The domestic sphere of the Corded Ware Culture: a functional analysis of the domestic implements of three Dutch settlements

García Diaz, V.

Citation

García Diaz, V. (2017, February 23). *The domestic sphere of the Corded Ware Culture: a functional analysis of the domestic implements of three Dutch settlements*. Retrieved from https://hdl.handle.net/1887/46262

Author: García, Diaz V.
Title: The domestic sphere of the Corded Ware Culture: a functional analysis of the domestic implements of three Dutch settlements
Issue Date: 2017-02-23

Chapter 3. Theory and methods

3.1 Introduction

This chapter is structured in two sections. First, the main theoretical concepts underlying the study and interpretation of artefacts from CWC domestic contexts are discussed. Tools and ornaments from domestic contexts are important components of the daily practices of prehistoric communities. In this chapter, I argue that tools from domestic contexts are: a material representation of the way(s) CWC populations perceived their landscape; transmitters of social traditions and rules; and a reflection of the main economic activities performed in the settlements. The second section of this chapter describes the methodology. The study of the CWC technological system entails the analysis of the different stages in the life-cycle of an object: the selection of the raw material, the technology used to produce the object, the way(s) it was used and its final discard. The analysis of the interconnected `*chaîne opératoires*' objects were involved in will provide a better understanding of the domestic organization of technology.

3.2 Knowledge, narratives and learning processes

Learning is a basic human action that continues throughout one's entire life. Through constant learning processes we not only achieve knowledge about the basic activities of daily life, such as walking and talking, but learning also includes more complex activities, such as the production of tools, engagement in social networks or the decoding of symbols. As humanity is linked with knowledge, knowledge is related to learning. Consciously or unconsciously, it is through teaching and learning that knowledge is transmitted.

An important component is done through physical perception, for the most part while the individual's capacity for verbal communication is limited (infancy). The physical senses act as a way to recognize the non-verbalized images (for example objects, animals or people) (Tehrani and Riede 2008). It is also through the physical senses that the first connections between the individual and the community – more specifically with the nuclear family – are made. However, another important part of the learning processes is the one taking place within the group. Perception is a biological quality of a new-born, considered part of the human capacity to understand and interpret the world in which they live. However, some sociological studies have proven that perception is also altered and determined by social context and group influence (Chapman and Gearey 2000; Ingold 2000a, 2011; Johnston 1998; Pink 2010).

At the same time, during the learning processes, the group transmits and maintains cultural traits through the so-called '*narratives*' (Zerubavel 2003: 5). These narratives refer to every aspect of social life: space, time, the individual, the community and the material culture. Narratives connect time and space within different generations of a community through foundational myths, they justify the individual role inside the community and they provide meaning to objects, places and social acts (Bender *et al*. 2007; Högberg 2006; Pearce 1994). Origin myths are a fundamental part of these narratives and have been recorded frequently by anthropologists and sociologists in different kinds of societies (Bourdieu 1973, 1994; Levi-Strauss 1973). Another important part of these narratives is the '*unconscious*' norms of behaviour implied in each individual action. Through narratives, life acquires meaning for individuals. Narratives are similar to what Hobswam calls '*invented traditions*' (Hobsbawm 1996: 1), defined as '*a set of practices, normally governed by overtly or tacitly accepted rules and of a ritual or symbolic nature, which seek to inculcate certain values and norms of behaviour by repetition, which automatically implies continuity with the past*' (Hobsbawm 1996: 1). Thus, knowledge is related to power or, as proposed by Foucault, '*knowledge works as a form of power and disseminates the effects of power*' (Foucault 1980: 69). This is what has been referred as 'mutual knowledge' (Giddens 1984: 4). Mutual knowledge allows a social group to 'go on with the routines of social life' (Giddens 1984: 4). It is the sum of what is known by the community, acquired through experience and practice, but also through narratives and memory.

But how can mutual knowledge be studied from an archaeological perspective? Some authors (Bourdieu 1973, 1994; Zerubavel 2003) have suggested that it is through daily routines that this knowledge is acquired and transmitted. During the early stage of life, children repeat activities, learn gestures, and integrate taboos and traditions which would be part of what defines them as part of the group, and that will be memorised, or even `embodied' (Zerubavel 2003; Hodder and Cessford 2004), to be transmitted generation after generation. Therefore, to study the mutual knowledge of a society, it would be important to understand how these daily routines were structured, organised and performed. From an archaeological point of view, the material result of this daily knowledge is what will be interesting to understand the organization of society. In some cases, this mutual knowledge has been investigated from the interaction between individuals and their landscape and the houses (Hodder and Cessford 2004; see next section). Other possibility is to study the material culture that was used during these daily practices. Some scholars (Dobres 1995, 2009; Dobres and Hofman 1994; Miller 2009) have argued for the active role that material culture holds on the creation and maintenance of the community. Material culture is the receptor and also the generator of social rules, norms, and processes of symbolic engagement that contribute to the creation of the social group (Dobres 1995, 2009; Dobres and Hofman 1994; Miller 2009). Therefore, the study of prehistoric technology facilitates an understanding of the society (Soressi and Geneste 2011). However, technology should be understood not only as the production of the implements itself but also as all the processes that involved the life of a tool, the entire `*chaîne opératoire*' (Pelegrin *et al*. 1988).

The production and use of implements was made possible thanks to the acquisition of knowledge, and implements were made by people who learned from other people how to produce new implements. Ethnographically, the importance of knowledge acquisition and transmission during daily activities has been extensively documented, as for example in the case of querns (Adams 1998, 1999, 2010; Hayden 1989), the production of stone tools (Arthur Weedman 2000, 2010, 2013; Stout 2002), the transmission of pottery style (Bowser and Patton 2008; Gosselain 2000, 2008), hide production (Beyries 2002; Frink and Arthur Weedman 2005), pastoral activities (Crabtree 2006) and basketry (Hurcombe 2006, 2008). Although it is difficult to prove archaeologically, some researchers have suggested that individual *gestes* can be deciphered through the analysis of lithic implements (Bamforth and Finley 2008; Ploux 1984). Therefore, the role of individuals with little knowledge of flint knapping, such as children, could be discerned (Finlay 1997; Högberg 1999, 2008; Stapert 2007; Sternke and Sörensen 2007). The imitation and observation of technological processes was a means to transmit and learn technical knowledge within the domestic context. Therefore, while cooking, hunting, fishing, producing implements and performing other daily activities, knowledge on which material was better for specific activities, on how tools were produced and maintained, on how wild animals were to be found was transmitted and embodied by the individuals. This technical knowledge was related to all the spheres of social life and, of course, implied a high level of knowledge related to landscape and the natural environment where the community was living.

3.3 Landscape

Time and space act as frameworks for '*mutual knowledge*' through the so-called '*narratives*' (Bender *et al.* 2007; Högberg 2006). Through '*invented traditions*' the community generates a present that it is linked with a past and a future. The link with the past is supported by the foundational myths and is made concrete through a connection to the ancestors (burial rituals), the reutilization of artefacts and the '*construction*' of the landscape. Archaeologically, different authors suggest the use of the natural elements of the landscape such as trees, rocks, hills or flows of water as a way of generating the social cohesion (Bradley 1998; Cummings 2003; Cummings and Whittle

2003; Evans *et al*. 1999; Pollard and Gillings 1998; Richards 1996a, 1996b; Tilley 1996). Geological and geographical elements, vegetation, animals and the cycle of climatic seasons all have physical components that were perceived and interpreted by prehistoric societies. And perception, as already discussed, is altered and determined by the social context of the individual (Chapman and Gearey 2000; Ingold 2000a, 2011; Johnston 1998; Pink 2010) through, for example, the act of remembering. Memory, in addition to narratives, works as a link between the past and the present (Zerubavel 2003: 13). Group's memory acquisition identify individual with the collective past and `*familiarizing members with that past is a major part of communities' efforts to assimilate them*' (Zerubavel 2003: 3). Through memory and perception landscape was interpreted by individuals as part of their `collective memory' (Zerubavel 2003: 3), identifying their physical surroundings (diverse geological sources, rivers, plants and animals), with `reliable locus of memories' (Zerubavel 2003: 41) and generating a deep `sense of permanence' for the individuals and a `historical continuity' of the group (Zerubavel 2003: 41). In addition, prehistoric groups were surrounded by geographical features so on the other hand, the landscape is always modified and the new situation acquires a meaning and starts to form part of the new narratives (Bender et al. 2007). In this sense, the work of several authors interpreting megalithic tombs and dwelling spaces as social markers is relevant (Bender *et al*. 2007; Chapman 1995; Hodder 1991; Patton 1993). Therefore, the landscape is used not only as recipient of knowledge but also as a generator of it. Following Bourdieu (1973), the space, or '*habitus*', is a system of dispositions that includes not only a '*way of being*' but also the '*result of an organizing action*' of being (Bourdieu 1973: 214).

Language, oral myths and tales, legends and rituals worked as tools to transmit information related to landscape. And, again, it is during the daily practices of the group that this information was exchanged. Material culture can be also used from an archaeological point of view to study how the use of the landscape was structured by prehistoric communities. As already discussed, material culture is a reflection of `communal knowledge' and plays a role in the generation of it. In this sense, the selection of specific raw materials is, in the first place, an expression of the location of a particular settlement within the wider landscape. However, it also reflects the learning processes and the transmission of knowledge from one generation to another. The use of a specific type of flint and stone, then, will work as tokens for the individuals. Through their use as implements, they become `portable relics' (Zerubavel 2003: 43), storing technical memories and helping to create a physical continuity between different generations. Again, learning processes and daily practices were fundamental to answer the question of how this `collective memory' and `communal knowledge' were generated.

