'Operational sequence analysis' applied to pottery making techniques in Korea

Park Song-Yong
Professor, the Department of Anthropology, Yeungnam University, Korea

ABSTRACT

This study uses 'operational sequence analysis' to examine the technical processes, methods and strategies that Korean potters have used in the adoption and rejection of new pottery technologies. We contend that the introduction of new technical elements weakens the relationship between the traditional agents of the pottery-making process. In particular, potters are compromising traditional techniques by using modern technology. On the one hand, potters still use traditional tools such as the bottom flattener, the wooden paddle, the anvil and cloth finishing strips while at the same time using improved kilns and electronic potters' wheels. This compromise has arisen because of changes in technical knowledge about making pottery which have resulted in this synthesis of traditional and modern methods. Anthropological studies will explain pottery-making techniques and knowledge relating to the craft in Korea on both macro and micro levels.

Introduction

In modern Korea, no operational sequence analysis of anthropology and folklore has been conducted to understand the techniques and technological choices potters make. Most research on pottery-making techniques has been done from an art historical perspective (Jung and Eddy 1973; Jeong et al. 2004) with only a few studies in the fields of anthropology or folklore. Examples of research topics in such disciplines include the historical origin and the changing processes of pottery making (Na Seon-hwa 2000), the current situation and future directions in pottery research (Lyeom Gyeong-Hwa 2001), pottery-making techniques (Bae Young-Dong 1997 and 2008; Sayers et al. 1987), terminology (An Ki-Nam 2008), the different forms pottery takes and how that relates to different cultural traditions (Park Song-Yong 2008a and 2008b), cultural boundaries seen from the perspective of cultural

diffusion (Kang Jeong-Won 2008), pottery and women's culture (Ito Abito 1985; An Hye-gyoung 2003; Kwon, Heon-Ik 2008), distribution and changes in pottery workshops in Gyeongju and the eastern coastal areas (Lee Chang-Un 2008a and 2008b) and the production and consumption of kkeomaegi pottery (Kim, Jae-Ho 2008).

The purpose of this study, however, is to review not only the relationship between technology and the pottery-making process, but also to see how new technical processes affect the way potters work, what technologies they have chosen to borrow and why. 'Operational sequence analysis' is an analytical tool which enables us to understand how technical knowledge affects the way natural elements are transformed to make artefacts. This type of analysis is useful in understanding the inter-relationships between historical periods when there were technical developments in the production process and the social relationship of production change (Cresswell 1975: pp.535-536).

Research on pottery in Korea has focused primarily on sequential descriptions of the manufacturing process. This, however, prevents an analysis of how manufacturing techniques, tools, raw materials and the cultural environment interact with each other. A systematic analysis is therefore necessary when it comes to understanding the historical development of pottery-making techniques, the variation in regional manufacturing processes, customs in usage (Kang, Jeong-Won 2009) and the behaviour of groups of pottery manufacturers.

To gain a comprehensive understanding of manufacturing techniques, the range of technological processes (Gosselain 2009) and the reasons why potters have chosen to use particular technologies (Van der Leeuw 2002), it is necessary to describe how raw materials obtained from the natural environment are transformed into artefacts and to explain the chronology of technological developments in the cycle of production.

Archaeologist Leroi-Gouran (1964) conducted research on ethnic groups, their technical environment and the material objects they produced. In introducing his theory of the 'operational sequence' approach, his research highlighted the significance of the technical environment in pottery-making in terms of the adoption and/or rejection of technologies.

Pottery-making is based on a specific system of material resources, tools, manufacturing process, skills, verbal and non-verbal knowledge and specific ways of co-ordinating work (Pfaffenberger 1992: p. 497). In Korea, the complexity of social relationships in pottery production went through various stages: decline and then a revival as society moved from an agriculture-based economy into the economic system of late industrialisation. Families and kinship organisations produced pottery as economically as possible, minimising expenditure and maximising efficient production methods (Park Song-Yong 2009: p.44). Throughout the whole process, from mining the clay to finishing the pot, the social organisation of the trade involves a whole range of people, from the skilled master potter to his assistants and labourers; there is a technical relationship between traditional and modern tools and a whole raft of folk traditions and technical knowledge relating to the craft. The main topic of our paper will be the problems that arise within this system.

In the following pages we discuss the technical process and the physical actions of the potters. We then analyse, at both macro and micro levels, how certain technologies have been adopted or rejected.

'Operational sequence analysis'

Pottery making requires raw materials, a socio-technical system and cultural location. Leroi-Gouran called this system a 'Chaîne Opératoire' (1964). Other scholars have called it a 'work chain' (Cresswell 1990), an 'operational sequence' (Lemonnier 2002) and a 'reduction sequence' (Shott 2003). Archaeologists use this analytical method to deal with lithic technology, epistemiological problems (Shott 2003; Tostevin 2003) and technical processes (Forestier 2000; Bar-Yousef et al. 2009). Anthropologists understand material culture as a social relationship of production and technical process (Cresswell 1975 and 1983).

