An Essay on Interdisciplinary Kiln Research and Agile Research Design

Maria Shinoto

Abstract: Archaeological research on kiln sites involves a wide range of additional disciplines in order to answer questions that archaeologists pose on their material and findings. Since kiln research typically poses questions on material used and processed, on the construction of kilns and firing technology which can only be solved with methods from natural science and engineering, kiln research is interdisciplinary in the first place. This essay summarizes the experiences of a decade of decidedly interdisciplinary research at the Nakadake Sanroku Kiln Site Center and other projects, tries to categorize the various patterns of collaboration and emphasizes the importance of an “agile” approach, which turned out to improve the results significantly as compared to traditional interdisciplinary research patterns.

Keywords: Agile Research, Interdisciplinarity, Archaeometry, Natural Sciences, Engineering, Research Process, Communication

4.1. Kiln research and interdisciplinarity

Archaeology benefits greatly from methods, theories and tools borrowed from other disciplines. Our sources are material remains of human life uncovered from the soil. Our method is excavating and documenting with words, drawings, photography, structured data and 3D data. The technology for excavating and documenting is getting increasingly sophisticated in the course of technological evolution in other disciplines, and recent developments are breathtaking. But excavation and documentation alone does not create a sensible narrative for understanding the past, the society, or whatever we are looking for to understand. Archaeologists need knowledge, ideas, methods, and tools from other sciences in order to make sense of their sources.

Kiln research is one of those fields of archaeological studies that are particularly dependent on interdisciplinary work. The construction and material of a kiln, the firing process and the firing material have to be understood from the point of view of an engineer as well as a potterer, excavated materials have to be handed over to mineralogists and other specialists in material sciences in order to understand the heat stress on the material and draw conclusion about temperatures and firing duration. Geologists can help finding sources of raw materials and, together with mineralogists, can offer hypotheses about the processing of the raw materials into an intermediate product that is then fired in the kiln. Of course, experiments under strict scientific observation and in cooperation with potters and other practitioners – whose expertise from another non-scholarly angle is highly valued – can help solving this problem from an additional angle. This is in contrast to a more archaeocentric and discipline oriented understanding, an understanding that is more focussed on problems, and which adds methods from various disciplines and even non-scientific knowledge to a project when needed. Thus, the constellation of disciplines involved in a problem may change in the course of the ongoing research due to new insights. However, the archaeologist stays in the center since research on kiln sites as such almost always starts with the finds and findings – the typical matter of archaeological study.

The interdisciplinary aspect in kiln research is not limited to questions of materials and technology: The social and political organisation of the craftsmen, accessibility of material and distribution of products as well as their role in the historical development of the region are another important aspect. In these cases kiln research is more leaning towards the humanities and collaboration with historians, sociologists, economists – to mention only the most obvious relations. This book introduces studies that deal with parts of all of these aspects in different regions and times, but this essay shall concentrate on cooperation regarding the technological and material aspects rather than on cooperation with researchers from other disciplines in the humanities. Cooperations between archaeologists and researchers from the natural sciences or engineering departments can pose problems on a research project because of the different “cultures” or traditions in these departments as compared to the humanities.
This essay is mainly based on the author’s experience of coordinating research and continuous discussion and exchange between researchers from various disciplines and nations in the Nakadake Sanroku kiln site center in South Japan (Shinoto et al. 2015, see also chapter 17 in this volume) among several others. Intermediate reflections on these experiences were presented at International Conferences. A first talk during the WAC8 conference in Kyōto (Shinoto 2016) stressed the roles of attitudes like curiosity, incomprehension, indifference, while the second talk on the SEAA8 in Nanjing (Shinoto 2018) discussed advantages and dangers of agile research design.

Rather than introducing the content of interdisciplinary research, this essay shall focus on the why and how.

4.2. Types of interdisciplinary research

Typically, an interdisciplinary research project is understood as successful when all contributions are integrated in the result and form a vital part in the final discussions. However, the integration of all contributions and vital participation of all researchers in the course of the whole project from its outset to the final stages leads to more, deeper, and even unexpected insights as compared to an approach where the archaeologist poses certain research problems to a research group and waits for the results to be presented at the end of the project.

