17. PRODUCT STANDARDIZATION, CRAFT SPECIALIZATION AND ORGANIZATION OF POTTERY PRODUCTION

Specialization is as much a social relation as it is an economic one, because it diminishes autonomy and creates new kinds of interdependencies that underwrite complex forms of social integration
(Costin 2005: 1062)

The application of an interdisciplinary approach to the processing of pottery assemblages from both sites has yielded the basis for reconstruction and identification of the context in which the pottery was produced, distributed and used. Each of these three categories comprises several aspects which have been analysed, and for which an attempt has been made to interpret them on the basis of data obtained. Special emphasis has been placed on production organization, craft specialization and pottery standardization. The results and interpretation of the analyses done within each of these aspects have facilitated better understanding and identification of social processes within Vučedol society. There are many variables that can be defined within the overall production process (Schortman & Urban 2004), and here only those have been selected that could be interpreted on the basis of the obtained and available data.

Although results pertaining to standardization and craft specialization in the Vučedol Culture arising from the processed material from Damića Gradina and Ervenica have already been published in several places (Miloglav 2012b; 2013), they are presented here again to facilitate a comprehensive and thorough interpretation of the pottery production and its role in Vučedol society.

PRODUCTION ORGANIZATION

Identification of the production process, craft specialization and pottery standardization began to develop more intensively in the 1980s (For an overview, see Tite 1999). Many papers have been written about this, and there is an increasing quantity of research focusing on production, standardization and craft-specialization models (Rice 1977; 1981; 1989; 1996a; Arnold 1985; 2000; Hagstrum 1985; Sinopoli 1988; Costin 1991; 2000; 2005; Costin & Hagstrum 1995; Roux 2003a). The majority of authors agree about one thing, and that is that production organization can be identified and defined in several ways. However, it is worth emphasizing that the proposed production-organization models have to present some flexibility, since they cannot be applied linearly to all the societies (Vuković & Miloglav 2016).

The majority of authors stress that, in order to identify and define organized production and craft specialization, first we need to develop a framework which was necessary for their creation. This framework includes socio-economic, political and environmental factors which affect the development and functioning of a community; answering questions concerning these factors is of key importance for identifying traces of organized specialization.

The economic strategy of the Vučedol population included herding and tilling, hunting and metallurgy, and it led to social stratification, in that a richer class stood over all the others. Hoarding animals and metallurgical products made it possible to create large reserves, and the population growth was probably a result of improved living conditions. Traces of social stratification are most evident in burial customs and certain indicators pertaining to housing and settlement organization.

Evidence of social hierarchy can easily be observed at the eponymous site of Vučedol, whose size and spatial organization sets it apart from other settlements of the period. The production of copper objects played a special place in the society and economy, as testified to by remains of metallurgical furnaces, moulds and tools discovered at many Vučedol sites. All this gives sufficient ground to claim with certainty that metallurgy was a highly specialized activity, and traces of organized production can be observed at nearly all large sites of the Vučedol Culture. In economic terms, craft specialization emerged in those societies which featured a certain level of complexity (Forenbaher 1999), and this can undoubtedly be confirmed by the well-developed Vučedol society. Although specialized metallurgical production is not the topic of this chapter, it is important to emphasize that it existed and that it was important within the overall framework of the Vučedol Culture.

CRAFT SPECIALIZATION

There are many different definitions and interpretations of specialization, with reference to an archaeological context and organization of production. One of the clearest is perhaps that by P. M. Rice (1981: 220), who defines specialization as regulated behavioural and material variety in productive activities. For C. L. Costin (1991), specialization is a relative state, not an absolute one, and she distinguishes between various degrees and types of specialization. Specialization can be organized in many ways, ranging from that at the level of an individual to community specialization, from household specialization to that in larger organized workshops. According to Costin, production is "the transformation of raw materials and/or components into usable objects", and specialization is "a way to organize this production."

One of the models most often cited is that proposed by Earle (see Costin 1991), involving attached and independent specialization. He made a distinction between the production of special, high-value goods consumed and controlled by the elite, and the production of utilitarian goods for broad distribution, which was not systematically controlled. The definition was soon accepted by many authors (e.g. Hagstrum 1985; Sinopoli 1988; Costin 1991). When she discusses specialization, Rice (1989: 110) differentiates between individual specialization and community specialization, and between specialization of a single form, or a single function, of a vessel.

As emphasized above, there are many types of specialization and many definitions, because specialization is not a uniform phenomenon and it depends on a number of factors, primarily on social, economic, political and environmental conditions. In terms of the economy, it is important to stress that any economic system comprises three components: production, distribution and consumption. Distribution and consumption jointly provide information on the economic, social and political contexts of production (Costin 1991). Distribution is linked to the model of exchange, and, to a certain degree, the organization of the production depends on it. The last link in this chain is consumption, or demand for the final product. In this respect, Costin (1991) distinguishes between: a) the nature of the demand, defined by the function of the products within the socioeconomic roles of the people using them; b) the level of the demand, which describes the number of products in circulation and the number required to satisfy the demand; c) the logistics of distribution, which include identifying the ways in which the producer acquires raw materials and delivers finished products to his end consumers; and d) the rationale of the supplier/producer, which identifies the main stimulating force behind production and distribution. In an archaeological context, the con-

sumption component is the most difficult to identify, and, in terms of its interpretation, it is the weakest link in the descriptions of the economic systems of the earliest communities.