'Operational sequence analysis' is a methodology for charting the chronological sequence of production. In other words, it provides a way of analysing the structure of the production process from raw material to finished product (Cresswell 1993: pp. 37-59) and pinpointing the

roles played by technical knowledge, tools, machinery and materials. The process of 'operational sequence' is a *logical method of analysis* (Cresswell, 1991: p.701).

When there are major technological advances and new equipment is developed, the whole production process, including the relative importance of certain jobs, is likely to be affected. Operational sequence analysis enables us to see how this happens (Cresswell 1975: pp.535-536).This analytical tool also plays an important role in enabling us to understand the natural environment and raw materials in the socio-economic context. Operational sequence analysis enables us to understand how all the parts of a production process are inter-connected (Lemonnier, 1980: p.1).

'Operational sequence' is a significant concept which we can use in our attempt to understand the inter-relationship between the elements concerned with pottery production. Making pottery uses materials such as clay and firewood and requires a team consisting of a skilled master potter (*daejang*), assistants (*geona*) and labourers (*ilggun*). The work process is divided into three stages, preparatory, shaping and finishing, each of which involves specific manufacturing techniques and tools. In effect there are functional links between the various elements of the processes. This internal technical logic is located within the social context. (Mahias 2002: p.162). In other words, the relationship of these elements is interdependent and the development process of each phase is logical and predictable. In particular, this method of analysis helps us understand the reasons why potters choose between traditional and newly-introduced equipment, what part natural elements play, the social relationship of production and how technology has social significance.

The other issue to be considered in the 'operational sequence' approach to pottery manufacturing consists of examining the socio-economic changes occurring on a nation-wide scale, because selection of manufacturing techniques can be more important at a macro-level than at micro-level. Economic, social and cultural changes brought about in Korea since the 1960s have changed the traditional production system. The spread of modern technologies means that local potteries no longer retain their individuality and a lot of ceramic production is now based in factories. Shifting from traditional

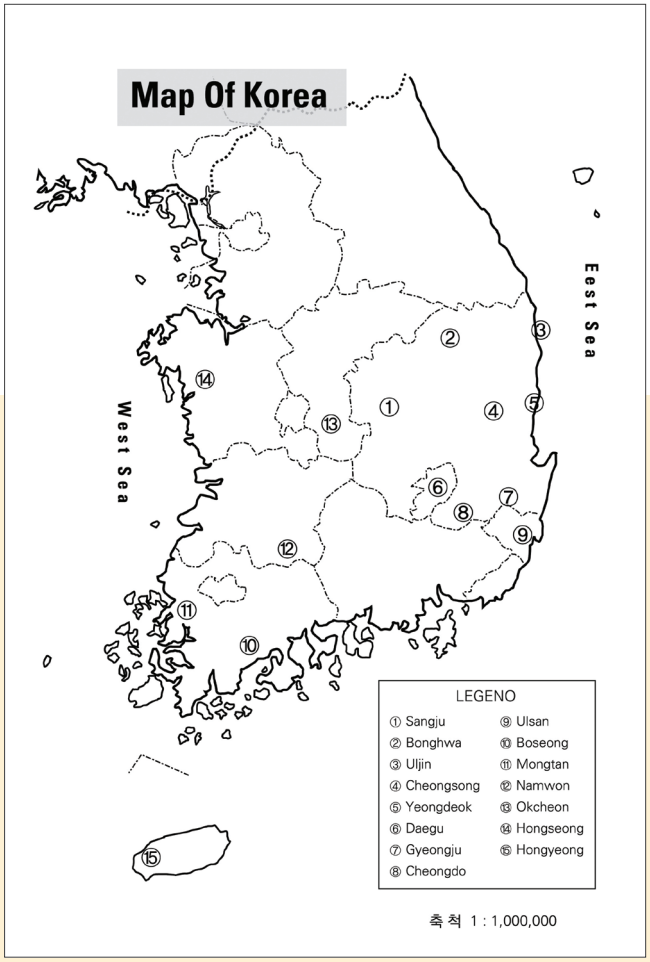

Figure 1
Location of the potters mentioned in the text

manufacturing tools to modern ones has led to various changes in technique. This means that the 'operational sequence analysis' of pottery manufacturing will necessitate a simultaneous examination of the macro-national economy determining major matters of national interest, as well as of the practical strategies found at the micro-manufacturing level.

Ethnographic survey

This study focused on skilled master potters, assistants and labourers from all across Korea: eight from Gyeongsangbuk-do, one from Gyeongsangnam-do, two from Jeollanam-do, one from Jeollabuk-do, one from Chungcheongbuk-do, one from Chungcheongnam-do and one from Jeju-do. Most of them were over sixty years old and had been making pottery for more than forty years. They were therefore well qualified to explain pottery making techniques, distribution processes and the history of the pottery villages.

Firstly, the participants in the study learned the techniques of their craft in the traditional way – as skills handed down from generation to generation. For them, a family constituted a production unit. These families were not geographically mobile and the areas in which they lived correspond in most cases to the regions where pottery is made.

Secondly, since the 1960s potters have replaced their traditional kilns with new ones. However, when faced with the choice between traditional and electric potters' wheels they are more likely to compromise.

Thirdly, the social relationships that characterised pottery making communities were based on the way the trade was organised technologically prior to the 1960s when men were paid according to the job they did and their level of skill.

