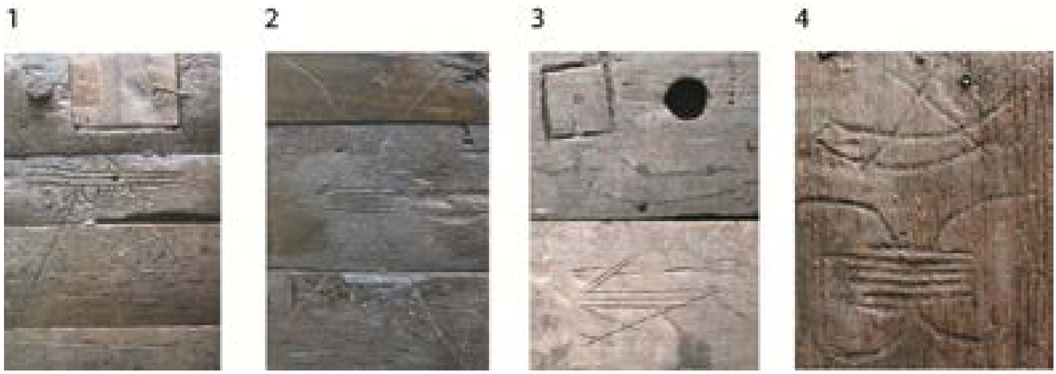

Figure 7.22: Examples of content quantification marks: Sources: 1. Vernimmen, n.d., 2. ID385; 2. Vernimmen, n.d., 2. ID386; 3. Knippenberg, 2007, 47. ID572; 4. Hoogendijk, 2020, 125. ID623.

424 Van Gangelen & Potze, 2017, 140.

Table 7.9: Number of count marks, by mark characteristic.

Context type	**Number of content quantification marks**
Maritime	2
Urban	36
Rural	12
Total	50
Application tool	
Timber scribe	40
Knife or timber scribe	8
Knife	2
Total	50
Location on cask	
Head (exterior)	5
Bilge (centre)	28
Bilge (centre near hole)	10
Bilge (bottom)	4
Unknown	3
Total	50

Written source material prescribes the use of a timber scribe exclusively for applying wine gaugers' marks (Section 7.7.6). This corresponds to the wine gaugers' marks found in archaeological contexts, where 40 out of 50 marks were made with a timber scribe. In eight out of 50 cases, it was not immediately clear whether a timber scribe or a knife was used. In only two examples of this type of cask mark was a knife definitely used.

The prescribed location for wine gaugers' marks, on the bilge next to the bunghole (Section 7.7.6), was followed in 56% of cases (28 out of 50). The remaining marks of this type were found on other parts of the bilge (n=14) and, in a few instances, on the heads (n=5). The application of the wine gaugers' mark appears to be sufficiently resistant to practical variations that the prescribed guidelines were not always be adhered to.

7.9 Conclusion

This sub-study focuses on the marks found on casks from archaeological contexts in the Netherlands, dating from the Late Middle Ages to the Early Modern period (1300–1800). These cask marks represent a valuable and largely untapped source for understanding the socioeconomic dynamics of trade and consumption. Despite their potential, they have not yet been studied in a comprehensive manner. As a result, cask marks are often only superficially described in archaeological reports. The main objective of this research is to address the current gap in the study of cask marks through developing a typology of cask marks and to assess whether this typology is suitable for cask marks from Dutch archaeological contexts.

The development of this typology required insight into several key sub-topics, including an overview of research on cask marks, the identification of their most distinguishing features, and an understanding of the potential function of the cask marks. To address these topics, each was initially investigated separately, guided by specific sub-research questions.

Research on cask marks, spanning various academic disciplines, reveals a notable lack of comprehensive studies on the subject. Studies of cask marks from archaeological contexts typically focus solely on those found at a specific site and describe the marks in a superficial manner. On the other hand, research based on architectural and historical data and written sources primarily focuses on cask marks that were applied for a specific purpose and therefore does not provide an overview of all possible functions. However, by analyzing the research results from these different academic fields in tandem, a broader understanding was gained regarding the reasons for the application of cask marks and their features.

The most distinguishing features were identified based on findings from previous studies. First, the design of the marks, ranging from simple scratches to tally systems and monograms with letters, is considered an important feature. Second, the location of a cask mark is considered significant for classifying marks, with distinctions made between marks found on the heads (interior and exterior) and on the bilge (bottom, centre, or near the hole). Third, the method of application is a significant feature, as the marks were applied using various tools, such as a timber scribe, knife, branding iron, compass, brush, or strike iron.

To gain further insight into the methods of application, a photometric stereo technique was used to examine the cross sections of cask marks applied with a knife, timber scribe, and branding iron (Figure 7.3). As expected, the sub-study revealed that the cross section of marks made with a knife were V-shaped, in contrast to the U-shape left by a timber scribe or branding iron. The research also showed that cask marks made with a branding iron leave a shallower impression compared to those made with a timber scribe.

Before the information gathered on several key sub-topics was used to develop a typology, the different functions of cask marks were examined. For marks with a specific function, insights could be drawn from previous research, while for others additional investigation was required. This involved consulting primary written sources and conducting interviews with present-day coopers, whose expertise proved valuable. The collected mark types were then analyzed in relation to the phases of the cask lifecycle and the actors involved in their application. This comparative approach not only provided deeper insights into the significance of cask marks but also allowed for the identification of missing types to be incorporated into the typology.

The typology for cask marks from the Late Middle Ages and Early Modern period in Dutch archaeological contexts is structured into six primary types. Four of these main types are further divided into subtypes, resulting in a total of 11 distinct types and subtypes, organized hierarchically (Figure 7.6). Each type within the typology has a unique function and purpose, and they are presented in a chronological order based on the lifecycle of a cask. The first types correspond to the first phase of the lifecycle, production, while the remaining types are associated with the second phase, a casks' use as a transport container.

The first type of marks to be applied in a casks' lifecycle were production marks, which are further divided into two subtypes, construction marks and coopers' marks. Construction marks were applied by coopers to assist in assembling casks or reassembling them correctly and efficiently after temporary disassembly. Coopers' marks were used to identify the craftsman who made the cask.

As part of the final step in the first phase of a casks' lifecycle, casks were gauged to ensure they met required standards, a process carried out by inspectors appointed by urban authorities. Inspectors determined whether a cask met the standards and indicated this by applying either an approval mark or a rejection mark on the cask. For each of these functions, a separate subtype has been assigned in the typology.
The casks then began the second phase of their lifecycle as transport containers, when they were filled with merchandise. For certain products like herring, the contents were inspected to assess their quality, which led to the application of a content gauge approval or rejection mark.

Throughout their use as transport containers, casks could also be marked with identification marks, which indicated the product or individuals and corporate entities associated the casks' contents. Each of these specific functions has its own subtype within the typology. Additionally, in the context of trade, casks were marked with count marks, which were used to track quantity and ensure the proper accounting of goods being transported. Upon reaching their destination, certain products, such as wine, were measured to determine the applicable excise duty. Once the contents were measured, content quantification marks were applied, indicating the volume or quantity of the merchandise.

Once the typology was established, its suitability was evaluated by using it as a framework to assign cask marks from various Dutch archaeological contexts. For this purpose, a database was compiled, consisting of 1,021 cask marks, including 405 from maritime archaeological contexts, 527 from urban contexts, and 89 from rural contexts. The database is now accessible online at www.woodancaskmarks.org, providing researchers and other interested parties with the opportunity to explore and utilize the data.

The typology for cask marks proved to be suitable to assign a large segment of the cask marks from Dutch archaeological contexts. Of the 1,021 marks, 902 have been assigned a specific type or subtype. Of these 902 cask marks, 33 cask marks have been assigned to a main type, where further division into subtypes would also have been possible. For these marks, there was insufficient information to assign them to a specific subtype. However, this still demonstrates that a hierarchical structure in the typology allows for a general classification of cask marks, when assigning the mark to a subtype is not possible.

Generally, the design of the cask marks was the most important feature in their classification. However, in some cases, other features were decisive. Coopers' marks, for example, are the only type of cask mark found on the interior of the head. Often, cask marks were classified based on a combination of features. For example, some marks were interpreted as construction marks because of both their design and the method of application.

Each type of cask mark served a unique function and has its own set of features. However, it is important to note that these features are not always exclusive to a particular type of mark. Some of the individual features of a cask mark type overlap with those of other types, but in different configurations. For instance, a mark can be placed at the centre of the bilge, applied with a branding iron, and featuring a monogram in its design. Based on the design alone, this mark could be classified as either a coopers' mark or a personal identification mark. However, an important distinguishing factor is the combination of the location of the mark—positioned on the centre of the bilge—and the method of application, which involved the use of a branding iron. When these two features are considered together, the likelihood of interpreting the mark as a personal identification mark increases, as this combination is most commonly associated with this type of cask mark.

In some cases, the assignment of specific cask marks to types was demonstrated using examples from archaeological contexts. One such example is a construction mark covered by a clamp, a structural element used to reinforce the head of the cask (Figure 7.17_2). Due to the placement of the clamp, the mark would have been largely invisible when the cask was being used as a transport container. his supported the interpretation of it as a construction mark, since this particular mark would not have been visible during the casks' use as a transport container.

In other cases, the analysis of examples from archaeological contexts has further elucidated the function of subtypes. For instance, the concentric lines of construction marks (Figure 7.8_3, Figure 7.17_1) were likely not only used to determine the orientation of the heads on the cask but also to place the measurements when outlining the contours of the heads. However, this additional function did not lead to a separate classification within the typology. Instead, it provided further insight into the function of an existing subtype.

Although it may seem unusual to encounter a cask without any marks, this does occur in archaeological contexts. This is evident from the casks found at the terrestrial archaeological site at Vlissingen Groote Markt where 85 barrel wells were uncovered.[425] These barrel wells mostly consisted of stacked casks, resulting in a total of approximately

425 Oosterbaan, 2015, 253–254.

135 casks from this excavation. Only 32 of these casks showed one or more cask mark, indicating that approximately 24% of the casks were marked.

A possible explanation for the absence of marks on many casks is that several of the typology's cask mark types were usually applied only to casks intended for export. Written sources mention this in the case of content gauge marks used for herring (Section 7.7.3). A similar pattern can be expected for content quantification marks, as these were mostly associated with products like wine, which were transported to other cities and passed through trading hubs where such marks were applied. The same likely applies to other types of marks, such as cask gauge marks.

The absence of cask marks in urban archaeological contexts may also be related to the period following their use as transport containers. When casks were repurposed as barrel wells, their heads were often removed, resulting in the loss of any marks that had been applied to the heads. Additionally, casks recovered from archaeological excavations are often covered in soil, and identifying marks requires thorough cleaning. Due to time constraints, this cleaning was not always carried out, which means marks may have been overlooked.

The absence of marks on casks from maritime archaeological contexts cannot be attributed to the possibility that the casks were not intended for export, as they are often found in the holds of ships engaged in long-distance trade. In these cases, post-depositional processes likely played a significant role. First, much of the wooden material is affected by shipworm (*Teredo navalis*) and the abrasive action of sand in the dynamic tidal environments that characterize much of Dutch water. Second, after a ship sinks, casks often disintegrate, and maritime archaeologists typically recover them as a large collection of cask components. This fragmentation makes it particularly difficult to reconstruct larger cask marks that originally extended across multiple staves or head pieces.

For cask marks from both urban and maritime archaeological contexts, it appears that they have not always received the necessary attention during the analysis of the recovered material. This may be due to a lack of recognition of their research potential, largely caused by the absence of comprehensive studies of cask marks. Without a clear typology or analytical framework, the marks may have been viewed as incidental or unimportant, and thus not systematically documented or interpreted. This sub-study aims to address this gap by introducing a typology for cask marks and enabling more targeted and systematic investigations.

Moreover, it would be valuable to approach the study of cask marks through the lens of specific product categories. Focused investigations into the types of marks used on casks intended for products such as beer, wine, herring, or oil could reveal patterns of marking practices tied to specific products. Such research would not only clarify the function and meaning of individual marks but also enable scholars to retroactively identify the original contents of casks based on their marks.

By combining this research on cask marks with the proposed future studies, cask marks can serve as a powerful tool for exploring broader socioeconomic dynamics. They have the potential to shed light on patterns of production and distribution, the enforcement of quality standards, and shifts in consumption behavior across different regions and time periods. In this way, the sub-study of cask marks contributes meaningfully to our understanding of the economic, social, and regulatory frameworks that shaped trade and material culture in the Late Middle Ages and Early Modern period.

Acknowledgements

This chapter draws heavily on the WOODAN Cask Marks Database project, which aimed to create a publicly accessible online database featuring cask markings from Dutch archaeological contexts dating between 1300 and 1800 (https://woodancaskmarks.org/). The database was developed in collaboration with Qursi Software and the WOODAN Foundation and was funded by a grant from the Samenwerkende Maritieme fondsen (Project: SMFp22.31). The development of the online database would not have been possible without the contributions of Stephan Nicolaij and Jelte van der Laan. Special thanks to Justyna Mrozewicz, whose online database Merchants' Marks served as a source of inspiration for the development of the Database WOODAN Cask Marks.[426]

Special thanks also to Liam Tran and Wouter Donders for compiling a significant portion of the dataset. The members of the Cask Marks Working Group also deserve thanks for their contributions to the WOODAN Cask Marks Database project. This group includes Silke Lange, Petra Doeve, Kirsti Hänninen, Leendert van der Schee, Caroline Vermeeren, Tamara Vernimmen, Yardeni Vorst, and Frits Vrede. During the research and writing of this chapter, valuable contributions were made by Roos van Oosten, Victor van Enthoven, and Nicole Schoute.

426 *Database Merchants Marks, n.d.*

8. The coffee was paid for dearly. Case study

8. The coffee was paid for dearly. Case study

This chapter is based on: Tran, L., Oosterbaan, J., Vos, A.D. et al. The Coffee was Paid for Dearly: Shipwreck BZN4 and the Frigate't Hart. *J Mari Arch* (2025). https://doi.org/10.1007/s11457-025-09458-2. [427]

8.1 Introduction

Identifying shipwrecks is notoriously difficult. To establish a wrecked ship's name using historical sources, carefully analyzing archaeological finds can help refine the search, significantly increasing the likelihood of success. When successful, archaeological data from the shipwreck can be compared to data from textual sources, enabling a detailed understanding of the exca*vat*ed wreck and its trade networks. Within the boundaries of Dutch waters, convincingly successful shipwreck identifications have remained relatively rare. In the few cases where identification has been possible, the wrecks have typically been linked to the Verenigde Oost-Indische Compagnie (VOC, Dutch East India Company), the West-Indische Compagnie (WIC, Dutch West India Company), or the Admiraliteitscolleges (navy).[428] In such instances, the extensive archival records maintained by these institutions have played a crucial role in facilitating the identification process.[429] In the case of merchant ships, the identification proves to be particularly challenging, given the scarcity of written records concerning these ships.

The waters of the Netherlands are littered with shipwrecks, which is not surprising considering its dominance in trade and shipping in the 17th and 18th centuries. This also applies to the roadstead of Texel, located in the Waddenzee directly east of the island. Estimates suggest that between 500 and 1,000 ships were lost in this area from the 16th to the 18th century.[430]

During this period, the deep waters east of Texel served as a frequent anchorage for large seafaring ships. Due to their deep draft, these ships could not cross the shallow Zuiderzee when fully loaded and anchored off Texel instead. Nevertheless, this location did not always provide a safe haven, as evidenced by the numerous shipwrecks, of which the vast majority remain unidentified. In this case study, we present strong evidence for the identity of one of the shipwrecks, known as *Burgzand Noord 4* (BZN4) as the two-deck frigate *'t Hart* (Figure 8.1).

427 Unlike the introductions to Chapters 2–7, this section does not include a schematic overview of the cask lifecycle, as it is a spin-off from the sub-study of cask marks (Chapter 7).

428 For an overview of Dutch shipwrecks and their identification, see the Database Maritime Stepping Stones (MaSS), 2020.

429 Boxer, 1965; De Vries & Van der Woude, 1997; Om Prakash, 1998.

430 Vos, 2012, 47-55.

Based on the archaeological findings, BZN4 has been identified as a merchantman on a voyage originating in South America. In its hold were numerous casks containing coffee beans, a typical product from the Dutch plantation colonies of the Wild Coast (Suriname, Berbice and Essequebo), situated between the Orinoco and Amazon. This ship remains the sole West Indiaman discovered in Dutch waters, making it important material evidence of the relationship between the Dutch Republic and its colonies in the 18th century. Dendrochronological analysis of the ship's timber suggests a construction date of 1740-1750, although dates on either side of this timeframe are also considered possible. Additionally, pottery recovered from the site places the shipwreck early in the third quarter of the 18th century.

Successfully identifying BZN4 as *'t Hart* would provide the opportunity to explore trade and shipping between the Dutch Republic and its South American colonies in the 18th century from both an archaeological and a historical perspective.

Figure 8.1: The location of the wreck BZN4 (N 53° 02.70′ O 4° 56.06′ (WGS 84); X = 124,628, Y = 562,107 (RD)) projected onto a map of the Zuiderzee. Source: Noord-Hollands Archief (NHO), Collectie kaarten Rijkswaterstaat vóór 1850 no. 108, Kaart van de Zuiderzee behelzende voornamelijk het vaarwater van Amsterdam, na Texel en 't Vlie, 1780).

Hypothesis

Identifying BZN4 as *'t Hart* was initially considered, because of the identification of several marks on the excavated casks, one of which consisted of the letters MSP; it was found four times on BZN4 (Figure 8.2). This mark is that of Matheus Sigismundus Pallak (1709-1767), who owned several plantations in Suriname and was a member of the Hof van Politieke en Criminele Justitie (court). He was closely connected to Amsterdam merchant Arent Hartjes/Hartjens (†1779). Pallak represented Hartjens in Suriname, and Hartjens returned the favor, conducting business for Pallak in Amsterdam, including coffee sales.[431]

Arent Hartjens was the *boekhouder* (husband) representing the owners of the frigate *'t Hart*. The ship was built in 1739 and was sailing from Suriname, located on the northern coast of South America, when it sank just east of Texel on 26 November 1751. These details match the features of BZN4. Therefore, we propose that BZN4 is *'t Hart*.[432]

Figure 8.2: Two examples of the mark MSP (Maritime Archaeological National Collection, Rijksdienst voor het Cultureel Erfgoed, object no. 60032365. Available via Collectie Nederland: https://www.collectienederland.nl/page/aggregation/maritieme-archeologische-rijkscollectie-maritieme-vondsten/60032365, licenced by CC BY-SA 3.0.

8

Research question

The main objective of this case study is to assess whether it is possible to identify BZN4 as *'t Hart*. To address this, we ask two sub-questions:

- What details of the shipwreck BZN4 can be used to identify the ship?
- To what extent can the identification of BZN4 as *'t Hart* be justified?

431 Nationaal Archief, The Hague (NA), Oud Notarieel Archief Suriname (ONAS) no. 760/439, 15 August 1748; Stadsarchief Amsterdam (SAA), Oud Notarieel Archief (ONA) no. 10223/349, 25 June 1742; no. 9181/442, 13 July 1745; no. 12789/67, 3 March 1746. For information about Pallak, see https://suriname.nu/surinamezoeken/knowledge-base/pallak-matheus-sigismundus.

432 SAA, ONA no. 10716/653, 2 August 1745; ONA no. 9432/14406, 8 December 1751; ONA no. 9432/14413, 21 December 1751.

8.2 Research methodology and sources

Methodology

The primary aim of this case study is to determine whether BZN4 is *'t Hart*. The initial step involves identifying the characteristics of BZN4 that can be used to make this determination. The data from BZN4 serve as the starting point. However, since this shipwreck has only been partially excavated, not all of the ship's features are known (Section 8.3).

From the assessment of the archaeological data, the following details were selected:
- construction date,
- ship's dimensions,
- ship's use as a merchantman,
- equipment and cargo on the final journey,
- geographical location of the shipwreck,
- date of wreck.

We discuss the finding for each of these details in section 4, first as they pertain to BZN4 and then to *'t Hart*. Our historical research focused solely on *'t Hart*, and we used various textual sources to garner information on the ship's history. We then provide a comparative analysis of the overlap of the details.

Sources

Archaeological data were gathered in several diving expeditions.[433] The data comprise various distinct features of the wreck, including its estimated construction date, ship dimensions, equipment and cargo on her final journey, geographical location and estimated sinking date.

The textual sources pertaining to *'t Hart* are found primarily in four collections:

1. Amsterdam notarial deeds
The Amsterdam Stadsarchief (SAA) holds the *aktes* (deeds) of the Oud Notarieel Archief (ONA). There are three important deeds for researching *'t Hart*:[434]

Declaratoir = a declaration by a shipwright on behalf of the ship's husband, stating that the ship was built in his shipyard, the date of its construction, and its measurements. During the uncertain period of the War of Austrian Succession (1740-1748), *declaratoirs* were used to prove the neutral status of Dutch ships. During wartime, a ship's *declaratoir* was generally issued well after its date of

433 Spoor-Hanraets & Jansma, 1999; Spoor-Hanraets, Vernimmen, Jansma, 2001, 2002; Kleij, 2002; Kuijper, 2004; Den Braven, 2006; Laarman & Lauwerier, 2006; Kuijper & Manders, 2011; Vos, 2012.