The intensity of mutual exchange or the integration of different disciplines may differ significantly in different research projects, and it is important to keep in mind that the circumstances for kiln research vary as they do in every archaeological project: There are rescue excavations that leave no time for discussion but require the excavators to save information for later that is at danger to be lost and therefore just organize separate scientific investigations. A short term project may be focussed on a limited question with a small group of researchers that does not need any formal discussions and exchange. Finally, long term projects with a wider range of research questions and larger groups of researchers from various disciplines may need some consideration of how research should be organized in order to gain really new, unexpected insights. The following classification keeps this variety of circumstances in mind but is most closely related to the latter scenario, the long term project which is predominant in kiln research as soon as production centers are concerned.

Looking at how research is done in the real world, a classification with four levels of integration seems applicable. Each level has its merits and demerits that have to be discussed and understood when designing research on a kiln site or a kiln site cluster.

4.2.1. Multidisciplinary or parallel research

Multidisciplinary research describes a rather parallel kind of working, with no real exchange between the fields. One may think of a project with several unrelated subprojects: Dating of features or layers with radiocarbon dating in one group and thermoluminescence dating in another group, creating a geological map for material research in a geological sub project, while doing research on chemical and mineralogical characteristics of the products in another subproject and mapping archaeological prospections by archaeologists, to name some examples.

In most cases, each of these subprojects finishes with a report that may be published separately as a journal article or as a chapter in a final, comprehensive report on the larger project. Nobody from the different subprojects or disciplines will understand what happens or what could be learned from each other before the final publication. In some cases, all results will be integrated in an overview by a project leader in the final stage of a project as another chapter in the report, in other cases, the reports from the respective disciplines stand only for themselves without further integration.

This kind of research design can often be found in excavation reports, where scientific studies like biological determination of species from wood or bone remains, or results of material analyses or scientific dating is added as a separate report of data without further discussion. Such parallel research is good practice as long as excavations or investigations into cultural heritage are to be documented urgently and left for later, advanced and integrated research. Each of the disciplines – archaeology included – offers information and data from its own research for further usage without offering overall “sense”.

The relation between the disciplines may be characterized by the terms “indifference” or “ignorance”, and while each subproject seems to be autonomous, the overall concept is hierarchical: Every discipline serves one central person or institution that will later use the data for whatever purpose – without discussing with those who provided the data. While this is inevitably part of research reality, these characteristics seem to be the root of problems in interdisciplinary research that can be observed frequently. These are (a) missing out of synergy effects and new learning as well as (b) lack of satisfaction or enthusiasm for the overall research.

(a) Synergy effects and learning: To start with an example from kiln site research, it is obvious that a geological map integrated with a historical map and distribution maps from archaeological prospection will inevitably lead to new insights and better options for the interpretation of findings in each of those maps. Exchange between geologists working on the geological map with mineralogists who analyse the material of kilns or ceramics is clearly necessary in order to understand the interaction of landscape and people. In a parallel research design, everybody keeps his or her own results separate, and a distribution map of archaeological finds alone for example
will not help understand how geology contributed to a certain distribution pattern as long as the geological map is created, presented and discussed separately, without informing the archaeologists creating their distribution map from surveys.

Deeper understanding is not always the aim of a project. However, academical research should aim at overall understanding, new insights, and relations that were unknown in the past.

**4.2.2. Phased exchange**

A slightly more integrated approach is what may be called a phased exchange. In parallel research, the results are presented to colleagues and the public simultaneously at the end of a project and influence research only afterwards, with phased exchange, intermediate results are presented to colleagues in the course of a project, often provided with intermediate reports in workshops on an annual basis, after “half time” or towards the end of the project.