The lack of information on domestic settlements until the last half of the twentieth century prevented a systematic analysis of the landscape in which they were situated. However, several pollen studies have been performed on samples from barrows and graves. These studies showed that barrows were located in an open space (Casparie and Groenman-van Wateringe 1980; Doorenbosch 2013; Waterbolk 1954). In the case of the Corded Ware communities, the barrow landscape has recently been interpreted as part of the collective material culture, through the creation of a specific landscape composed by mounds of land covering the ancestors (Bourgeois 2013). The barrows studied were mostly placed on heath, although forest was also part of the barrow landscape (Doorenbosch 2013). The barrow landscape was created by the Corded Ware people, but evolved over time, changing in spatial distribution and in social meaning (Bourgeois 2013; Doorenbosch 2013). The analysis of the CWC landscape through the analysis of the distribution of the mortuary monuments provided significant information about the use and perception of the landscape (Bourgeois 2013; Doorenbosch 2013).

After the excavations of the settlements from the CWC in the wetland areas of the North-Holland province, a preliminary analysis of the landscape through the study of botanical and palynological samples taken during the excavations was performed (Van Heeringen and Theunissen 2001). In addition, a more complete analysis of the domestic use of the landscape by the CWC is available in the recently published monographs of Keinsmerbrug (Smit *et al.* 2012), Mienakker (Kleijne *et al.* 2013) and Zeewijk (Theunissen *et al.* 2014). New analysis of botanical and faunal remains offered further insights regarding the perception and use of the landscape by the Corded Ware communities. The Noord-Holland Corded Ware settlements were located on the large tidal basins of West-Friesland. The tidal basins started to silt up between 4500 and 4000 BC as a result of sea level rise, and became habitable around 2900-2800 BC. Beach barriers developed at the beginning of the third millennium BC, resulting in a more closed coastline. As a result, peat started to grow. Between 3200 and 2900 BC, the shoreline was almost completely closed and a lagoon formed, which was active for at least two centuries. At the end of this period, the landscape was characterized by a combination of different ecological zones. Finally, from 2900 to 2250 BC, two branches of the large tidal channel developed, forming a brackish marsh environment, protected at the west border by a complex of beach barriers and connected to the sea by an open water system (Smit 2012). The Late Neolithic settlements, which flourished in this system, exploited the various ecological niches.

The analysis of the material culture from the three sites studied formed an opportunity to better understand how the corded Ware groups interacted and used the surrounding landscape. Through the identification of the different resources used in the settlements, it is possible to identify different areas of exploitation, assessing the degree of knowledge and experience required for the exploitation and use of some resources. The use and recurrence of the space and the raw material could also be suggesting the symbolic importance of the landscape for the prehistoric communities, which formed part of the `collective memory' of the society.

In addition, the reinterpretation of existing house plans and the discovery of new ones (Kleijne *et al*. 2013; Nobles 2012a, 2012b, 2013a, 2013b, 2014a, 2014b) provided a fresh opportunity to understand the relationship that Corded Ware groups had with their landscape. During the 1990s, a new approach to the dimension of the landscape was taken, based on the idea that the social and symbolic dimensions of the landscapes were to be found in the remains of everyday life (Bruck and Goodman 1999; Gerritsen 1999, 2001; Parker Pearson and Richards 1994). Dwellings began to be considered as a way of creating a link between the landscape and the society, a way of constructing a landscape (Ingold 1993: 162). Houses were considered as the centre of the social organization, providing social identity to their occupants. Therefore, the material remains found at the excavations of the prehistoric dwellings constitute a physical remainder of the use of landscape by prehistoric groups and a reflection of the social organization and identity of these communities.

Figure 3.1. Actual landscape of the Noorth-Holland province (Image courtesy of Jeroen de Groot).

3.4 Craft production systems

An economic system can be defined by three interlinked components: distribution, consumption and production. The distribution component is related to when and by whom goods are consumed. In archaeology and anthropology, distribution is studied mainly from the point of view of exchange (Akerman *et al.* 2002; Cosmides and Tooby 1992; Costin 2011; Zvelebil 2006), whereas consumption is related to the use of the goods. Not only the production of tools but also their use is embedded in social norms and constrictions. Tools can be exploited in different ways, by different people. The way people use tools is heavily influenced by cultural knowledge transmitted from generation to generation, and changes in the use of implements can be related to fundamental changes in society linked with group composition, the legitimization of power and status, and gender beliefs (Costin and Earle 1989; Frink and Arthur Weedman 2005; Hurcombe 2006; Jordan and Mace 2008; Owen 2006; Sørensen 2006).

Crafting, or the production of goods, is not free from the *'narratives'* embedded in the social spheres of a group. In fact, the production of an implement is determined by the economic, social and political organization of the society. Prehistoric tools are a reflection of these spheres, and carry information about different domains of prehistoric societies (Costin 1998, 2001; Dobres 1995, 2009; Miller 2009; Schlanger 1994). Tools express the ideas, memories, political status and beliefs of a society (Costin 2005; Giddens 1984). Therefore, understanding the production of the tools, or the economic system in which they are involved, offers an avenue to understanding the social composition of a society.

The organization of production can be structured in several ways by a society and it varies *'across space and time'* (Costin 2005: 1036). Although several attempts have been made to classify production systems (Costin 1991, 2001), generally a distinction is made between a domestic mode of production and a specialized mode of production. Whereas in a specialized production system *'fewer people make a class of objects than use it'* (Costin 2011: 276), a domestic mode of production implies that the production and consumption of tools is organized by and for the household (Shalins 1972: 100). The study of the organization of production, then, can answer two main questions referring to group composition: when and how the production occurs; and what the roles of the different agents of the society are in different productive activities. As it will be discussed in the next section, the production and use of tools are embedded in different technological systems (Lemonnier 1986, 1992). The study of cross-craft interactions, which can be understood as the process by which two or more crafts interact and the technological and social impact they have on each other (Brysbaert 2007: 328; Foxhall and Rebay-Salisbury 2009/2010: 3), is a way to understand the exchange and transmission of knowledge and materials (Brysbaert 2007: 326), how the technological daily practices of prehistoric groups were structured and which were their social relationships.

While studying the material culture associated with the daily practices of prehistoric groups, cross-craft interactions have to be taken into account. In fact, usually one or more crafts are linked and connected, as is the specific knowledge related to their work. For example, ethnographically it has been recorded that during the processing of crops, knowledge on the use and production of querns was also shared (Adams 1999, 2010; Dobres 1995; Hamon and Le Gall 2013). Therefore, different expertise and skills were shared by different people and, sometimes, even by different groups. Cross-craft interaction has been considered as `*one of the main drivers of innovation*' (Rebay-Salisbury *et al.* 2014: 3). While encountering other people, knowledge is shared and ways of doing things change and evolve (Lightfoot *et al*. 1998). The categories of groups may change and the use of implements may vary. Therefore, analysing how crafts interacted in prehistoric societies in general, and Corded Ware communities in particular, is a way to explore and comprehend which social networks existed, how technology was organised and how societies used material culture as a symbol of their identity. Some of these interactions took place inside of dwellings and houses. As already stated, house plans were reinterpreted and discovered during the NWO project and, thanks to the spatial analysis, it was possible to ascribe specific implements to specific spaces (Nobles 2012a, 2012b, 2013a, 2013b, 2014a, 2014b). Houses are not only an expression of the use of the landscape by prehistoric communities, but have also been regarded as the centre of social and economic production, reproduction and consumption (Allison 1999; Çevik 1995). Therefore, the analysis of material culture associated with domestic dwellings could provide information about the types of activities performed there, the existence of specialized areas of production and the function of the site more broadly.

3.5 The study of tools in archaeology

3.5.1 Typology, technology and chaîne opératoire

The use of categories can be understood as the definition and division of the world in small fragments for a better comprehension of reality. By doing that, things become meaningful for society (Zerubavel 1991: 5). In archaeology typology was used for relative dating of archaeological sites and stratigraphy. In fact, flint and pottery typology is still used as relative dating nowadays. Typological lists of flint tools were generated as a methodological aim for the study of lithic assemblages. The main proposals were the typologies created by F. Bordes (1950, 1961) and F. Bordes and D. Sonneville-Bordes

(1956, 1985) and the one created by G. Laplace (1954, 1957, 1964 and 1966). These lists were mainly oriented to Palaeolithic contexts through Europe and Asia. While Bordes' typology was based on the forms and shapes of lithic implements and their similarities , Laplace proposal intended to be an analytical typology introducing mathematical and statistical methods to eliminate the subjective aspect of other typological classifications (Arrizabalaga *et al.* 2014; Hermon and Niccolucci 2002). However, Bordes' typology was more widely accepted and used until the 1970's, when the arrival of more systematic dating methods, the introduction of Leroi-Gourham's concept of the *chaîne opératoire* (1964) and a change in paradigm that conceived material culture as part of social systems, changed the way tools were studied and understood.