Supply and demand are very important aspects of any study of organized production. In typical economic systems, those are the fundamental economic principles and the main fabrics of the market economy. However, in archaeological contexts, we come across economies which were neither market economies nor capitalist economies, and the above terms are used to describe social and political factors affecting the need to have a product. The demand or consumption conditions cannot always clearly be identified in an archaeological context, and they include the following questions: 'Who were the goods produced for?', 'For what purpose?' and 'In what context?' One of the aspects of the demand is the product's function, which relates to the use of a product and its function in everyday life, in rituals, or in social life (Costin 2005: 1047). Characterization of demand involves three sets of analytical techniques: a) identification of the context in which the products were found; b) morphological analysis of the pottery, to establish its function (which includes analyses of organic residues, of raw material, and use-wear and use-alteration analysis of the vessel); c) quantitative and qualitative methods (Costin 2005: 1048). All these attributes can be identified as characteristics of a production system. As for the pottery production, it is important to emphasize that it can be organized in many ways (Rice 1981; Sinopoli 1988; Costin 1991; 2000; Costin & Hagstrum 1995).

Here, we will present a model developed by van der Leeuw which outlines various levels in the organization of pottery production as known from ethnographic and archaeological investigation (see Sinopoli 1991: 98–117). According to him, organization of pottery production can be divided into four levels.

At the lowest level, we have household production. At this level, pottery is produced periodically, in the open, with meagre and limited investment in tools and raw materials (clay and temper). The pottery produced usually consists of a household's yearly needs.

The second level of production also refers to production within a household, but this time much of the production is oriented towards needs other than those of the household, i.e. towards trade or exchange within the settlement. The potters are still not specialized with 'full-time jobs'; they produce pottery as a part-time activity, and their production fulfils the needs of an increased economic demand. At this level, the production volume is higher, and it takes place more frequently, than at the previous level.

Only with the third level of pottery production does there emerge a workshop industry, in which a specialist labour force is needed, which produces pottery as a full-time job. This level includes some major technological changes. However, some authors include, in the notion of technological innovations, the organization of production, that is, a division of the population which makes the core of the labour force, their social status or the location in which the work is done (Miller 2007: 185-186). As pottery-making becomes a regular activity, the number of vessels increases proportionally, leading to the first signs of standardization, as the potters attempt to reduce the time and energy needed to produce a single vessel. In this period, vessels are also produced for a wider distribution.

The last level of pottery production involves the notion of higher-scale production, which means mass production and the employment of a large number of highly specialized potters. This level implies the existence of workshops and work organized at a 'factory level'. The pottery is extremely standardized, and technology is highly specialized.

Another interesting model which is also useful for identifying the production organization at the Vučedol sites studied has been proposed by Costin (1991). She distinguishes among eight degrees of production organization, based on four parameters: context of production, concentration of production facilities, scale and intensity of production.

HOW CAN WE RECOGNIZE ORGANIZED POTTERY PRODUCTION?

Archaeologists generally agree that there are two types of evidence which make it possible to reconstruct organized production: direct and indirect. Direct evidence comprises pottery-production sites, pottery kilns, tools, waste material, pigments, moulds etc. However, a production locus differs from a production unit. *Production loci* are sites in which pottery vessels are manufactured, and they can refer either to the production site as such, or to the community in which the production took place, without specifying the number of producers or workshops. The *production unit* implies not only the production site, but also elements of discrete organization (Costin 1991: 29-30).

Within the Vučedol Culture sites, no pottery kiln has been found, making it evident that pottery was fired in open fireplaces or in pits. Vučedol settlements consisted of very densely-set houses separated by passageways which were less than 1 m wide (Forenbaher 1994). Thus it is likely that refuse and waste materials were often cleared from the houses' surroundings, to keep them passable. As a result, it is very difficult to discover and identify direct evidence of production sites and waste-disposal sites by archaeological excavation.

The only indirect evidence of a possible production site is perhaps three large piles of hematite, which was used for vessel decoration (incrustation); they were discovered in the immediate vicinity of a house at the site of Vučedol ('Streim Vineyard' position). Although they suggest that production took place at the site of Vučedol, and not at the sites discussed in this book, the importance of this evidence should be emphasized, as an indication of a production site which does not include pits, fireplaces or kilns, tools, or unworked clay (Miloglav 2013: 207, Fig. 4).