These workshops may become an inspiring platform for exchange, adjustments and progress. On the other hand experience shows that due to time constraints these workshops often turn out to be a mere exchange of results in order to confirm that everybody is “on track”. It is more important to get the own presentation done and well rather than incorporating ideas and results from other work. In order to escape this trap, a good organisation that encourages discussions and adaptation to new insights in the next phase is necessary. This is the responsibility of the project leaders, but more than that, researchers participating from different disciplines need a certain amount of curiosity towards and understanding of the other disciplines as well as an interest in the overall project and its aims in order to react flexibly on research going on in various sub projects.

Although “phased exchange” in interdisciplinary research does still allow for mutual incomprehension between the disciplines, in order to really stand out from “parallel research”, on the side of the participants it needs to overcome indifference toward the other disciplines involved and to the overall project aim. Not at last, it demands a certain understanding of all disciplines from the side of the project leader in order to monitor the exchange during workshops and other phased events. Since the organisation depends on these qualities of the project leader, interdisciplinarity with phased exchange may still be characterized as hierarchical. It should be obvious though, that phased exchange if done well may encourage a certain progress in the course of the project and will prevent the lack of satisfaction mentioned in relation to parallel research.

**4.2.3. Continuous integration**

Continuous integration or cooperation may be the most fruitful form of research, where specialists from each field do not only exchange their final results but almost continually exchange and discuss intermediate insights and problems arising during the course of the whole project. In this case, research design evolves on common ground, based on a comprehensive understanding of new results from various disciplines. In the continuous process of exchange, research design may be altered, new questions may turn up while other questions may be abandoned – because they are valued as “solved” or due to new insights from the ongoing research process which show that these old questions are not relevant. New interdisciplinary cooperations between researchers or groups may form according to these changes. This is where agile research design comes into play, which will be discussed below.
To expand on the example from above: Geologists may map an area with a certain soil quality that is not suitable for building kilns and report this to the archaeologists who could then shift their prospections and search for distribution of kilns to a more suitable area; the archaeologist in this case is not a hierarchically higher person that needs to be reported to, but rather a partner for solving a thematic problem who needs this information in order to adjust the activities. In the same project, researchers creating a historical map may better understand certain patterns thanks to insights on soil quality and hypothetical kiln distribution that they receive as soon as possible from their partners in the departments of geology or archaeological prospection. In other cases, a historical map may reveal historical activities that have destroyed areas in the kiln site cluster, and together with geologists and 3D surface data, the whole group of researchers working on different maps may attempt to set up hypothetical models about the original distribution of kiln sites in the region.

In an ideal world, all participants discuss on equal ground, but experience from the Nakadake Sanroku project shows that a managing part is often necessary in order to keep the discussion going and to give all researchers a voice. Language, research tradition, personal preferences, or character form barriers that cannot be overestimated. The managing part can understand its own role hierarchically, but rather than transferring well defined research problems to subprojects or collecting results from a higher position like in phased exchange, the managing part should facilitate discussions and encourage mutual development of ideas and common research problems among the researchers from various fields. These researchers may ideally form independent ad-hoc groups if an opportunity for exchange arises.

This stage of continuous integration will encourage identification of each researcher with the project as a whole, the ongoing process will lead to a certain degree of mutual understanding, and an ideal outcome can be described as follows: (1) Research problems and processes that could not be envisioned at the start of the project will turn up in the course of a project and thus significantly promote knowledge and understanding. (2) Like in the saying “the whole is more than the sum of its parts”, final results reflect a knowledge that exceeds the capabilities of separate “sub projects” and of a single project leader; they lead to a new and comprehensive understanding.

Figure 4.1. On a tour guided by archaeologists in the forests of the Nakadake Sanroku Kiln Site Center; a geologist and a potterer take the lead and discuss potential raw materials and their change in quality during natural or artificial processing. (Foto M. Shinoto 2016).
There is another side of the coin, and this is the danger of working with immature, intermediate research results. Before a whole project abandones certain questions or focusses on a new perspective, it is important to assure that the intermediate results are valid to state a new hypothesis. A gradual adaptation, starting with some tentative collaboration among a small group of researchers is a good starter for such adaptations; and the continuous exchange about the chosen paths with the managing part is imperative.