434 The deeds are available on the webpage of the SAA: https://archief.amsterdam.

construction, as is the case with *'t Hart*, which was issued in 1745, while the ship itself was constructed in 1739. The Amsterdam and the Zaandam archives hold many hundreds such deeds from the 1740s.

Inventaris = an appraisal of a person's estate following death, listing assets and sometimes debts.

Verklaring = a statement, in this context of one or more crewmembers, commonly used to settle insurance claims. In the case of *'t Hart*, several crew members gave an account of the sinking of the ship on behalf of Arent Hartjens.

2. Archief van de Sociëteit van Suriname (SvS), held by the Nationaal Archief (NA), The Hague[435]

The plantation colony Suriname was governed by the Sociëteit van Suriname[436], which levied an export duty of 2.5% on sugar, coffee, cocoa, cotton, lemon, gold, etc. Other products, notably dyewood (often used as stowage material) were exempt. The sources used in connection with the cargo of *'t Hart* relate only to the products that were taxed, not the entire cargo. For the most part, the different sources contain more or less the same information.

Journaal Gouverneur (governor's daybook) = All incoming and departing ships in Suriname were listed. For the ships arriving, only the goods for the Sociëteit were noted. For the departing ships, the volume or weight of the taxed products was noted.

Carga & Calculatie = a list of products levied the 2.5% tax, probably prepared by a clerk. The 2.5% tax had to be paid in sugar, and the unit of account was one hogshead sugar (800 lbs). The weight of the products being taxed had to be converted into a value of sugar: 1 lb coffee was valued at 6 lbs of sugar (later 10 lbs, and 1 lb cocoa was valued at 8 lbs of sugar. The list, as part of the *overgekomen brieven en papieren* (OBP; letters and papers dispatched), was sent to the Sociëteit directors in Amsterdam. An example from 1740 is shown in Table 8.1.

435 Archief van de Sociëteit van Suriname is available on the webpage of the NA, https://www.nationaalarchief.nl/onderzoeken/archief/1.05.03.

436 Fatah-Black, 2019.

Table 8.1: The Carga & Calculatie of 't Hart, 1740.

Cargo	**Value**	**2.5%**
	In sugar (lbs)	**Sugar (lbs)**
Sugar: 668.25 hogshead	534,600	13,365
Coffee: 74,275 lbs	445,650	1,114
Cocoa: 288 lbs	2,304	57
*Bolleterie**: 10 lbs	400	10
		24,573 = 30.7 hogshead

**Massaranduba wood, used in windmill construction*

Source: NA, SvS, no. 267/779 (OBP), 28 May 1740

Rekening = ship's inventory levied 2.5%: agreement between the ship's captain and the Sociëteit, listing the cargo, the amount paid in sugar (debit) and the costs incurred by the Sociëteit (credit). The ship's captain was responsible for paying the 2.5% tax to the Sociëteit. As a consequence, every ship leaving Suriname had a consignment of sugar for the Sociëteit on board. An example from 1740 is shown in Table 8.2.

Table 8.2: Rekening between captain Cornelis Roos and the Sociëteit, 1740 (guilders (f) and sugar (lbs)).

Taxed commodities	**Debit**			**Credit**		
	Value	**2,5%**				
	Sugar	*f*	Sugar		*f*	Sugar
Sugar: 668.25 hogshead	534,600	668.0	13,365	Shipped for the SvS	57.0	1,140
Coffee: 74,275 lbs	445,650	557.0	1,114	Idem	3.0	60
Cocoa: 288 lbs	2,304	3.0	57	In cash (Holland)	1,163.5	13,273
*Bolleterie**: 10 lbs	400	0.5	10			
		1,228.5	24,573		1,228.5	24,573

** massaranduba wood, used in windmills.*

Source: NA, SvS no. 267/779 (OBP), 28 May 1740

Factuur = invoice for the hogsheads of sugar shipped for the Sociëteit. In 1741, for instance, 59 hogsheads (44,831 lbs) of sugar from eight plantations were shipped in *'t Hart*.[437]

3. Suriname Doop-, Trouw- en Begraafboeken (DTB, church records of christenings, marriages and burials). The NA in The Hague has digital copies, available on its webpage.

437 NA, SvS no. 268/728 (OBP), 20 May 1740.

4. Suriname notary deeds (ONAS). The NA in The Hague has digital copies, available on its webpage.

8.3 Research history of BZN4

BZN4 was first discovered in 1984 in the Waddenzee, seven kilometers east of the Island of Texel.[438] From roughly the 16th to the 18th century, the deep waters to the east of the island were frequently used for anchorage by large seagoing vessels. Because these ships often had too deep a draft to sail fully loaded across the shallow Zuiderzee to ports like Amsterdam, Hoorn, and Enkhuizen, they anchored in the deep waters near Texel. Small boats and barges were then used to load and unload them as they waited for favourable winds to set sail.

The ships were usually safely sheltered behind the island, but occasionally disaster struck. During severe storms, multiple ships could be lost at once, sometimes even dozens in a single storm. Not all of these ships' remains have been preserved on the seabed. However, since the 1960s and 1970s, remains of 75 to 100 ships have been found in the expansive area of the Texel roadstead.

Burgzand project

Burgzand is a relatively small, shallow area in the Texel roadstead where shipwrecks were first discovered in the 1970s and 1980s when fishermen's trawl nets were being caught in places where they had never encountered obstructions before due to shipwrecks emerging from the seabed.[439] Recreational divers learned of these locations and discovered shipwrecks.

In 1998, the professional archaeological dive team of the (former) Netherlandish Institute for Ship Archaeology (NISA), which was part of the Cultural Heritage Agency of the Netherlands, carried out archaeological research on Burgzand, focusing on an area approximately 1.5 km2.[440] The goal was to document, date, and interpret wreck remains emerging from the seabed, in order to assess the research potential and identify the degradation processes affecting these remains.[441]
Between 1998 and 2005, the remains of 12 wrecks were documented. Additional research was conducted on some of the wrecks using exploratory trenches, and five shipwrecks were covered for protection using a new method involving scaffolding mesh.[442]

438 Vos 2012, 169.

439 Vos, 2012.

440 Vos, 2009, 2012.

441 Vos, 2005, 2012, 61-70.

442 Vos, 2012, 89-100.

Burgzand Noord 4

One of these 12 wrecks in the Burgzand project was BZN4.[443] Local divers, who first explored the wreck around 1984 or 1985, described it as a small, not very seaworthy, open ship. Due to the presence of casks seemingly filled only with sand, which were therefore assumed to be water casks, the ship was believed to be a small lighter transporting fresh water from Texel to the ships moored in the roadstead, hence the alias *watervatenwrak* (water cask wreck).[444]

Figure 8.3: Aerial view of BZN4, showing the ship's structure and cargo (Vos, 2012, 169; 373-374).

After the survey in 1999, additional archaeological research was carried out in 2001, involving three trial trenches at the rear, middle, and front of the ship (Figure 8.4). This research provided a wealth of new information. The wreck site turned out to be much larger than initially anticipated. BZN4 stretched over an area of approximately 37 x 12 m and consisted of an almost complete bottom section from stem to stern and from port to starboard bilge (Figure 8.3). About four meters of the sternpost was preserved and still stood upright. The stem had become dislodged and lay flat on the sea floor. No parts of the ship's sides were found, apart from a small fragment on starboard.

The dimensions of the ship were estimated based on the remains, taking into account the different possible degrees for the stem's rake and common length-to-beam ratios, which ranged from 4:1 to 4.5:1. With a beam of approximately 9 m, the length from stem to stern was estimated to be 35-37 m, although the keel was never fully exposed or measured during the archaeological investigation.

443 Vos, 2012, 166-187.

444 Vos, 2012.

Dendrochronological samples from the ship's construction were analyzed[445], resulting in estimated felling dates of 1742 ±6-1744 ±6. Taking into account the period between the felling of the trees and their use in the ship's construction, the construction date was placed around 1740-1750, with a preference for the second half of the decade.

Based on the archaeological data, the sinking of BZN4 was dated early in the third quarter of the 18th century. This was primarily based on the ceramic assemblage[446] and the clay pipes in the wreck, which also indicated the ship had departed from a Dutch port.[447] Since the lifespan of early modern seagoing merchant ships was expected to be 15-25 years at most[448], the sinking date in the third quarter aligns with the construction date (1740-1750). Research was also conducted on the ship's cargo, which primarily consisted of casks, 47 of which were documented underwater and 24 were recovered. The botanical samples from the casks consisted mainly of unroasted coffee beans, along with a few cocoa beans.[449] In the heads of several casks, sugarcane stalks had been placed as a pressure valve in case the coffee beans fermented. The casks and their contents, along with the tropical timber used as stowage material, were the primary indicators that led to the identification of BZN4 as a West Indiaman, transporting goods from one of the Dutch West Indian colonies to the Netherlands.[450]

445 Spoor-Hanraets & Jansma, 1999; Spoor-Hanraets, Vernimmen, Jansma, 2001, 2002; Lückers, 2002.

446 Kleij, 2002.

447 Den Braven, 2006.

448 Vos et al., 2019, 96-97, 112-119, 120-121.

449 Kuijper, 2004; Kuijper & Manders, 2011.

450 Vos, 2012.

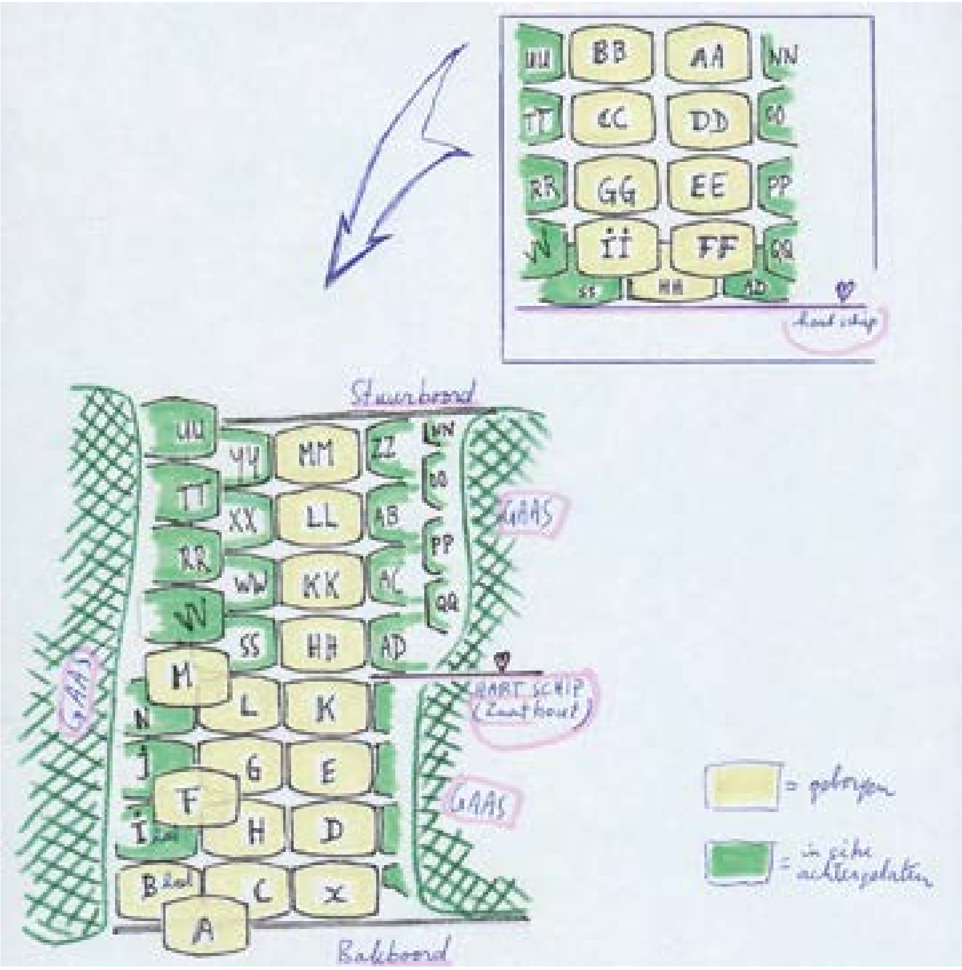

Figure 8.4: Overview of the midship trial trench. Green: casks left in the wreck; Yellow: casks recovered (Vos, 2012, 174).

8.4 Identification of BZN4 as 't Hart

The identification of BZN4 as *'t Hart* is based on several distinct details of the ship, which we present in chronological order. First, the construction and the dimensions of the ship will be examined. Subsequently, its use as a merchantman will be discussed. And finally, its final journey, detailing the equipment and cargo on board. Each section addresses these details as evident in BZN4, followed by the parallel specifics of *'t Hart*, and concluding with a comparison of the two.

8.4.1 Construction date

BZN4

Based on the results of the archaeological investigation, the construction date of BZN4 was estimated to be between 1740 and 1750.[451] This timeframe was established through a dendrochronological analysis of eight samples extracted from the ship's hull, which were considered parts of the original ship and not of subsequent repair work.

Three of the samples, which had sapwood on them, provided felling dates of 1742 AD ±6, 1743 AD ±6, and 1744 AD ±6 (Table 8.3). However, it should be noted that the margin of ±6 years allows for some flexibility in this dating. Besides the dendrochronological datings, the estimation of the construction date is also based on the time required for the timber to be transported from the felling site to the shipyard. The comparative analysis with *'t Hart* calls for a critical review of the dendrochronological dating and the uncertainties associated with it.

Table 8.3: Summary of the dendrochronological samples from BZN4 (Spoor-Hanraets & Jansma, 1999; Spoor-Hanraets, Vernimmen & Jansma, 2001, 2002).

Find nr.	Estimated Felling Date	Date of Tree Rings	# of Tree Rings	# of Sap-wood Rings	Provenance	Description
WVW-518	post-1734 ±6	1599-1704	106	-	Central Germany	Unidentified beam from original ship
WVW-519	1743 ±6	1638-1728	91	5	Germany, Schlegswig-Holstein	Unidentified beam from original ship
WVW-1480	1742 ±6	1610-1730	121	8	Germany, East Frisia	Rider
WVW-1830	post-1700 ±8	1510-1672	163	-	Germany, East Frisia	Frame timber
WVW-1833	1744 ±6	1627-1736	111	12	Germany, East Frisia	Frame timber
WVW-1762	post-1692	1566-1688	123	-	Germany, Hannover	Frame timber
WVW-1831	post-1732	1628-1718	91	-	Central Germany	Rider
WVW-1832	post-1735	1611-1721	111	-	Central Germany	Frame timber

't Hart

In 1739, Arent Hartjens purchased the bespoke two-deck frigate from Zaan shipwright Adriaan Jacobsz Ouwejan (1685-1749). In November that year, the ship set sail for Suriname under captain Cornelis Roos.[452]

451 Vos, 2012, 187.

452 SAA, ONA no. 10716/653, 2 August 1745; ONA no. 9147/1003, 24 November 1739.

Ouwejan belonged to a well-known shipbuilding family. In his day, he was one of the major Zaan maritime entrepreneurs. Commencing as an apprentice at age 15, he was a skilled shipwright within a decade. His first recorded ship sale dates back to 1708, marking the beginning of a prosperous enterprise. As years elapsed, he expanded his domain, amassing three shipyards, a timberyard, and a house. By 1749, his estate exceeded *f* 40,000, including shares in 17 ships and *vleten* (whaling gear in the Zaan region).[453]

Ouwejan is thought to have constructed more than 100 ships, of which 88 have been identified. Among the ships identified were 55 *fluitschepen* (fluyts) (62.5%) and 16 frigates (18.2%) including *'t Hart*. The average dimensions of the frigates built by Ouwejan were 105.8 x 29.0 x 12.5 x 5.6 ft (n=12). Two stand out: a 124-foot ship and one with a *gewrongen spiegel* (sloping transom), a British design.[454]

Since the latter half of the 17th century, Zaan shipwrights used predominantly oak from the Rhineland. The logs were floated down the Rhine and sawn at Amsterdam and Zaan windmills. But following the Great Northern War (1700-1721), the trade of Baltic timber resumed. In addition, the timber imports from North Germany increased over the course of the 18th century. This pre-sawn Hamburger timber came from the Weser and Elbe river basins. This oak was heavier than the Rhinish, but of inferior quality.[455] At the local timber auctions, Ouwejan purchased oak beams and arched timbers in 1738/39, both originating from the Rhineland or Hamburg (North Germany). This timber was likely used in the construction of *'t Hart*.[456]

Arent Hartjens was the son of lawyer Jacob Hartjens (†1708). His estimated inheritance was around *f* 300,000. It is apparent that Arent was active in the Suriname trade as early as 1731. As the ship's husband, he ordered from Adriaan Ouwejan the 91-foot frigate *Westerveen*, named after his wife Margaretha *Westerveen*, in 1736, to be followed by *'t Hart* three years later. The *Westerveen*, as *'t Hart*, made several voyages to and from Suriname. Hartjens did not pursue a political career but became a colonel in the civic militia of Amsterdam. Until his death on 26 July 1779, he was involved in the Suriname trade. He owned a spacious townhouse on the Singel between the Brouwersgracht and the Blauwburgwal where, in the *pakzolder* (attic), coffee was sorted, weighed and repacked. He owned large shares in the plantations Laarwijk and Belgard (both on the Commewijne River), a house in Paramaribo and 20 enslaved Africans. At the time of his death, his assets were *f* 194,691 and debts *f* 131,101. In total, his estate was worth only *f* 63,590. He must have been a particularly unsuccessful entrepreneur, or he squandered his

453 Gemeentearchief Zaanstad (GAZ), Oud Notarieel Archief Zaandam (ONAZ) no. 5942/101, 13 December 1749.

454 Cornelis Jacobsz Ouwejan built the frigate Vrouw Margaretha (106 x 29.5 x 13.5 x 5.5 ft), comparable to 't Hart, which sailed to Suriname in 1753. Enthoven Dataset.

455 Schillemans, 1947, Adam, 2015, Enthoven, 2023.

456 GAZ, Oud Rechterlijk Archief Westzaan no. 1755/1738 (scan 18/9); no. 1755/1739 (scan 82/3).

money on gambling, booze and women. He never remarried after his wife's death in 1760.[457]

Comparative analysis

't Hart was constructed in 1739 and sailed to Suriname in November of that year.[458] A total of eight BZN4 samples have been successfully dated dendrochronologically. Fragments of sapwood were detected on three samples, facilitating the estimation of felling dates based on the missing sapwood rings. This analysis yielded estimated felling dates of 1742, 1743, and 1744, with a 1σ margin of six years. These dates create a tight timeframe relative to the start of the construction of *'t Hart* in 1739. Therefore, these dendrochronological estimates have been reassessed.

The dendrochronological analyses were conducted by RING between 1999 and 2002, making them at least 22 years old.[459] The 1σ margin for the original estimated felling dates only covers 68.3% of cases, meaning there is a 31.7% chance the actual felling date falls outside the interval. Additionally, this method only considers single samples and does not use the additional information that multiple overlapping estimated felling intervals provide.

The estimated felling dates were recalculated using Bayesian statistics (Table 8.4; Figure 8.5).[460] A new, combined probability distribution was derived from an individual probability distribution with an estimated felling date and a 95.4% confidence interval (Figure 8.5). The difference in the estimated felling interval obtained in 1999-2002 (1738-1748) and those obtained using our method (1736-1746) is minimal. However, it is not clear from the initial reports what the accuracy of this estimate is.

Table 8.4: Reassessment of dendrochronological samples with sapwood from BZN4 using the Hollstein sapwood model.

Find #	Estimated Felling Date (1999-2002 reports)	μ	Beginning Date	End Date	Estimated Felling Date (2025 evaluation)
WVW-519	1743 AD ±6	1741	1729	1757	1741 (1729-1757)
WVW-1480	1742 AD ±6	1741	1730	1756	1741 (1730-1756)
WVW-1833	1744 AD ±6	1744	1736	1759	1744 (1736-1759)
Combined		1740	1736	1746	1736-1746

457 SAA, ONA no. 9751/27, 13 February 1731; ONA no. 10716/652, 2 August 1745; ONA no. 12449/622, 24 September 1779; Zandvliet 2020, no. 55.