Workers formed a stratified, socio-technical relationship involving the factory owner, the skilled master potters, the potters' assistants and the labourers. During the process of transition from subsistence economy to the economy of post-industrial society, producers reduced the number of employees as various jobs were amalgamated in an attempt to maximise profits. Typically, the factory owner acted as the master potter and used family members to assist him rather than hiring in outside labour.

A survey of these artisans was conducted between July 2007 and August 2009. We initially visited potters living in provinces all across the nation and collected ethnographic data about the regional diversity of pottery-making techniques, individual life stories and information

Figure 2
Spreading soft white clay on the wheel

Figure 3
Beating the bottom of the pot to flatten it

Figure 4
Shaping the pot using a paddle

Figure 5
Smoothing the surface with a pine scraper

Figure 6
Using a leather strip to form the rim

Figure 7
Removing the pot from the wheel using a cotton sling

Author's photos taken in Cheongsong in 2009

about the potters' technical knowledge. While collecting this data, we conducted in-depth interviews about changes in technique and the development of technology. This gave us information about the process of making clay rings for coil pots, methods of shaping wares, surface treatments, drying, firing and finishing processes. We also collected ethnographic data on the ways in which potters adopted or rejected new pottery-making techniques.

Techniques

The pottery-making process can be divided broadly into three processes: preparation, shaping and finishing. Preparation involves mining and transporting the clay, then sieving and kneading it and removing all the impurities. The second stage, shaping, consists of placing the treated clay on the potter's wheel, shaping it, applying surface treatments, shaping the rim, engraving patterns, drying the clay form and applying ash water to form a glaze. The final stage is finishing - decorating, glazing and smoothing off any rough bits prior to firing. The next stages are firing and checking. (Jung Myung-Ho and Eddy 1973; Jung Myung-Ho 1987; Bae Young-Dong 1997; Song Jae-Sun 2004; Park Song-Yong 2009).

There are at least ten main processes that have to take place in sequence: sourcing the clay; blungeing; throwing/coiling/slabbing; drying; decorating; glazing; stacking the kiln; firing; cooling and unloading; fettling and checking. Firstly, clay containing a suitable mix of minerals has to be selected. To organise the work requires a factory owner, a skilled master potter, assistants and labourers. The factory owner provides the funding. The master potter is the senior worker who is also responsible for the exacting tasks of setting and firing the kiln. The assistants help the master potter and manual labourers do the rest of the work. The social relationship between these men is based on the jobs they do and their level of expertise.

Clay can be acquired in two ways. It can be bought ready-processed for pottery making, alternatively the potters can dig the clay themselves at a nearby pit. Few potters now employ labourers to dig their clay and the quality of pottery across the nation is becoming standardised as more and more potters use ready-prepared clay. At a pottery that still uses traditional methods, labourers dig the clay with traditional tools like shovels and picks and take it to the workshop on A-frame carriers. However, to a large extent factories producing ready-prepared clays have substituted mechanical diggers and lorries for men with picks and shovels carrying loads on their backs. Mechanical blungers are used to prepare the clay for sale. Technological changes have played a significant part in the extraction/preparation process.

The clay used by traditional master potters is called *yakto* or 'locally-mined clay' and it is classified according to its colour and mineral composition. It varies from district to district. Mr. Lee, Hak-Su (aged fifty-nine, from Boseong, Jeollanam-do) describes *yakto* as being clay containing decayed fallen leaves that is slightly black in colour. Mr. Lee, Mu-Nam (aged sixty-seven, from Cheongsong, Gyeongsangbuk-do) regards the clay which has five colours - shades of yellow, red, white, blue and purple - as being the best. Mr. Kim Jin (aged sixty, Jeju-do) calls the clay containing volcano ash and sea sand *yakto*. Skilled master potters and their assistants have to understand the properties of clay such as colour, viscosity, quality and resistance to heat and how it performs in the kiln. These traditional folk classifications of clay are losing their cultural significance as standardised, homogenised, ready-prepared clays are now in general use across the nation. Generally speaking, traditional technical knowledge about locally-mined clay is being lost because of the commercialisation of raw materials.

There are various methods of preparing clay depending on the size and type of the vessel to be made. For example, potters prefer the clay to be slightly drier with less water when they are making larger pots but slightly softer with more water for making smaller pots.

The next process deals with the preparation of ash and ash water for glazing. Ash is mainly made from pine wood and rice straw. When making the glaze, the potter mixes ash with water in a ratio of 4:3, 7:3, 6:4 or 10:4 depending on individual preference and region. Ash water mixed in this way is sieved once and processed three or four times more using a sieve with a fine mesh. Sieving usually takes about a day but it does not have to be done at any specific time of day. The glaze is stirred with a long wooden stick to make sure the ash is mixed evenly. Deposits left at the bottom are diluted with water

and are then passed through a sieve. In the past, ash water for pottery was usually prepared by assistants but nowadays it is made jointly by a skilled potter and his assistants. Ready-prepared glazes are also available in powdered form and used in several places.