Leroi-Gourham's concept of the *chaîne opératoire* (1964) offered a methodological approach to the ideas proposed by Mauss (1935), which considered technology and tools not only as a physical transformation of material, but also as a way to transmit social traditions (Dobres 1999: 127). Technology was understood as a reflection of social actions. Tools not only needed to be typologically classified, but their production process needed to be understood (Soressi and Geneste 2011; Terradas 2001; Tixier 1979; Tixier *et al*. 1980). The use of the concept of the *chaîne opératoire* since the 1970s has complemented and improved the use of the typological analysis that until then was the basis of archaeological studies (Bleed 2001). The use of the *chaîne opératoire* method enabled a better study of the economic practices and the social relations of a particular society, a better understanding of the relationship between people and their landscape, and a deeper insight in how knowledge and technical skills were embedded in the production of an implement (Pelegrin *et al*. 1988). The production of tools is defined by a succession of mental decisions and is 'marked' by a sequence of *gestes* that defines the entire process (Perlès 1987: 23). In addition, this production process is also determined by natural conditions (for example the geological distribution of the raw materials or the physical properties of materials). The basis of the *chaîne opératoire* is the conception of tool production as a sequence of different steps, from the selection of the raw material to the discard of the tools. The method considers the different steps taken in the production of a tool to be structured by an internal logic. The main steps are the raw material acquisition, the technical production of the tool, the use of the tool and its discard (Geneste 1989; Pelegrin 1990; Pelegrin *et al.* 1988; Sellet 1993; Terradas 2001; and for a review see Soressi and Geneste 2011).

Although the *chaîne opératoire* approach is still one of the methods widely used in prehistoric archaeology, there are some issues pertaining to its application. The first is related to the linearity and rigidity of the steps proposed by the method. Tools are produced using a technical system consisting of different technical sub-systems (Lemonnier 1986, 1992). For example, during the production of a flint knife the technological system involving the flint knapping will be related to the technological system applied to produce the wooden handle. Therefore, the tool could be used and discarded within a technical system, but reused within another. The steps followed during the production and use of an implement are not always rigid and predetermined, but rather imply an interconnectivity of different *chaînes opératoires.* Following the same example, the technological system of flint knife will be connected to the one related to the production of the wooden handle, which at the same time would be related to the flint implements used to produce it. The knife could be used to work different resources, as for example hide and bone, participating then in the different *chaînes opératoires*. Therefore, it is important to study all the steps of the production and use of an implement to understand all the technical systems the implement took part on. The second criticism deals with the assumption that the mental conception of the entire process is inside the brain of the flint knapper (Bar-Yosef and Van Peer 2009: 113-114). As suggested by ethnographic research, implements could be used as expected. However, some other tools could be produced or used in another ways, or never used (Holdaway and Douglass 2012). Again, *chaînes opératoires* have to be considered flexible, and tools have to be studied in their totality using different methodologies. In addition, it is necessary to contextualise the *chaînes opératoires* of single implements within the technical systems interpreted in the studied assemblage, and within the data obtained by other researchers.

3.5.2 Typology and functionality: form vs. function

From the point of view of functionality, typology also involved other implications. The implements classified typologically displayed not only formal, but also functional connotations. Retouched artefacts were instantly identified as "tools", while unmodified objects were not considered to have had a function. In addition, tool classification did not take into account the real functional role of the tool, as no use-wear analysis was performed, but the possible use was instead based on the tool shape. Therefore, borers were assumed to have been used to perforate and scrapers to scrape, but typology did not take into account the real use of the implement or the different processes the tool pass through (Pawlik 2009: 9).

The form vs. function problematic has been extensively addressed by use-wear analysis. The selection of specific implements for specific tasks has been indicated the use of scrapers for scraping activities during the Late Palaeolithic and Mesolithic, and the use of geometric microliths as projectile points during the Neolithic period. However, both ethnographic and archaeological studies have demonstrated that these assumptions are not always valid (see Shott 1986 and Gibaja 2006 for an extended discussion). In addition, the use of unretouched or unmodified implements has been indicated by use-wear analysis in several archaeological contexts (Gibaja 2006; Gueret 2013; Vaughan 1985; Van Gijn 1990). Furthermore, ethnographic studies show the use of both unmodified and retouched implements (Holdaway and Douglass 2012). However, the analysis of assemblages is still determined by the typological classification of the implements, and use-wear studies are, for the most part, focused on what is considered as a '*formal tool*'. As an example, and except notable exceptions (Van Gijn 1990), most of the use-wear analysis performed on TRB and Vlaardingen flint implements focused on retouched and formal tools (see Chapter 7). This selection is mainly determined by a low budget for the performance of use-wear analysis and by preconceived ideas about tool use. The main consequence is the lack of functional information for assemblages in which unretouched tools constitute more than 50% of the assemblage, and the impossibility to reconstruct the various *chaînes opératoires* and the role played by different types of implements in the several tasks carried out in the settlements. Besides, it is possible that the results of the use-wear analysis show a misrepresentation of the importance of the function of retouched implements on the site. Therefore, the selection and analysis of implements should be based on scientific analysis, which in practical terms entails a different sampling strategy of the assemblages under study that would be determined by the context of the archaeological site studied (Hayden 1998; Holdaway and Douglass 2012).

3.6 Towards an understanding of the tools of the domestic Corded Ware settlements: Methodology, datasets and sampled materials

In this thesis tools are understood both as the material reflection of the technological system of the prehistoric communities and as the carriers of social knowledge and practices. Therefore, understanding how these tools were produced and used is a very important step towards elucidating their function within the social system of the group that used them. In this thesis, and following the *chaîne opératoire* approach, the implements were studied taking into account the different steps in which they were involved: *raw material acquisition*. The study of raw material is important to obtain information on: how was the landscape exploited by the prehistoric groups; the existence of social networks used to exchange specific raw materials; technological and functional choices related to the use of a preferred raw material to produce specific tools; *technological practices used to produce the tools.* Technology is understood both as a physical transformation of material, but also as a way to transmit social traditions

(Dobres 1999: 127). Therefore, the typological description of the implements has to be accompanied by a technological study to understand the main methodology used to produce the tools; the preference for specific methods to produce specific tools; the interaction between technologies; the social networks existing between different communities and how knowledge was passed from one generation to another, or from one group to another;and to measure the technological degree of the groups; *the use of the implements* and *their discard.* The main methodology used in this thesis is use-wear analysis. Use-wear analysis is based on the idea that the contact between two different surfaces provokes physical alterations (Semenov 1981[1957]: 27-29). Use-wear analysis provides information about the type of activities performed at settlements reveals technological traits of tool production and, frequently offers evidence about the location of the production. Therefore, the study of the implements used and produced by the Corded Ware communities will enable us to gain a deeper understanding of their social composition

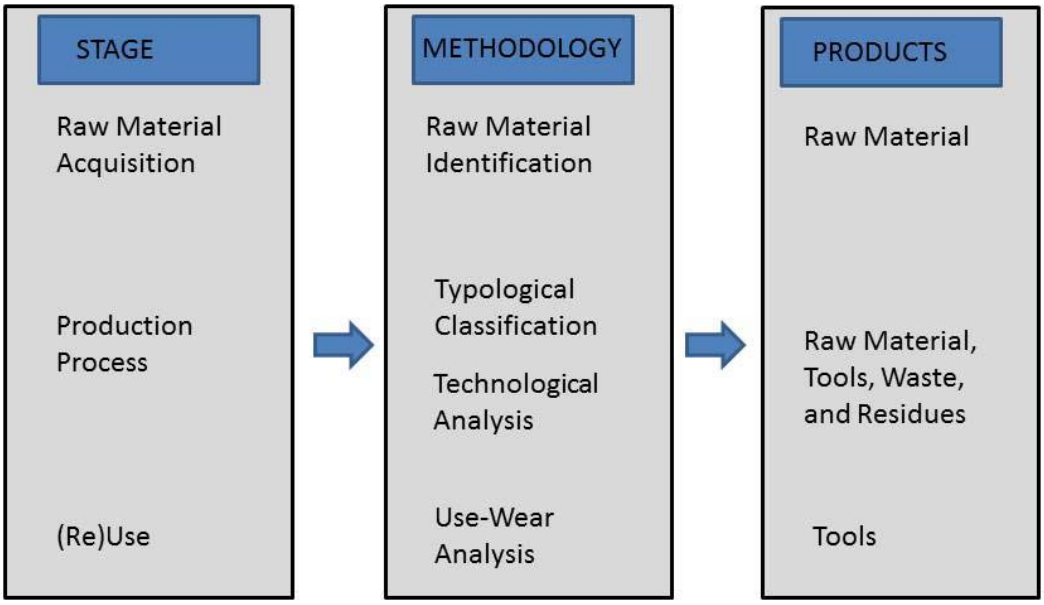


Figure 3.2. Graphic explaining the methodology followed in this book.

3.6.1 Raw material identification

Raw materials were identified using the reference collection of flint and stone of the Faculty of Archaeology at Leiden University. The main characteristics were recorded visually with the naked eye, although in some cases a stereomicroscope (5x to 100x) was used. In the case of Mienakker, the classification of the flint raw material was performed in accordance with the work published by Peeters (2001a). At Keinsmerbrug amber was analysed with the help of a stereomicroscope with magnification between 5x and 100x. At Mienakker most of the amber was missing, so a previous raw material determination performed by Bulten (2001) was used.