Indirect evidence is present when, in an archaeological context, the production sites cannot be located, but the pottery product in itself testifies to specialized production. However, indirect products rarely allow us to identify the context, degree and intensity of production. There are several factors which are taken into consideration when dealing with indirect evidence. They include primarily the recognition of large numbers of more or less standardized products, and the skill and efficiency of their manufacture. Indirect evidence of skill is usually measured by technical attributes of finished products. Several ways of measuring skill have been proposed, and they include gestures used to decorate vessels (Hagstrum 1985) and movement control (Costin & Hagstrum 1995). Some ethnoarchaeological research suggests that the potter's skill and repertoire vary with years of experience, and that the skill in manufacturing large vessels progresses linearly as the years go by (Kramer 1985; Roux 2003a).

It is very difficult to define skill in an archaeological context. It is a combination of social and individual learning, transferred in practice and accumulated over years. The degree of the potter's skill can be identified by the so-called technological signature, which can be identified on finished vessels. Just as each potter possesses skill at a certain level, a different skill level is required by each vessel, depending on its purpose and complexity of shape. For example, small vessels of simple shapes, such as cups and small bowls, require a lower skill level than large ves-

sels of more complex forms, such as pots for food storage or urns. Furthermore, vessels of simple shapes require fewer steps in the chain of operations which constitutes the production process.

S. Budden (2008) has proposed a method to measure skill degree using 12 technological variables that can be defined and measured for various morphological forms, i.e. for various degrees of technological complexity of pottery making. This approach to measuring and defining the skill allows relatively simple measuring during the processing of archaeological material. Since, within the sites of Ervenica and Damića Gradina, no areas have been identified which would suggest that some organized production had taken place there, the pottery material has been used as indirect evidence of craft specialization and production organization.

PRODUCT STANDARDIZATION

Standardization of excavated pottery is normally applied in the analysis of production organization (Rice 1989; Stark 1991; Blackman et al. 1993; Kvamme et al. 1996; Arnold P. J. 2000). The best definition of standardization might be that offered by Rice (1987; 1996a: 178-179), who defined it as a reduction in variability of shapes, dimensions and decoration of ceramic vessels. This also implies a reduction in the chain of operations in the production process, and, consequently, a simplification of manufacturing methods (Rice 1981: 220). Furthermore, Rice believes that we should differentiate between standardization within the technology of production, and a reduction of variability resulting from specialization and an increase in the number of people making the pottery. She also emphasizes the need to make a distinction between increased production (intensification) and specialization, since the two are not necessarily linked. The former includes an economic process, or the need for massive production, which implies an increase in labour and funding, while specialization involves special skills necessary to produce a certain product.

Standardization actually measures the number of production groups, and it is usually assumed to be an integral part of specialization for two reasons. The first is that specialized systems consist of fewer producers, which means less individual variability, and the second reason is that specialists practice their craft more often, through both training and practice, and their actions become routinized (Costin 1991: 33–35; Costin 2005: 1067). However, some authors believe that what reduces variability in pottery is not necessarily specialization, but routine. The constant repetition of the same actions, or routinized actions, is mostly discussed separately from specialization, which implies product standardization (Arnold 1991).

Generally, the degree of specialization is affected by the degree of production, and, in identifying the degree of specialization, an important role is played by the ratio of the number of potters/specialists to the number of final users/consumers. As we saw previously, the production can be organized in several ways, from small pottery units at the level of a household, to large workshop centres. The production consists of several components which together form a production system. A production-system model proposed by Costin (2005) includes:

a) artisans (people who manufacture products);
b) means of production (raw materials, tools, skills, knowledge);
c) organization and social relations of production (relationship between producer and consumer);
d) objects;

e) relations of distribution (mechanisms whereby products are transferred to consumers);

f) consumers.

The first component of this production system is potters, that is, specialists producing standardized pottery vessels, as a result of their knowledge, skill and experience. It is usually emphasized that a distinction should be drawn between intentional and mechanical attributes. The former affect the vessel's functionality, and include technological, morphological and stylistic attributes; they cannot reveal much about the way the production was organized. Such actions reflect social and economic norms and the community's demand for a certain functional product. Mechanical attributes are actions that the potter does unintentionally as he manufactures a vessel. Given that they are unintentional, they can tell us more about the production organization. These actions include the selection of clay, and variability in measures such as small deviations in the vessel's morphology (symmetry of the rim, base, handle, wall thickness, etc.). Mechanical attributes are affected by skill, knowledge, experience and working habits (Costin & Hagstrum 1995; Costin 2005).

The standardization hypothesis (Blackman et al. 1993) suggests that the reason for higher uniformity in pottery products lies in a higher degree of production, and that it is linked to economic specialization (Rice 1981; Costin & Hagstrum 1995; Costin 2000; 2005). Specialist pottery production has to be defined in an archaeological context through standardization of raw materials and techniques (Rice 1981), shapes and dimensions (Sinopoli 1988), and decoration (Hagstrum 1985). Although decoration is considered to be an intentional attribute, deliberately placed on the vessel by the potter (Hagstrum 1985; Costin & Hagstrum 1995), measurings of pottery standardization mostly avoid this variable.