The sharing of roles that used to be specialised is also demonstrated by the workers who use the 'L'-shaped clay slicer to remove sand and stones from the clay. While the potter and his assistants complete the shaping process, the labourers are also engaged, especially in preparing the clay which is critical, removing impurities and air bubbles in it. All of them, however, use the same traditional tools. Pine wood flatteners are used to mould the wall of the vessel and an anvil is used to form the inside of the pot. Paddling is done with a wooden paddle. Scrapers made of persimmon wood are used to smooth the surface of the pot inside and outside. The final smoothing is done with a leather strip or a cotton pad. These tools are designed because they work best with the physical properties of the clay and the potter's skill. Moreover, although there is an environment in which *new technical features should be appropriate for the existing practices* (Lemonier, 2002: 14), some traditional techniques and tools continue to be used.

Rotating the pottery wheel is an important part of this process. Some traditional wheels have been replaced by steel electric wheels fitted with bearings. Nowadays, potters choose either traditional or electric wheels, whichever they find most convenient. The electric wheel offers the advantage of providing a smooth and even outer surface due to a faster spin speed. However, less skilled potters have difficulty in shaping pottery on an electric wheel because it goes so fast. Older potters often prefer traditional wheels because they have got used to working in a certain way and find it difficult to adapt to the new physical movements they need to operate an electrical wheel (Park, Song-Yong 2009: pp. 30-31).

The next processes to consider are coiling and slab building. Methods of coiling vary from region to region (Lyeom Gyeong-hwa 2001). Potters living in Gyeongsang-do prefer coiling while those in Jeollanam-do and Jeollabuk-do prefer slab building. Coiling the clay in rings is mainly done by the skilled master potter, who uses flatteners, anvils, trapezoids, wooden scissors and strips of finishing cloth. Mounting the clay rings and slabs is chiefly done by the master potter together with his assistants.

In addition, the skilled potter and his assistants engrave designs, dry the pots, glaze and stack the pots in the kiln. They engrave the designs with a wooden knife or their bare hands. The skilled master potter, his assistants and labourers work jointly to dry the pots in the workshop. The skilled potter and his assistants work together to stack the pots in the kiln and build the fire. Potters pay the utmost attention to the intensity of the fire and how heat is transmitted as this is crucially important in determining how the pots will turn out.

Physical actions

The technology affects the potter's physical behaviour – the ways he uses his body. Mauss (1967) called it the *techniques of body* which means the physical actions related to a particular technical process. The technical process and physical actions form the operational sequence. During pottery making these include, ways of using hands and tools, the techniques of making joints when moulding the walls of the vessel, and the technical action of creating and shaping the vessel.

The potter's actions are related to the rotary motion needed to spin the pot on the wheel during the process of throwing and controlling the pot shape (Vander Leeuw 2003: p.260). To turn the wheel the potter performs such actions as sitting, kneeling, squatting and pivoting. He needs to manipulate the clay so that it remains malleable while he is throwing the pot. Lastly, he needs to mould, squeeze, press and stretch the clay with his fingers. Such ordinary skills vary from regional to region. As aforementioned, potters from Jeolla provinces use the slab building technique while those from Gyeongsang provinces prefer the coiling method.

Firstly, the coiling technique calls for various hand skills depending on the type of vessel being built. For the slab building technique, potters frequently use tools as the slab is often wider than their hands, and they use their fingers less than in the coiling technique. Potters from Jeolla provinces often use an anvil and paddle to extend the slab by pounding it. In the coiling technique, potters use their thumbs and index fingers more frequently when raising the wall of the vessel.

Secondly, potters from all across the nation generally tend to make very thin pottery. The technique used to support the vessel wall can affect its thickness. Potters from Gyeongsang provinces use many clay rings which are drawn upwards from the bottom to form the vessel wall and their pottery is relatively thicker than that of Jeolla provinces. Pottery from this area is relatively thinner as potters there make the vessel wall by extending slabs of clay.

Thirdly, for the slab building technique, potters put a slab around a cylinder wall and then place another slab over it and level the joint off evenly using a paddle (Sayers and Rinzler 1987: p.200). The potters typically work and extend the clay with their thumbs. The potters use their index fingers to create the desired height and vessel wall thickness.

Fourthly, in the clay ring technique, a version of coiling – building a pot from layers of clay rings, potters put the joint together by adding a thin ring of clay at the junction when raising the vessel wall in a process called *Goyeok Doligi*. On the other hand, potters using the slab building technique press with their left hand against the inside of the horizontal joint while connecting the upper and lower slabs along the external joint using their forefingers with a force which can hollow out a shallow groove. Potters choose slightly different techniques depending on whether they are making a large vessel, whether it enables them to work quickly, individual preference and the effect they are trying to achieve.

The process of spinning the potter's wheel does not vary regionally. The speed of the spinning wheel, the potter's skill with his hands and the surface treatment of the pottery are all functionally related (Park, Song-Yong 2008: p.194). Potters and their assistants use the rotary and centrifugal force of the wheel. The most important factors in using the wheel are the spin speed, momentum, stability and the absence of any vibration (Rice 1987: p.134). When working on a pottery wheel the potter turns the wheel with his foot, holds his working hand firmly on his thigh on the same side and regulates the speed and spin of the wheel according to the size and type of pot he is making. A fast spin speed makes for a smoother surface and an even shape. However, potters who are not so good with their hands may produce misshapen wares if the wheel goes too fast.