3.6.1.1. Flint

The main characteristics recorded for the flint implements were:

- Raw material source: if possible, flint was grouped by provenience. The main groups used were: The Netherlands, mainly flint implements which origin was located in the south of the Netherlands, as Rijckholt flint, Valkenburg flint and southern Limburg flint; Belgian flint, mainly consisting of Rullen flint; French flint, as Grand Pressigny and Cap Blanc flint; and flint with an undetermined and a northern origin, mainly composed of moraine flint, rolled pebbles and coastal flint. Raw material is an important variable for different reasons. In the first place, it gives information on the use of landscape, the preference of a determine raw material to manufacture tools and it may suggest the existence of network exchanges (Van Gijn 1990: 14). In addition, the type of raw material is determines the appearance of the wear-traces (Clemente Conte 1997; González Urquijo and Ibáñez Estévez 1994; Hurcombe 1988; Keeley 1980; Plisson 1985; Van Gijn 1990).

- Coarseness of raw material. Flint was classified into five groups: glass-like flint; fine-grained flint; medium-grained flint; coarse-grained flint; and undetermined grained flint, when it was not possible to determine coarseness of the raw material due to post-depositional alterations. The type of coarseness gives information on the type and quality of raw material, being the finest flint types the better to flake (Whittaker 1994: 66). In addition, it is crucial for use-wear analysis. As suggested by several authors, the coarnseness of flint determines the development of use-wear traces. These develop more slowly on coarse flint (Clemente Conte 1997; González Urquijo and Ibáñez Estévez 1994; Van Gijn 1990).

- Extent of the cortex. The extent of cortex was classified as: absent, when the flint implement did not show cortex; present on less than 50% of the dorsal surface; present on more than 50% of the dorsal surface; present on the platform; present on the platform and on less than 50% of the dorsal surface; present on the platform and on more than 50% of the dorsal surface; present on less than 50% of the ventral and the dorsal surface; present on more than 50% of the ventral and the dorsal surface; present on 100% of the implement; and unsure, where it was not possible to determine the presence of cortex due to heavy postdepositional alterations. The exent of cortex on a flint implement provides information on the raw material availability and the exploitation of the cores (Van Gijn 1990), and, individually, provides technological information of the implements. For example, a flake displaying 100% of cortex on the dorsal surface indicates that the flake was one of the forst ones to be removed from the core (Whittaker 1994).

- Type of cortex. The cortex was classified as: absent, when the flint implement did not show cortex; weathered; rough cortex without chalk; rough cortex with chalk; old patinated surface; and unsure, when it was not possible to determine the type of cortex due to heavy postdepositional alterations. The type of cortex provides information on the source of the raw material used.

3.6.1.2. Stone

The main characteristics recorded for the stone implements were:

- The stones were divided into six groups: sedimentary stones; metamorphic stones; igneous stones; quartz; other stones, less predominant during the classification of the assemblage; and undetermined stones, when it was not possible to determine the type of stone.
- Coarseness of raw material. Stones were classified into five groups: glass-like stone; fine-grained stone; medium-grained stone; coarse-grained stone; and undetermined grained stone, when it was not possible to determine coarseness of the raw material due to postdepositional alterations. The coarness of the stones, or *texture* (Adams 2002a: 21), provides information on the quality of the raw material and the use of specific stones for specific activities (Adams 2002a).
- The preservation of the natural surface of the stone, that was grouped into: absent, when the natural surface of the stone was not present; between 0 and 24% of the natural surface of the stone is preserved; between 25 and 49% of the natural surface of the stone is preserved; between 50 and 74% of the natural surface of the stone is preserved; 100% of the natural surface of the stone is preserved; and unsure, when it was not possible to determine the presence of natural surface of a stone due to postdepositional alterations. The

preservation of the natural surface of the stone provides information on the raw material availability, the exploitation of the raw materials and how tools were produced and used (Adams 2002a; Tsoraki 2008).

- When the natural surface of the stone was preserved, it was classified as: water-rolled; weathered; rough; old patinated surface; and unsure when it was not possible to determine the presence of natural surface of a stone due to postdepositional alterations.

3.6.1.3.Bone

Bone implements were analysed from the sites of Mienakker and Zeewijk. No modified bones were encountered at Keinsmerbrug. In both cases, the determination of the bone implements was performed by the faunal specialists of the NWO project, Zeiler and Brinkhuizen (García-Díaz 2013, 2014a; Zeiler and Brinkhuizen 2013, 2014). The determination of the faunal remains is important to acquaire information on the type of animals

3.6.2 ***Technology and typology***

For the purpose of this research, the typological and technological description and categorization of the flint and stone implements was performed following the methodology developed by the Laboratory for Artefact Studies at Leiden University (Van Gijn 1990). The implements were recorded in a MS ACCESS database, one for each type of raw material studied.

3.6.2.1. Flint

All flint implements available from Keinsmerbrug, Mienakker and Zeewijk were typologically classified and studied from a technological point of view. The main objective of the technological analysis was to understand the processes involved in the manufacturing of the flint tools. The main recorded attributes were:

- Primary classification. A primary technological classification was given to every single implement. The main technological classifications used were: flake, understood as an implement obtained after a strike that presents technological traces such as a bulb of percussion and a platform of percussion (Inizan *et al*. 1995; Whittaker 1994); blade, understood as a tool twice longer than wider, and usually showing two parallel ridges and two parallel edges (Tixier *et al.* 1980: 55); waste or fragments, not showing technological modifications, but occasionally used as blanks for tools as borers or scrapers; splinter, understood as flint implements smaller than 1 mm (Inizan *et al.* 1999); block, understood as unmodified nodules of flint intentionally transported to the settlement; core and core fragments, understood as those implements used to extract blanks (Whittaker 1994); core preparation flake; core preparation blade; pebble, understood as flint nodules (unmodified or flaked) which show water-rolled cortex as their natural surface; and unsure when it was not possible to determine the primary classification due to postdepositional alterations.

- Tool type. A classification, related to typology and use, was given to every single implement. The main classifications used were: arrowheads, when typologically or by use-wear analysis it could be inferred that the tools were related to their used as projectiles; scrapers, understood as retouched implements with a steep angle (Whittaker 1994: 27). Scrapers were classified as long end scrapers, short end scrapers, round scrapers, side scrapers, and undetermined scrapers; retouched implements, classifying the retouch as steep retouch, border retouch, or surface retouch. The retouch was measured and classified as bigger than 1 millimetre or smaller than 1 millimetre; hammer stones, understood as tools used for percussion activities. The tools were classified as one side hammer stone when percussion traces were present only on one surface, bipolar hammer stone when percussion traces were recorded on two opposite surfaces, multiple sides when percussion traces were present on more than two surfaces; and borer, when use-wear traces show the use of the implement on a rotary activity.
- Metrical attributes. Metrical attributes, length, width and thickness, were taken for all implements, always in millimetres.
- Platform type: on implements where the platform was preserved, the type of platform was recorded. The main types used were: with cortex; plain (with a single flake negative); facetted; linear; point shaped; retouched; and undetermined (Whittaker 1994). The type of platform gives different information on the technology used to produce an implement, as the type of percussion used by the knapper, the level of preparation of the implement, and the skills of the knapper (Whittaker 1994). Plain platforms are generally related to direct percussion while pressure flaking flakes display other types, as point shape or linear platforms (Inizian et al. 1995; Whittaker 1994).
- Platform metrical attributes. Metrical attributes of the preserved platforms, length and width, were taken in millimetres. The size of the platform is an

attribute used for differentiating between types of percussion used to produce the implements. For example, platforms of flakes produced with hard-hammer percussion tend to be bigger (Inizian *et al.* 1995).

- Dorsal face preparation. The dorsal face can be worked to create a good flaking platform and it is an indication of the type of technology applied to produce the tool and the experience of the knapper (Whittaker 1994). It was classified as: absent; retouched; and abraded.
- The impact angle, consisting of the angle form between the platform and the and the ventral side, was measured on the implement where both attributes were preserved. It is also an indicator of the percussion used to produce the tool. For example, soft-hammer percussion is related to angles higher than 90 degrees (Inizian et al. 1995; Whittaker 1994).
- Bulb of percussion. When it was preserved, the bulb of percussion was classified as: light; medium; heavy; retouched; and scarred. Bulbs are and indication of the type of percussion used to produce the implement. Hard-hammer percussion usually produces a medium/heavy bulb of percussion while soft hammer percussion and presspure flalikng produce less pronounced bulbs (Inizian et al. 1995; Whittaker 1994).
- Termination. On the distal fragments of the implements, the shape of the termination was classified as: retouched; with cortex; broken; feather; hinge; and step (Whittaker 1994). Flake terminations are and indicator of the precussion technique used. For example, hinge and step fractures are usually related to hard-hammer percussion (Van Gijn 1990; Whittaker 1994).
- Percussion technique. Taking into account the technological attributes recorded, the percussion technique was classified as: hard percussion; soft percussion; and undetermined.
- Bipolar. When it was possible to observe that the implement was produce using the bipolar technique, it was recorded on the database.

3.6.2.2. Stone

Stone tools from Keinsmerbrug, Mienakker and Zeewijk were typologically and technologically classified. Implements were given a primary classification based on their morphological characteristics and metrical dimensions, and then a functional typology was attributed to the implements. The macro- and microscopic technological traces on the stone tools were also documented with the help of a stereomicroscope (5x to 100x) (García-Díaz 2012, 2013, 2014a, 2014b). The main recorded attributes were:

- Primary classification. A primary technological classification was given to every single implement. The main technological classifications were: flake, blade, core, fine gravel (0.2 to 0.5 cm), moderately coarse gravel (0.5 to 1.6 cm), very coarse gravel (1.6 to 6.4 cm), stone (6.4 to 10 cm), boulder (10 to 50 cm), block (more than 50cm), and broken stone.