458 SAA, ONA no. 10716/653, 2 August 1745; ONA no. 9147/1003, 24 November 1739.

459 Spoor-Hanraets & Jansma, 1999; Spoor-Hanraets, Vernimmen, Jansma, 2001, 2002.

460 Bronk Ramsey, 2009.

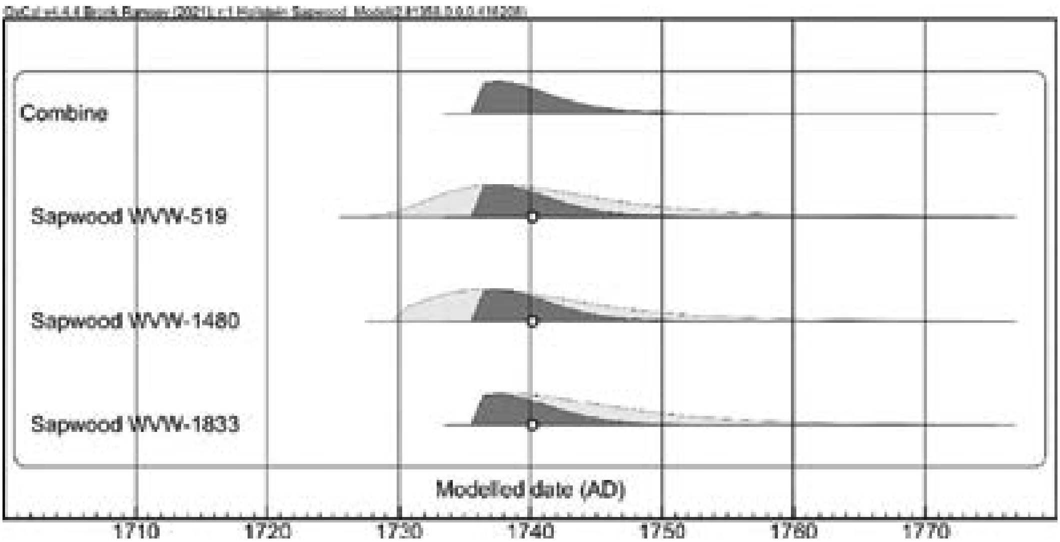

Figure 8.5: Probability density distribution for the three samples of sapwood fragments (light grey) and the combined felling interval (dark grey).

The combined felling interval of the dendrochronological samples of BZN4 was placed around 1740, with a 95.4% confidence interval from 1736 to 1746. As with the individual estimates, this is nearly identical to the earlier intervals and fits the known construction year of 1739. For samples without sapwood, only the earliest possible felling year can be estimated. As expected, these fall some years before 1739. However, the notation used for these dates in the initial reports stated both a lower boundary (i.e., after year x) as well as an interval (i.e., x ± 6), leaving room for multiple interpretations of the felling interval.

Initially, three dendrochronological samples containing sapwood posed a challenge in identifying BZN4 as *'t Hart*. These samples provide an estimated felling year that postdated the construction year of 1739, if the margin is not taken into account.[461] However, it should be noted that sapwood estimates are derived from large populations that are then applied to individual trees. The number of sapwood rings (and therefore any estimates based on them) vary based on age[462] and provenance[463], but also between trees (and even in a single tree) as part of natural variation. Furthermore, adding or removing samples can shift the resulting estimated intervals.[464] Variations of a small number of years between estimated felling years and the construction year such as this case should not be taken as an argument to reject the identification of BZN4 as *'t Hart*.

461 Hollstein, 1980.

462 Hollstein, 1980.

463 Haneca, 2005.

464 Bridge, 2013.

8.4.2 Ship dimensions

BZN4

The estimated length of the wreck from stem to stern was approximately 35-37 m. This measurement was determined without the keel being measured, as it lies inaccessible deep beneath the shipwreck's structure, but is based on the ship's beam of approximately 9 meters and an average length-to-beam ratio of about 4:1 for Dutch ships in the 18th century. As mentioned above, the sternpost was found in position, but the stempost was lying flat on the seabed. The width of 8 meter high up on the bilge, suggested a beam of about 9 m. The remaining part of the stern was approximately 4 m high. The skin planks and ceiling planks were made of oak, approximately 7 and 5 cm thick. The tops of the frame timbers were too eroded to measure reliably, but they were at least 13 cm thick. Deeper in the ship's structure, where less erosion had occurred, the cross-section of the frame timbers measured between 30 and 35 cm. Outside the ship, pine doubling planks with a layer of animal hair and tar, intended as protection against naval shipworms (*Teredo navalis*), were found.

All these details indicate a medium-to-large seagoing ship intended for tropical destinations where naval shipworms were present.[465]

't Hart

In the ship's *declaratoir*, the following dimensions for the two-deck frigate *'t Hart* are given:
- length from stem to stern: 106 voet and 3 *duym* (30.8 m),[466]
- beam: 29 *voet* and 7 *duym* (8.4 m),
- hold: 12 *voet* and 9 *duym* (3.6 m),
- deck: 5 *voet* and 2 *duym* (1.5 m).

Additionally, the ship had a half deck and a forecastle.[467]

465 Vos, 2012, 166-187.

466 One Amsterdam voet (foot) = 0.283 m; one duym = 2.57 cm. Database De oude Nederlandse maten en gewichten, n.d., https://mgw.meertens.knaw.nl/maat.

467 SAA, ONA no. 10716/653, 2 August 1745.

Figure 8.6: A frigate sailing before the wind (Frigate sailing before the wind [Engraving, inv. no. 003965], by Gerrit Groenewegen, 1789. Zuiderzee museum, Enkhuizen, The Netherlands.

The Zaan region just north of Amsterdam was the largest maritime pre-industrial area of Europe. Around 1730, hulls were being built on docks in 38 shipyards, supported by dozens of timberyards, sawmills, ropewalks, mast and tackle makers, and anchor forgers.[468]

Of the ships built in the Zaan region, almost three quarter were *fluitschepen* (fluyts, Table 8.5). A Zaan specialty was medium-sized fluyts of 110-115 ft, built on venture without a commission. They began as whalers, to be sold later. Frigates were in general ordered and purposely built, like the *'t Hart*. In the 1740s, the dimensions of an average Zaan frigate were 105 x 29 x 12.5 x 5.2 ft (n=36), with a ratio of 3.6:1.[469]

468 Enthoven, 2018a.

469 Enthoven, 2018b, 2020.

A frigate was a small to large merchantman with a square stern and a V-shaped bottom that rose sharply in the stem and stern (Figure 8.6). The rake or overhang of the sternpost extended rather backward. They were nicknamed *hanggat* (lazy ass) and built for speed rather than cargo capacity. They were usually armed, hence the large ratio of 3.4:1.[470] With a length of 106 ft (30.8 m), the *'t Hart* was a small merchantman, but an average frigate.

Table 8.5: Ships sold in Zaandam, 1701-1750, and dimensions of ships around 1700 (in ft, N = 815) (Enthoven dataset (Zaan ships sold); SAA, Archief van de Directie van de Oostersche Handel en Reederijen no. 244, 1688 (average specifications Dutch ships).

Ships Sold in Zaandam, 1701-1750			**Average Specifications Dutch ships**					
Type	No.	%	*Last*†	Length	Beam	Hold	Deck	Ratio
Fluyt	579	71.0	213	129	29.0	13.0	5.25	4.4: 1
Katschip	14	1.7	150	123	23.5	13.0	-	5.2: 1
Hekboot	27	3.3	248	117	33.0	14.5	6.80	3.5: 1
Frigate	59	7.2	196	109	32.5	12.5	5.50	3.4: 1
Hoeker	18	2.2	116	90	27.0	12.0	-	3.3: 1
Galjoot	68	8.3	85	84	25.0	11.0	-	3.4: 1
Boeier	-	-	73	83	21.0	10.5	-	4.0: 1
Kofschip	5	0.6	69	81	22.0	9.7	-	3.7: 1
Smakschip	3	0.4	36	68	19.0	7.0	-	3.6: 1
Not specified*	42	5.5						
Total (N)	815	100.0						

** predominantly inland ships*

† 1 last = 2,000 kg or 2 metric ton

Comparative analysis

Based on the archaeological data, the initial estimates of the dimensions of BZN4 were different than those of the *'t Hart*. The original estimated length of BZN4 was 35-37 m, significantly longer than the documented length of *'t Hart*, which was 30.8 m, but BZN4's estimated maximum beam of approximately 9 m closely matches *'t Hart*'s beam of 8.4 m. This discrepancy in length provided a reason to reassess the estimated dimensions of BZN4.

The estimated beam of 9 m for the BZN4 beam was reliable since both sides of the ship's bottom have remained relatively intact. The length of BZN4 was harder

470 Enthoven, 1991, 2013.

to estimate accurately because of the collapsed stem and the uncertainty of the steepness, or rake, with which it had been positioned in the ship's structure. Therefore, the initial estimation of the length of the ship relied on an average length-to-beam ratio of approximately 4:1. Taking into account a margin of error, an estimated length of 35-37 m for BZN4 was established.

However, the average length-to-beam ratio of Dutch frigates during this period is 3.4:1, which sets them apart from other contemporary ships (Table 8.5). Using this ratio, the length of BZN4 can be determined to be approximately 30.6 m, which closely matches the documented length of *'t Hart* at 30.8 m.[471] The reconstruction of the main dimensions of the ship's remains, therefore no longer serve as a contra-indication for identifying BZN4 as *'t Hart*.

8.4.3 Use as a merchantman

BZN4

Evidence of a wreck's previous use is difficult to identify archaeologically. This is especially true for BZN4, because it was only partially excavated and because of the extensive deterioration of the site. This means that the archaeological research has not yielded additional information on its use. However, the archaeological data provide enough material to characterize the ship's general use, namely, that it was in service as a merchantman and not as a (heavily built) warship or a fishing vessel.

't Hart

't Hart made nine voyages to and from Suriname (Table 8.6). On the outgoing leg, the ship carried mainly provisions for the Sociëteit and the privately owned plantations. This included cereals, salted meat and building materials like chalk, cement and bricks for plantations. The ship also carried passengers, mostly Sociëteit soldiers. It was a typical *Surinamevaarder* (Suriname ship).[472]

Cornelis Roos captained the first five voyages. During his last trip, *'t Hart* briefly got stuck on a mudbank at the estuary of the Suriname River. Dirck Verbrugge captained the next two trips. He died in 1747. Claas Grell took Verbrugge's place, running into trouble with a French privateer on the return trip. The French confiscated part of the cargo. Captain Pieter Orelius sailed the ship's second-to-last voyage and was also the captain as the ship began its last journey. But after departing from Texel in 1751, the foremast

471 If we use the average dimensions of Ouwejan's frigates from the 1740s, with an average 3.6:1 ratio from the Enthoven database, a beam of 9 m would suggest a ship length of 32.4 m, while a beam of 8.5 m would indicate a length of 30.6 m. As with most archaeological shipwrecks, exact dimensions remain uncertain, and only carefully reconstructed estimates can be made.

472 NA, SvS no. 200, 13 November 1745, 13 March 1747; SvS no. 201, 26 October 1749, 29 March 1751; Postma Suriname Dataset, available on the webpage of DANS, https://dans.knaw.nl.

broke, requiring the crew to stop at Plymouth for repairs. Orelius succumbed to mental illness while there and was succeeded as captain by first mate Pieter Groenenberg. Groenenberg captained the ship on its last voyage when it sank east of Texel on 26 November 1751. Groenenberg survived but never sailed to Suriname again.[473]

Table 8.6: Voyages of 't Hart between Suriname and Amsterdam, 1740-1751.

ID	Captain	Suriname		Sugar		Coffee	Cocoa
		Arriving	Departing	Hogs-head	lbs	lbs	lbs
1267.0	Roos, Cornelis	27-Feb-1740	1-Jun-1740	668	534,400	74,275	288
1306.0	Roos, Cornelis	14-Feb-1741	20-May-1741	657	525,600	77,235	318
1363.0	Roos, Cornelis	9-Jan-1742	29-Apr-1742	737	589,600	23,429	0
1411.0	Roos, Cornelis	8-Dec-1742	19-May-1743	742	593,600	26,388	261
1471.0	Roos, Cornelis	Unknown	14-Nov-1744	741	592,800	20,895	2,667
1546.0	Verbrugge, Dirck	13-Nov-1745	26-Jul-1746	730	584,000	36,997	7,732
1601.0	Verbrugge, Dirck †	13-Mar-1747	21-Oct-1747	607	485,600	89,334	6,248
1709.0	Orelius, Pieter	26-Oct-1749	21-Feb-1750	654	523,200	45,149	2,846
1793.0	Orelius, Pieter (disqual)	29-Mar-1751	30-Aug-1751	619	495,200	74,204	6,586
Average *'t Hart*				684	547,111	51,990	2,994
Total Suriname export, 1740-1749				177.053.800		32.668.847	3.280,600
Average per ship (n=444)					400,00	73.578	7.389

Source: Postma Suriname Dataset, available from DANS, https://dans.knaw.nl; Postma 2003; NA, SvS no. 267/779 (OBP), 28 May 1740; SvS no. 268/716 (OBP), 18 May 1741; SvS no. 268/717 (OBP), 18 May 1741; SvS no. 268/728 (OBP), 20 May 1741; SvS no. 269/825 (OBP), 27 April 1742; SvS no. 271/846 (OBP), 17 May 1743; SvS no. 271/857 (OBP), 18 May 1743; SvS no. 199/176, 17 May 1743; SvS no. 274/583 (OBP), 15 November 1744; SvS no. 274/625 (OBP), 16 November 1744; SvS no. 200/310, 26 July 1746; SvS no. 200/597, 20 October 1747; SvS no. 201/396, 21 February 1750; SvS no. 202/73, 30 August 1751.

8

Comparative analysis

Due to the limited archaeological data on the use of BZN4 as a merchantman, a comparison with *'t Hart* provides little additional information. However, based on descriptions of *'t Hart*'s previous voyages as a merchantman, a comparison can be made between the registered cargo weight of its final voyage and that of earlier voyages. This comparison

473 NA, SvS no. 199, 22 July 1744; SAA, ONA no. 9419/13390, 17 April 1748; NA, SvS no. 202, 20 April 1751; SAA, ONA no. 9432/14406, 8 December 1751; ONA no. 9432/14413, 21 December 1751; SAA, Archief van de Schout en Schepenen (SS) no. 2843, 7 March 1752.

reveals that the total cargo weight of the last voyage, 575,990 lbs, was below the average of 602,095 lbs recorded for *'t Hart*. The total registered cargo weight on *'t Hart* was not excessive and is unlikely to have influenced the ship's stability on its last voyage.

8.4.4 Equipment and cargo on the final journey

BZN4

Materials recovered from BZN4 can be interpreted as the ship's inventory, provisions and cargo. The inventory consists of a limited number of artifacts, with 37 finds allocated to pottery and five to artifacts of glass. Additionally, the following items were found on BZN4: 12 animal bones, 34 metal objects, nine fragments of clay pipes, and two flintstones.[474]

The analysis of the pottery indicated a dating early in the third quarter of the 18th century and that it originated from the Netherlands and the German Rhineland. In terms of composition, this assemblage does not differ from other contemporary Dutch sites, leading the researchers to designate BZN4 as a Dutch ship.

Another category of finds on BZN4, clay pipes, can be accurately dated. Out of the nine fragments, only four were deemed to be part of the inventory of BZN4.[475] The other five likely were embedded in the ship some time after the ship had foundered, as their dating differs.[476] Among the four inventory fragments, only one bowl was found. Of the other three clay pipes only the stems were preserved. The bowl was oval-shaped with a mark bearing the initials VD.[477] This pipe was probably manufactured in Gouda by either Klaas Marté (1733-1782) or his widow, Trijntje Cornelis Pot (1782-1788).[478]

The ship's inventory also included a fake wooden cannon barrel, which probably had been used previously for its deterrent value but served as stowage material on BZN4. Additionally, coopers' tools such as a short-handled axe were found. Some of the staves recovered were interpreted as processing waste, making it possible that a cooper had been on board who made or repaired casks.[479]

The vast majority of the artifacts found on BZN4 were located in the hold and designated as cargo (87%). Stowage material made from tropical hardwood had been placed under the casks to create a level surface. During the exploratory trench investigation in 2001, at least 47 casks were documented, of which 24 were recovered.[480] It is certain that many more casks were on board BZN4. The casks

474 Vos, 2012, 181-183.

475 Den Braven, 2006; WVW-569, WVW-506, WVW-560, WVW-765-1, WVW-765-2, WVW-1092, WVW-1093, WVW-1456 and WVW-1806.

476 WVW-569, WVW-506, WVW-765-1, WVW-1092 and WVW-1456.

477 WVW-1093.

478 Written communication from Bert van der Lingen, 18 April 2024.

479 Vos, 2012, 172.

480 Vos, 2012.

contained mainly remnants of unroasted coffee beans and several cocoa beans.[481]

Timber species and origin were determined for 79 wood samples from the casks, revealing 21 different timber species. For 15 of these, the genus or even the species could be identified. Of these 15, 14 are found in the tropical northeast of South America: Venezuela, Guyana, Suriname, French Guiana, and Brazil. For six species, neither genus nor species could be identified, but the wood anatomy in all cases indicated a tropical origin.[482] Two hundred and twenty-two marks were found on the casks from BZN4, of which about 42 are unique. The precise number of unique marks is difficult to estimate because of their fragmentary preservation. Many consist of letter combinations, monograms, and illustrations (Figure 8.7; Table 8.7). A significant portion of the marks could be identified and could be matched with merchants and plantations.

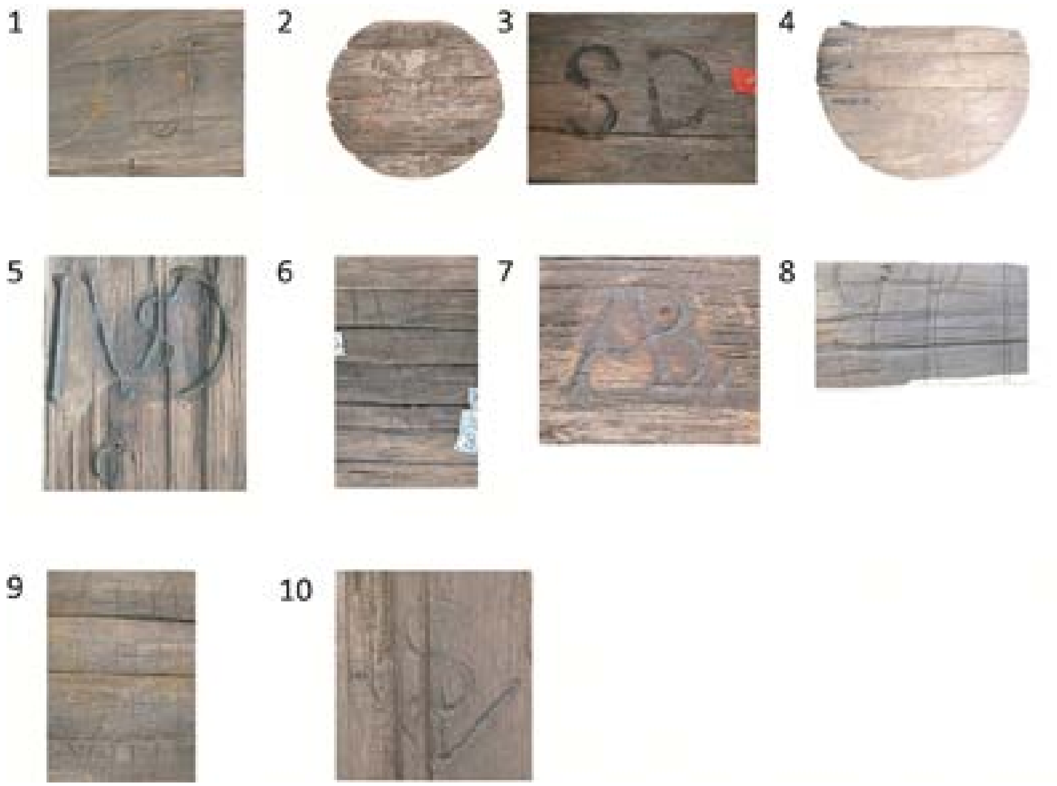

Figure 8.7: A selection of the marks found on casks on BZN4 (Maritime Archaeological National Collection, Rijksdienst voor het Cultureel Erfgoed, object no. 60032365. Available via Collectie Nederland: https://www.collectienederland.nl/page/aggregation/maritieme-archeologische-rijkscollectie-maritieme-vondsten/60032166, licenced by CC BY-SA 3.0.).

Table 8.7: Cask marks found on BZN4 that could be connected to a person.

481 Kuijper, 2004; Kuijper & Manders, 2011.

482 Vos, 2012, 184-185.

Number	Mark	Person identified	Product*
1	MSP	Matheus Sigismundus Pallak	Coffee
2	IPV SD	Jan Pieterz Visser and his wife Anna Dufour	Coffee and cocoa
3	SD	The plantation Sardam, planter Jan Pieterz Visser and wife	Coffee and cocoa
4	ECS	Ephraim Comans Scherpingh	Not sampled
5, 6	IVSD	Jan van Sandick, later Jean Couderc†	Coffee
7	ABL	Jan Labadie	Not sampled
8	GPI	Ephraim Comans Scherpingh	Unknown
9	Warehouse	Johan van Scharphuizen, later the heirs of Jonas Witsen	Coffee
10	Anchor S	Johan van Scharphuizen, later the heirs of Jonas Witsen	Coffee

** The product was determined through the samples that were taken during the archaeological research.*

† A record from 1743 mentions Jean du Peirou/Pérou with this mark transporting sugar to Isaac Couderc. Jean du Peirou was administrator of Van Sandick's plantation Roosenburg in Suriname. Couderc was a merchant and executor of the Roosenburg estate after Van Sandick's death. SAA, ONA no. 10036/232, 12 May 1744; ONA no. 10432/2017, 1 October 1750. For Roosenburg, see Oostindie 1989.