When shaping a pot on the wheel, the potter needs to make the rim the right shape. Doing this involves tools, finger movements, clay quality and traditional techniques. The process of shaping by potters nationwide generally consists of centring the clay on the wheel, moulding it with tools, smoothing off the surface and controlling the height and width of the pot. In the process of moulding the form potters should consider at each stage to what extent they will let the pot be inclined inward or outward at its belly and shoulder. The thickness of the vessel wall and rim has to vary according to whether the pots are to be placed in the lower or upper part of the stack for firing in the kiln. Pots placed in the lower part should have slightly thicker rims and walls as they are required to withstand the weight of other pots placed on top of them. The rims and walls of the pots placed in the upper part of the stack should be made thinner to lessen the load on the pots below. Further differences naturally arise depending on the individual potters. During the process of raising the body of the pot, one hand is used to fix the shape with the other hand supporting it. When raising the vessel wall the way in which the potter's thumbs, ring fingers and long fingers are used is important. The extent to which each finger has contact with the clay and the shape of bending fingers play different roles when making the bottom, belly and rim of the pot.

For levelling off the surface, potters use a shaping tool made of persimmon wood. A shaping tool made of pine with resinous knots should not be used if possible as it is likely to leave scratch marks. Shell scrapers were used as trapezoids until the 1970s. Some potters still use a sharpened piece of a broken pot.

After levelling the surface off, potters use a soft piece of thin leather to make the rim and absorb the water in the clay at that point. If the rim is softened with too much water it will affect the strength of the pot which may break during the drying process. After making the rim the potter measures the mouth, height and width of the pot using a pine stick gauge.

The next stage is to apply ash water glaze, to the dried pot. For larger jars, ash water is applied using a kettle. Smaller jars are dipped in a container of ash

water, spun around by hand and then pulled back out. Two men spin the pot around, turn it upside down and put it back in the ash water again three or four times. The glazed pots are left drying in the sun. The dried pots are divided into 'normal condition' and 'abnormal condition' – those that have developed cracks, broken or become distorted.

After being stacked and placed in the kiln, the dried pots are fired. The stacks of pots should be made level by using wedge stones placed under them. For a stack of smaller pots, one small wedge stone is used. For a stack of larger pots, two or three wedge stones will be needed.

Potters consider firing the most important process. Fires are classified according to their colour, intensity and the density of the smoke into 'beginning', 'middle', 'large' and 'window' fire stages (as described by Mr. Lee, Mu-Nam of Cheongsong, Gyeongsangbuk-do). The 'beginning fire' is that which is built with only smoke rising. The 'middle fire' corresponds to a temperature of about 700 degrees C and can be obtained a few hours after building the fire. The 'large fire' corresponds to a temperature of about 900 degrees C and has a bright colour. Lastly, the 'window fire' means a fire built by putting pine twigs into each window of the kiln in an attempt to adjust the temperature. If twigs are put into the windows when the pots have begun to glow, the pots will distort slightly and then return to their original condition. If the pots are not red hot they will break. Conditions inside the tunnel kiln need to be adjusted. Pinewood is best for a 'window fire' as it burns fast and cools fast. The use of other wood for a 'window fire' will make the surface of the pots dirty. Potters can determine the degree of success of the fire with 80-90% accuracy just by examining 'window fires'.

After a 'window fire' the kiln entrance and all the holes in the side are sealed off. This is to let the pots cool off slowly in the kiln in order to prevent breakage. Cooling takes four to five days in summer and three to four days in winter. Potters can gauge the temperature in the kiln by looking at the changing colour of the pots as they are being fired.

Adoption and rejection of technology

To understand how artisans adopt or reject new pottery making techniques it is necessary to examine their choices from the perspective of changes in the economic system at the macro-level and in the context of the relationship between materials, social influences and techniques. Although pottery making techniques are usually handed down over time within a regional community, under certain circumstances potters may sometimes deliberately borrow techniques from elsewhere.

Due to the forestation initiative undertaken by the government since the 1960s, traditional pottery making techniques have been influenced by the introduction of modernised kilns and the shortage of firewood. The latter problem has introduced the use of ashes from plane, acacia and apple trees and rice straw as substitutes for pine ash in glazing. Potters also began to borrow modern tools to prepare clay. Artisans began to use extruders instead of wooden mallets. Before such modern tools were available, they carried the clay with A-frame racks, poured water onto the clay and kneaded it by hand, trod it and pounded it with mallets. The clay mass was then cut into several pieces which were kneaded again and rolled into a suitable sized pieces for making clay rings. Nowadays, however, bought, ready-prepared clay is loaded directly into an extruder which rolls out clay rings ready for use. Before the introduction of extruders much of this work was done by the potters' assistants and the skilled potters, assistants and workers all made the clay rings together. These changes illustrate the way potters have adapted to a new socio-technical environment.