- Tool type. A typological and functional classification was given to every single implement. The main classifications were: unmodified stones, understood as stones that were brought to the settlement without a clear technological modification, but that could have been used as a tool. Unmodified stones were subdivided into broken stones, pebbles, and possible tools with a smooth surface; hammer stones, understood as tools related to percussion activities. Hammer stones were classified as one side hammer stone when percussion traces were present only on one surface, bipolar hammer stone when percussion traces were recorded on two opposite surfaces, multiple sides when percussion traces were present on more than two surfaces. The classification used for cereal processing tools varies and is not always standardized. Cereal processing tools consist of two parts: the upper surface, that is considered the active part of the tool, generally referred to as *mano*, upper grindstone or handstone, and the passive part of the tool, usually denominated quern, grinding slabs or *metates* (Hamon 2008: 1504). In this publication, when it was possible to classify the implements as lower or upper parts of the cereal processing tools, the terms handstone and quern were used; from a functional point of view, it was decided to distinguish between the tools used to process cereals and other tools used to grind other resources. Therefore, to classify a stone tool used to grind a material that was not cereal, the term grinding stone was used; polishing stone, understood as a tool with a smooth and rounded surface; flaked stone, understood as stones that show flake negatives; pestles, understood as tools that show a combination of percussion and rotational traces, usually related to crush and grind (Adams 2002a: 143); and multiple use tools, or tools with more than one use, understood as tools that show a combination of traces (percussion traces and grinding traces, for example) that could not be interpreted as related to the same use (Adams 2002a).

- Metrical attributes. As suggested by Adams (2002a: 21), the metrical attributes of a stone assemblage can reflect technological choices of the group or the available sources on the site. Metrical attributes, length, width and thickness, were taken for all implements, always in millimetres.
- Weight. All the implements were weighted and the value was registered in grams.
- Manufacturing traces provide information on the technology used to produce a stone tool (Adams 2002a). The main technological traits observed were flake negatives, polishing, pecking and grinding traces and different types of perforations.
- Rejuvenation traces. The main traces recorded were flake negatives and pecking traces.

3.6.2.3. Bone

The preservation of the bones was so poor in some cases that bones could not be typologically classified and some of the technological traits could not be inferred. However, where possible, bone tools were observed through a stereomicroscope (5x to 100x) and technological traits were described from a macro- and a microscopic point of view. The main recorded attributes were:

- Primary classification. When possible, a typological classification was given to every single implement. The main classification used were: needles, understood in this case as small and flat pins, in this case without a perforation, too small to be considered awls (Camps Fabrer 1967: 280); awl, understood as tools displaying a pointed tip made on any bone splinter (Camps Fabrer 1967: 280); bead, understood as an implement with a perforation in the centre of its body (Falci 2015: 72); pendant, understood as an implement with a perforation that is not located in the centre of its body (Falci 2015: 72); spatula, characterised as a tool displaying a rounded edge and a polished surface; ripples or *bobbelkammen*, understood as long tools usually produced from long, flat bones such as cattle ribs. One of the long edges of the bone was sawn, producing several rounded teeth, so that the tool resemble a comb (Drenth *et al.* 2008; Lauwerier in Van Heeringen and Theunissen 2001: 181); and chisel.

- Manufacturing traces provide information on the technology used to produce a bone tool. The main technological traits observed were polish and striations related to the cutting and grinding of the surface.
- Weight. The bone implements were weighted and the values recorded in grams.

3.6.2.4. Amber

Amber ornaments and by products were only analysed at Keinsmerbrug (García-Díaz 2012), while at Mienakker and Zeewijk information provided by other researchers was used (Bulten 2001; Van Gijn 2014a). In addition, technological attributes concerning the fabrication and the method of perforation were documented and entered into the database (García-Díaz 2012). The main recorded attributes were:

- Primary classification. A technological classification was given to the amber implements of Keinsmerbrug. The used terms were bead; flakes, understood as an implement obtained after a strike that presents technological traces such as a bulb of percussion and a platform of percussion; and splinter, understood as an amber fragment smaller than 1 mm.
- Metrical attributes. Metrical attributes, length, width and thickness, were taken for all implements, always in millimetres.
- Manufacturing traces provide information on the technology used to produce the beads and ornaments. The main technological traces observed were flake negatives and perforations.

3.6.3 Use-wear analysis

3.6.3.1 History of the methodology

The function of archaeological implements has always been one of the main questions in archaeology. Although several attempts were made in the nineteenth century to study the use of archaeological implements, use-wear analysis originated as a methodology in the earlier decades of the twentieth century. Semenov, a Russian archaeologist from the Academy of Science of Saint Petersburg, developed the methodology and published it in 1957 (Semenov 1981[1957]). His method was based on the assumption that, if a tool was used, its surface would be modified. This modification could be macroscopic and/or microscopic, and it would be different depending on the material being worked. Semenov (1981[1957]) differentiated four types of attributes:

micro-retouch or edge damage, edge rounding, polish and striations. The method, however, did not become popular in Western Europe and the United States until his book was translated into English in 1964.

After the translation of the book, the method spread quickly through Western Europe and the United States. Several theses and scientific articles were published during this time trying to consolidate and replicate Semenov's method (1981[1957]). The papers focused mainly on replicating the different use-wear attributes that Semenov had defined (Anderson 1980a, 1980b, 1981; Keeley and Newcomer 1977; Moss 1983a, 1983b; Newcomer 1974; Odell 1977, 1979; Tringham *et al.* 1974). On the basis of the methodologies applied to observe the use-wear traces, two different approaches emerged: the *low-power approach* and the *high-power approach*. The *low-power approach* (Odell 1977, 1980; Tringham *et al*. 1974) used a stereomicroscope (up to 60x) to examine wear traces such as striations, edge damage and edge rounding. The *high-power approach*, as developed by Keeley and Newcomer (Keeley 1974, 1980; Keeley and Newcomer 1977; Newcomer and Keeley 1979), involved an incident-light microscope (up to 400x) to observe different wear traces such as striations, edge damage, and edge rounding, but also polish and residues (Anderson 1980b; Shafer and Holloway 1979).

From 1985 to 1990, however, there was a period of pessimism. The controversial results of the blind tests carried out at Tübingen and London (Newcomer *et al.* 1986, 1987; Unrath *et al.* 1986) provoked widespread rejection of use-wear analysis. The method was considered subjective, as it was dependent on the experience of the researcher to distinguish the overlap of different attributes. In addition, several factors affect the formation of use-wear traces and obscure their interpretation (Bamforth 1988; Bamforth *et al.* 1990; Moss 1987; Odell 1980). One outcome of the blind tests was an added awareness of the importance to consider the effects of taphonomy and post-depositional surface modification (PDSM) on the preservation of use-wear traces. Several articles have been published showing the surface alteration of flint and different use-wear attributes caused by the effects of patina, abrasion, burning and heat treatment, and trampling (Gero 1978; Levi-Sala 1986, 1993; Plisson and Mauger 1988; Rottlander 1975; Stapert 1976). In addition, it has been documented by several authors that the type of raw material from which the implements are produced determines the types of traces developed (Clemente Conte 1997; González Urquijo and Ibáñez Estévez 1994; Hurcombe 1988; Keeley 1980; Shea 1987; Sussman 1985). Finally, experimental research shows that some activities left fewer traces than others. For example, the longitudinal processing of soft materials, such as meat or fish, and the impact traces on projectile points generate a small amount of edge damage, and create a poorly developed polish

(González Urquijo and Ibáñez Estévez 1994; Grace 1990; Fisher *et al.* 1984; Van den Dries and Van Gijn 1997; Van Gijn 1986).

However, with the acceptance of the limitations of the method, use-wear analysis started to become popular after 1990. Use-wear analysis has an empirical basis: experiments. The performance of experiments was fundamental to the origin of the use-wear analysis as a methodology and it is still necessary for a good development of the method. The formulation of a replication experimental programme gives the researcher more detailed knowledge of the production processes in which the tools are involved (González Urquijo and Ibáñez Estévez 1994). The performance of an experimental programme is based on the necessity of answering questions within a research framework. The experimental programme is an empirical way to reconstruct the social and economic techniques and uses of prehistoric societies through an archaeological interpretation of their tools (Baena Preysler and Terradas Batlle 2005: 145). The need for this methodology emerges from the study of archaeological tools, and their analysis generates knowledge and, at the same time, new working hypotheses. Therefore, the role of the experimental programme, which could be considered both dynamic and dialectical, is also a constant training tool for the researcher (Baena Preysler and Terradas Batlle 2005: 147).

From 1990 onwards, the use of a combination of low and high power approaches was proposed, and flint implements were analysed taking into account the main characteristics of both low and high magnifications (Clemente Conte 1997; González Urquijo and Ibáñez Estévez 1994; Gräslund *et al.* 1990; Ramos Millán 1990; Van Gijn 1990, 2010a). Since 1995 the technique was applied not only to flint but also to other materials such as stone, bone, antler, pottery and shell (Adams 2002a, 2002b; Buc 2011; Cuenca Solana 2013; Cuenca Solana *et al.* 2011; Dubreuil 2004; Gravina *et al.* 2012; Hamon 2005, 2008; LeMoine 1994, 1997; Maigrot 2000, 2003, 2005; Sharovskaya 2008; Van Gijn 2006a; Van Gijn *et al.* 2002; Van Gijn and Hofman 2008).