4.2.4. Incorporation

Incorporation is the most integrated form of interdisciplinary research. In this case, one person covers several disciplines and acts as an archaeologist and as a scientist of one or more disciplines at the same time. Archaeologists may perform chemical analyses with pXRF on site, they may specialize on the use of a microscope for mineralogical analyses, others may specialize on wood as the object of their research. These kinds of incorporation of several roles in one person can be fruitful and dangerous at the same time.

Archaeologists have incorporated new technologies since the early stages of the discipline; the documentation of findings with photography may be one example. In the beginning, and in some cases even until today, photographic documentation was the job of specialists, but in the course of the decades, the technology became easier to use and archaeologists, though not specialized on photography, are now in the position to incorporate this technology into their own workflow. A similar trend can be seen with 3D documentation. Ultimately, incorporation of the technique by the archaeologist can be helpful in these cases, since the archaeologist sees what has to be documented, and rather than discussing this with a specialist, it may be easier to execute the task oneself. On the other hand, the fruitful discussion between experts with different backgrounds gets lost in this case.

While these are examples of possibly successful incorporation, others which are closely related to kiln research may illustrate negative side effects. In recent years, chemical analysis of pottery with portable XRF performed by the archaeologist is increasingly popular, but a chemical analysis is more than just looking at numbers produced by a random machine. An understanding of the weaknesses and limits of the technology and the applicability of the outcome to a certain research problem have to be understood as well as the meaning of certain elements in the mineralogy and the ceramic system.

After all, the incorporation of foreign methods, technology, and research topics like chemistry by the archaeologist is an extension of archaeological tools, but it is imperative that the archaeologist has sufficient knowledge about (1) the nature of the measured object and (2) the limitation of the method used in comparison to alternative methods.

Finally, recent decades show a trend of archaeologists being trained as experts in certain fields or technologies like pollen analysis, analysis of wooden artefacts, scientific pottery analysis to name just a few. Certainly, the expertise of two disciplines unified in one person, the accumulation of knowledge about archaeological research on wood only e.g. has great potential. As long as the researcher is not just “trained to use a machine” but has an equal expertise in archaeology as well as the other field and is able to follow the research development in the related disciplines, this approach is most promising and as such also valuable in a project oriented at “continuous integration”.

4.3. Agile research

When it comes to continuous cooperation like in the third stage of interdisciplinary integration, an agile research process is most appropriate. The following sections will discuss what this means, why it is appropriate, discuss its strengths and pitfalls, and not at least, share some ideas on the process and tools in an international academic environment, where people from different cultures, with different languages and from different time zones cooperate on a common goal with different methods.

Since 2013, a group of nearly twenty researchers from various disciplines and countries work in a cooperation in Japan’s southernmost Sue kiln site center, Nakadake Sanroku in Kagoshima prefecture (see chapter 17). The planning phase started on a smaller scale in 2012, and while it was the intention from the outset to design the whole research process as an integrated process according to Stage 3 as described above, the growing number of researchers and disciplines involved posed some serious challenges to the organization. Such organization was the task of the author who is also involved in digital applications and developments, therefore choosing the agile concept was an option that suggested itself. This chapter will introduce incentives for choosing an agile approach, the research design and tools as well as the conclusions the author draws from experiences in several interdisciplinary projects. After all, the strength of this approach – the speed and dimension with which knowledge increases and new perspectives arise – is significant. But there are pitfalls to be aware of, which might be balanced with a well thought-out set of rules and tools.

4.3.1. The concept

The idea of “agile” was first introduced by software developers in 2001 in the “Manifesto for Agile Software Development” (“Manifesto...” 2001) with a set of values and twelve related principles. Although it can be assumed that the ideas have been practiced naturally earlier in a less formalized way and in a variety of businesses, the manifesto made the idea explicit and paved the way for a more fundamental and standardized implementation. The idea spread from software development to other business fields, and a whole industry of consultants dealing with “agile” and related approaches like “kanban”
Table 4.1. Values and principles in the Agile Manifesto