On the other hand, some potters have adopted completely new technical processes. With the appearance of many new potteries from the late 1960s, it became difficult for them all to obtain good quality clay within a 4km radius. The clay they found was mixed with stones and sand and had to be refined. The potters introduced a washing operation to remove sand which had been traditionally applied to porcelain production. The clay was first mixed with wooden paddles in a square box, and then strained into an adjoining settling tank through a fine screen. After repeating this operation several times, the liquefied clay was conveyed by a swing scoop onto eight drying beds lined with straw mats (Sayers and Rinzler 1987: 145). This illustrates how artisans learnt to cope with constraints that come from

the natural environment.

Other than borrowing technology to cope with changes in the external environment, potters have sometimes chosen to compromise their traditional manufacturing techniques by using commercial methods. In the traditional wheel used before the 1950s, a wooden plank and pivot were made of wood from the jujube tree which was hard and durable. The wheel was made from a jujube stake driven into the ground and the portion of the stake left sticking out of the ground was cut into a cone shape to make the hub of the wheel. The body of the wheel was usually made from a pine plank. The jujube tree stake held the disc firmly in place to prevent it from moving. The wooden plank was rotated and the lump of clay to be thrown was placed on this upper wheel head. In the upper and middle parts of the stake a set of jujube tree pivots were provided to allow the wooden plank to rotate. The upper pivot was called the 'female pivot' and the middle pivot was called the 'male pivot'. If the wheel made a creaking sound while rotating, cottonseed oil was applied to the pivots using cotton soaked with oil.

After the 1960s potters nationwide began to adopt the electronic wheel as it was more efficient and lasted longer. The electronic wheel enabled potters to make pottery at faster speeds with a daily production increase of three to four pots (Park Song-Yong 2009: p.30). However, not all potters used the electronic wheel; some refused to change and stuck to the traditional wheel because the electronic wheel's faster spin speed did not suit their way of using their hands and their surface treatment techniques.

Although some technical elements are compatible with both adoption and rejection, traditional technical elements have sometimes been replaced completely by modern ones. The kiln is an example. The structure of kilns used for pottery production has been greatly improved. Potters find that the new kilns do not have all the technical problems inherent in traditional kilns (Park, Song-Yong 2009: p.25). In traditional kilns, the tunnels might collapse, fuel consumption increased over time and the kilns needed constant maintenance as they were likely to enlarge, contract or be damaged by the heat from repeated firings.

Because it is so important to control the transmission of heat in the kiln, potters were keen to replace traditional kilns with improved ones which allowed the flow of flames to circulate throughout the entire tunnel and made it possible to adjust the intensity of the fire. In the new kilns, pottery matures from the upper part while in traditional kilns the heat is transmitted directly upward so that the pottery matures from the bottom. Another advantage of the new kilns is they allow for very even firing. In a traditional kiln a pot may fall during firing and damage or break other pots. The new improved kilns have partitioned chambers, each of which has a flame inlet, so that one broken pot does not destroy a whole kiln full of wares. They also have windows through which potters can check the progress of the firing and adjust the temperature by putting in additional firewood. To build a traditional kiln, the ground must be excavated to a certain depth and earth piled over it in the form of an arch. Potters prefer the modern, improved kilns over traditional ones because of their higher efficiency and lower maintenance costs (Park Song-Yong 2008: p.192). According to potters, the production volume from one of the improved kilns is one-and-a-half to two times greater than that from a traditional one.

Mr. Heo Deok-Man, who made pottery at Namchang, Ulju-gun, Gyeongsangnam-do, was the first person in Korea to use a chamber kiln – in about 1953 - and this marked the start of the nationwide spread of such types of kiln. Unlike traditional kilns, this new type of kiln used oil for fuel which was more economical than firewood, and this, too, encouraged the spread of these kilns across the country (Cultural Heritage Administration of Korea, 1990: 127). In addition, the new kilns increase firing efficiency and reduce the failure rate by having fire inlets and chambers inside and window holes outside. As well as being more efficient, the new kilns allowed potters to be more creative because they could sell more pots and suffered fewer breakages in the kiln.

Conclusion

This study has used operational sequence analysis as a tool to describe and analyse the technical process, the potters' physical movements (or 'body technology') and their adoption or rejection of technology. The direct and indirect relationships between the various elements of pottery making have also been described.

After the 1960s, Korean pottery production witnessed a transition from pottery workshops to factories and a gradual conversion to modern manufacturing technology. With the introduction into the market of vessels made of new materials suitable for apartment-style living, traditional pottery began to lose its role. Due to such socio-economic and technical changes, the numbers of handicraft potteries and pottery villages has been drastically reduced (Park Song-Yong 2008: pp.181-212).

'Operational sequence' is a useful and significant way of analysing the inter-relationships between processes and the inherent logic of the technical process for each stage. We have tried to understand the technical processes and 'body techniques' used in pottery making and the strategies potters have applied in choosing to adopt or reject technologies.

Firstly, an 'operational sequence' approach to the pottery-making process at micro-level is useful when taken in conjunction with an understanding of the techno-social and economic factors which are changing the national economy and material civilisation. Incremental technical changes in manufacturing technology have come from macroscopic changes in the technical environment rather than from the inter-relationship between the various technical elements of the pottery-making process.