The majority of authors agree that the best way to measure standardization is by comparing two different pottery assemblages, since this method provides the best chance of observing the degree of standardization (Rice 1981; Blackman et al. 1993; Costin & Hagstrum 1995; Roux 2003a). Standardization tests are usually based on metric values, manufacturing technology and chemical composition of the clay. However, some authors believe that the composition of the paste cannot tell us anything about the organization of pottery production, while it can reveal a lot about the organization of pottery distribution in the landscape. Moreover, it has been emphasized that uniformity of clay paste cannot be taken as evidence of product standardization and an elevated degree of specialization, and that some other factors should be considered, such as availability and procurement of raw material, and its employment in the preparation of paste. In this respect, it should be borne in mind that technological and environmental factors do not affect the organization of pottery distribution in the same way in which they affect the organization of production, which is largely conditioned by socio-political and socio-economic factors (Arnold 2000).

It is important to emphasize that several things should be borne in mind when establishing standardization, which will be useful for interpretation of specialization and production organization:

1. the attributes analysed reflect production organization, and not unconscious actions which are conditioned by social, economic or political factors (Costin 1991)
2. it is necessary to compare two or more analytical units (sites, assemblages, regions, phases or types)

3. when interpreting data, due attention should be paid to subjectivity, which is an integral part of typological classification; thus, it is advisable to use various statistical tests and methods
4. the sample size is very important, since it should ensure that the data are representative
5. it is very important that, for the purpose of measuring and comparing, data be taken from the same typological group, to avoid deviations in metric values
6. utilitarian objects should be separated from high-value and luxurious objects, whose size and decoration set them apart from the usual repertoire, and their purpose and meaning for the community are different
7. cumulative blurring should be taken into account when interpreting the scale of production.

It has already been mentioned that standardization tests are most often conducted within the scope of ethnoarchaeological studies (Arnold 1985; 2000; Kramer 1985; Stark 1991; Kvamme et al. 1996; Arnold P. J. 2000; Roux 2003a), which help us interpret archaeological theses, while the information used in them cannot be obtained (or is very difficult to establish) in an archaeological context. This includes the majority of metric measurements (e.g. the height of the entire vessel, or the vessel's maximum diameter), information concerning distribution, consumption and production, and on pottery originating from a single potter or from a single production series.

Ethnoarchaeological studies are particularly precious for determining the demand and supply – important aspects of any research into organized production. Some works warn, though, that ethnoarchaeological studies cannot be fully projected onto archaeological research (Costin 2000; Harry 2005). On the other hand, ethnoarchaeological studies do provide some new information and expose archaeologists to different ways of thinking about the material world, and they provide an opportunity to examine the value of the information we possess (Tite 1999). Still, information obtained by ethnoarchaeological studies is very difficult to obtain in an archaeological context, and the values of the coefficients of variation will be much higher. One of the reasons for such results is so-called cumulative blurring, which occurs when measuring all the pottery products from one settlement, which means vessels produced by several potters and originating from several production series (Blackman et al. 1993). This is a fairly common problem in archaeology, since the majority of archaeological material does not come from clearly closed units, as is the case with the investigated site of Damića Gradina. Ethnoarchaeological studies have shown that the coefficient of variation is much smaller when the vessels analysed were produced by a single potter (Roux 2003a: 775; Underhill 2003: 250).

RESULTS OF THE STANDARDIZATION TEST CARRIED OUT ON POTTERY MATERIAL FROM THE SITES OF ERVENICA AND DAMIĆA GRADINA

Looking at the processed pottery material, it could be noticed even at the lowest level of visual perception that pottery assemblages from two sites, observed within individual typological shapes (bowl. pot, cup, jug), were similar. The simplest comparison of variables measured within each typological group has shown that metric data are either matching, or that they depart by very small metric values. For this reason, a test was made to measure the degree of standardization, and to either confirm or deny its presence.

Generally, standardization can be measured in several ways, one of which uses coefficient of variation (CV) to measure the dispersion within a cluster of data. When coefficient of variation

is calculated, the standard deviation (SD) of a group of data has to be divided by its mean (M), and the calculation is expressed as a percentage (Shennan 2001). The mean is the arithmetic mean of a group of data, which represents its centre of distribution. It includes all the values/measurements within a group of data. Thus, if the data are widely dispersed, i.e. if some of the results are extremely low or extremely high, it causes problems. In such a case, the mean will no longer reflect a typical value for the group of data. In order to correct such deviations, standard deviation can be used, which features in many statistical tests as the most important measure of data dispersion around the mean.

Nowadays, standard deviation is usually calculated using various statistical programs. We used the SPSS (Statistical Package for the Social Sciences) program. It has already been explained that, in archaeology, the coefficient of variation is used to calculate the degree of standardization of certain products. Generally, the higher the mean, the higher the standard deviation, which could be interpreted as a lesser degree of production standardization. This problem can be overcome using the coefficient of variation, calculated using this formula: $CV = \frac{\sigma}{x} 100\%$ (Shennan 2001).