<table>
<thead>
<tr>
<th>Values in the Agile Manifesto</th>
<th>Contrasted traditional values</th>
<th>Keywords to corresponding principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals, interactions</td>
<td>Processes, tools</td>
<td>Continuity, collaboration, motivation, simplicity, self-organisation (1, 4, 5, 10, 11)</td>
</tr>
<tr>
<td>Working software</td>
<td>Comprehensive documentation</td>
<td>Results, sustainability (7, 8)</td>
</tr>
<tr>
<td>Customer collaboration</td>
<td>Contract negotiation</td>
<td>Collaboration, motivation, face-to-face conversation (4, 5, 6)</td>
</tr>
<tr>
<td>Responding to change</td>
<td>Following a plan</td>
<td>Flexibility according to changing circumstances, frequent delivery, sustainability, adjustments at regular intervals (2, 3, 8, 12)</td>
</tr>
</tbody>
</table>

and “scrum” has developed since, creating a sometimes rigid formalization. Not at least because of this overformalization, “agile” has become heavily criticized and is even considered “dead” at times. Some of the first and best known statements in that regard were made by Dave Thomas in 2015 (Thomas 2015).

Such a reaction of insiders in the software industry should be of no concern in the context of interdisciplinary research. First of all, as mentioned earlier, “agile” is the explicit formalization of natural ways of interaction in collaboration that had previously existed, and thus can be expected to be a durable concept in the future as well. Secondly, as long as the formalization process is not overdone for the sake of itself, it is worth considering and drawing conclusions about the process of interaction in interdisciplinary academic collaboration. A look back to 2001 when everything started with enthusiasm may help to get some ideas. The values and principles of the original manifesto are summarized in Table 1.

Obviously, the focus in the Agile Manifesto is on software development and customer relationships. In kiln research, these may be replaced with research on the one side and internal interdisciplinary collaboration and public communication on the other – which may become more obvious below.

Not all of the principles mentioned in the manifesto are of interest for research teams, but mainly continuous exchange among individuals as well as highly motivated individuals that continuously communicate about their results and demand results from others seem to be responsible for unexpected progress in unforeseen directions. Also, the more motivated an individual is the more he or she is willing to self-organize smaller groups and exchange ideas directly with other researchers.

Starting with the last pair of contrasting values in Table 1 – either responding to change or following a plan – the parallels to interdisciplinary research are obvious. Projects are mostly planned out in the outset, funding is closely linked to certain institutions and selected research partners from beginning to the end of the project, and they are supposed to work on a fixed range of research problems and material that is estimated at the beginning of the project. The project will follow this plan if it is designed with an interdisciplinary integration of level 1 (parallel research) or level 2 (staged exchange) in mind. In certain cases, a researcher or a single research group may change the course of a certain analysis or method applied just in their realm of methods – mostly in case of unexpected problems and in order to keep up with the original plan and adapt the procedure to achieve the original goals. Obviously, continuous interaction between individuals is the easiest way of information exchange and for adaptation of goals and research design. However, conversation in larger groups needs rules and some form of formalization as well as standardized tools; these will be discussed below.

The second value pair of working software in contrast to comprehensive documentation cannot easily be converted to the world of research. Although “working software” may stand for “meaningful research” or “acceleration and broadening/deepening of research”, thorough documentation is certainly demanded and thus in no contrast in the case of research.

The third constrasting pair of values – customer collaboration versus contract negotiation is less obvious in their relation to research design. Although contract negotiation has its counter part in project applications, it is difficult to decide whether the customers are the foundations or institutions that donate to research, or whether the academic and non-academic public that finally receives the research results should be considered the customers. The important point is to ensure that applications do not lead to fixed workflows that cannot be adapted to new insights; and where possible, sporadic exchange about the course of the project with the donating institutions may help in changing directions and re-direct funds.

The 12 principles published on the website of the agile manifesto give some more detailed ideas of how the values may be implemented and summarized.