Secondly, Korean potters are now searching for new technological developments in an effort to maximise profits. In particular, their choice of technologies for the process of making pottery relates to social strategies as well as to the availability of raw materials and tools. They select those technologies they consider useful, combining traditional and modern manufacturing methods in an attempt to reduce their failure rate. The introduction of new technical elements weakens the relationship between various traditional components in the working process. Potters are attempting to discard traditional management approaches and save labour costs by using simplified manufacturing processes through the introduction of mass production systems.

Thirdly, we have explored the processes of pottery manufacture by focusing on continuity and discontinuity in traditional technologies. On the one hand, potters use traditional tools like flatteners, paddles, anvils, cloth finishing strips and traditional pottery wheels, while on the other hand, using improved kilns and electronic potters' wheels. Nowadays, potters running studio workshops are trying to save labour costs and simplifying their manufacturing processes because of competition from producers who have discarded traditional ways of manufacturing and management and have instead introduced strategies to cope with the new economic environment. To deal with this new socio-technical environment, producers are adapting selectively by adopting strategies to maximise technical efficiency and pursue economic rationality, while retaining some traditional aspects of the production process. Artisans have adopted extruders and improved kilns in an effort to speed up production to suit the new socio-economic climate.

Fourthly, changes in the socio-technical system at both macro and micro levels have affected the roles and position of pottery producers and production units. Changes in the nature and number of members of pottery-making teams, and in the ways they work, are specific examples of such developments. The migration of potters to metropolitan areas, the adoption of innovative manufacturing technologies and changes in product distribution networks are all factors that have a major impact on the composition of manufacturing groups. In particular, teams of workers that used to consist of five or six men now have just one or two members. This is the result of the adoption of adaptive strategies to reduce the size of the production unit in the transition from a subsistence economy to the economic system of a post-industrial society in an attempt to overcome the economic crisis. The reduced number of workers has caused factory owners to assume the role of the master potter and his assistants and to share his job with the other workers.

Fifthly, with the number of separate jobs in the pottery industry declining, and while manufacturing techniques have generally been standardised, there are a few traditional techniques that continue to be handed down in each individual region. Slab building and coiling techniques are specific examples. The former is practiced mainly in Jeolla provinces while the latter is used in all of the other provinces.

This study has examined the processes by which traditional and modern techniques have been selected. This information will be of help in providing the ethnographic data necessary to understand the characteristics of the technical knowledge now being utilised by Korean potters.

To overcome the limitations of the present study, the following aspects will have to be addressed. The path by which pottery-making techniques have developed over time needs to be examined at each stage of historical development in terms of manufacturing tools, raw materials and technical and social relationships. Further research will have to be undertaken on the materiality of pottery in different eras, the geographical distribution of kilns nationwide, the distribution networks for pottery and the life stories of potters, to give an insight into how traditional technical knowledge is created or destroyed under the influence of new technologies and new technological information. In addition, we need to conduct surveys on how folk terms, semantic systems and representations of meanings are constructed, in order to gain a better understanding of the ideology that informs, and has informed, the making of pottery

We are now faced with a situation in which advances in the technical environment and the adoption of modern production techniques and economic gains have almost destroyed traditional methods of pottery production. Galla (2008: p.13) emphasised the importance of the 'voice' of the bearer of intangible heritage in safeguarding cultural rights. Further research, on a nationwide scale, is urgently needed to protect and sustain the cultural diversity of the master potters and their assistants who maintain traditional technical knowledge about making pottery.

REFERENCES

An, Hye-Gyoung, 2003, *Research on the Use of Pottery and Women's Domestic Work - Case Studies in Geumdangsil, Yecheon,* MA Dissertation, Seoul National University.

An, Kwi-Nam, 2008, 'Derivation of Pottery Terminology - Focusing on Names of Jars in Gyeongsangbuk-do Province' in *Minjok munhwa nonchong* (*Journal of Korean Cultural Studies*) 39: Institute of Korean Cultural Studies, Yeungnam University.

Bae, Young-Dong, 1997, 'Pottery-making Techniques and Sales Method' in *Yeoksa minsokhak* (*Korean Historical Folklore*) 6: The Society for Korean Historical Folklore.

Cresswell, R., 1975, 'Rapports techniques et rapports sociaux: l'exemple de l'Irlande' in *Ethnologie et Histoire* (Melanges offerts à Charles Parain). Paris: Editions socials: pp. 535-536.

———. 1983, 'Transferts de techniques et chaîne opératoires' in *Techniques et Cultures,* 2.

———. 1990, 'New Technology revisited' in *Archeological Review from Cambridge* 9: pp. 39-54.

———. 1991, 'Technologie', in P. Bonte et M. Izard (sous la direction de), *Dictionnaire de l'ethnologie et de l'anthropologie*, Paris: P.U.F: p.701.

———. 1993, 'Tendance et fait, logic et histoire' in *Techniques et Cultures* 21: pp. 37-59.

Cultural Heritage Administration of Korea, 1990, *Interpretation of Intangible Heritage*: p.127.

Forestier, H., 2000, 'De quelques chaîne opératoire lithiques en Asie du Sud-Est au Pléistocène supérieur final et au début de l'Holocène' in *L'Anthropologie* 104: pp. 531-548.