However, use-wear analysis on stone and bone implements is not as well developed as in the case of flint. The absence of microscopes that allow a proper analysis of large objects is one of the reasons for the lack of stone tool analysis with higher magnifications. The use of acetate foil and dental casts, and the analysis of implements under low magnifications have been the traditional options to solve the problems concerning microscope availability. However, a large number of publications related to the use-wear analysis of stone tools have been published over the last two decades (Adams 1988, 2002a, 2002b; Adams *et al.* 2006; Delgado Raack *et al.* 2008, 2009;

Dubreuil 2001a, 2001b, 2004; Hamon 2005, 2008; Hamon and Plisson 2005; Martial *et al.* 2011; Verbaas 2005; Van Gijn and Houkes 2006; Van Gijn and Verbaas 2009).

Deciphering the functionality of bone implements was one of the objectives of Semenov's publication (1981[1957]). Some pioneering work published by French researchers focused on the study of prehistoric bone typology and technology (Camps-Fabrer 1968, 1979). However, during the last two decades bone implements began to be studied more frequently. The study of bones has focused on every step of their production process, from raw material acquisition to the use and discard of the implements (Averbouh and Choyke 2012/2013; Beugnier and Maigrot 2005; Choyke and Schibler 2007; LeMoine 1994, 1997; Maigrot 1997, 2000, 2001, 2003; Van Gijn 2006a).

In addition, use-wear analysis reveals technological traits of tool production, especially with respect to bone and antler manufacturing. The technological *gestes* could be observed with low and high magnifications through the observation of the physical modifications produced in the surface of the tools. A good example of the possibilities of use-wear analysis as a technological methodology is the analysis of bone tool production. Flint and bone technology are both reductive processes, generating a variable amount of debitage, but whereas the debitage of flint technology is usually documented, bone debitage generally disappears from the archaeological record (LeMoine 1997). However, most methods of manufacturing bone tools leave microscopic traces on the tools that are as distinctive as the wear patterns themselves. This means that use-wear analysis can be performed on bone tools to reconstruct both the manufacturing process and the functionality of the object (d'Errico *et al*. 1984; LeMoine 1994, 1997; MacGregor 1975; Newcomer 1974; Plisson 1984).

3.6.3.2 Use-wear analysis in the context of the corded Ware Culture

One of the main aims of the NWO project was to understand the type of settlement that Keinsmerbrug, Mienakker and Zeewijk were, and the role played by the material culture in the activities performed there (see Chapter 1). Use-wear analysis, therefore, is a suitable method to discern which activities were carried out on each site; whether some settlements were specialized in some activities; which tools were used for each activity; whether toolkits for specific activities could be identified; and which relationships existed between each craft. Use-wear analysis, however, must be contextualized and considered in relation to other types of analysis. Spatial analysis of the used tools can reveal the existence of specialized areas and the way space was structured. In addition, through the integration of the results of use-wear analysis with raw material identification and the technological and typological analysis, it is possible to understand the interconnectivities between different *chaînes opératoires* (Pelegrin *et al*. 1988; Soressi and Geneste 2011).

Until 2009 CWC assemblages were never analysed microscopically (see Chapter 2). Therefore, the possibilities and expectations of the analysis were high, but so were the challenges. The first challenge was that, with the exception of the case of Mienakker, an accurate inventory of the implements was lacking. While for the small assemblage from Keinsmerbrug this did not pose significant issues, the case of Zeewijk was different. The Zeewijk assemblage comprises more than 10,000 flint implements and more than 7,000 stone tools. It was decided that a basic technological and typological classification would be given to every flint and stone implement from all three sites under investigation. A database from the Leiden Material Culture Studies at Leiden University, interconnected with the technological and typological classification of the implements, was used to register all the data concerning use-wear analysis. In addition, flint, stone and bone implements and amber ornaments selected for use-wear analysis were drawn, and the main characteristics of the use-wear traces were mapped and indicated on the drawings.

The second challenge concerned the sampling process. The presumed difference in functionality established by traditional typology between formal and non-formal tools has already been discussed. To avoid this limitation, all the flint and stone implements from Keinsmerbrug and Mienakker were analysed for the presence of use-wear. This decision was taken for two reasons. First, the flint assemblage from both sites was small enough to analyse all the implements at low magnifications. Secondly, the Keinsmerbrug and Mienakker use-wear analysis could be used as a departure point to sample the larger assemblages, forming the basis for subsequent analyses to be performed on implements from Mienakker and Zeewijk. Zeewijk consisted of thousands of flint implements, so the results from Keinsmerbrug helped to define a better sampling strategy for Zeewijk (García-Díaz 2012, 2013). During the classification of the Zeewijk flint artefacts, 596 were considered suitable for use-wear analysis. The selection was taken by observing the pieces under a stereoscopic microscope at low magnifications or with the naked eye. The selection of tools was based on the presence of the following parameters: a) rounding, b) edge damage, c) the presence of retouch, d) a suitable edge for use, such as a point or regular cutting edge, and/or e) visible polish. As the collection was too large to examine microscopically, 23% of the implements (N=140) were selected for use-wear analysis (García-Díaz 2014a).

The selection of the Zeewijk stone implements for use-wear analysis was based on the presence of macro-traces. These included: a) rounding b) a flat and/or polished surface, c) macroscopically visible striations, and d) the presence of pounding traces on the surface. A total of 69 tools were selected as suitable for use-wear analysis. Of these, a random sample of 53 implements (76.8%) was analysed. The selection comprised one axe, four flaked stones, two hammer stones, seven cereal processing tools (two handstones and seven querns) and 39 unmodified stones (one broken and 38 with a smooth surface). Upon microscopic analysis, 21 tools were seen to display no use-wear traces, ten tools were classified as not interpretable and 22 tools showed use-wear traces on a total of 29 edges (García-Díaz 2014a).

The surface preservation was also a limitation for the use-wear analysis. At the three sites, the percentage of burnt implements was relatively high. In addition, other type of alterations, such as several types of patinas, fractures and abrasion, were documented on flint and stone implements (García-Díaz 2012, 2013, 2014a; see Chapters 4, 5 and 6). Similarly the preservation of bone implements was not excellent. Bone implements were available for analysis at Mienakker and Zeewijk, and in this case, as the assemblage was small enough, the selection of the analysed tools was made based on the level of preservation of the bone surface. Bones mainly presented fractures and/or patinas, although other types of alterations such as burning traces or abrasions were present. In addition, several tools were treated with consolidate glue, that impeded their analysis in several cases (García-Díaz 2013, 2014a; see Chapters 5 and 6). At Mienakker, 29 of the 53 bones available were selected for use-wear analysis, while at Zeewijk, 11 bones were available for study, of which five were considered unsuitable for use-wear analysis (García-Díaz 2013, 2014a; See Chapters 5 and 6).

Cleaning the artefacts was fundamental before the analysis of the implements. All analysed flint implements were cleaned with water and soap first. If a more thorough cleaning was still necessary, a 10% HCL solution was subsequently applied in an ultrasonic tank during 30 to 45 minutes. Additional cleaning was needed during the analysis. To remove the grease and the dirt coming from the hands of the analyser, alcohol and/or refined petrol were used, following the indications of other researchers (Clemente Conte 1997; González Urquijo and Ibáñez Estévez 1994; Semenov 1981[1957]; Van Gijn 1990, 2010a). In addition, stone artefacts were cleaned with water and soap if needed, while amber and bone were not cleaned at all. In the case of amber, the analysed fragments were probably washed after the excavation, and the surface was clean enough (García-Díaz 2012). However, in the case of the analysed bone implements, the decision not to clean was taken because of the fragility of their surfaces, which probably won’t tolerate aggressive cleaning methods to remove glue and other chemical preservatives used after the excavation (Graziano 2014).

Finally, the last challenge concerned the methodology employed. Within the context of this thesis use-wear analysis was applied to a wide range of materials that include flint, different types of stone, bone and amber. A combination of both high-power approach and low-power approach was used, independently of the raw material. This approach was followed taking into account the questions of the research project, as the objective of the analysis was not only to determine which tools were used, but also to understand the functionality of the tool at its maximum extent. Therefore, a combination of both approaches was considered more appropriate, according to the other published research (see for example Clemente Conte 1997; González Urquijo and Ibáñez Estévez 1994; Gräslund *et al.* 1990; Maigrot 1997, 2000, 2001, 2003; Ramos Millán 1990; Van Gijn 1990, 2010a). As such, use-wear analysis was performed using a stereoscopic microscope with magnifications ranging from 7-160x and an incident light microscope with magnifications between 50 and 1000x. Photographs were taken of the more representative traits of the use-wear traces (Table 3.1).