Source: NA, ONAS no. 760/439, 15 August 1747; ONAS no. 760/721, 16 February 1752; ONAS no. 760/724, 27 August 1752; SAA, ONA no. 9766/35, 14 May 1749; no. ONA 10430/1601, 5 August 1750; NA, ONAS no. 760/758, 26 February 1752; ONAS no. 760/723, 17 February 1752; NA, SvS no. 213/194, 5 March 1685; NA, ONAS no. 759/72, 30 July 1740; ONAS no. 761/288, 13 June 1758; no. 761/126, 23 April 1756.

't Hart

't Hart left Suriname on what would be its last voyage with 619 hogsheads of sugar (15 for the Sociëteit), 74,204 lbs of coffee and 6,585 lbs of cocoa.[483] Receipts of the cargo also list 161 casks stored beneath the orlop deck (Figure 8.8; Table 8.8).

Figure 8.8: Marks on the 161 casks stored beneath the orlop deck of 't Hart (Sources in subtitle table 8.8).

483 NA, SvS no. 202, 30 August 1751.

Table 8.8: Overview of the 161 casks stored beneath the orlop deck.

Figure 8.8	**Mark**	**Person identified**	**Cargo**		
			Casing	**Number of Casks**	**Product**
1	SDP	Miss J. M. Duplessis	Cask	6	Cocoa
1	SDP	Miss J. M. Duplessis	Cask	10	Coffee
2	IPV SD	Anna Dufour, widow of J.P. Visser SD = plantation Sardam	Hogshead	40	Sugar
3	ECS	Ephraim Comans Scherpingh	Hogshead	10	Sugar
4	GPI	Ephraim Comans Scherpingh	Hogshead	20	Sugar
5	IH	Ephraim Comans Scherpingh	Hogshead	10	Sugar
6	CK	Elias van der Gaegh	Cask	5	Coffee
7	IB	Widow of A. Braet	Hogshead	10	Sugar
8	ABL	Jan Labadie	Hogshead	15	Sugar
	Unclear	Jan Hendrik Muller	Hogshead	18	Sugar
9	HTBS	Nicolaas Lemmers	Hogshead	17	Sugar
		Total		**161**	

Source: NA, ONAS no. 760/720, 16 February 1752; ONAS no. 760/721, 16 February 1752; ONAS no. 760/723, 17 February 1752; ONAS no. 760/724, 17 February 1752; ONAS no. 760/725, 17 February 1752; ONS no. 760/740, 24 February 1752; ONAS no. 760/758, 26 February 1752; ONAS no. 760/765, 13 March 1752; ONAS no. 760/767, 10 April 1752.

Comparative analysis

The identification of BZN4 as *'t Hart* is primarily based on the matching cargo of the two. *'t Hart* transported 619 hogsheads of sugar, 74,204 lbs of coffee and 6,585 lbs of cocoa on its final journey. Unroasted coffee beans, along with a few cocoa beans, were found in the casks of BZN4. Additionally, casks were found on BZN4 that appeared empty and had been identified as water casks during the initial archaeological research. But the original contents of coffee or cocoa may have been washed out of the casks, or the sugar they contained may have dissolved over the centuries.

A match can also be made in terms of the quantity of cargo. To calculate the total number of casks on board, the weight of the coffee and cocoa must be converted into the equivalent number of casks. A crucial factor in this calculation is estimating the weight contained in an individual cask. Based on the dimensions of the recovered casks, we calculated an average capacity of 330 liters.[484]

484 The volume was calculated using the formula: $V=\varpi r2h$. The calculation is based on the length of 116 cm and a diameter of 60 cm for cask AA (Vos 2012, 175).

The specificweight of coffee and cocoa beans was 750 kg/m³, or 1,518 lbs/m³.[485] The 6,585 lbs of cocoa and 74,204 lbs of coffee on board is approximately the equivalent of 4.34 m³ of cocoa and 48.88 m³ of coffee. Converted into casks with a capacity of 330 liters, this amounts to 13 casks of cocoa and 148 casks of coffee. Combined with the registered number of hogsheads of sugar, this brings the total of estimated cargo casks on *'t Hart* to 780.

To estimate whether this is a realistic number of casks to be transported on *'t Hart*, the total *tonnage* of a mid-18th-century frigate was considered. The registered cargo on *'t Hart* weighed a total of 258 metric *ton* (780 casks of 330 liters each). On average, a frigate measuring 109 ft had a capacity of 196 last (390 metric *ton*, Table 8.5). Given that *'t Hart*, at 106 ft, could accommodate approximately 190 last (380 metric *ton*), there would have been ample space for additional commodities.

The marks on *'t Hart*'s registered cargo and those on the cargo found on BZN4 were also compared. It should be noted that the data from both archaeological and textual sources are far from complete. Only 47 casks from BZN4 were documented, representing just 3% of the estimated original shipment of at least 780 casks. Similarly, the textual sources provide insight into only a small number of the marks. While the cargo manifest lists a total of 780 casks on board *'t Hart* (Table 8.1), only 161 casks were recorded in the cargo list (Table 8.8), meaning that markings were recorded for just 21%.

Nevertheless, the marks found on BZN4 and *'t Hart* were compared, resulting in a partial overlap. Five marks were found on both BZN4 and the cargo of *'t Hart* on her final journey: IPV SD, SD, ECS, GPI and ABL (Figure 8.9). There were multiple versions of the subscript of the mark IPV (Jan Pietersz Visser): SD, OB, RR, and a three-leaf clover. Each subscript corresponds to one of Visser's plantations (Figure 8.10).[486] When multiple variants of this mark were registered on the receipts of the same ship's cargo on earlier voyages, they were registered together.[487] Only IPV SD was present on *'t Hart* according to the cargo receipts. On BZN4, IPV SD is also the only known variant present. This mark indicates that the cask and its contents are connected to Jan Pietersz Visser and the plantation Sardam. The mark SD was also used separately on the BZN4 casks. In the casks marked with IPV SD or SD, coffee was found. However, on the receipt, these casks were associated with sugar. The marks ECS, GPI and ABL also contained sugar according to the receipts. However, these casks were not sampled, making it impossible to compare the content.

485 This calculation is based on the weight of 494.09 grams per Amsterdamse pond (Amsterdam lb). Database De oude Nederlandse maten en gewichten n.d., https://mgw.meertens.knaw.nl/plaats/44.

486 NA, SvS no. 280/318 (OBP), 24 October 1747. SD = Sardam, OB = Ornamibo, RR = Rorac and the three-leaf clover for Claverblad. https://www.allesurinamers.org/databestanden-met-zoekfunctie.

487 NA, ONAS no. 760/201, 19 July 1748; ONAS no. 760/657, 13 February 1750.

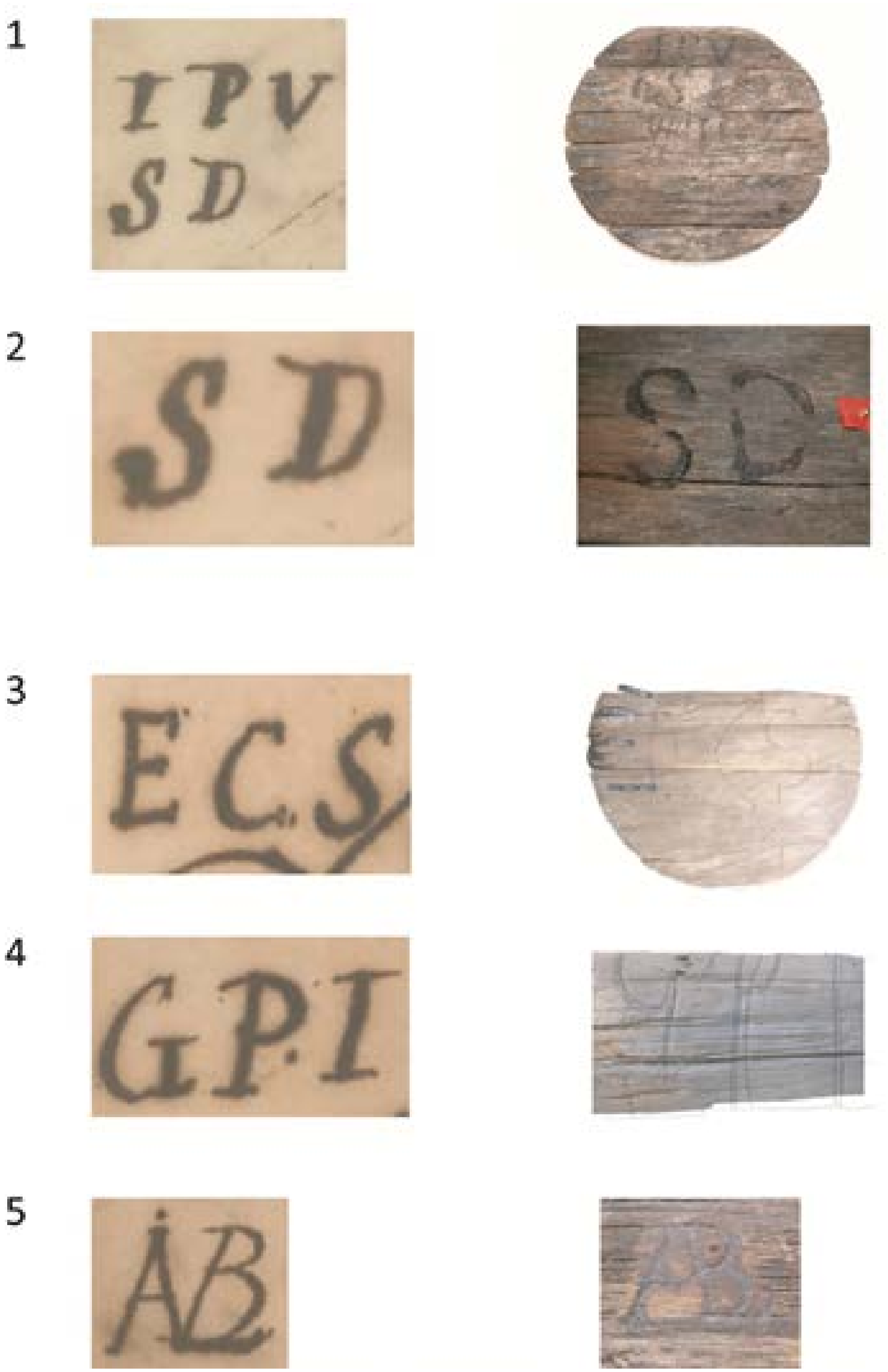

Figure 8.9: Cask marks found on BZN4 and 't Hart (Maritime Archaeological National Collection, Rijksdienst voor het Cultureel Erfgoed, object no. 60032365. Available via Collectie Nederland: https://www.collectienederland.nl/page/aggregation/maritieme-archeologische-rijkscollectie-maritieme-vondsten/60032166, licenced by CC BY-SA 3.0.).

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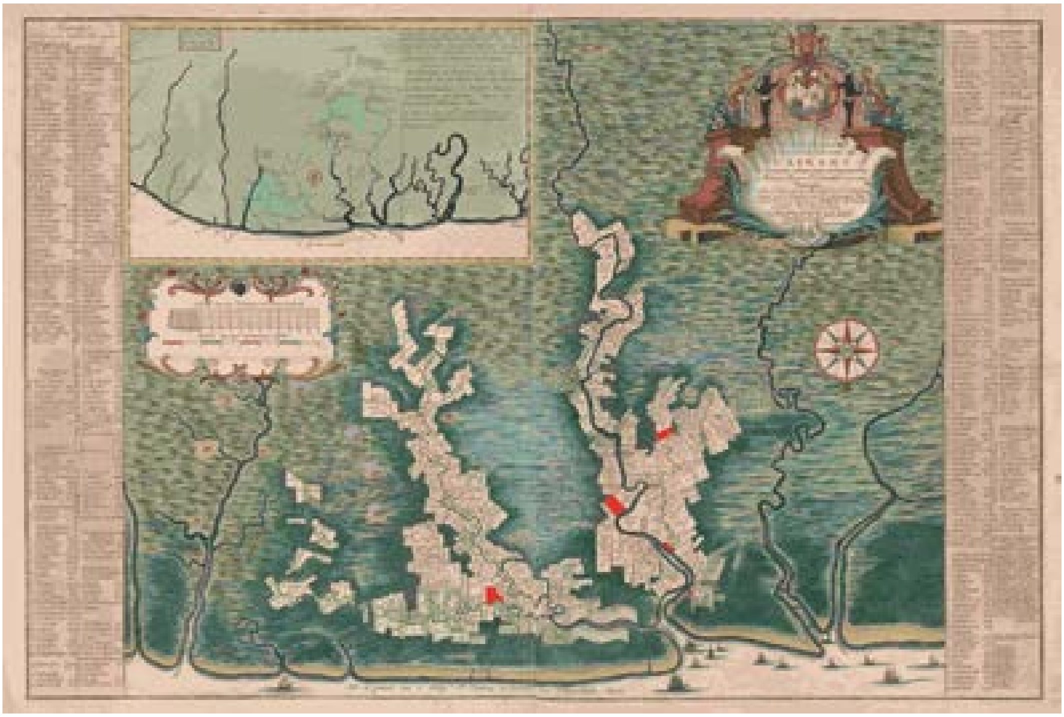

Figure 8.10: Map of the plantations in Suriname, 1737-1757. The plantations marked in red were owned by Jan Pietersz Visser. His mark, IPV SD, was on casks carried on 't Hart and discovered on BZN4 (General Map of Suriname [map, inv. no. NG-478], by Alexander de Lavaux, 1737-1757. Rijksmuseum, Amsterdam, The Netherlands).

Another noteworthy mark, MSP, was found on only one cask from BZN4 and was not recorded in the cargo receipts of the *'t Hart*. The mark belonged to Matheus Sigismundus Pallak.[488] Arent Hartjens, *'t Hart*'s husband, handled all of Pallak's business affairs in Amsterdam, beginning in 1742. In 1746, Hartjens sold casks of coffee marked MSP.[489] It is likely that the casks marked MSP did not require consignments because the ship's captain, representing Hartjens, oversaw the delivery, hence they were not listed in the cargo receipts.

Various coopers' tools were salvaged from BZN4. Mathijs Nieuwerkerk was the ship's cooper. Looking for marks on the coopers' tools for further confirmation yielded no results.[490]

488 NA, ONAS no. 760/439, 15 August 1748.

489 SAA, ONA no. 10223/349, 15 June 1742; no. 12789/67, 3 March 1746; no. 12789/123, 18 April 1746.

490 SAA, ONA no. 9432/14413, 21 December 1752; SAA, SS no. 2843, 7 March 1752.

8.4.5 The geographical location of the sinking

BZN4

BZN4 was discovered on the Burgzand (Figure 8.1), which served as part of the roadstead of Texel from the 16th to the 18th century. The shipwreck lies at a depth ranging from approximately 7.5 to 11.0 m, with an orientation nearly perfectly aligned north-south.[491]

't Hart

Several crewmembers made a statement about the foundering of *'t Hart*. These accounts serve as the basis for the following description of the ship's sinking, with particular attention being paid to the location of the ship on the fateful day.[492]

On 1 September 1751, *'t Hart* set sail from Suriname, carrying a cargo of sugar, coffee, and cocoa, bound for Amsterdam. On 26 November, after a voyage of 87 days, the ship and its crew reached the coast of Holland. Visibility was poor due to dense fog and drizzle. Around 11:00 AM, the crew realized they had entered the Zuiderhaaks, a vast area of shallows and sandbanks west of the Marsdiep, the approach to the Texel roadstead. Somewhere in this shallow area, the ship struck a sandbank forcefully, losing its rudder. Pieces of the hull broke off and floated to the surface. The ship stuck fast, and the crew discovered that it had sustained leaks from the impact.

Several distress shots were fired to call for assistance from a pilot and rescue ships. The tide was apparently rising, as after about half an hour, the ship refloated. It then bounced over the shallows until it reached deeper waters. From there, the crew maneuvered it through the channel – the Marsdiep – toward the east side of Texel, the intended first stop at the roadstead. In the channel, a barge with a pilot arrived from Den Helder. Eight men from the barge came aboard *'t Hart* to assist with pumping, while the barge itself was used to help steer the rudderless ship through the channel toward the safety of the roadstead.

Around 1:00 PM, *'t Hart* passed through the channel and was immediately maneuvered toward the Zuidwal. This was a shallow coastal area located directly to the east of the northern tip of Holland, forming the southern boundary of the Texel roadstead. The goal was likely to bring the damaged ship into shallow waters, to prevent it from sinking. However, a strong wind from the south-southwest pushed the ship toward deeper waters. To prevent this, two anchors were deployed, one after the other, but both anchor lines broke, causing *'t Hart* to be blown in a northerly direction.

491 Vos, 2012, 167.

492 SAA, ONA no. 9432/14406, 8 December 1751; ONA no. 9432/14413, 21 December 1751.

The crew then dropped a third anchor, which held, but by that time the ship had already been blown far from the Zuidwal and ended up in deeper water. After an hour, despite the efforts to pump out the water, the ship was slowly sinking. Additionally, the strong wind had shifted from south-southwest to south. They no longer thought it would be possible to bring the ship back to the shallow Zuidwal, but hoped to bring it to the shallow Texel shore, across the deep water. To attempt this, the line of the third anchor was cut, and they tried to steer the ship in the desired direction by setting the jib, hoping the wind would propel the ship towards Texel. Unfortunately, they were unsuccessful.

The ship sank deeper and deeper, listing to one side, which was initially counteracted by the barge from Den Helder, which had been brought alongside. Then the sinking increased rapidly, and there was no time to save any cargo or personal belongings. Eighteen of the 25 crew members were transferred to the barge, and around four or half past four in the afternoon (16:00-16:30), the ship disappeared beneath the water. Left behind were former captain Pieter Orelius, the master, the cook, the sailmaker, two sailors, and an unknown passenger. The survivors were brought ashore in Den Helder at around six to seven in the evening (18:00-19:00).

Comparative analysis

The exact location of the sinking of a ship is rarely mentioned in textual sources, and the statements regarding the sinking of *'t Hart* are no exception. However, a rough indication of the location, specifically between the Zuidwal and the east coast of Texel, can be established from the statements.

The location where *'t Hart* began to sink does not necessarily match the location where the shipwreck eventually landed on the seafloor. A strong south-southwest wind could have blown the sinking ship in a north-north-easterly direction. Additionally, the direction of the tide would likely have influenced the precise location where the ship ended on the seabed.

BZN4 was found approximately at the longitude where *'t Hart* had sunk, but it is located further to the north than its last-mentioned position off the Zuidwal (Figure 8.1). Given the unknown influence of the currents and tide immediately after the sinking, the location where BZN4 was found provides no reason to dismiss the identification of BZN4 as *'t Hart*.

8.4.6 Date of shipwreck

BZN4

The sinking of BZN4 was dated in the early third quarter of the 18th century. This is based on the collective dating of the pottery assemblage, with an upper limit around the third quarter of the 18th century.[493] This corresponds to the estimated construction date between 1740 and 1750, based on the dendrochronological dating of the ship's construction and the maximum life expectancy of a merchantman, which is typically between 15 and 25 years.[494]

't Hart

't Hart sank in the roadstead of Texel on 26 November 1751.[495]

Comparative analysis

The dating of BZN4 early in the third quarter of the 18th century corresponds with the date of *'t Hart*'s sinking on 26 November 1751. However, the archaeological data were reexamined to determine whether a more specific date for the sinking of BZN4 could be established and to compare it with the sinking date of *'t Hart*, focusing primarily on the cask marks and pottery.

The mark IPV SD found on casks in BZN4 indicates a sinking date between 1747 and 1756. As mentioned earlier, IPV stands for Jan Pietersz Visser, who was married to Anna Dufour, and SD stands for the plantation Sardam. However, Visser only began marking his casks with his initials at the beginning of 1747. Prior to that, the casks were marked with FLW after Frans Lorens Wriedt, the original owner of Sardam and Anna Dufour's first husband, who passed away in 1745.[496] In March 1756, Anna married for the third time, at which time the mark was changed to BVW, the initials of her third husband, Lodewijk, Baron van Wangenheim. This makes it most likely that BZN4 sank between 1747 and 1756.[497]

We also reassessed the ceramic assemblage found on BZN4. During the archaeological investigation, it was noted that due to the limited number of ceramics and their poor datability, the sinking date could only be estimated with a wide margin of error. The reassessment of the pottery and the cask marks show that the sinking date of *'t Hart* in 1751 could align with the BZN4 finds. Therefore, this date supports the positive identification of BZN4 as the frigate *'t Hart*.