When measuring the coefficient of variation, extreme values (the highest and the lowest) were excluded, to a maximum number of three measurings per type. Such an approach is not unusual, and it is generally applied, and for two reasons. The first reason is the necessity to differentiate between utilitarian objects and exclusive ones, made for special purposes, which deviate both in terms of their shape and decoration from other pottery. The second reason is to reduce the subjectivity and possible mistakes made during typological classification, especially when the size of the vessel is at issue (Blackman et al. 1993). In view of the above, measurements resulting in extreme values which are not excluded from statistical analysis yield false and unreliable data. Furthermore, it is important that data from the same typological group be taken for the purpose of measurement and comparison, precisely because of deviations in metric values.

For the purpose of standardization testing of pottery material from both sites, measures of vessel rim radius and wall thickness were taken. Ethnoarchaeological studies have shown that the vessel's height and the diameters of its rim and shoulders are those parameters that have the greatest impact on the potter's motor habits (Roux 2003a), and, in today's traditional communities, particularly important is the standardization of the vessel's orifice (Underhill 2003). It is not necessary to reiterate how important the vessel's orifice is for its appearance and function, but the wall thickness – although an important variable from the point of view of the vessel's function – is much less suitable for comparing different types, since measures are taken from different parts of the vessel. Thus, when wall thickness was measured, attention was paid always to measure the same parts of the vessels, usually bodies. For certain types, heights and radiuses of bases were measured, and for those types for which the relevant parameters were few or none, comparisons and measurements were not made.

Already during the processing of pottery finds, a great similarity among bowls of type A 4 was noticed. The type was divided into five variants, with variants A 4a, A 4b and A 4c exhibiting minimal morphological deviations. The coefficient of variation for these bowls is exceptionally low and displays the highest degree of standardization. For rim radiuses from both sites, the coefficient of variation varies 11.61–12.75%, and for wall thickness it is 10.84–13.79% (*Table 25*).

Ervenica - Vinkovci					Damića Gradina - Stari Mikanovci				
Type	**n**	**Mean**	**SD**	**CV**	**Type**	**n**	**Mean**	**SD**	**CV**
A 1a - WT	5	12.10	1.91	15.79%	**A 1a - WT**	9	13.11	2.75	20.97%
A 1d - RR	4	11.87	1.43	12.05%	**A 1d - RR**	7	13.72	2.71	19.75%
A 1d - WT	8	8.13	1.38	16.97%	**A 1d - WT**	18	8.08	1.18	14.60%
A 2 - RR	6	8.57	2.16	25.20%	**A 2 - RR**	30	9.10	1.95	21.42%
A 2 - WT	27	6.85	1.18	17.23%	**A 2 - WT**	88	6.42	1.07	16.66%
A 3a - RR	10	12.60	2.22	17.62%	**A 3a - RR**	33	13.62	1.98	14.53%
A 3a - WT	25	7.32	0.98	13.39%	**A 3a - WT**	78	7.92	0.99	12.50%
A 4a - RR	14	12.02	1.52	12.65%	**A 4a - RR**	14	11.34	1.35	11.90%
A 4a - WT	36	7.00	0.91	13.00%	**A 4a - WT**	28	6.82	0.92	13.48%
A 4b - RR	3	15.50	1.80	11.61%	**A 4b - RR**	3	13.46	1.70	12.63%
A 4b - WT	7	6.80	0.75	11.03%	**A 4b - WT**	9	7.25	1.00	13.79%
A 4c - RR	6	14.26	1.66	11.64%	**A 4c - RR**	28	13.09	1.67	12.75%
A 4c - WT	22	7.19	0.78	10.85%	**A 4c - WT**	90	7.06	0.86	12.18%
A 5 - RR	8	5.57	0.79	14.18%	**A 5 - RR**	24	6.14	1.40	22.80%
A 5 - WT	22	6.34	0.89	14.04%	**A 5 - WT**	75	6.40	1.06	16.56%
B 1a - RR	13	9.31	2.27	24.38%	**B 1a - RR**	49	10.74	2.88	26.80%
B 1a - WT	23	7.33	1.03	14.05%	**B 1a - WT**	87	8.86	1.35	15.23%
B 1b - RR	4	5.75	0.64	11.13%	**B 1b - RR**	32	7.23	1.25	17.28%
B 1b - WT	8	6.54	0.87	13.30%	**B 1b - WT**	56	6.85	1.23	17.95%
B 3b - RR	7	7.28	1.28	17.58%	**B 3b - RR**	11	6.51	1.41	21.65%
B 3b - WT	7	9.32	2.53	27.15%	**B 3b - WT**	15	8.37	1.40	16.72%
C - RR	4	4.10	0.33	8.05%	**C - RR**	3	3.83	0.47	12.27%

n - number of sherds; SD - standard deviation; CV - coefficient of variation; RR - rim radius (cm); WT - wall thickness (mm).