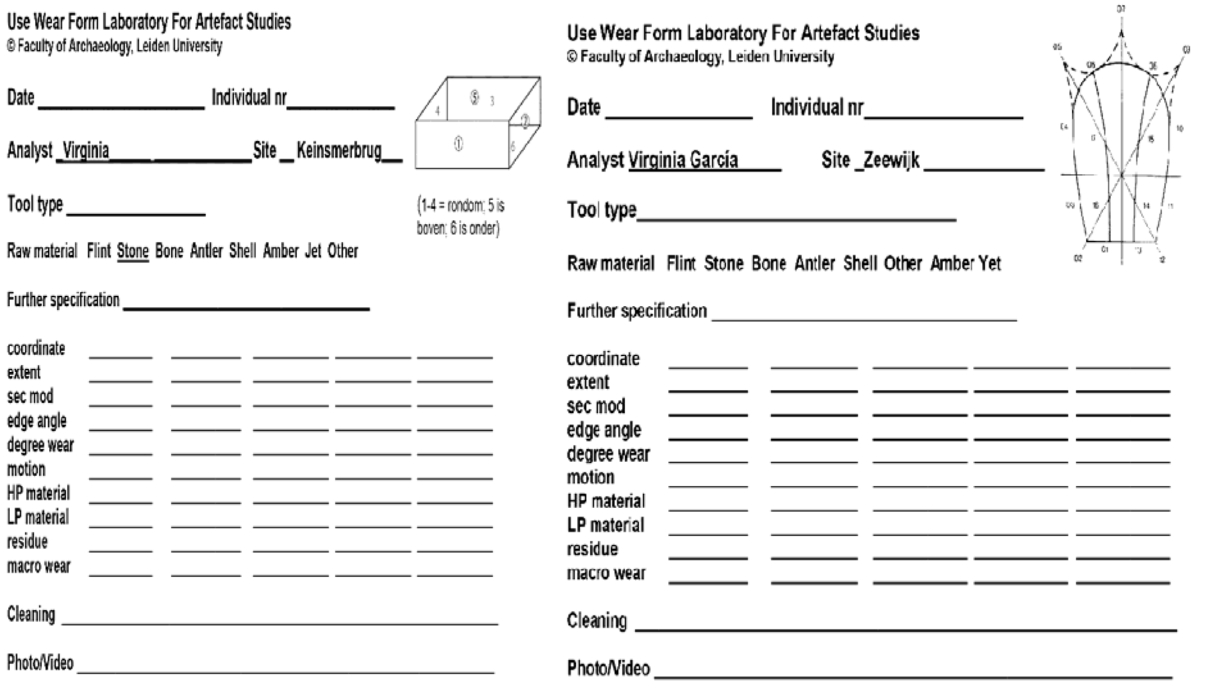
Stereomicroscope	Camera Type	Flint	Stone	Bone	Amber
Nikon (7-63x)	Nikon DXM1200	x	-	-	x
Wild M3z (26-160x)	Nikon DSFi1	-	x	x	-

Metallographic Microscopes	Camera Type	Flint	Stone	Bone	Amber
Nikon Optiphot-2 (50-1000x)	Nikon DXM1200	x	x	x	x
Leica DM6000M (50-100x)	Leica DFC450	x	-	x	x

Table 3.1. Types of microscopes and cameras used during this dissertation.

3.6.3.3 Use-wear recording

During the analysis of the flint, stone, bone and amber implements the information inferred about these variables was entered in a MS ACCESS database, one for each material analysed. In addition, a paper form was created containing a schematic drawing of every analysed implement. The implements were divided following a coordinate system based on Van Gijn's work (1990). In this form, then, use-wear traces were mapped and additional information was recorded when needed in relation to the coordinates (Figure 3.3).



Use Wear Form Laboratory For Artefact Studies
© Faculty of Archaeology, Leiden University

Date ________________ Individual nr__________

Analyst _Virginia______________Site _ Keinsmerbrug__

Tool type ______________

Raw material Flint Stone Bone Antler Shell Amber Jet Other

Further specification ________________________

coordinate
extent
sec mod
edge angle
degree wear
motion
HP material
LP material
residue
macro wear

Cleaning ____

Photo/Video ______________________________________

(1-4 = rondom; 5 is boven; 6 is onder)

Use Wear Form Laboratory For Artefact Studies
© Faculty of Archaeology, Leiden University

Date _____________ Individual nr_______________

Analyst Virginia García_____ Site _Zeewijk____________

Tool type______________________________

Raw material Flint Stone Bone Antler Shell Other Amber Yet

Further specification _________________________

coordinate
extent
sec mod
edge angle
degree wear
motion
HP material
LP material
residue
macro wear

Cleaning ____

Photo/Video ____

Figure 3.3. Forms used to map use-wear traces on flint and stone implements (García-Díaz).

The recording of the use-wear traces are based on the distinction of the four attributes considered by Semenov (1981[1957): polish, edge-damage, edge rounding and striations.

- Polish. Although the characteristics of polish have not been unanimously defined by the researchers, in this dissertation a combination of the classification used by several authors (Clemente Conte 1997; González and Ibáñez 1994; Van Gijn 1990) was used. Polish was classified based on the following categories:

- Distribution. It provides information about the worked raw material and the type of work performed. For flint and bone implements, and referring to the used edge, the category includes the following: only ventral; only dorsal; ventral and dorsal equal; dorsal and ventral, but more extended on the dorsal surface; and dorsal and ventral, but more extended on the ventral surface. For stone and amber implements, the coordinate system was used to classify the distribution of the polish.

- Degree of linkage. It refers to extension and dimension of the polish. Depending of the characteristics of the polish, it can be characterised as as:

  - Open: when the polish of the active zone are isolated points and without any contact between them.
  - Half-linked: when the polish of the active zone is more extended and in some places the polish begins to unite in a single extension.
  - Linked: when more than half of the surface of the polish area shows a uniformed polish.
  - Compact: when practically all the surface shows polish.

- Texture or aspect. This characteristic refers to the uniformity of the polish and, basically, can be described as smooth, rough and greasy.
- Brightness or reflectivity: Refers to the intensity of the light reflected by the polish area. This intensity can be classified as very bright, bright and dull.
- Morphology (Clemente Conte 1997), micro-topography (González e Ibáñez 1994) or topography (Van Gijn 1990). This characteristic refers to the appearance of the polish in its more developed stage. Polish can be flat, domed and pitted.

- Edge damage. Edge damage can be defined as the fractures produced by the contact of the edge with the worked material. Its location gives information about the type of work performed, but also about the hardness of the contact material and the performed motion. Keeley (1980) suggested that edge damage can be classified by its general appearance, its deepness and its size. Following this author, edge damage classification was performed by taking into account the distribution of the edge damage, its morphology, its length, and its width.

- Striations. The formation of striations is determined by various factors: the addition of abrasive material into the worked material; the hardness of the worked material; the morphology of the active edge/surface of the tool; the pressure appplied during the use of the tool; and the duration of the work (Mansur-Franchomme 1980: 26). Striations were classified following this categories:

- Location of the striations. For flint and bone implements, and referring to the used edge, the category includes the following: only ventral; only dorsal; ventral and dorsal equal; dorsal and ventral, but more extended on the dorsal surface; and dorsal and ventral, but more extended on the ventral surface. For stone and amber implements, the coordinate system was used to classify the distribution of the striations.

- Directionality of the striations, which provides information of the motion in which the tool was used. The directionality was classified as: parallel to the active edge; perpendicular to the active edge; diagonal to the active edge; random (Van Gijn 1990).

- Edge rounding. The formation of edge rounding depends on: the morphology of the used edge; the duration of work; the abrasive characteristics of the worked material; and the type of work carried out (Clemente Conte 1997). Edge rounding was classified as: sharp; slightly rounded; and very rounded.

The formation of use-wear traces depend on different variables, which have been described more or less uniformly by different researchers (Clemente Conte 1997; González and Ibáñez 1994; Van Gijn 1990). Some general variables, common to all implements, are related with the type of raw material and the typological and technological classification already discussed (Clemente Conte 1997; González and Ibáñez 1994; Van Gijn 1990). Other variables are related to the specific functionality of the tool and the active edge/surface of the implement (Clemente Conte 1997; González and Ibáñez 1994; Van Gijn 1990).

The main variables registered in relation with the functionality of the flint, stone, bone and amber implements were:

- Degree of wear. It has been classified as: without traces; lightly worn; medium worn; and heavily worn.

- Number of active edges/surfaces.

- Worked material. The more significant characteristics of the worked material in the use-wear formation process are: the hardness, the level of humidity, the flexibility and the elasticity.

- Degree of probability, classified as high or low, taking into account the results of the analysis.

The main variables registered in relation with the active edge/surface of the tool were:

- Edge angle (only for flint implements). The angle of the used edge was measured using a goniometer.

- Type of edge/surface. If the edge/surface was retouched/reshaped/modified before use or unmodified.

- Surface preservation. If the edge/surface is broken or is complete. In addition, it is really important to distinguish the alterations from the use-wear traces. In the case of the analysed materials, this alterations are mainly caused by fire. A prolonged contact with fire produce different types of alterations that, depending on its degree of development, can affect the preservation of the use-wear traces, and even make them disappear (Mansur-Franchomme 1986; Clemente Conte 1997). During the current analysis, the degree of burning was recorded. It was classified as: not burned; glossy; red spots present; and *craquelé*. In addition, thermal fractures were also registered. Different types of patinas were frequently recorded on the studied assemblage. Patinas are chemical reactions that develop gradually and can cover the entire surface of the implements, making difficult or impossible the analysis (Mansur-Franchomme 1986; van Gijn 1990). During the analysis of the implements, the presence and degree of patinas was recorded as: not patinated; light gloss patina; heavy gloss patina; light colour patina; heavy colour patina; light white patina; and heavy white patina. Mechanical alterations were also documented in the studied assemblage. The main ones were erosion, abrasion and macro and micro fractures, which were documented both on the database and the use-wear form. Fiinally, bone implements showed several alterations produced after the excavation that impeded partially or totally the performance of use-wear analysis. Abrasion and erosion of the surface caused by contact with the sediment, partial fractures, and gnawing are present on some of the tools. In addition, some of the bone implements were restored using glue and other chemical preservatives which covered the original surface of the tools. Consequently, the technological and functional traces on these could not be analysed (García-Díaz 2013, 2014)

Taking into account the functional variables and the use-wear attributes, functional interpretations of the tool were made in different levels:

- Functionality of the implement. Taking into account the degree of use-wear traces and the post-depositional alterations, the analysed tools have classified as: without use-wear traces; probably used; used; and not interpretable.