8

493 Vos, 2012, 183.

494 Vos, 2019, 96-97, 112-119, 120-121.

495 SAA, ONA no. 9432/14406, 8 December 1751.

496 NA, SvS no. 280/318 (OBP), 24 October 1747; SAA, ONA no. 9179/267, 24 & 26 April 1745; https://www.allesurinamers.org/databestanden-met-zoekfunctie.

497 NA, Suriname DTB no. 3/119, 19 March 1756; SAA, ONA no. 10789/1396, 4 November 1760.

8.5 Conclusion

The main objective of this chapter has been to assess whether it is possible to identify BZN4 as the frigate *'t Hart*, with an initial outline of the details of BZN4 relevant to the identification. The next step involved a point-by-point comparison of the archaeological data from BZN4 with the information from textual sources about *'t Hart*, ultimately determining that *'t Hart* is a very strong candidate for the identification of BZN4.

Specifications of BZN4 for identification

The details of BZN4 that were important for its identification include the construction date, details about the ship and its use as a merchantman. A crucial element of BZN4, however, is the cargo, specifically the cask marks. The use of these marks provides a direct connection to historical records of *'t Hart*. Additionally, the location and sinking date were also examined, further establishing a link with *'t Hart*.

Justification for identifying BZN4 as *'t Hart*

The identification of BZN4 as the two-deck frigate *'t Hart* is strongly supported by a convergence of archaeological evidence and historical records. First of all, the construction date of BZN4 was compared to the known construction date of *'t Hart*. Dendrochronological analysis of BZN4's timber indicates a construction period around 1740-1750, which, after reassessment of the dendrochronological dating, was adjusted to 1736–1746. This timeframe aligns perfectly with the known construction date of *'t Hart*, that is, 1739.

The archaeological research provided insight into the dimensions of BZN4, allowing for an estimate of the ship's length to be between 35 and 37 m and a beam of 9 m, based on a 17th-century assumption. These estimates were also reassessed using the length-to-beam ratios of frigates built in the Dutch Republic in the first half of the 18th century. This resulted in a reconstructed length of 30.6 m and a beam of 9 m, which closely matches the documented length of *'t Hart* at 30.8 m and beam of 8.4 m.

One of the most compelling pieces of evidence supporting the identification of BZN4 as *'t Hart* is the cargo. On BZN4 the cargo consisted primarily of marked casks filled with coffee beans, which is what *'t Hart* was carrying according to documented evidence. In total, five marks on casks found on BZN4 were also found in the cargo receipts of *'t Hart*, while only 47 of the estimated 780 casks on board BZN were documented during the excavation.

A comparison of the two ships was initiated based on the matching marks and this provided the opportunity to conduct extensive archival research on *'t Hart*. This revealed that Arent Hartjens, who acted as husband and likely named *'t Hart*, conducted business with Pallak, owner of the MSP mark found on BZN4. Deeds show that Hartjens managed Pallak's business affairs in Amsterdam and was involved in the trade of coffee beans marked with Pallak's initials. This business relationship provides a direct link between the shipwreck and *'t Hart*. This was also evidenced in the cargo found on BZN4, which consisted of coffee and some cocoa beans packed in casks, matching the registered cargo of *'t Hart*, which included coffee, cocoa, and sugar.

In summary, the identification of BZN4 as *'t Hart* is justified by the strong alignment of archaeological findings with historical textual sources. The convergence of construction dates, cargo type, cask marks, and business relationships between key figures, provides a robust foundation for this hypothesis. Each piece of evidence corroborates other evidence, forming a cohesive and convincing argument.

The identification of the shipwreck BZN4 as the two-deck frigate *'t Hart* offers a unique opportunity to delve into the maritime history of the Dutch Republic and its colonial trade in the 18th century, and therefore its maritime landscape. By combining archaeological findings with archival research, a detailed picture of the ship, its cargo, and its final voyage has been reconstructed. This multi-faceted approach not only strengthens the identification, but also highlights the importance of integrating archaeological and archival research to uncover and understand historical narratives.

Acknowledgements

We would like to express our gratitude to Joran Smale for his invaluable assistance in recovering the cask parts from BZN4 at Batavialand in Lelystad, Nationaal Scheepsarcheologisch Depot. Special thanks also go to Bert van der Lingen for his expertise in identifying the clay pipes.

This chapter represents the first concrete outcome of the efforts to compile a dataset for the online database Woodan cask marks (www.woodancaskmarks.org), made possible through a grant from the Samenwerkende Maritieme Fondsen and the hard work of Stephan Nicolaij, Jelte van der Laan and Silke Lange. The database was developed as part of Jeroen Oosterbaan's PhD research, funded by the Dutch Research Council (NWO, Promotiebeurs voor Leraren 2019-I). The editorial work was carried out by Kerry Fast.

9. Conclusion

9. Conclusion

9.1 Introduction

This dissertation explores the multifaceted role of casks from Dutch archaeological contexts dating from the Late Middle Ages to the Early Modern period (1300–1800). The archaeological data are enhanced through the application of complementary analytical techniques, including dendrochronology, 3D scanning, and photometric stereo analysis. Through a multidisciplinary approach that integrates this archaeological data with information from outside the discipline, such as written sources, iconographic materials, museum collections, and interviews with present-day coopers, the study provides a comprehensive understanding of the production, use, repurposing, and broader economic significance of these wooden containers. The analysis of cask marks and their associated data not only enriches our understanding of the material culture of trade and craftsmanship but also highlights the significance of combining primarily historical and archaeological data. At the core of this doctoral research lies the central question:

What do casks from Dutch archaeological contexts from 1300 to 1800, examined through an interdisciplinary analysis, reveal about their lifecycle (production, use, and repurposing)?

The research question incorporates the various phases in the lifecycle of the casks, forming the conceptual backbone of the dissertation (Figure 1.6). This lifecycle perspective aligns with the study's analytical approach based on *chaîne opératoire* theory. The theory emphasizes the sequence of actions, choices, and transformations involved in the production, use, and reuse of material objects, providing an effective framework for understanding the technological and social dimensions of cask manufacture and use throughout their lifecycle.

In addition to these three lifecycle phases, the production, use as transport containers and repurposing a fourth theme, cask marks, was also studied. While cask marks appear in several phases of a casks' lifecycle, they offer valuable insights into production control, trade networks, ownership, and trade regulation. For this reason, cask marks are addressed as a separate research theme, following the chronological treatment of the lifecycle phases in the earlier chapters. The research results of this theme are discussed in Section 9.2.

Section 9.3 presents the main research results derived from the various sub-studies, organized according to the key research themes of production, use as a transport container, repurposing, and cask marks. The results of each sub-study are discussed within these thematic categories, with attention both to their specific contribution to addressing the overarching research question and to their broader significance for archaeology and related disciplines. The section concludes with an integrative reflection on the cumulative insights in relation to the central research question. Section 9.4 offers a theoretical and methodological reflection, including a critical evaluation of the methodology and data limitations. Finally, section 9.3 outlines opportunities for future research and provides recommendations for advancing the study of casks in both archaeological and multidisciplinary contexts.

9.2 Conclusions

Between 1300 and 1800, the Netherlands experienced a profound economic transformation, emerging as one of Europe's most urbanized and commercially advanced regions. This transformation was fueled largely by trade, which unfolded along a series of overlapping trade networks in which the Netherlands played a central role.

Casks were indispensable transport containers for bulk goods throughout this period, coming into increasingly widespread use from the Late Middle Ages onward. Their functionality extended far beyond their capacity to store commodities: casks offered durable, stackable, and reusable solutions that supported both storage, long-distance transport. In urban settings, casks were a visible presence within the cooper guilds and among their principal clients, such as breweries and fisheries. They were also a familiar sight in marketplaces and at trade fairs, as well as in taverns and inns. Within domestic contexts, repurposed casks found new uses as tables and chairs, and, in less visible ways, as structural components such as shafts of cesspits and water wells. In this sense, the cask was an omnipresent element of both the maritime and urban landscape.

Consequently, casks occur frequently in both urban and maritime archaeological contexts in the Netherlands. Nevertheless, as previously noted, they have received only sporadic academic attention, and comprehensive studies devoted to this artifact group remain rare. Therefore, essential aspects such as the successive phases that constitute the casks' lifecycle and the lifespan of the lifecycle have remained poorly known. These research topics are examined in detail in the first sub-study.

The lifecycle of casks comprises three main phases: production, use as transport containers, and repurposing. The production phase can be further divided into the production of coopers' timber, the drying and transport of the timber, and its subsequent processing into casks. The lifecycle therefore begins with the growth of the oldest tree rings in the timber that was eventually used by coopers to assemble the casks. Subsequent research examined the lifespan of the casks using several dating methods, with dendrochronological analysis and dates from finds in repurposed casks providing the principal chronological data (Chapter 2).

Analysis of the dataset indicates that the timber production phase, spanning the period from the formation of the oldest tree ring to the felling of the tree, had a median duration of approximately 150 years. The data further show that the subsequent drying and transport phase lasted around three years, during which the timber was seasoned and transported to cooperages. The production process itself lasted seven weeks and included both the final drying of the timber and the manufacture of the casks. The use phase, during which casks served as transport containers, had a median duration of six years, while repurposed casks, often employed as linings for cesspits and water wells, remained in use for an additional 75 years.

The total reconstructed lifespan of a cask was approximately 234 years. This sub-study not only sheds light on the longevity of casks, which is crucial for interpreting the results of the other sub-studies of this dissertation, but also highlights how the dating of casks should be interpreted in other studies. For instance, dendrochronology is frequently used to date cask-lined features. However, this research demonstrates that there can easily be a time gap of over a hundred years between a dendrochronological date (when samples with sapwood are absent) and the repurposing phase of the cask.

A similar issue arises in maritime archaeology, where dendrochronological samples are frequently used to approximate the sinking date of a ship. Again, if the sample lacks sapwood, the timber used for a cask could fall within a time range of over 150 years, offering only limited precision regarding the actual date of sinking. For wood specialists working in archaeological contexts, the median value of 150 years for the timber used in casks is particularly valuable. It offers important insights into the variation in the age of the timber that can be present in a single cask.

Production of casks

The first stage of the cask production was analyzed in a sub-study that focused on the specifications of coopers' timber (Chapter 3). This research examined both the provenance of the timber and its diachronic development. The primary objective was to gain a better understanding of the extent to which coopers' timber was imported and to assess what proportion of the casks from Dutch archaeological contexts had been produced domestically in the Netherlands.

For this purpose, a comprehensive dataset was assembled, comprising 946 successfully dendrochronologically dated tree-ring series derived from cask staves or headboards. These series represent a total of 357 casks recovered from archaeological contexts across the Netherlands. A notable finding from this dataset was that only 16% of the casks included one or more tree-ring series containing sapwood. This low percentage indicates a marked preference for timber not containing sapwood for cask construction.
This preference is consistent with historical regulations documented in coopers' guild records from several cities in the Netherlands, such as Haarlem (1567),

Dordrecht (1606), Amsterdam (1609), and Leiden (1743), which explicitly prohibited the use of timber containing sapwood (Table 5.1). Such regulations were likely intended to ensure the quality and durability of the casks, as sapwood is generally more susceptible to decay and less suitable for a tight seal.

The casks recovered from Dutch archaeological contexts revealed seven distinct provenance areas for coopers' timber: the Rhineland, the Meuse Valley, the North German Plain, the Baltic region, Poland, France, and the Burgundy/Loire Valley (Figure 3.3). Compared to other crafts in the Netherlands that relied on imported timber, one particularly notable absence is southern Scandinavia. Although timber from southern Scandinavia was widely used in the Netherlands for a variety of purposes such as shipbuilding, the construction of buildings, and foundations (Section 3.3.1), there is no evidence that it was used for the production of casks. A clear explanation for this absence has not been found. However, it appears that timber from southern Scandinavia either did not meet the requirements or satisfy the preferences of coopers, or, simply, it may not have been available to them.

Conversely, French timber is rarely identified in dendrochronological research focused on applications outside of cask-making, yet it is distinctly present in the cask dataset. This pattern is also evident in written sources, although the references to the import of French timber to the Netherlands are few. Archival sources, such as the records of the Zaandam timber auctions between 1655 and 1811 do not mention France as a source of imported timber. In contrast, timber from regions such as the Rhineland, the port of Hamburg (representing the North German Plain), and various ports along the Baltic Sea is frequently mentioned in both written sources and in customs records such as the Sound Toll Registers (Section 3.3.1). These sources consistently identify these areas as key points of origin for imported timber, while French timber is notably absent.

The fact that French timber is almost entirely absent from both archival records and dendrochronological analysis of timber used in non-cooperage contexts, while it is distinctly present in the cask assemblage, strongly suggests that casks made from French wood were most likely manufactured in France. These casks probably served as containers for French products and were imported into the Netherlands as such, rather than as raw timber intended for local cask production.

The diachronic analysis of the provenance of timber in the casks from Dutch archaeological contexts revealed several significant patterns that reflect broad economic and logistical developments in northwestern Europe. Throughout the High Middle Ages, large-scale timber trade was primarily conducted along major river systems, with the Meuse Valley and the Rhineland emerging as the dominant source regions. Between 1100 and 1300, no less than 81.5% of the timber used for casks can be attributed to these two areas (Table 3.3).

From the late 13th century onward, the Dutch archaeological record reflects a shift in timber trade patterns with the rise of the Hanseatic League, which expanded supply routes via the Baltic Sea. Timber from Poland, the Baltic region, and the North German Plain became increasingly prominent, indicating a growing reliance on maritime transport alongside traditional riverine trade. This reliance on seaborne trade was not limited to the north and east; by the late 15th century, French timber also appears in the record, pointing to expanding maritime connections with the southern parts of Europe. This development marks a geographical broadening of timber supply routes and indicates a growing reliance on seaborne trade alongside traditional riverine systems.

These developments point to a clear shift in timber supply patterns over time. Until around 1500, the Rhineland and Meuse Valley dominated as sources of coopers' timber. In the Early Modern period (1500–1700), maritime trade led to a more balanced distribution: 42.2% of the timber came via river routes, 41.5% from Hanseatic regions (Baltic, Poland, North German Plain), and 16.3% from France, suggesting the import of finished French casks (Table 3.3).

Provenance analysis alone cannot determine how many casks were made in the Netherlands, as casks made abroad could have been imported as finished products containing goods from their region of origin, as previously demonstrated by the examples of casks made from French timber.

To identify casks likely produced in the Netherlands, the presence of multiple provenance areas within a single cask was used as a proxy for local assembly. Among the casks in the dataset for which provenance could be determined for several parts, around 18% showed timber from more than one provenance area (Section 3.3.3). To rule out incidental repairs as the cause, a stricter analysis was conducted focusing on casks with multiple parts from different provenance areas. This reduced the share to 9.7%, supporting the conclusion of genuine multi-sourced timber in the construction.

The occurrence of multiple provenance areas within a single cask can also be considered diachronically. The earliest examples of this in the Dutch archaeological record appear in the 14th century, coinciding with the founding of the first of what would become 38 coopers' guilds across the Netherlands. A second line of evidence comes from the provenance regions themselves: of the 15 casks with multiple timber sources, nine contain at least one stave of Baltic or Polish origin. As shown in the Sound Toll Registers (Table 3.2), the Dutch Republic was a major importer of timber from these areas, strengthening the argument that such casks were produced in the Netherlands.

The second sub-study on cask production (Chapter 4), examines the next phases in the production of casks in the Netherlands. It outlines the development of the coopers' trade in connection with urban, economic, and technological changes

from the Late Middle Ages to the Early Modern period. The chapter opens with an analysis of the role and functioning of craft guilds in the Netherlands, among which coopers' guilds were responsible for overseeing cask production.
Thirty-eight coopers' guilds are registered in the Database Dutch Craft Guilds, which catalogs historical guilds within present-day Netherlands.[498] A clear diachronic pattern can be observed in their establishment, which closely reflects regional economic development. The earliest coopers' guild appeared in Sluis in 1397, near the thriving trade hubs of Flanders and Brabant. In the 15th century, coopers' guilds spread across Zeeland, especially on Walcheren, and to key towns in Holland such as Dordrecht (1437) and Gouda (1453), where demand for casks was driven by, for instance, the beer breweries. The 16th century marked further expansion into major urban centres like Delft, Leiden, and Amsterdam, and also into inland towns connected to major waterways, including Breda and Deventer. By the 17th and 18th centuries, the spread had stabilized, with new guilds emerging both along the coast, such as in Schiedam and Hoorn, and further inland, in cities like Leeuwarden, Amersfoort, and Zwolle. This geographic diffusion of coopers' guilds reflects both the economic growth and logistical integration of the Dutch Republic over time (Section 4.3).

The products of the coopers' guilds are often closely linked to developments in the industries they served. High-volume goods like beer and herring, stored in casks, generated substantial demand, meaning the growth of coopers' guilds should be considered alongside the guilds related to brewing, beer trade, fishing, and its trade. The data show that in 62.1% of the cities with a coopers' guild, a brewers' guild was also present, and in 40% of these cities, a fishmongers' guild existed, indicating a strong interconnection of these trades (Table 4.2).

The organizational structure of Dutch coopers' guilds, well-documented from the 16th century onward, remained remarkably stable until their dissolution in 1811. The Amsterdam coopers' guild charter of 1542 outlines a clear hierarchical system led by a small board of four masters, or *overlieden*, responsible for administration, quality control, and representation. Inspectors (*keurmeesters*) oversaw the craftsmanship standards, ensuring casks met strict specifications. Guild membership required an apprenticeship, an admission fee, and passing a master examination tailored to making local products. Apprentices and journeymen formed the workforce, with numbers fluctuating according to economic demand and seasonal cycles (Table 4.3). The guild system allowed for a flexible workforce, adapting to changes in trades reliant on casks. Guild leadership was often held by a select few over multiple terms, reinforcing a stable and tight-knit governance.

The actual production of casks in cooperages between 1300 and 1800 is described in several publications, such as those by Waelput and Kilby (Section

498 *Database Dutch Craft Guilds, 2012.*

4.4). These publications include step-by-step accounts provided by 20th-century coopers, describing the artisanal production process without the use of lathes or machine-made cask components. The assembly of casks is also documented in 18th-century encyclopedias, where the process is not only described in detail but also illustrated (Section 4.4.1). To verify whether the production techniques described in these sources were applicable throughout the full research period, 3D scans were made of four archaeologically recovered casks, dated between the 15th and 20th centuries.

The analysis of the 3D-scanned casks focused on three aspects: stave width variation, wedge marks indicating wood splitting, and traces of hoop placement. The 20th-century cask had evenly sized staves and no distinguishable closing stave, suggesting machine production. Wedge marks, a sign the timber had been split with a wedge rather than sawn, were visible only on the 15th- and 16th-century casks. The absence of such marks in later examples aligns with a shift to sawn staves from the 18th century onward, though finishing could have obscured wedge traces on earlier casks. Tool marks on the exterior of the casks, often appearing as transverse lines across the staves, indicate the placement of hoops during production or later repairs.

To estimate the value of casks during the research period, a brief sub-study of cask prices was conducted. While prices varied depending on cask type, records show that in the mid-17th century, an unskilled laborer could buy a half-*anker* (specific type of cask) with about one day's wages, while a beer cask equaled nearly two days' wages. Additionally, an 18th-century document from the Vlissingen coopers' guild provides insight into cask pricing for salted fish. The pricing breakdown reveals that raw materials accounted for 55% of the total price, labour for 35% of the selling price, and the master coopers' profit made up the remaining 10% (Section 4.5).

Use as transport containers

Chapter 5 examines the use of casks as transport containers, with a particular focus on establishing the specifications of beer and herring casks, with the aim of enabling their identification in archaeological investigations. The focus on casks for these two products is informed by findings from Chapter 4, which highlight how coopers' guilds were closely tied to the beer and herring trades, two sectors that dominated export activity in regions such as Zeeland and Holland. To estimate the scale of cask circulation, herring-catch data were used to assess container demand, revealing that approximately 350,000 herring casks were needed annually. The demand for beer casks was even higher; between 1543 and 1545, an estimated 950,000 beer casks were used in just nine major beer-producing cities in Holland (Section 5.1).

This sub-study began with identifying the specifications of beer and herring casks, which were not always the same. These specifications included capacity, dimensions, number of staves and headboards, stave thickness, number of hoops, timber used, and the presence and type of holes. To determine the standard characteristics for each cask type, ordinances from various coopers' guilds were analyzed, as these documents prescribed the required measurements and construction details (Section 5.4.1). Additionally, several gauging instruments from the Amsterdam Museum, dating from 1658 to 1801, were examined. These tools, inscribed with designations such as *1658 1/2 HARING VADT* (1658 half-herring cask), were used to measure and gauge the length and maximum and minimum diameters of casks, allowing their capacity to be calculated (Section 5.4.2). Other features, such as the number of staves, headboards, hoop sets, and types of holes, were studied using historical paintings, which provided visual evidence of construction details not always documented in written sources (Section 5.4.3). These specifications were applied to archaeological casks to analyze potential correlations. Although clear material evidence for herring casks is rare, one example was found in the wreck of the *Biddinghuizer Colfschip*, where a cask containing herring remains was recovered. Comparable examples of beer casks have not yet been identified in Dutch archaeological contexts (Section 5.4.4).