Table 25 – Comparative table with coefficients of variation (CV) for values measured on types from both sites

In contrast with type A 4, type A 2 does not display a high degree of standardization (21.42% and 25.20% for the rim radius), the reason lying in the fact that this type varies considerably in terms of its height and rim radius. Although they appear to be similar, these two types are actually rather different in their morphologies, as regards both their shapes and dimensions. Type A 2 is smaller, has an *omphalos* base and an S-profiled contour. Type A4 is larger, with a flat base and biconical contour.

Small variations in the morphology of bowls of type A 4 reveal that this type of vessel was primarily used for utilitarian purposes, while type 2 was evidently also made for some special purposes, and its morphology varies considerably.

It has already been emphasized that it is very important to use data from the same typological group for the purpose of establishing the coefficient of variation, due to deviations in metric values and in order to reduce subjectivity and potential mistakes in the development of typology. An example of this problem can be observed on bowls of type A 1. The CV of the rim radius for all bowls of type A 1 from Ervenica is 35.89%, and for those from Damića Gradina as much as 43.75%. The same is true of values calculated for all bowls of type A 4 and all pots of type B 1 (Miloglav 2012: 42, Table 3). If we were to consider these results in isolation, we could conclude

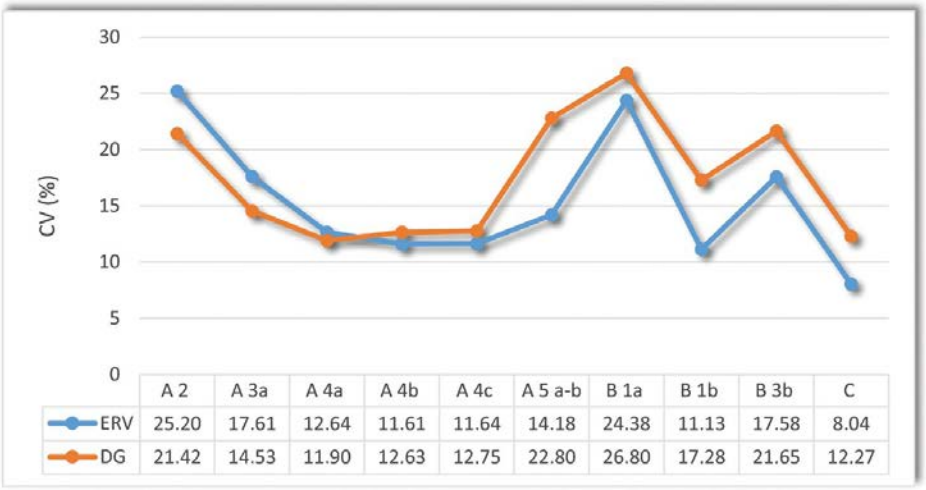
that this type of bowl shows no standardization. Type A 1 is divided into several variants, based on the height, wall thickness and rim radius; therefore, it would be unrealistic to expect a degree of standardization, when measurements are made on all variants of this type of bowl. However, if metric values focus on the same shape within a typological group, the CV is significantly reduced, and a certain degree of standardization is identified (*Table 25*).

The high degree of standardization observed on bowls, especially those of type A 4, does not come as a surprise, especially in view of the fact that bowls are the most numerous shape at both sites. As discussed in previous chapters, type A 4 is the bowl type with the highest presence at both sites, making up 40.32% of all bowls at Ervenica, and 28.81% at Damića Gradina. It was said previously that one of the analytical techniques used for the purpose of interpretation of the demand is the vessel's function. The function of bowls of type A 4 was serving and consumption of food that had not been thermally treated. Several important factors point to this. In addition to the bowl's morphology, there are no traces of oxidation on its exterior, nor traces that would speak of thermal shocks such as suffered by vessels constantly exposed to heating and cooling. Moreover, the GC-MS analysis (chapter 15) has revealed remains of wax, which was applied as a waterproof filter/coat on both the interior and exterior surface of the vessel, to prevent its liquid contents from escaping. Therefore, the reason for a higher degree of standardization of bowls of this type probably lies in their intensive use in everyday life, which implied an increased rate of wear, deformation and breakage, and thus also more frequent production and more experience in their manufacturing (*Fig. 82, p. 156*).

Repair marks present on pottery vessels, including perforations on both sides of the fracture, are present most frequently on bowls of type A 4, and those of type A 3a, which is an additional confirmation of the intensive use and wear of certain types of bowls and of their recycling and secondary use (*Fig. 28; Table 28*).

It has been established that the CV of pots is considerably high, especially of types B 1a and B 3b, while the variability of smaller pots of type B 1b is somewhat lower. A reason for the higher CV of pots is probably the size of such vessels, in that the manufacturing error increases linearly with the size of intended end products (Roux 2003a: 778). Confirmation of this could be found in pots of types B 1a and B 1b, since those are pots of the same functional shape, which are separated into different subgroups solely on the basis of their heights (type B 1a is m uch larger). The very low CV of the cups from Ervenica – 8.04% for rim radius and 4.57% for height – can be explained as a reflection of a small number of samples, although cups exhibit a relatively high degree of standardization, irrespective of their small share in the whole assemblage.