- Individuals are motivated and able to continuously collaborate and spontaneously self-organise and to adapting a complex research problem to changing circumstances and new insights.
- Frequent delivery and exchange of intermediate results for discussion, and in order to receive ideas from those with a different expertise, face-to-face communication and adjustment of plans in regular intervals is key to achieving the utmost goal: insights. This relates to insights that were envisaged in the planning stage of the project, but also those that come to the surface unexpectedly.
4.3.2. Advantages

Advantages of agile research management are similar to those in software development: New insights in one area or by a group of related researchers are immediately accessible to the project, which can in turn react upon the insights accordingly. Developments adapt to research results in a significantly shorter period of time, particularly, adaptations occur in the course of the project rather than after the submission of all isolated results after the project is closed.

4.3.3. Constraints and problems

The agile idea of teamwork was based on the reality in office work in 2001: Sharing the same office and having face-to-face communications on a day to day basis. But not only in software development this is not the reality any more in 2021, and it was never true in interdisciplinary research. It is well known that the earliest developments in asynchronous communication over the internet were implemented by researchers at the CERN, and the overlap between research and software development has continued ever since. Teams can form with members on a global scale, both in the software industry and business as well as in research. Technical problems can be overcome.

However, there is a decisive difference that separates teamwork in research from teamwork in business: The human factor has a larger impact because researchers with special expertise are rare, only few individuals or institutions can replace each other, while software engineers with similar backgrounds are distributed in almost all regions of the world. Therefore in research, it may be necessary to bend the principles of agile to time zones and the personalities involved – rather than expecting personalities with experience and well established routines to adapt to the principles of agile. Worldwide distribution of researchers, traditional biases towards other disciplines, different background as regards culture, society, language, and personality of a researcher may hamper continuous exchange on equal grounds.

Another pitfall of agile research design may be immature reasoning and decision making in cases where new findings are adopted without sufficient critical examination.

The worldwide distribution of researchers is a problem that can be solved with a mixture of focussed meetings and the use of the internet, as will be explained below. However, biases between disciplines or methods do exist, and it is sometimes impossible to encourage the conversation between members of opposing camps. Of course, choosing the appropriate research partners from the start is one solution to the problem, but not always possible.

Furthermore, an interdisciplinary project brings together people of different native language, cultural and social behaviour, academic traditions and the different thinking and behaviour common in their respective disciplines. All these factors are even obstacles to the implementation of a smooth conversation whenever people with these backgrounds meet somewhere face to face. However, they become more serious whenever a conversation has to be kept alive over the long period of a project and over several continents and time zones without personal meetings.

English is the lingua franca in nowadays academia, but still not felt as a natural means of conversation or discussion in certain academic communities. Language can keep people away from the discussion, and it is particularly difficult for persons of a more introvert character to actively take part. Finally, in a larger project some research progresses quickly for whatever reason while other research needs longer to produce results that will be useful for the whole group. It needs mutual understanding and trust to keep all members actively contributing to the community and waiting for those who need more time.

4.4. Implementation of continuous integration and agility

Continuous integration can be the most fruitful approach to interdisciplinary research, and an agile research design with clear communication of rules, duties, and rights is the appropriate way to reach or get beyond original research goals and to create a project that is driven by common excitement about the subject and its development. Such success does not come naturally, and the following paragraphs discuss experience with some tools for communication and organization. Unfortunately, there is not yet a comprehensive solution that fits to all potential scenarios.

The recent years are characterized by an overwhelming dynamic in the development of communication tools in and outside research, but also – in the realm of scientific research – by the development of new value systems as regards open and fair data in the European Union (2016) and elsewhere (e.g. “Forschungdaten.info” 2021), as well as the increasing demand for transparency of the whole research process – even in the documentation of archaeological excavations (e.g. Boyd et al. 2021). Additionally, formal contracts between researchers or research groups are increasingly enforced by universities in interdisciplinary research.

Both phenomena will be important factors for the successful implementation of agile research processes in the future for two reasons. Firstly, with open and fair data becoming the norm in thinking about research data, the wide spread understanding that data are the property of the researcher who produced them, is becoming a minority’s view which can be excluded from agile research processes in the outset while the majority will accept sharing data and insights during the research process as a natural concept.