The sub-study revealed clear and consistent differences between beer and herring casks in terms of size, construction, and design. Beer casks typically had a larger capacity (over 130 liters), thicker staves (at least 1.4 cm), and a greater number of staves (14–15), whereas herring casks were standardized at 120 liters, with thinner staves (minimum 0.9 cm) and slightly fewer staves (12–13). In terms of holes, beer casks often featured multiple types, such as bungholes, tapholes, and ventilation holes, while herring casks generally included only a single round bunghole in the bilge.

A notable distinction between beer and herring casks lies in the consistency of their characteristics. Herring casks from Holland were standardized at a volume of 120 liters and subject to stringent regulations, whereas beer casks exhibited considerable variation. This discrepancy can be attributed to the comprehensive regulatory oversight of the herring fishery and its related components, including casks in which the herring was packed. Such regulation was closely linked to the internationally recognized reputation of herring from Holland and Zeeland, enforced by interregional interest organizations like the College van de Grote Visserij. Beer casks, on the other hand, exhibited considerable variation in size, which can be interpreted as the absence of a shared reputation and consequently a lack of centralized oversight and standardization. Regulation of the beer trade was primarily a local urban matter, resulting in specifications that varied between cities or even breweries, which meant that standardization of the capacity of beer casks was largely absent (Section 5.5).

Repurposing

Casks, originally designed for storing and transporting goods, were frequently repurposed after they were no longer useful as a transport container. Their sturdy wooden construction made them ideal for secondary functions, including household furniture and storage containers. In maritime contexts, they served as buoys and flotation devices for fishing nets. Even when dismantled, their parts were repurposed in urban settings for building frameworks or as flooring. When no further repurposing was possible, the wood could then be used as firewood. Thanks to their versatility, casks became a common sight in both domestic and public environments throughout the Late Middle Ages and Early Modern period.

The most recognized archaeological repurposing of casks is as linings for cesspits and water wells. Typically, the heads were removed, and the casks were stacked and dug in to form a shaft. As soil was dug out from inside the cask, the cask could be sunk into place, serving both as structure and a temporary casing during placement.

The study presented in Chapter 6 focuses on the repurposing of casks as shaft linings, using a case study approach centered on three large-scale excavations in Vlissingen: Groote Markt, Spuistraat, and Dokkershaven. Drawing on a dataset of 226 casks repurposed as linings for cesspits and water wells, the case study explores how soil conditions, economic factors, and cask availability influenced the decision to use casks instead of brick in cesspit and well construction. These factors likely shaped the choice to repurpose casks as a practical and cost-effective construction solution.

The first factor considered in the case study as a possible influence on the choice between cask-lined and brick-lined cesspits and water wells is soil condition, with unstable soils often linked to more frequent use of cask linings, as seen in Dordrecht. Vlissingen, where soil variability is present, offers a case to test this hypothesis, as its historic centre contains three soil types: stable, sandy creek beds in the west, an infilled former channel with unstable soils in the centre of the city, and peat-rich sediment in the east.

Contrary to expectations, the more stable creek bed and peat areas showed a higher percentage of cask-lined cesspits (94% and 96%, respectively) than the unstable channel zone (77%). Water wells showed a similarly inconsistent pattern, with cask linings more common in stable soils and less so in peat-rich areas (Section 6.3.2). Differences in soil conditions did have a consistent effect on the depth of water wells, with the deepest wells found in the infilled channel area, likely due to a lower groundwater table. Overall, these results suggest that soil conditions in Vlissingen had limited impact on lining choices, implying that other factors such as material availability and economic considerations played more decisive roles.

Financial means was the second factor considered, with brick lining requiring a significantly higher financial investment but offering greater durability. This hypothesis was confirmed by data from the Groote Markt excavation in Vlissingen (1575–1625): parcels owned by individuals with below-average financial means predominantly had cask-lined cesspits and water wells, while those owned by wealthier individuals more often featured brick lining (Section 6.3.3).

The third possible factor influencing the choice between a cask- or brick-lined cesspit or water well was the availability of casks for repurposing. This factor is closely linked to the second one, economic considerations, since the abundant availability of repurposable casks likely reduced the financial investment required for the cask-lined option.

The availability of casks was initially examined through the presence of a coopers' guild in Vlissingen. The existence of such a guild was taken as an indication of coopers engaged in production and repair work, which in turn implied that casks suitable for repurposing would be available in the city. In Vlissingen, cesspit data reveal a sharp increase in the number of cask-lined structures following the founding of the coopers' guild. This suggested a correlation, but to verify this, data from other cities in the Netherlands were also analyzed.

However, the ratio between cask-lined and brick-lined features in the cities of Dordrecht, Haarlem, Leiden, Alkmaar, 's-Hertogenbosch, Deventer, and Amersfoort showed no straightforward or immediate correlation between the establishment of a coopers' guild and a concurrent rise in the proportion of cask-lined cesspits following the guilds' foundation (Table 6.10). The situation in Vlissingen was therefore reassessed, revealing that the number of brick-lined features also increased from 1500 onward (Table 6.9), leading to the conclusion that the overall increase in the number of cesspits and water wells was more closely related to the expansion of Vlissingen rather than specifically to the founding of the coopers' guild and an increased availability of repurposable casks it ensured (Section 6.3.4).

A striking aspect of the comparison between Vlissingen and other cities was the high proportion of cask-lined features found there. In Vlissingen, 86% of cesspits and 55% of water wells were constructed from casks. In contrast, the cities of Haarlem, Leiden, Alkmaar, 's-Hertogenbosch, Deventer, and Amersfoort combined have only 39 cask-lined cesspits out of a total of 640, representing just 6%. Only Dordrecht showed similar percentages of features with cask-lined features.

Both Dordrecht and Vlissingen stand out from other cities because they functioned as trans-shipment ports during the Late Middle Ages and the Early Modern period. In these ports, casks were routinely transferred from one ship to another. For certain products, such as beer and wine, the contents were often decanted into different casks before being traded further. This process undoubtedly led to many casks no longer being needed as transport containers, which likely resulted in an abundance of repurposable casks in a wide range of sizes, as a great variety of products passed through the trans-shipment ports.

The sizes of the casks used for the lining of features in Vlissingen were analyzed to determine whether there was a wide variety of sizes used, as would be expected in a trans-shipment port, or a consistent size, as would be expected if the casks were repurposed from the locally dominant herring fishery in Vlissingen. The analysis revealed a great variety of repurposed cask sizes in Vlissingen (Table 6.11). Therefore, the availability of casks in these cities is likely less related to the presence of a coopers' guild and more to the abundance of casks that had outlived their use as transport containers in these trans-shipment ports.

Overall, the case study on the repurposing of casks reveals that the widespread use of cask-lined cesspits and water wells in Vlissingen was primarily driven by cask availability and economic considerations. As a trans-shipment port, Vlissingen had an excess of discarded casks, offering an affordable and readily available alternative to brick. This option was especially preferred by property owners with limited financial means. In contrast, local soil conditions had little influence on construction choices. Together, these findings highlight that material repurposing in urban infrastructure was shaped not only by practical constraints but also by broad economic and logistical factors unique to port cities like Vlissingen.

Unlike many other sub-studies in this dissertation, the research on cask repurposing was conducted as a case study, focusing on a limited aspect of the overall research area. The dataset consists solely of cesspits and water wells in Vlissingen, which were then compared to those from several other cities. Therefore, it is important to assess to what extent the results of this case study are representative of other cities in the Netherlands.

Vlissingen was chosen as the case study area due to the large number of excavated cesspits and water wells, as well as the significant presence of cask-lined features. However, Vlissingen occupies a unique position compared to many other Dutch cities. First, it experienced rapid growth during the 16th century, and second, it functioned as a trans-shipment port, serving both maritime trade and commerce with cities like Antwerp. Furthermore, the soil conditions in Vlissingen differ significantly from those of inland cities such as Deventer and Nijmegen. Therefore, generalizing the results of this Vlissingen-focused study to all Dutch cities would be ill advised. However, the comparison is valid for cities with a similar diachronic development, position in trade networks, and soil conditions, such as Middelburg, Veere, and Dordrecht.

Cask marks

One of the key studies in this dissertation focuses on cask marks, which are frequently found on casks from archaeological contexts, yet often receive only superficial attention in archaeological reports. This is primarily the result of ambiguity about their purpose, preventing a proper understanding of their significance and related position in trade networks. However, when studied in detail, these marks offer valuable insights into production control, trade networks, ownership structures, and regulatory practices of cask production, transport, and contents.

The aim of this sub-study is to clarify the function of cask marks by examining their intended purpose, the phase in the casks' lifecycle during which they were applied, and the individuals or groups responsible for marking the casks. To this end, the Database WOODAN Cask Marks (www.woodancaskmarks.org) was developed to group cask marks by function (Chapter 7) according to a newly established typology. The database contains 1,021 cask marks from archaeological contexts, supplemented by 880 examples from written sources, bringing the total dataset to 1,901 marks.

Although cask marks have been studied in archaeological, historical, and architectural-historical disciplines, a comprehensive and integrated investigation into the full range of marks found on casks has so far been lacking. Archaeological studies of cask marks in the Netherlands usually focus on situations where large numbers are found at a single site. These studies are rare and tend to be site-specific, focusing only on the marks found in that particular context. Historical and architectural-historical research, on the other hand, has often concentrated on a single type of mark, for example, gauge marks or count marks. This narrow focus has resulted in a fragmented understanding of wider marking practices and has hindered efforts to distinguish clearly between different types of cask marks and their function.

The findings from research have been combined in this dissertation to create a new typology, supplemented by an analysis of primary written sources to extract additional information about cask marks, as well as interviews with contemporary coopers. After the typology was established, it was applied on cask marks found in archaeological contexts, revealing additional details about the various cask marks. The resulting typology identifies six main cask mark types, some of which are further divided into subtypes.

1. Production mark
   A. Construction mark
   B. Coopers' mark

2. Cask gauge mark
   A. Cask gauge approval mark
   B. Cask gauge rejection mark

3. Content gauge mark
    A. Content gauge approval mark
    B. Content gauge rejection mark

4. Identification mark
    A. Product identification mark
    B. Personal identification mark

5. Corporate identification mark
    A. Count mark
    B. Content quantification mark

Each type and subtype of cask mark served a distinct purpose, and to differentiate them, three features were analyzed (Section 7.5). First, the design of the cask marks varied between types. Additionally, the methods used to apply these marks differed and involved tools such as timber scribes, knives, branding irons, compasses, brushes, and strike irons. The application methods were further examined using photometric stereo techniques, which enabled detailed cross-sectional imaging of the marks. Finally, the location of the marks on the cask also varied by type, including the head (external), head (internal), bilge bottom, bilge centre, and bilge near the hole.

The first type of cask mark applied during a casks' lifecycle was a production mark, which could be one of two subtypes: a construction mark and a coopers' mark. Construction marks were made by coopers to assist in assembly, such as measuring, matching parts, and sequencing staves. These marks, typically incised with knives or compasses, mainly appear on cask heads and sometimes on bilges, though marks on the bilge were often removed during finishing. Their designs vary, including V-shaped marks for matching and concentric lines for orientation and measuring of the heads. Coopers' marks were added after production to track output, identify makers, and ensure quality control. Often required by guilds and export laws in the 15th century and following, these marks feature straight lines, crosses, monograms, or Christian symbols, applied with tools such as timber scribes or branding irons, which made durable marks. Production marks are commonly found on cask heads (internal and external) or the bung stave in the bilge, with some regulations specifying exact placement (Sections 7.7.1 and 7.8.1).

The second type of cask mark, the cask gauge mark, was applied at the end of production by inspectors (*keurmeesters*) to certify a casks' quality and capacity. Approval marks indicated compliance with strict regulations on dimensions, materials used, and watertightness, clearing casks to be filled for trade. Rejection marks identified casks that failed inspection and needed repair before they could be filled. These marks were crucial for maintaining standards, especially for export goods like beer, herring, and butter, and their use dates back to the 15th century.

Approval marks often featured a city's coat of arms or identifying letters and were typically branded onto the widest stave of the bilge. Rejection marks commonly had a circular design. Annual inspections of reused casks ensured ongoing quality. The distinctive role of these marks, applied by official inspectors, highlights their importance in a casks' lifecycle and justifies their classification as a separate mark type (Sections 7.7.2 and 7.8.2).

After casks entered the second phase of their lifecycle as a transport container for goods, a second gauging process was carried out. Unlike the initial inspection, which focused on the casks' quality and capacity, this subsequent gauging was aimed specifically at the contents of the cask. This resulted in the application of a third type of cask mark, known as the content gauge mark. The contents were assessed, and if they met the requirements, the cask was marked with a content gauge approval mark. Contents that did not met the required standard, were marked accordingly. Particularly important in the export-oriented herring trade in Holland in the Late Middle Ages and Early Modern period, these marks guaranteed product quality, indicated the catch period and the export destination. They were clearly visible and applied to be durable typically with a timber scribe, most often on the bilge or heads of the cask (Sections 7.7.3 and 7.8.3).

The fourth and most frequently occurring cask mark type, an identification mark, was used to identify a casks' contents and associated persons or companies. During their use as transport containers, casks were marked with identification marks to enable easy recognition. Product identification marks indicated the contents. Such clear labelling helped avoid confusion, for example, keeping track of the many different products in VOC ships' cargo (Verenigde Oost-Indische Compagnie, Dutch East India Company). Personal marks acted as signatures of merchants or owners, facilitating trade and transport. Corporate marks signified ownership or origin, often used by breweries or the VOC. Unlike official inspection marks, these marks were applied by traders themselves without strict regulations regarding design or placement. They ranged from letters to logos and were applied using branding irons, ink, or paint, allowing quick identification of the casks' contents and ownership (Sections 7.7.4 and 7.8.4).

Count marks, the fifth type of mark in the typology, were used to indicate the quantity of casks during their use as transport containers. Applied informally by merchants, consumers, and traders, these marks helped quantify goods. As part of everyday trade, such as the counting and marking of ship cargoes at toll stations, these cask marks were applied outside any formal institutional framework, which explains the limited written evidence concerning their regulation. Typically, count marks comprised tally systems or numeric symbols like Arabic or Roman numerals, reflecting regional and temporal variations. Archaeological evidence shows these marks were usually incised with a timber scribe or knife and placed on random parts of a cask, such as the bilge or heads. Their widespread, practical use justifies their classification as a distinct type of cask mark (Sections 7.7.5 and 7.8.5).

The sixth and final type of cask mark is the content quantification mark, applied by officials after the casks arrived at their destination. These marks recorded the measured volume of the contents so that excise duties could be calculated, which was a vital source of cities' revenue. The mark that has received the most attention, the wine gaugers' mark, features distinctive design elements, lines indicating quantity and transverse crosses to indicate counting had been completed, thus preventing fraud. These marks were incised with a timber scribe and placed on a casks' bilge near the bung hole. The marks' detailed design and institutional role underscore their importance in regulating trade and taxation in medieval cities (Sections 7.7.6 and 7.8.6).

The eleven subtypes of cask marks, some of which, such as personal ownership marks, could be applied multiple times to a single cask, suggest that most casks were marked. Nevertheless, archaeological reports often mention unmarked examples. This absence can be partly explained by the fact that certain marks were typically applied only to casks with export products, like wine or herring, each of which had its own set of marks. Casks used for products intended for local trade generally bear fewer cask marks, as there was no need for elaborate quality control since the producer of the cask or its contents was in direct contact with the final consumer.

Additionally, many marks may have gone unrecognized during archaeological research. In maritime contexts, casks often disintegrate, making marks harder to detect, especially after exposure to post-depositional factors like shipworm damage. On terrestrial sites, insufficient cleaning or limited focus may have hindered mark identification. This may be the result of limited attention to cask marks, which this sub-study seeks to address by highlighting their value and promoting more systematic documentation.

Building on the results of the individual sub-studies, the four central research themes, namely production, use as transport containers, reuse, and cask marks, have been examined in detail. They have been addressed together in this dissertation within the framework of the casks' lifecycle, guided by the *chaîne opératoire* theory (Section 1.3.1), which served as the primary theoretical backbone. This approach has produced multifaceted insights into casks from Dutch archaeological contexts dating from the Late Middle Ages to the Early Modern period (1300–1800). At the same time, it establishes a methodological foundation that enables a further interpretative step, in which the cask can be employed not only as an object of study but also as an analytical tool for situating the archaeological site of discovery, for instance a shipwreck, within a broader maritime cultural landscape (Section 1.3.2).

The way in which casks can be employed to situate an archaeological site within the maritime cultural landscape is particularly illustrated in the final sub-study, which focused on identifying the shipwreck BZN 4 as the frigate *'t Hart* (Chapter 8). The research was initiated with the identification of a specific mark, MSP, found on four casks from the shipwreck, which could be directly linked to an individual recorded in historical sources, Matheus Sigismundus Pallak (1709–1767). This ultimately allowed the identification of the BZN 4 shipwreck and the contextualization of both the casks and the entire shipwreck within the maritime landscape, providing a clear example of the value of casks as tangible archaeological evidence for situating not only the artifacts themselves but also their site of discovery within a maritime cultural context.

As stated, the research was initiated by identifying the cask mark MSP and establishing its direct link to Matheus Sigismundus Pallak in historical sources. This connection allowed for targeted archival research, which clarified Pallak's trade network. The investigation also revealed the frigate *'t Hart*, known to have sunk near Texel in 1751, which matched BZN 4 in both location and date. These findings supported the hypothesis that the BZN 4 shipwreck could be identified as the frigate *'t Hart*.

To test this hypothesis, a systematic comparison was made between archaeological data from BZN4 and historical records about *'t Hart*. These included the construction date, ship dimensions, use as a merchant vessel, cargo and equipment, the location of the shipwreck, and the date of sinking. Dendrochronological analysis dated BZN4's timber to 1736–1746, aligning closely with *'t Hart*'s known construction year of 1739. Measurements from the wreck suggest a ship of 30.6 m in length and 9 m in beam, very close to *'t Hart*'s documented dimensions of 30.8 m x 8.4 m (Section 8.4).
The cargo provides perhaps the strongest evidence: BZN4 carried casks filled with coffee beans, and written sources confirm that *'t Hart* was transporting coffee, cocoa, and sugar. Five cask marks found on BZN4 matched those listed in *'t Hart*'s cargo documentation, even though only a small portion of the estimated 780 casks was recorded during exca*vat*ion. Further archival investigation revealed that Arent Hartjens, likely the ship's namesake, conducted business with Pallak and handled shipments of coffee bearing the MSP mark, in Amsterdam, further linking the wreck to *'t Hart*.

This convergence of archaeological evidence and historical documentation makes a compelling case for identifying BZN4 as *'t Hart*. The case study highlights the significant potential of cask marks to connect material remains with written records. By combining archaeological and archival research, this case reconstructs not only the identity of a shipwreck but also offers insights into 18th-century maritime trade, shipping practices, and commercial networks in the Dutch Republic (Section 8.5).

Reflecting on the central research question, the sub-studies reveal significant insights into the phases of a casks' lifecycle between 1300 and 1800. Cask production was an important and extensive craft, especially in the port cities of the western Netherlands, which served as key markets for the trade of beer and herring. These cities imported the necessary timber primarily from the Rhine and Meuse valleys, as well as from regions around the North Sea and Baltic Sea.

During its use, the cask primarily served as a storage and transport container for liquids such as beer, wine, as well as for dry goods, highlighting its versatility. Herring and beer casks each had their own specific characteristics, and other products likely required casks with distinct features, including their own sets of cask marks. Archaeological evidence shows that damaged or discarded casks were rarely wasted; instead, they were often repurposed as household furniture, storage containers, or shaft for cesspits and water wells, demonstrating sustainable practices. The lifecycle of a cask reflects not only the skilled craftsmanship and economic networks of the period but also the resourcefulness and sustainability embedded in its use and repurposing. This comprehensive understanding underscores the casks' crucial role within the maritime cultural landscape of the Netherlands between 1300 and 1800 and offers substantial opportunities for future research into this underexplored and underappreciated wooden container from Dutch archaeological contexts.

9.3 Data limitations and methodological considerations

This study employs a multidisciplinary research design, integrating archaeological, dendrochronological, historical, iconographic, and material data from museum collections. Throughout, the archaeological data remains central, providing the primary framework for analysis and situating the research firmly within the archaeological domain, while the complementary data sources enriches contextual and supplementary understanding and supported cross-disciplinary interpretations. Each of the data sources have its own limitations and is collected and employed in different ways. In the first instance, however, it is important to reflect on the archaeological data, as it forms the foundation for the study's interpretations and conclusions.

The main focus of source criticism lies in the limited representativeness of archaeological data. Although a considerable number of casks have been included across the various datasets, they still account for only a fraction of the total casks that circulated during the research period. Consequently, analyses based on these datasets should be used primarily to identify overarching patterns and long-term trends in the lifecycle of casks, rather than to draw conclusions about specific developments linked to short time spans or isolated events.