The chart showing the CVs for both sites, for all the types of pottery processed, is very interesting: the same CV curve can be observed in it (*Fig. 83*). The values that match the most pertain to bowls of type A 4, discussed above. Other values can be traced linearly for both pottery assemblages, which undoubtedly confirms that a certain degree of standardization of pottery vessels was present. The linear curve of the CV, with values for both sites dropping or rising equally, definitely confirms the presence of standardization which depended on the intensity of production of specific pottery shapes, which were present at both Ervenica and Damića Gradina, almost to the same degree. The metric data reveal that the size of vessels from both sites is relatively equable; thus, further analysis in a broader cultural-geographic area could provide indications of the possible economic function of a certain type of vessel.



	A 2	A 3a	A 4a	A 4b	A 4c	A 5 a-b	B 1a	B 1b	B 3b	C
ERV	25.20	17.61	12.64	11.61	11.64	14.18	24.38	11.13	17.58	8.04
DG	21.42	14.53	11.90	12.63	12.75	22.80	26.80	17.28	21.65	12.27

Fig. 83– Coefficient of variation for rim radius of the measured types from the sites of Ervenica and Damića Gradina

MODEL OF ORGANIZED POTTERY PRODUCTION IN VUČEDOL SOCIETY

The values obtained by the CV measuring for both sites discussed here undoubtedly point to a certain degree of standardization of pottery material. These percentages cannot be compared to those obtained by ethnoarchaeological studies, where the values do not go beyond 5%. Some researchers believe that the coefficient of variation should be a standard statistical technique, and they have endeavoured to provide basic values for a minimum and a maximum coefficient of variation used to establish the presence of pottery standardization. Thus a value of 1.7% is the minimum amount of variability, or the highest degree of standardization, attainable through manual production of pottery artefacts. It is also the limit of human ability to perceive a difference in size. A coefficient of variation of 57.7% would indicate that the pottery material is completely non-standardized. This value can also represent an error on behalf of a person creating typological groups, who has put different types into the same typological class (Eerkens & Bettinger 2001).

On the basis of the research carried out to date, it can be concluded that standardization reflects intensified production and manufacturing organization, that it arises from the economic and social framework of a community, and that it affects the homogeneity of the product (Miloglav 2012). The values obtained by measuring the CV point to standardization of certain types of bowls. The reason lies in the fact that bowls make up the largest pottery category, and in time their production reached a certain skill level, related to experience. The intensified production of bowls resulted in increased experience in their making, enhanced motor skills and a higher degree of product standardization, as indicated by results of ethnoarchaeological studies (Eerkens & Bettinger 2001). It is also very probable that bowls and pots were produced by different potters, because, generally speaking, higher standardization means a smaller number of potters/specialists.

In Vučedol society, an organized pottery production must have been present – it still took place within the household, but it was more intensive and oriented to trade and exchange both within and outside the household. We still cannot speak of workshop centres, but there is no doubt that a certain number of people stood out with their skills and took part in pottery manufacturing. The level of such specialization was not yet professional, in that pottery-making was

not a full-time job. The measuring results lead to the conclusion that there were several potters who manufactured ceramic vessels within a settlement. This can be read from the CV percentages, which vary considerably, making it likely that each of the potters introduced their mechanical attributes into the pottery making. Even when samples were taken from a single closed unit (pit SU 47/48) and measured, the CV percentages did not display any significant differences (*Table 26*). As a rule, a higher percentage of the coefficient of variation indicates a higher number of potters/specialists who produced the pottery, while a lower CV points to a single potter. Given that the pottery material from pit SU 47/48, the most prolific pit at the site of Ervenica in terms of pottery material, is not susceptible to 'cumulative blurring' and that the degree of standardization measured in it is no higher than the results of other measurements made on the material from both sites, we believe that this also corroborates the thesis that there were several potters and several pottery units within the settlement.

Ervenica - pit SU 47/48				
Type	**n**	**Mean**	**SD**	**CV**
A 4a - RR	4	13.27	2.20	16.58%
A 4a - WT	12	6.81	0.89	13.07%
A 4 - RR	6	13.85	1.92	13.86%
A 4 - WT	17	6.84	0.80	11.70%

n - broj ulomaka; SD - standardna devijacija; KV - koeficijent varijacije; PR - polumjer ruba (cm); DS - debljina stjenki (mm).