Galla, Amareswar, 2008, 'The First Voice in Heritage Conservation'.in *International Journal of Intangible Heritage*. Vol.3: p.13.

Gosselain, O. P., 1992, 'Technology and Style: Potters and Pottery Among Bafia of Cameroon' in *Man*, New Series 27(3): pp.559-586.

———. 1999, 'In Pots We Trust: The Processing of Clay and Symbols in Sub-Sahara Africa' in *Journal of Material Culture*, 4:205.

Ito, Abito, 1985, 'Pottery and Housewives' in *Hanguk munhwa illyuhak* (*Korean Cultural Anthropology*), 17.

Jung, Myung-Ho, 1987, *Pottery*: The National Ministry of Cultural Heritage.

Jung, Myung-Ho, and Eddy, R.L., 1973, 'On the Pottery-making Process at Pottery Workshops in Korea' in *Archaeology and Ancient Art History* 119 and 120.

Kang, Jeong-Won, 2009, 'Imitation and Distinction: How they exchanged *'Suldurumi'* for food at a wedding ceremony at Gimcheon, Gyeongsangbuk-do' in *Jibangsa wa jibang munhwa (Journal of Local History and Culture),* 12:1.

Kim, Jae-Ho, 2008, 'Production and Consumption of Kkeomaegi Pottery and Its Significance in Cultural History in *Minjok munhwa nonchong (Journal of Korean Cultural Studies)* 39: Institute of Korean Cultural Studies, Yeungnam University.

Kwon, Heon-Ik, 2008, 'Jangdok, Family and Family History'. Paper presented at the International Conference on Cultural Maps and Boundaries, Institute of Korean Cultural Studies, Yeungnam University.

Lee, Chang-Un, 2008a, 'Essay on Drafting a Cultural Map on Pottery Workshops' in *Minjok munhwa nonchong (Journal of Korean Cultural Studies*) 39. Institute of Korean Cultural Studies, Yeungnam University.

———. 2008b, 'Distribution and Changes in Pottery Workshops on the East Coast' in *Minjok munhwa nonchong (Journal of Korean Cultural Studies)* 40: Institute of Korean Cultural Studies, Yeungnam University.

Lemonnier, P.1980. *Les Salines de l'Ouest: logique technique, logique sociale*. Paris: Editions de la Maison des Sciences de l'Homme.

———. 2002. 'An Introduction', in P. Lemonnier, (ed.), *Technological Choices: transformation in material cultures since the Neolithic,* London: Routledge.

Leroi-Gouran, A., 1964, *La Geste et la parole: technique et langage,* Paris: Editions Albin Michel.

Lyeom, Gyeong-Hwa, 2001, 'The Present State and Tasks of Pottery Research - Focusing on its origins, locality, and scientific characteristics' in *Saenghwal munnmul yeongu (Research on Living Civilizations)* 2: The National Folk Museum of Korea.
Mauss, M., 196,. *Manuel d'ethnographie,* Paris: Payot.
Maihas, M-C., 2002, 'Pottery Techniques in India' in P. Lemonnier, (ed.) in *Technological Choices: Transformation in Material Cultures Since Neolithic,* London: Routledge.
Na, Seon-hwa, 2000, 'Study on the Origins of Pottery' in *Je sam-ui jeontong, onggi-ui wollyu-reul chajaseo (In Search of the Origins of Pottery),* the Third Tradition, Ehwa Womans University Museum.
Park, Song-Yong, 2008, 'Cultural Boundaries According to Vanished Pottery Shapes' in *Minjok munhwa nonchong (Journal of Korean Studies)* 40: Institute of Korean Cultural Studies,Yeungnam University.
———. 2009, 'The Technical and Social Systems of Pottery Production: the case of artisans in Gyeongsangbuk-do' in Jibangsawa *jibang munhwa (Journal of Local History and Culture)* 12(1): pp.7-44.
Pfaffenberger, B., 1992, 'Social Anthropology of technology' in *Annual Review of Anthropology* 21: pp. 491-516.
Rice, P. M., 1987, *Pottery Analysis,* Chicago: The University of Chicago Press.
Sayers, R., and Rinzler, R., 1987, *The Korean Onggi Potter,* Washington: Smithsonian Institution Press.
Shott, M. J., 2003, 'Chaîne Opératoire and Reduction Sequence' in *Lithic Technology,* 28(2): pp. 95-105.
Song, Jae-Seon, 2004, *Korean Pottery: History of Potter,* Seoul: Dong Mun Seon.
Tostevin, G., 2003, 'Levels of Theory and Social Practice in the Reduction Sequence and Chaîne Opératoire Methods of Lithic Analysis' in *Reduction Sequence, Chaîne Opératoire, and Other Methods: the Epistemologies of Different Approaches to Lithic Analysis*. Papers from an Electronic Symposium held at the April 2006 meeting of the Society for American Archaeology. New York: Springer.
Van der Leeuw, S., 2002, 'Technological Choices' in P. Lemonnier (ed.) *Technological Choices: Transformation in material cultures since the Neolithic,* London: Routledge.