The representativeness of the dataset is further limited because only casks from archaeological contexts with sufficient contextual information were included. The compilation of the datasets relied primarily on published archaeological data, with only limited use of unpublished material. As a result, casks from excavations conducted prior to approximately 1990, many of which are documented only in unpublished excavation records, are largely absent from the datasets. This introduces an additional layer of selection bias into the archaeological evidence used in this dissertation.

Further limitations in the composition of the dataset become clearer when examining the two distinct find contexts: urban and maritime. Urban contexts are particularly limiting because the casks recovered there were primarily repurposed, especially as linings in cesspits and water wells. The data show that only casks with a diameter greater than 45 centimeters were suitable for such repurpose. As a result, smaller casks, which also circulated between 1300 and 1800, are underrepresented in the dataset.

Additionally, the dataset shows a relative overrepresentation of casks originating from the coastal zone of the Netherlands. While this may partly reflect the actual higher prevalence of cask use in this region, it is also influenced by varying soil conditions. The waterlogged environments typical of the Dutch coastal zone provide favourable preservation conditions for wooden artefacts. In contrast, such conditions are largely absent in the eastern and southern parts of the country where the soil is sandy. Here wooden casks are less likely to have survived, except in cases where they remained below the groundwater table. This preservation bias may therefore have contributed to the apparent concentration of archaeological cask finds in the coastal region of the Netherlands.

The portion of the dataset derived from maritime archaeological contexts comes primarily from shipwrecks. It is evident that many of the casks disintegrated after the sinking of the ship, unless they had already been washed away during the sinking. The fragmentation into individual cask components also means that, at many shipwreck sites, the cask elements are recorded as separate finds rather than reconstructed as complete casks. This complicates analysis of these finds at cask level.

Furthermore, casks that have been dendrochronologically analyzed play an important role in several sub-studies. In assembling the datasets presented in Chapters 2 and 3, successful dendrochronological dating was even a requirement for a cask to be included. This introduces a bias, as not all casks from Dutch archaeological contexts have been dated dendrochronologically, resulting in a dataset that is inherently selective. In many cases, only the components with the highest potential for tree-ring analysis are sampled during fieldwork, typically those from relatively large casks, which are more likely to contain sufficient tree rings for successful dendrochronological analysis.

As previously indicated, the casks from archaeological contexts, whether dendrochronologically analyzed or not, are further contextualized through the use of additional data sources. This applies particularly to written sources, which are employed in each sub-study but represent only a fragment of the available material, leaving considerable potential for further data extraction. For example, approximately 880 cask marks from historical records are included, collected from only a few archival documents, which was already regarded as a significant yield. Similarly, in the study of iconographic sources, the RKD Netherlands Institute of Art History database was consulted. While this database contains many relevant historical paintings and etchings, it does not capture all potential material. Beyond this source, only limited use was made of iconographic materials, as the time required to conduct a more exhaustive search within the scope of this research would not have produced proportionate results.

The methodological considerations for the research presented in this dissertation primarily concern reflection on the theoretical framework, with the lifecycle of the cask serving as the central *chaîne opératoire*. The study has been successful in providing a general overview of the various individual phases that together constitute this lifecycle, making it a broadly applicable study of a category of finds from Dutch archaeological contexts.

Building on the methodological reflection outlined above, this dissertation demonstrates that casks constitute a particularly suitable artefact category for application of the *chaîne opératoire* framework. The approach has proven effective in structuring and integrating the successive stages of the cask lifecycle, from production through use, reuse, and final deposition, thereby confirming its value for analyzing complex artefact biographies. However, the results also suggest that casks are especially informative for the socio-cultural dimension of the framework, as they embed the object within broader networks of production, trade, and consumption.

Rather than focusing solely on manufacture, the study highlights how casks connect producers, packers, transporters, merchants, and consumers, and how successive reuse and repurposing extend their interpretative potential. In addition, merchant marks enable direct linkage with increasingly detailed archival sources for the period 1300–1800.

In this sense, the case study suggests that the *chaîne opératoire* framework can be meaningfully extended through the study of casks, as these differ in important respects from the lithic artefacts for which the approach was originally developed. In contrast to lithics, casks are directly embedded in their use phase as containers for identifiable commodities, linking them explicitly to the products they once held. Moreover, they acquire different meanings for different actors: as packaging for producers, as trade goods for merchants, and as containers of merchandise or foodstuffs for consumers. This multi-layered functionality is materially inscribed on the object itself, not only through use-wear but also through deliberately applied caskmarks that create a bridge to archival sources. Finally, their later repurposing as furniture or as shafts in water wells and cesspits represents an additional and distinct use phase in the cask lifecycle, thereby adding an extra layer of interpretative potential for this artefact category within the *chaîne opératoire* framework.

Based on the results of the sub-studies structured through the *chaîne opératoire* framework, the next step is to position casks within their contexts by adopting the maritime cultural landscape approach as the subsequent theoretical backbone. So far, this has only been done to a limited extent, as the absence of an overall understanding of the casks' lifecycle previously made such an approach challenging. However, the sub-study presented in Chapter 8 serves as a clear example of how casks can be used to place a shipwreck within the broader maritime landscape, illustrating that these frequently encountered archaeological finds hold a key role in reconstructing and interpreting such maritime landscapes.

Another methodological aspect concerns the multidisciplinary framework through which the research in this dissertation was conducted. This approach integrated archaeological, dendrochronological, historical, iconographic, and material data from museum collections. In addition, supplementary data were gathered through 3D scanning, photometric stereo techniques, and interviews with contemporary coopers who continue to practice traditional methods. The multidisciplinary setup proved methodologically productive, as it enabled the analysis of casks not merely as material remains but as historically embedded artefacts with social, economic, and technological significance. In particular, the integration of material and textual sources deepened the interpretative scope and provided multiple layers of evidence for reconstructing the casks' lifecycle.

This general overview, however, can vary significantly when examining specific types of casks. For example, a herring cask followed a different lifecycle than a beer cask. Herring casks had particular characteristics, which affected the way they were constructed. Their lifespan also differed from casks intended for other products such as beer or wine, as they were typically used only once and not reused. The cask marks applied to herring casks also differed, reflecting a separate quality control system and trade network. In other words, the herring cask fulfilled its role within a distinct maritime landscape compared to, for example, a beer cask. Specific studies on cask for individual content could potentially be conducted in future research, using the results of this dissertation as a foundational framework.

9.4 Recommendations for future research

The research is structured around a layered theoretical framework, with the *chaîne opératoire* as the primary focus, examined through the lifecycle of casks, and the maritime landscapes in which they operated forming a secondary analytical layer. In line with this layered approach, recommendations for future research are first presented with regard to the casks' lifecycle, followed by potential additional studies focused on the maritime landscape.

Firstly, it can be noted that the datasets compiled for this dissertation capture a substantial proportion of the casks documented in Dutch archaeological contexts, a level of coverage that was not achieved with other types of data sources. Information from these complementary sources, particularly written records, can be considerably expanded to provide more detail on specific aspects, such as their use as transport containers, patterns of repurposing, and cask marks. In future research, it would also be possible to approach the topic primarily from the perspective of written sources, using archaeological data as contextual and supplementary evidence to enrich interpretations and validate patterns identified in the documentary record.

Secondly, it is recommended that the research framework established in this dissertation be applied to casks from other countries. The current study's geographical scope was necessarily limited by the present-day borders of the Netherlands, but as expected, the topic is best approached from an international perspective. Research in neighboring countries, such as the United Kingdom, Belgium, France, and Germany, would provide a valuable extension and contribute to a better understanding of casks in a broader international context, , as cask circulation was not constrained by modern national borders.

Thirdly, some of the focused sub-studies presented in this dissertation could be further expanded by conducting similar research on additional topics. For example, research could examine the specifications of casks used for products other than beer and herring, as explored in Chapter 5, such as dairy products or wine. Similarly, the sub-study of the repurposing phase, which was addressed here through a case study focused on Vlissingen (Chapter 6), could be extended to other cities or regions.

As indicated, the research results from the various phases of the cask lifecycle can also be used to situate the casks within the maritime landscapes in which they operated. This could be initiated with studies of the lifecycle of casks used for specific products that were widely produced in the Netherlands, such as herring, beer, or dairy products. Such research could also be conducted with a focus on specific regions or time periods, provided that sufficient archaeological data is available to ensure reliable analysis. Such targeted research would provide a stronger foundation for reconstructing the associated maritime landscapes, allowing for a more precise understanding of their organization, economic networks, and special scope.

Further research into cask marks on as-yet unidentified shipwrecks could be highly fruitful, as demonstrated by the successful identification of the BZN 4 wreck (Chapter 8). In such cases, cask marks can provide a vital link between the archaeological evidence of a shipwreck and the historical documentation recorded in written sources. To maximize the likelihood of identification, research should initially focus on shipwrecks that have yielded a substantial number of marked casks, preferably bearing letter or character combinations, as these facilitate searches in digitized and transcribed archival materials. Comprehensive documentation of the ship's details and cargo is also essential for achieving a reliable identification. Consequently, the most promising candidates are often relatively recent shipwrecks, such as those dating from the seventeenth or eighteenth century.

As a final recommendation, both urban field archaeologists and maritime archaeologists are encouraged to pay greater attention to the systematic documentation of casks. The compilation of the dataset for this study benefited from the numerous archaeological reports in which casks were recorded. However, it also became clear that the level of detail in which these finds were documented varied considerably between reports, resulting in incomplete datasets for many individual casks. To fully realize the analytical potential of this artefact category, a more consistent recording strategy is required. Casks should be documented through a set of standardized measurements and construction attributes, including overall dimensions (height and minimum and maximum diameter) from which capacity can be derived, as well as the number of staves and headboards, stave thickness, hoop configuration, timber type, and type of holes.

Summary

Summary

This study focuses on casks from Dutch archaeological contexts dating from the Late Middle Ages to the Early Modern period (1300–1800). During this time, the Netherlands emerged as one of the most urbanized regions in Europe, with trade serving as the primary driver of this transformation, in which casks were employed as transport containers. It is therefore not surprising that these casks are a common find within Dutch archaeological contexts, particularly in urban settings, where they were often repurposed as linings for cesspits or water wells, as well as in the excavation of shipwrecks. Yet despite their frequent occurrence, casks have attracted surprisingly little scholarly attention. This lack of focused study can largely be attributed to an underestimation of their interpretive potential, stemming from a general lack of background knowledge about these artefacts.

The research presented in this dissertation aims to address this gap through a series of studies focused on casks. Each sub-study is guided by a specific research question and draws on its own dataset, consisting primarily of archaeological data. In addition to archaeological data, written sources have been extensively used to contextualize and supplement the research results. Furthermore, iconographic material and artefacts from museum collections have been employed, alongside dendrochronological data applied on a broad scale to gain further insights into the provenance and dating of the casks.

Chapter 1, the introduction, formulates the central research question: What do casks from Dutch archaeological contexts from 1300 to 1800, examined through an interdisciplinary analysis, reveal about their lifecycle (production, use, and repurposing)? The research question, in conjunction with the research design presented in Chapter 1, highlights the lifecycle of the cask as the guiding framework that structures this dissertation. Within this lifecycle, three main phases were identified: the production of casks, their use as transport containers, and their repurposing. Each of these themes has been analyzed as a separate research topic in this dissertation, along with a fourth theme: cask marks. Since cask marks cannot be exclusively linked to a specific phase in a casks' lifecycle, they are addressed separately following the chronological analysis of the other research themes. Below is a concise summary of each research theme, based on the sub-studies, each of which are presented in detail in a separate chapter.

Overarching studies

In Chapter 1, in addition to presenting the theoretical framework, research questions, and research design, the key functions of casks are also outlined. Here, the large-scale adoption of casks from the Late Middle Ages is compared to the introduction of shipping containers in modern global trade, in order to illustrate how they significantly influenced the development of trade networks, both in the

past sixty years and during the Late Middle Ages and Early Modern period. Both shifts were part of broader transformations in international trade that led to substantial reductions in transport costs and an increased specialization within trading markets. These changes affected not only trade practices but also port and maritime infrastructure: ships became larger, harbors were deepened and expanded, and cranes were installed to optimize loading and unloading.

However, a key difference between casks and shipping containers lies in the preservative function of casks. Their ability to protect contents from sunlight and air substantially extended the shelf life of a wide range of products. This was particularly vital in the context of Late Middle Ages and Early Modern trade, as casks' storage facility enabled longer periods of transport. As a result, goods could be traded over greater distances, which in turn stimulated further regional specialization in food production.

Chapter 2 focuses on the lifecycle of casks, with particular attention to its average lifespan. This lifespan is divided into several successive phases: the production of coopers' timber, its drying and transport, the processing of this timber into casks, the use of casks as transport containers, and finally their repurposing. For this sub-study, a comprehensive dataset was compiled consisting of 464 casks that were analyzed using dendrochronology. The data originates from maritime archaeological contexts, where casks have mostly been recovered in their original function as transport containers. Additional data were collected from urban archaeological excavations, where casks were more commonly found in their repurposing phase, typically as linings for cesspits and water wells.

The analysis of the dataset reveals that the timber production phase, the time from the formation of the oldest tree ring to the felling of the tree, had a median duration of 150 years. Following felling, the timber underwent drying and was then transported to cooperages. This phase lasted approximately three years. Once at a cooperage, the timber was processed into casks over a period of roughly seven weeks, a phase that included both additional drying and the actual production. The primary use of the 464 casks in the dataset, as transport containers, had a median duration of six years. This was followed by the repurposing phase, in which the casks from the dataset were used for a median duration of 75 years. On average, the full lifespans of the casks in the dataset amounted to approximately 234 years.

Production phase

The production phase of casks was analyzed in two separate studies. The first, presented in Chapter 3, focuses on the provenance of the timber found in Dutch archaeological contexts and its diachronic development. The aim of this sub-study was to gain insight into the import of coopers' timber and to determine what proportion of the casks were produced in the Netherlands. For this research, a dataset was compiled consisting of 357 casks, of which one or more components were successfully analyzed dendrochronologically.

The analysis revealed seven provenance areas of coopers' timber: the Rhineland, the Meuse Valley, the North German Plain, the Baltic region, Poland, France, and Burgundy/Loire Valley. These areas are represented in varying proportions in the casks studied, showing a clear diachronic development. Until around 1500, timber from the Rhineland and the Meuse Valley dominated, indicating transport via the major rivers. From the Early Modern period (1500–1700) onwards, sea transport increased, with timber from the Baltic region and the North German Plain playing a greater role in Dutch coopering.

To determine whether casks were actually produced in the Netherlands, timber from multiple provenance areas within a single cask was examined. Notably, combinations of Polish and Baltic timber were often found in casks, indicating timber import and assembly in the Netherlands. Additional archival research, including records from 38 Dutch coopers' guilds, confirms that there was indeed significant cask production within the Netherlands during this period.

The second sub-study of the production of casks, presented in Chapter 4, focuses on the subsequent steps in the production of casks in the Netherlands. It explores the multifaceted history of the coopers' craft in relation to broad urban, economic, and technological developments in the Late Middle Ages and Early Modern period. Special attention is given to the role of coopers' guilds, which played a central role in organizing cask production. The structure of these guilds, the number of members per guild, and the various roles within them are discussed in detail.

In addition, the step-by-step production process of a cask is discussed, using 3D scans of casks from archaeological contexts to visualize technical aspects. Finally, research was conducted into the price of a cask and the composition of that price, in order to gain a better understanding of the economic value of casks during the research period.

Use as transport container

The sub-study of the use of casks as transport containers, presented in Chapter 5, focused on the characteristics of the two most common cask types produced in the Netherlands: beer casks and herring casks. Central to the analysis were the distinguishing features of these casks, including capacity, dimensions, number of staves and headboards, stave thickness, number of hoops, timber used, and the types of holes. The research was primarily based on written sources, gauging instruments from museum collections, and iconographic material, with archaeological data used for verification.

The sub-study revealed clear distinctions between beer casks and herring casks, both in their physical characteristics and in the degree of regulation regarding these characteristics. Herring casks from Holland had a standardized volume of 120 liters, which was strictly enforced, likely due to the international reputation of quality herring from Holland, which was protected by interested parties. Beer casks, by contrast, showed much more variation: their capacity differed by city and time period, which was related to the local nature of the beer trade and the absence of centrally prescribed specifications for beer-cask capacity.

Repurposing

The sub-study of the repurposing phase was designed as a case study and focuses on three large-scale excavations in Vlissingen: the Groote Markt, Spuistraat, and Dokkershaven. The results are presented in Chapter 6 and are based on a dataset of 226 casks that were repurposed as linings for cesspits or water wells. The case study examined the influence of three factors on the choice between cask or brick lining: soil conditions, economic considerations, and the availability of casks. Each of these factors could play a role in decisions whether to repurpose casks as a practical and cost-effective solution or to use bricks for the construction of cesspits and water wells.

The analysis showed that variation in soil conditions in Vlissingen had no clear impact on the use of casks as shaft linings. The hypothesis that unstable ground would more often lead to the choice of a cask-lining due to their quick and safe handling, was not supported by the data. However, the financial means of the property owner did play a role: cask shafts were significantly more common on plots owned by individuals with below-average financial means, suggesting a preference for this more affordable construction option.

Additionally, the availability of casks was likely an important factor. An exceptionally high number of cask-lined cesspits and water wells were found in Vlissingen: 86% of the cesspits and 55% of the water wells were constructed with casks. Only the Dutch city of Dordrecht shows comparable percentages. Since both cities served as trans-shipment ports, there was probably a larger supply of used casks that could be repurposed as building material.

Cask marks

An important sub-study within this dissertation is dedicated to cask marks. This sub-study aimed to achieve a comprehensive understanding of these marks by exploring several key aspects: first, to determine the intended purpose behind the application of the marks; second, to identify the specific phase within a casks' lifecycle when a mark was applied; and third, to clarify the role or function of the individual or group responsible for marking the casks. Based on these objectives, a typology was developed, based on the cask marks' intended functions. This typology, along with the supporting analysis and reasoning, is presented in detail in Chapter 7. During this research, the analysis of cask marks from the shipwreck *Burgzand Noord 4* (BZN4) unexpectedly led to the highly probable identification of the wreck as the ship *'t Hart*. This discovery resulted in an additional, initially unplanned case study—research on BZN4 and *'t Hart*—presented in Chapter 8.

The sub-study that led to the development of a typology for cask marks began with the creation of a dataset containing 1,021 cask marks from archaeological contexts. These were supplemented with an additional 880 cask marks from written sources that were combined in the publicly accessible Database WOODAN Cask Marks (www.woodancaskmarks.org). Initially, the most distinctive characteristics of the cask marks were identified. These consist of the design, the method of application, and the marks' location on the cask.

Based on the characteristics of cask marks, previous research, and information from written sources about the reasons for applying cask marks, a typology was developed. This typology includes a total of six main types and nine subtypes.

1. Production mark
    A. Construction mark
    B. Coopers' mark

2. Cask gauge mark
    A. Cask gauge approval mark
    B. Cask gauge rejection mark

3. Content gauge mark
    A. Content gauge approval mark
    B. Content gauge rejection mark

4. Identification mark
    A. Product identification mark
    B. Personal identification mark
    C. Corporate identification mark

5. Count mark

6. Content quantity mark

In the sub-study, the individual types were initially described based on information from written sources, supplemented by data from architectural-historical research and, in some cases, interviews with present-day coopers. The typology was then applied to the cask marks from archaeological contexts within the dataset. This process provided additional insights into the characteristics and use of the cask mark types and subtypes.

The second sub-study using cask marks as its starting point, focused on the analysis of marks recovered from the shipwreck *Burgzand Noord 4* (BZN4). One particular cask mark, consisting of the letters MSP, was found a total of four times on the wreck. This mark was successfully attributed to Matheus Sigismundus Pallak (1709–1767). Through this connection, targeted research into his trade relations was carried out using written sources, which revealed the frigate *'t Hart*, known to have sunk near Texel in 1751. The strong correspondence in both location and time period between the wreck of BZN4 and *'t Hart* led to the formulation of the hypothesis that BZN4 may, in fact, be the remains of the frigate *'t Hart*.

To test this hypothesis, a number of details were identified for further assessment. These included, for both BZN4 and *'t Hart*, the construction date, the ship's dimensions, its use as a merchantman, its equipment and cargo during the final journey, the geographical location of the shipwreck, and the date of its sinking.

Each of these details was then examined by comparing written source material on *'t Hart* with the maritime archaeological data from BZN4. This ultimately led to the conclusion that *'t Hart* was a very strong candidate for the identification of BZN4, marking the first time a merchantman has been identified in Dutch waters. Moreover, this study highlights the importance of research into cask marks, which can serve as a crucial link between written sources and archaeological data.

Chapter 9 presents the conclusion and focuses on answering the central research question of the dissertation. By combining the results of the various sub-studies and placing them within the context of previous research, an integrated understanding emerges of the lifecycle of casks in Dutch archaeological contexts. In addition, Chapter 9 briefly discusses the added value of an multidisciplinary research approach and outlines possible directions for future research, positioning this study as a foundation for further exploration.