Secondly, with explicit contracts being the norm, writing down clear rules and potential sanctions is becoming just
another natural step at the beginning of a research project rather than a sign of “lack of trust” as it might have been interpreted earlier. On the other hand, this change in research culture and common sense still seems limited to some regions or disciplines, and is has to be seen how and with which pace archaeological research in East Asia will evolve.

With these developments in mind, the following ideas about cooperation, based on technology available at the time of this writing, may give some ideas of how to – or how not to – organize kiln research or other interdisciplinary projects with agility in mind.

4.4.1. An organizing hub

In a small project, the project leader will have an overview over all research questions, methods, and researchers involved. But in projects with a wide range of research questions and methods, assistants serving as a facilitator may become necessary. They need a certain understanding of the whole project and of the methods or disciplines involved, and should be able to draw new links between research questions and results, methods and researchers – in order to create cooperations that overcome the limitations of isolated work on a certain problem. Furthermore, a certain command of the language of the counterparts is helpful, as well as personal acquaintance of the researchers – which is not always possible.

The workload of a facilitator cannot be overestimated, and there is an aspect of self sacrifice. On the one hand it is inspiring to think across the borders, implement new ideas and encourage the specialists to give new ideas and cooperations a try. On the other hand, fact is, the results are presented by others, and the scholarly value of the contribution of a facilitator or organizer may be disputed. While this is finally a question of mutual respect as regards the contribution of the rôle of each participant, it is always a good idea to discuss expectations and commitments clearly at the beginning of the project.

4.4.2. Formal implementation of conversations

The best conversation happens naturally and in personal. At least annual meetings seem to be necessary to keep up the dynamics among the group members, but they are not easy to implement due to financial or time constraints. Meetings at the start of a project and before summarizing the results at the end seem to be a good compromise that should be part of the project finance plan; in longer projects intermediate meetings are desirable. But how to keep the conversation going between these highlights?

Video conferences have become a replacement of personal meetings in many cases in the course of the pandemic that started in 2020. It already has become obvious beyond doubt that video conferences will help greatly in further implementations of agile research design. In the Nakadake Sanroku project, they are now covering a large amount of the interdisciplinary discussions between the continents. Not at least the option to chat in the course of the verbal discussion helps with language problems. Together with a rigid track of the contents of discussions in written protocols, video conferences have largely improved the agile workflow.

Email being spontaneous, direct, and asynchronous, is convenient and the most popular means of communication – at least, we all know it very well and use it daily. Unfortunately, it is a mess when it comes to get organized, since with emails it is almost impossible to track who was part of which conversation and what the final decision was in a certain case. Except for short term consultations on a particular, preferably non scientific topic between two persons where email is still the most convenient tool, email should be replaced by other tools for serious discussions.

A modern conversation platform like SLACK demands constant access to the software, in many cases immediate reaction in order not to fall behind in a group, and due to the noise that comes with it, is not as transparent as needed. The author has been part of several attempts from several sides on various occasions to introduce such a platform to an academic conversation, but it never lasted. Not at least, most conversation platform software is proprietary with all its demerits and should be avoided for this reason alone. In the future, better organized OpenSource tools may replace these solutions which then may also replace the next suggestion: a forum.

Forum software is not only OpenSource, easy to implement and transparent to all members. It offers (1) sub forums on sub topics or temporal topics for a more closed conversation between members of varying access rights, it serves as a (2) self-documenting system without need for protocols, and not at least, it offers (3) asynchronous participation with all its merits like in email. The author is an avid supporter of the forum solution, but unfortunately, at least in the Nakadake Sanroku project, this approach was equally unpopular as the modern conversation platforms mentioned above. Reasons may be as follows: (a) The necessity to open a browser and log in as well as doing this regularly in order to actively participate in the conversations seems to be too much of a barrier for most of the researchers. A forum thread needs serious thinking and writing because it is semi-public and stays open to the forum members, while an email can be written more leisurely.

A wiki is a solution similar to a forum, it has the advantages of being OpenSource and offering various access rights for users as well, but the focus of a wiki per se is less on the ongoing conversation but rather on presenting results of a conversation. So despite being a solution to create a final report, it is not suited for ongoing conversations.