- Motion: longitudinal; transversal; boring/piercing; diagonal; hafting; multiple use; dynamic activities, including percussion activities (pounding, chopping, wedging) and shooting; and not interpretable.

- Worked material. Besides the main characteristics already discussed, the combination of the four different attributes and their characteristics can guide to the interpretation of the contact material. The contact material was divided in three main types: plant materials, including all types of wood (hard wood, soft wood, bark and unspecific wood), siliceous plants (cereals, reeds, grasses and unspecified siliceous plants), non-siliceous plants and unspecified plant materials, defined by their hardness (hard, medium and soft plants and undetermined plant materials); animal materials, including bone, antler, bone/antler when it is not possible to distinguish between both materials, hide (classified as dry hide, fresh hide, hide with mineral addition or hide unspecific when it was not possible to determine), fish, meat, and animal unspecific; and inorganic, including different types of stone and fossil resins (pyrite, jet, amber, schist or undetermined types of stones), pottery/clay, and shell.

3.6.3.4 Experiments

As already discussed, experimental archaeology is a basic tool to perform use-wear analysis. In this dissertation, the experimental collection of the Laboratory of Material Culture Studies, from the University of Leiden, was used as a reference. At the time of this analysis the reference collection was composed of c. 2000 experimental tools, covering the entire range of raw materials analysed in this dissertation. To address specific issues and questions and where the Leiden reference collection was lacking, additional experiments were performed (García-Díaz 2013; Chapter 5), specifically pertaining to amber bead production and the use of borers. The experiments were performed taking into account the variables discussed above and:

- The duration of the work is a fundamental variable of the use wear process, because the longer the tool surface and the worked material stay in contact a more developed wear traces can be recorded.

- The presence or absence of hafting. The tools can be use without hafting (hand held), with a wooden, bone or horn haft, but also using an intermediate material as skin. Hafting affects the development of use-wear traces, because when a tool is hafted, it is easier to apply a greater amount of force during the activity.

The experimental program had two main objectives. The first one was the understanding, reconstruction and recording of the technological process of amber bead production. The second one focused on the different use wear traces recorded on the flint borers. Following the previous work of Bulten (2001), six steps are distinguished in the production sequence of amber beads:

- Raw material acquisition. Although some authors have suggested that the amber arrived to the North-Holland province as a result of exchange networks with the Baltic area (Brongers and Woltering in Bulten 2001), it seems more plausible that the small nodules of amber were picked up from the nearby beaches of the North Sea (Garcia Diaz 2012, 2013, 2014; Van Gijn 2006, 2008). Bulten (2001) suggests that the rounded shape of the amber implements coming from Mienakker could be interpreted as a consequence of the transportation and alteration of the sea (Bulten 2001).
- Cortex removal. Removing the cortex could be done by two different methods: by flaking or by scraping (Bulten 2001). Both methods left different patterns on the surface of the amber, with flaking being the easier process to be recognized in the archaeological samples. Negatives of cortex removal by flaking have been recorded for different amber beads from different sites, like Keinsmerbrug (García-Díaz 2012), Mienakker (Bulten 2001) and Kolhorn (Bulten 2001). However, scratching marks related to cortex removal are difficult to determine on archaeological tools, as they can be easily misinterpreted as traces related to post depositional alterations or polishing. During our experiment we used both methods to remove the cortex. In the first case, we used a small quartz pebble to remove the cortex while, in the second, we used a flint scraper. Both tool types proved to be effective.
- Cutting. The cutting of amber can be done using a rope or a string or using a flake or a blade. In our case, we used a flake to cut the amber in the cases that we need it. The use of a string has been tested on several occasions, as in the case of the Laboratory of Artefact Studies. The marks inflicted on the surface of the amber, described by Bulten (2001: 474) as concentric circles, were observed on some amber pieces of Mienakker.
- Polishing and shaping. The shaping of the amber bead was done using an abrasive stone. In our case we used a medium grain quartzite. Bulten (2001: 474) suggests that this first shaping will be accompanied with a first polishing of the surface. As in the cases of the cortex removal, those marks could also be covered by the marks left by subsequent stages of production, such as the final shaping or post depositional surface alterations.
- Perforation. The perforation is the more delicate step in the production of the bead because of the risk of mistakes or accidental fracturing. Through the analysis of the beads from several sites, three different kinds of perforations have been recorded:

- one sided conical perforation. The one sided conical perforation does not occur very often. This type of perforation is irregular, being wider at the beginning of the side from which the borer started to work than at the end. Some authors interpret this type of perforation as a mistake (Bulten 2001: 475). However, I think that probably this kind of perforation was produced on purpose, as it is easy and quick to do and produces a wide enough hole to permit the string to pass easily. For the experimental program one hafted flint borer was used to produce these perforations. The flint borer was used in regular time intervals of 15 minutes to a maximum of one hour of work.
- bi-conical or hourglass-shaped perforation. The risk in this type of perforation is the miscalculation of the location of the perforations. Such mistakes are frequently seen in the archaeological samples (Van Gijn 2006: 200). Bi-conical perforations are mainly done with flint borers, like in the case of the conical ones. Five experimental borers were used to produce this kind of perforations. In every case the borers were used without hafting. The borers were used in regular intervals of 15 minutes to a maximum of 90 minutes of work.
- cylindrical perforation. Because of the characteristics of the perforation (its homogeneity and size) it is believed that these perforations were made with hafted bone or antler borers. In the experimental program, one bone borer was used to perforate the beads. Making a cylindrical perforation is a hazardous step in the entire sequence due the fragility of the beads. Probably this is the main reason why this step often was performed before the final shaping of the bead. This type of perforation was done in two ways, with a bow drill or by holding the hafted drill in the hand. In both cases it is crucial to immobilize the amber bead in order to concentrate the pressure on just one point of the bead. In addition, the information obtained from a previous experiment of the Laboratory of Artefact Studies was used. In this experiment, an antler borer was used, hafted in a wooden stick, with the help of a bow. In both cases, the main priority of the experiment was to immobilize the amber bead to prevent it from breaking.

- Polishing and final shaping. The final step of the production process consisted of the polishing and shaping of the beads. A medium grain quartzite was used to perform this action, with acceptable results, although Bulten (2001: 476) suggest the use of different kind of stones for the two polishing processes, as a fine grained sandstone.

The experimental reconstruction of amber bead production reveals interesting information when we compare the findings to the archaeological samples (García-Díaz 2013, 2014; Chapter 4 and 5) and the use-wear analysis of the flint replicas used to produce the beads have allowed us to describe the main patterns of the use-wear produced by boring amber. The main characteristics of the use-wear are mainly reflected in the rounded edge and the generation of a well-developed polish.

- Edge rounding develops very fast, being constant during the entire process and easily observable even during the first 15 minutes just with the naked eye. The rounding of the edges is concentrated on the point of the borer and on the dorsal ridges, the areas that have more intensive contact with the amber during the work.
- Edge fractures. In one case, one of the borers presents a fracture of the edge due to contact with the amber, after 15 minutes of work. However, with the continued use of the borer the rounding of the edge became more developed and the fracture almost disappeared.
- Striations are not common and none have been recorded on the experimental tools.
- Polish: the polish does not develop very quickly. After 15 minutes of work the polish distribution is restricted to isolated spots on the edge. The polish is flat, relatively bright, and well delimitated, with a rough appearance. After 30 minutes of work the polish shows a more developed appearance and is widely distributed. However, the polish distribution never became continuous and the degree of linkage was minimal with the polish present for the most part as isolated spots. Polish is located at the more prominent areas of the edge. However, and after one hour, the edge/working surface became more regular and polish appears in some other areas.

3.7 Conclusions

In this chapter it has been argued that tools and ornaments from domestic contexts provide detailed information about the nature of the society in which they are used. These tools are not only a reflection of the economic practices of the groups and an indicator of the skill level of their owners, but they are also embedded within the '*symbolic knowledge*' (Broadbent 1989) of the groups. Through the production and use of material culture, the '*mutual knowledge*' of the groups, as defined by Giddens (1984), is learned, structured and maintained. Therefore, the study of Corded Ware tools from domestic contexts will allow a better understanding of the society which used and produced them. For such an understanding to be achieved, tools from settlements contexts have to be understood and studied in their entirety and contextualized. In this thesis, and following the *chaîne opératoire* approach, tools are considered and studied from the moment the raw material was selected, taking into account the production of the tools, their uses and how they were discarded. The function of the different implements is accomplished through the application of use-wear analysis on a wide range of materials. The results of the analysis of the three studied assemblages are present in Chapters 4, 5 and 6, and will be contextualized in Chapters 7 and 8.