Samenvatting

Samenvatting

Deze studie richt zich op vaten uit Nederlandse archeologische contexten uit de late Middeleeuwen en de Vroegmoderne tijd (1300-1800). In deze periode behoorden de Nederlanden tot de meest verstedelijkte regio's van Europa, met handel als belangrijkste drijvende kracht, waarbij vaten een centrale rol speelden. Het is dan ook niet verwonderlijk dat deze vaten veelvuldig worden aangetroffen bij archeologische onderzoek uitgevoerd in Nederland, met name bij stadskernonderzoek en het onderzoek naar scheepswrakken. Ondanks hun frequente voorkomen hebben *vaten* echter verrassend weinig wetenschappelijke aandacht gekregen. Dit gebrek aan gerichte studie valt grotendeels te verklaren door een onderschatting van hun interpretatieve waarde, die voortkomt uit een algemeen gebrek aan achtergrondkennis over deze artefacten.

Het in dit proefschrift gepresenteerde onderzoek beoogt hierin verandering te brengen, door middel van een reeks deelstudies gericht op vaten. Elke deelstudie is uitgewerkt aan de hand van een specifieke onderzoeksvraag en gebaseerd op separaat samengestelde dataset, waarin voornamelijk archeologische gegevens zijn opgenomen. Naast deze archeologische data is intensief gebruikgemaakt van geschreven bronnen om de onderzoekresultaten te contextualiseren en aan te vullen. Bovendien is dendrochronologische data op ruime schaal ingezet om aanvullende inzichten te verkrijgen in herkomst en datering.

In hoofdstuk 1, de inleiding, wordt de centrale onderzoeksvraag geformuleerd: *What do casks from Dutch archaeological contexts from 1300 to 1800, examined through an interdisciplinary analysis, reveal about their lifecycle (production, use, and repurposing)?* Uit deze centrale onderzoeksvraag, en de in hoofdstuk 1 beschreven onderzoeksopzet, blijkt dat de levenscyclus van vaten centraal staat bij het promotieonderzoek. Binnen deze levenscyclus zijn drie fasen te identificeren: de productie van het vat, het gebruik als transportcontainer, en het secundaire functioneren. Elk van deze is als een afzonderlijk onderzoeksthema in het proefschrift verwekt, samen met een vierde onderzoeksthema: tonmerken. Aangezien tonmerken niet exclusief aan een specifieke fase in de levenscyclus kunnen worden gekoppeld, zijn zij apart behandeld, na de chronologische bespreking van de overige thema's. Hieronder volgt per onderzoeksthema een beknopte samenvatting gegeven van de deelstudies, die elk in een afzonderlijk hoofdstuk van dit proefschrift zijn uitgewerkt.

Overkoepelende deelstudies

In hoofdstuk 1 worden, naast het theoretisch kader, de onderzoeksvragen en het onderzoeksontwerp, ook de belangrijkste functies van vaten uiteengezet. Daarbij wordt de grootschalige in gebruik name van vaten vanaf de Late Middeleeuwen vergeleken met de introductie van zeecontainers in de moderne wereldhandel.

Hiermee wordt geïllustreerd hoe de wijze van verpakken en transporteren van goederen en levensmiddelen invloed kan uitoefenen op de ontwikkeling van handelsnetwerken, zowel op de handelsnetwerken van de afgelopen zestig jaar als die uit de late Middeleeuwen en Vroegmoderne tijd. Zowel de grootschalige ingebruikname van vaten als de zeecontainer maakten deel uit van een reeks fundamentele transformaties in het internationale handelsverkeer, die hebben geleid tot een aanzienlijke verlaging van transportkosten en een groeiende specialisatie van handelsmarkten. Deze veranderingen beïnvloedden niet alleen de handelspraktijken, maar ook haven- en scheepvaartinfrastructuur: schepen werden groter, havens werden verdiept en uitgebreid, en er werden kranen geïnstalleerd om het laden en lossen te optimaliseren.

Een belangrijk verschil tussen vaten en zeecontainers is de conserverende functie van vaten. Door hun vermogen om goederen af te schermen van zonlicht en lucht, verlengde het verpakken in vaten de houdbaarheid van producten aanzienlijk. Deze eigenschap was essentieel voor de ontwikkeling van late middeleeuwse en vroegmoderne handelsnetwerken, omdat zij langere opslagperioden mogelijk maakte. Daardoor konden producten over grotere afstanden worden verhandeld, wat leidde tot verdere regionale specialisatie in de productie van levensmiddelen.

In hoofdstuk 2 staat de levenscyclus van het vat centraal, met daarbij specifieke aandacht voor de gemiddelde levensduur van een vat. Deze levensduur is onderverdeeld in verschillende opeenvolgende fasen: de productie van het kuipershout, de verwerking van het kuipershout tot vaten, het gebruik als transportcontainer, en ten slotte het secundaire gebruik. Voor dit onderzoek is een uitgebreide dataset samengesteld van 464 vaten die dendrochronologisch zijn geanalyseerd. De gegevens zijn afkomstig uit maritiem archeologisch onderzoek, waarin vaten vooral zijn teruggevonden in hun oorspronkelijke rol als transportcontainer. Daarnaast zijn gegevens verzameld bij stadskernonderzoek, waar vaten in hun secundaire functie werden aangetroffen, als schachten van beer- en waterputten.

De analyse van de dataset laat zien dat de houtproductiefase van het kuipershout een mediaan kende van 150 jaar, gerekend vanaf de groei van de oudste boomring tot het moment van kappen. Na het kappen volgde een droog- en transportfase van ongeveer drie jaar, waarin het hout naar de kuiperijen werd vervoerd. Eenmaal aangekomen bij de kuipers, werd het hout in circa zeven weken verwerkt tot vaten. Deze periode omvatte zowel het aanvullende drogen van het hout als het daadwerkelijke productieproces. Het primaire gebruik van de 464 vaten uit de dataset als transportcontainer kende een mediaan van zes jaar. Aansluitend volgde een fase van secundair gebruik, waarin de vaten 75 jaar dienst deden als schacht van een beer- of waterput. Bij elkaar opgeteld komt de levensduur van de vaten uit de dataset uit op 234 jaar.

Productie fase

De productiefase van vaten is onderzocht in twee afzonderlijke deelstudies. De eerste, gepresenteerd in hoofdstuk 3, richt zich op de geografische herkomst van het hout dat in Nederlandse archeologische contexten is aangetroffen en op de diachronische ontwikkeling daarvan. Doel van deze studie was om inzicht te krijgen in de import van kuipershout en om te bepalen welk aandeel van de vaten daadwerkelijk in de Nederlanden is geproduceerd. Voor dit onderzoek werd een dataset samengesteld van 357 vaten, waarvan één of meerdere onderdelen met succes dendrochronologisch zijn geanalyseerd.

Uit de analyse kwamen zeven veelvoorkomende herkomstgebieden van kuipershout naar voren: het Rijnland, de Maasvallei, de Noord-Duitse laagvlakte, het Baltische gebied, Polen, Frankrijk en de Bourgogne/Loirevallei. Deze gebieden komen in wisselende verhoudingen voor in de onderzochte vaten, met een duidelijke diachronische ontwikkeling. Tot circa 1500 domineerden het hout uit het Rijnland en de Maasvallei, wat wijst op aanvoer via de grote rivieren. Vanaf de Vroegmoderne tijd (1500–1700) neemt de aanvoer via zee toe, met een grotere rol voor hout uit de Oostzee en de Noord-Duitse laagvlakte.

Om te achterhalen of tonnen daadwerkelijk in de Nederlanden werden geproduceerd, werd gekeken naar het voorkomen van hout uit meerdere herkomstgebieden in één ton, waarbij vooral combinaties van Pools en Baltisch hout in vaten werd aangetroffen. Dit wijst op houtimport en assemblage in de Nederlanden. Aanvullend archiefonderzoek naar onder andere 38 Nederlandse kuipersgilden toont aan dat er in deze periode daadwerkelijk sprake was van aanzienlijke productie van vaten binnen de Nederlanden.

De tweede deelstudie gericht op de productie van vaten, uitgewerkt in hoofdstuk 4, richt zich op de vervolgstappen in het productieproces van vaten in de Nederlanden. Hierin wordt de veelzijdige geschiedenis van het kuipersambacht onderzocht in relatie tot bredere stedelijke, economische en technologische ontwikkelingen tussen de Late Middeleeuwen en de Vroegmoderne tijd. Bijzondere aandacht gaat uit naar de rol van de kuipersgilden, die centraal stonden in de organisatie van de productie van vaten. De structuur van deze gilden, het aantal leden per gilde en de verschillende functies binnen de gilden worden in detail besproken.

Daarnaast wordt ingegaan op het stapsgewijze productieproces van een vat, waarbij ook 3D-scans van tonnen uit archeologische contexten zijn gebruikt om technische aspecten te visualiseren. Tot slot is er onderzoek gedaan naar de prijs van een vat en de opbouw van die prijs, om zo meer inzicht te krijgen in de economische waarde van vaten binnen de onderzoeksperiode.

Het gebruik als transportcontainer

Het onderzoek naar de inzet van vaten als transportcontainers, uitgewerkt in hoofdstuk 5, richtte zich op de eigenschappen van de twee meest geproduceerde vattypen in de Nederlanden: bier- en haringvaten. Centraal stonden de onderscheidende eigenschappen van deze vaten, zoals capaciteit, afmetingen, aantal duigen en bodemdelen, duikdikte, aantal hoepen, houtsoort en type gaten. De analyse baseerde zich vooral op geschreven bronnen, ijkinstrumenten uit musea en iconografisch materiaal; archeologische gegevens dienden ter verificatie.

Uit de studie bleek dat bier- en haringvaten duidelijk van elkaar verschilden, zowel in fysieke kenmerken als in de regulering van het verpakkingsmateriaal. Haringvaten uit Holland hadden een vaste inhoud van 120 liter en voldeden aan strikte voorschriften, vermoedelijk vanwege de internationale reputatie van Hollandse haring die onder toezicht stond van belangenorganisaties. Biervaten kende daarentegen veel meer variatie: de capaciteit van biervaten verschilde bijvoorbeeld per stad en periode, wat samenhing met de lokale reputatie van bier en het ontbreken van centrale voorgeschreven specificaties voor de capaciteit van biervaten.

Het secundaire functioneren

Het deelonderzoek naar de secundaire functie van vaten is opgezet als een casestudy en richt zich op drie grootschalige opgravingen in Vlissingen: de Groote Markt, Spuistraat en Dokkershaven. De resultaten zijn uitgewerkt in hoofdstuk 6 en gebaseerd op een dataset van 226 vaten die als schacht van beer- of waterputten secundair zijn gebruikt. In het onderzoek is specifiek gekeken naar de invloed van drie factoren op de keuze voor houten of juist bakstenen schachten: de bodemgesteldheid, de financiële investering die met putaanleg gepaard ging, en de beschikbaarheid van vaten. Elk van deze aspecten kon bijdragen aan de beslissing om gebruikte vaten in te zetten als praktische en goedkope oplossing bij de aanleg van beer- of waterputten.

Uit de analyse bleek dat variatie in de bodemgesteldheid in Vlissingen geen duidelijke invloed had op het gebruik van vaten als schachten. De hypothese dat instabiele grond vaker zou leiden tot de keuze voor vaten vanwege hun snelle en veilige verwerkbaarheid, werd niet door de data ondersteund. Wel speelde de financiële draagkracht van de perceeleigenaar een rol: tonnen als schachten kwamen beduidend vaker voor op percelen van eigenaren met een beneden gemiddelde financiële middelen, wat wijst op een voorkeur voor de goedkopere constructie-optie.

Daarnaast was de beschikbaarheid van vaten vermoedelijk een belangrijke factor. In Vlissingen werden uitzonderlijk veel vatschachten aangetroffen: 86% van de beerputten en 55% van de waterputten waren opgebouwd uit vaten. Alleen Dordrecht vertoont vergelijkbare percentages. Aangezien beide steden fungeerden als doorvoerhavens, was er waarschijnlijk een groter aanbod van gebruikte vaten, die vervolgens als bouwmateriaal hergebruikt konden worden.

Tonmerken

Een belangrijk deelonderzoek binnen dit proefschrift richt zich op *ton*merken. Dit onderzoek had als doel inzicht te verkrijgen in deze merken door verschillende kernaspecten te onderzoeken: allereerst het vaststellen van het beoogde doel achter het aanbrengen van de merken; ten tweede het identificeren van de specifieke fase in de levenscyclus van het vat waarin de merken zijn aangebracht; en ten derde het verduidelijken van de rol of functie van de persoon of groep die verantwoordelijk was voor het aanbrengen van de merken. Op basis van deze doelstellingen is een typologie ontwikkeld, waarbij de *ton*merken zijn ingedeeld naar hun beoogde functie. Deze typologie, samen met de onderliggende analyse en motivering, wordt uitvoerig behandeld in hoofdstuk 7 van het proefschrift. Tijdens dit onderzoek leidde de analyse van *ton*merken afkomstig van het scheepswrak Burgzand Noord 4 (BZN4) onverwacht tot de zeer waarschijnlijke identificatie van het wrak als het schip 't Hart. Deze ontdekking resulteerde in een aanvullende, aanvankelijk niet voorziene deelstudie. Het onderzoek naar BZN4 en 't Hart is opgenomen in hoofdstuk 8.

De deelstudie die leidde tot de ontwikkeling van een typologie voor tonmerken werd gestart met het opzetten van een dataset van 1021 tonmerken uit archeologische context. Deze werden aangevuld met 880 tonmerken uit geschreven bronnen en gezamenlijk verwerkt in de online toegankelijke Database WOODAN Cask Marks (www.woodancaskmarks.org). In eerste instantie zijn de meest onderscheidende kenmerken van tonmerken geïdentificeerd. Deze bestaan uit het ontwerp, de methode van aanbrengen en de locatie op het vat waar het merk is aangebracht.

Op basis van de karakteristieken van tonmerken, eerder uitgevoerd onderzoek en gegevens uit geschreven bronnen over de doeleinden van het aanbrengen van tonmerken, is een typologie opgesteld. Deze typologie omvat in totaal zes hoofdtypen en negen subtypen, namelijk:

1. Productiemerk
    A. Constructiemerk
    B. Kuipersmerk

2. Ton ijkmerk
    A. Ton ijk-goedkeurmerk

B. *Ton* ijk-afkeurmerk

3. Inhoud ijkmerk
    A. Inhoud ijk-goedkeurmerk
    B. Inhoud ijk-afkeurmerk

4. Identificatiemerk
    A. Product identificatiemerk
    B. Persoonlijk identificatiemerk
    C. Bedrijf identificatiemerk

5. Telmerk

6. Inhoud kwantificatiemerk

In de deelstudie zijn de afzonderlijke (sub)typen in eerste instantie beschreven op basis van gegevens uit geschreven bronnen, aangevuld met informatie uit bouwhistorisch onderzoek en interviews met hedendaagse kuipers. Vervolgens is de opgestelde typologie toegepast op de tonmerken uit archeologische context in de WOODAN Cask Mark dataset. Dit leverde aanvullende inzichten op in de eigenschappen en toepassing van de betreffende (sub)typen tonmerken.

De tweede deelstudie met tonmerken als uitgangspunt richt zich op de analyse van tonmerken afkomstig van het scheepswrak Burgzand Noord 4 (BZN4). Het tonmerk bestond uit de letters MSP, die in totaal vier keer op het wrak werden aangetroffen en kon worden gekoppeld aan Matheus Sigismundus Pallak (1709–1767). Via deze connectie kon gericht onderzoek worden gedaan naar zijn handelsrelaties aan de hand van geschreven bronnen, waarbij het fregatschip *'t Hart* naar voren kwam, dat in 1751 bij Texel is vergaan. De sterke overeenkomsten in zowel locatie als tijdsperiode tussen het wrak van BZN4 en *'t Hart* leidden tot de formulering van de hypothese dat BZN4 mogelijk de resten zijn van het fregatschip *'t Hart*.

Om deze hypothese te testen, zijn in eerste instantie een aantal specifieke elementen geïdentificeerd die nader onderzocht moesten worden. Deze betreffen zowel voor BZN4 als voor *'t Hart* de bouwdatum, de afmetingen van het schip, het gebruik als koopvaardijschip, de uitrusting en lading tijdens de laatste reis, de geografische ligging van het scheepswrak en de datum van het vergaan.

Elk van deze elementen is vervolgens onderzocht door de gegevens uit geschreven bronnen over *'t Hart* te vergelijken met de maritiem-archeologische data van BZN4. Dit leidde uiteindelijk tot een zeer waarschijnlijke identificatie, waarmee het eerste koopvaardijschip in Nederlandse wateren is geïdentificeerd. Deze bevinding benadrukt bovendien het belang van onderzoek naar tonmerken, die een brugfunctie kunnen vervullen tussen historische en archeologische gegevens.

Hoofdstuk 9 bevat de conclusie en richt zich op het beantwoorden van de centrale onderzoeksvraag van het proefschrift. Door de resultaten van de verschillende deelstudies te combineren en te plaatsen binnen de context van eerder uitgevoerd onderzoek, ontstaat een geïntegreerd inzicht in de levenscyclus van vaten uit Nederlandse archeologische context. Daarnaast wordt kort ingegaan op de meerwaarde van een multidisciplinaire onderzoeksmethode en worden mogelijke vervolgstappen in toekomstig onderzoek besproken, waarbij dit promotieonderzoek als uitgangspunt kan worden beschouwd.

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About the author

Jeroen Oosterbaan was born in Nijmegen, the Netherlands, on February 18, 1980. After completing primary and secondary school in Nijmegen, he attended the HEAO in Utrecht. Following the completion of his propaedeutic year, he began a Bachelor's program in Archaeology and Prehistory, specializing in Mediterranean Archaeology, at the *Universiteit van Amsterdam* in 2001. As part of this program, he completed a minor at the *Università degli Studi di Bologna* in Bologna, Italy, during the 2003–2004 academic year. After graduating in 2004, he continued with a Master's degree in Prehistory at the *Vrije Universiteit Amsterdam*, which he completed in 2007.

During his Master's degree, Jeroen Oosterbaan began working in 2006 as an archaeologist for the municipal archaeological service of Nijmegen (the Netherlands). In this role, he gained extensive experience in conducting large-scale archaeological excavations, focusing primarily on the Roman period, a specialization he maintained until the end of 2010.

In 2011, he joined Archaeological Research & Consultancy B.V. (ARC B.V.) as a project leader. There, he led several large-scale projects, including a major excavation at the site known as *Groote Markt* in Vlissingen (The Neherlands). This excavation yielded a large number of *casks*, which he personally analyzed as project leader. His analysis revealed a significant knowledge gap regarding these transport containers, sparking the idea for further research into this subject. In addition, his work at ARC B.V. provided him with extensive experience in excavating and interpreting sites from the Late Medieval and the Early Modern periods. This exposure led to a growing interest in these time periods, in which he has since built up substantial expertise.

After the bankruptcy of ARC B.V. in 2013, Jeroen Oosterbaan started working as a freelance archaeologist, carrying out assignments for various companies and municipalities. In this capacity, he gained additional experience and developed further expertise, particularly in the Late Medieval and Early Modern periods. Since 2014, he has combined this fieldwork with a part-time position as a lecturer and researcher in the Archaeology program at *Saxion Hogeschool*, where he remains employed to this day.

As a lecturer and researcher at an university of applied sciences, there is the possibility to apply for a grant called the *Promotiebeurs voor leraren* (PhD Grant for Teachers) at the *Nederlandse Organisatie voor Wetenschappelijk Onderzoek* (NWO, Netherlands Organization for Scientific Research). This grant enables candidates to conduct PhD research at a university and aims primarily to reduce the gap between universities and the rest of the Dutch education system. In this role, PhD candidates act as a bridge between these two educational sectors.

After applying for and receiving this grant, Jeroen's appointment began on September 1, 2019. As a result, his position at Saxion University of Applied Sciences changed to a combined role within the Archaeology program and the Sustainable Areas and Soil Transitions (SAST) research group. Since 2021, Jeroen Oosterbaan has also been involved in the research project Constructing the Limes (C-Limes) as a researcher. This project, which focuses on the functioning of borders in general and specifically on the Roman imperial border in Northwest Europe, is scheduled to conclude in 2026.

Currently, Jeroen Oosterbaan holds multiple roles: he works as a lecturer-researcher at Saxion University of Applied Sciences, serves as a researcher for the C-Limes project, operates as an independent archaeologist, and pursues a PhD at Leiden University, with this thesis representing the completion of his doctoral research.

List of publications

Accepted peer-reviewed publications

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Main other publications

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Database WOODAN Cask Marks (2024). University of Leiden. Available online at: www.woodancaskmarks.org.

Appendix

The datasets and related articles have all been deposited in the DANS Data Station Archaeology under the title The Lifecycle of Casks and are accessible via the following DOI: https://doi.org/10.17026/AR/IUWWEC.