Table 26 – Results for the coefficient of variation of type A 4 from pit SU 47/48

The results obtained can be interpreted through the prism of the abovementioned four parameters that define the organization of production, described by Costin (1991: 8):

a) ***context of production*** – This defines the nature of control over production and distribution. In Vučedol society, control over the production of copper objects, that is, over metallurgical production, was probably in the hands of the elite. It is an important fact that this raw material was not easily accessible, and it could be found neither within the settlement nor in its vicinity; thus, the possibility of a certain social control over the raw material cannot be ruled out, since the finished products brought wealth, prestige and power. On the other hand, the elite would not have been particularly interested in controlling items of everyday use, for which raw materials were easily accessible. In the case of the sites of Ervenica and Damića Gradina, such raw materials could be found in the immediate vicinity of the settlements (Chapter 16). Although some signs of social inequality can be observed in Vučedol society, that inequality was still in the making, and it is unlikely that all segments of economic and political life were controlled. As for pottery production, it is more likely that it relied on independent specialists, who produced utilitarian objects for all the households and distributed them within and outside the settlement, without any control over the products and raw materials. Here, the possibility should remain open that certain special-purpose objects were ordered by better-off families or individuals, which has been confirmed by archaeological finds. The appearance of special-purpose objects, or vessels which stand apart from the standard pottery repertoire by their shape, size and decoration, has been ascertained in nearly all the sites of the Vučedol Culture,

including those of Ervenica and Damića Gradina (Pls 31, 32). Such vessels were manufactured by exceptionally skilful potters/specialists, and it cannot be excluded that there was a special category of specialists who produced particular types of vessels to which the community attached great social or religious meaning. The difference can be observed most easily at the site of Vučedol, which displays some visible marks of differentiation and the emergence of a large number of high-value objects. However, further analysis, study and testing should be made on the pottery material, to obtain data relevant for scientific interpretation.

b) ***relative regional concentration of production*** – This relates to the geographic organization of production, the way in which specialists are organized across the landscape, their mutual relationship and their ties with the consumers for whom they produce. This aspect of the production system could be the most difficult to define at the sites under examination. Although the two settlements were very large, and in terms of their organization they belong to large Vučedol sites, for the time being we can only speculate about the distribution of specialists across the landscape and about their mutual relationships. As far as distribution goes, it could have included supplying smaller settlements in the surrounding areas whose level of organization was not as high as in the settlements discussed here.

c) ***scale of production units*** – This includes the number of individuals working in a single production unit, and the division of labour. The pottery production was organized at a household level, and it could encompass several production units. Each consisted of individuals with certain knowledge, skills and experience, or even members of the same family. Since there is no direct evidence of labour division in an archaeological context, we cannot comment on it with certainty, but there is no doubt that tasks were divided on the basis of sex and kinship, since knowledge was passed down from generation to generation, usually within the same family.

d) ***intensity of production*** – This reflects the amount of time the potter spends and the way in which the production is organized, as either a part-time or a full-time occupation. Generally, it is very difficult to establish how much time was invested in production in an archaeological context. Taking into consideration a broader background of the socio-economic demands of the Vučedol community, the post of potter did not require full-time engagement which would imply that pottery manufacturing was the only daily activity. This task could have been performed alongside other duties in the community. For example, pottery could be fired in one part of the day, while the rest of the time could have been dedicated to other chores (tilling or animal herding). Furthermore, ceramic vessels were certainly not produced every day; rather, their manufacturing depended on the weather and economic activities. This means that pottery was not produced during rainy periods, and that manufacturing must have intensified during harvests and other agricultural activities. Bowls, the most numerous functional category, were most widely used in everyday life, and, consequently, they were worn, broken, repaired and manufactured the most frequently. A high degree of standardization of some types of bowls points to their regular production, a certain level of skill acquired through experience and less time spent on their making. It is also very likely that those bowls and pots that do not exhibit a high degree of standardization were produced by different potters. Generally, production at a household level can vary between less intensive and very intensive (Costin 2005:

1040), and many ethnoarchaeological studies have shown that the production which takes place in small communities, at a household level, can be very intensive even without full-time engagement (Henrickson & McDonald 1983; Hagstrum 1989). This parameter can be estimated on the basis of the total quantity of ceramic vessels produced by a single household/house during its lifespan (Naroll 1962; Brown 1987; Costin 1991; Loeffler 2003) – but, at both sites under examination, the formation processes have not provided sufficient data for such calculations.

The organization of production in Vučedol society can be best defined using the model proposed by van der Leeuw: it still took place within the household, but the production was mostly oriented towards the demand that existed outside it, that is, to trade and exchange beyond the household's consumption (Miloglav 2012: 51, Fig. 3). If we were to elaborate this further, the production was caused by a model of supply and demand whereby intensified pottery production was caused by enhanced economic activity, a growing population, and a social organization which showed signs of social stratification and the development of hierarchical relations.

Thus, the increased pottery production was a reflection of new socio-economic changes, and it included a division of labour within the scope of everyday activities. This can be explained simply with the system of supply and demand. The production had to be organized in such a way as to satisfy the population's daily requirements and to ensure that some products could be traded and exchanged. In addition, the demands of all layers of the society had to be met, from more affluent individuals/families to smaller and poorer households, whose demand did not go beyond satisfying their annual and seasonal need for pottery inventory.

In general, identifying and defining specialization and its importance in a society in archaeological terms is both challenging and ungratifying, because the relationship between specialization and the socio-political situation is very complex. However, it is worth reiterating that some parameters can already be identified during archaeological excavation (direct evidence) and during the processing of pottery material (indirect evidence). Finally, it is up to us to recognize those patterns and endeavour to interpret them as credibly as possible within the data available.