A distributed version control system like git with options like GitLab or GitHub and Bitbucket should
not be ruled out as a tool of communication in such a research project. They offer a range of tools for conversation and problem solving; and of course, since git was introduced to create software, it combines well with agile project management. But a distributed version control system with its fixed rules and technical aspects may be too much for most members of a project from the humanities department. In the experience of the author during the last years, distributed version control can only be implemented in an interdisciplinary workflow with smaller groups of researchers with experience in programming at this point in time but serves the purpose well where it is chosen.

After all, in order to include the technically less inclined, the author suggests the combination of a forum and video conferences for the project or sub projects in combination with sporadic email exchange between two or three persons on matters of no public or scientific interest as a means to compensate the lack of personal meetings on a frequent basis. An explicit agreement on the conversation style between all participants at the beginning of the project may help getting over the first time where this approach is not yet familiar.

4.4.3. Integration of members and formal agreements

As mentioned above, integration of all researchers into the discussion can be a problem due to a variety of reasons. It is the job of the project leader or facilitator to keep the discussion going and guarantee fair usage of research data. An agreement on the form of conversations and on the frequency of the conversations may be an additional means, but it is difficult to enforce a discussion with rules. However, rules may be a means to raise awareness regarding conversation in the beginning.

4.5. Conclusion

Archaeological kiln site research requires the integration of methods and knowledge from a variety of disciplines based in the humanities, in engineering, and in natural sciences; not at least it requires knowledge and experience from practitioners.

The most fruitful research is done when all members of a project are in constant exchange regarding ideas, newly arising problems, and upcoming results on equal terms, thus offering precious insights to other members and influencing the course of the whole project before final reports are written. Such vivid exchange is a chance, but it inevitably consumes more time and effort than isolated research on a fixed problem. Furthermore, it bears the problem of unbalanced contribution of the participating researchers due to a variety of factors.

Each of these potential problems has to be considered when setting up clear rules and agreements at the start of the project and whenever another researcher joins in the course of a project. A central figure needs to monitor the behaviour of the participants; this central figure will in most cases be the project leader or a researcher in charge of organizing the interdisciplinary part, never being above but always being a partner of the researchers. An important responsibility of such a central figure is to keep the conversation between the research groups going, to be aware of chances, new topics arising and to stimulate new cooperations in the project. A certain command of the languages of the researchers involved, some knowledge of the various methods and materials is essential for this role, while active participation of each researcher with as little interference as possible by organizers is most desirable.

After all, broader and deeper insights, even unpredictable insights can be expected from a project that is driven by enthusiasm and cooperation of all participants and which benefits from an agile approach.

Acknowledgements

The author wishes to thank Dr. Radegund Hoffbauer, a model for interdisciplinary dialogue and cooperation since student days, Prof. Nakamura for starting the agile experiment on a large scale, and my colleagues from various disciplines.

References


Abstract: Provenancing of ceramics, i.e. the establishment of a ceramics physical origin, greatly enhances our understanding of ancient civilizations, their cultural development, exchange and movement patterns. Basing provenance studies on objectively measurable and reproducible data like the chemical composition of the material offers important insights in this respect. Various multivariate statistical methods are in use to analyse the large datasets produced by analytical methods like Neutron Activation Analysis (NAA). Of those statistical methods, a well established method using a modified Mahalanobis Distance that takes measurement errors as well as dilution effects (best relative fit factors) into account has repeatedly proven its usefulness specifically for the provenancing of ancient ceramics. Three examples from recent studies, two from East Asia and one from Northeast Africa show what the combination of NAA and this statistical approach can provide beyond simple establishment of a ceramic sample’s origin.

Keywords: Neutron Activation Analysis; Best relative fit; Provenancing; Ancient ceramics; Statistical analysis

5.1. Introduction

Provenancing of ceramics is important for understanding ancient civilizations, their cultural development and their exchange and movement patterns. Provenancing by archaeological means alone presents difficulties because typologies, changes in form or pattern, and even production techniques can be exchanged between sites. Basic raw materials like clay, however, are very rarely exchanged over significant distances. Objectively measurable and reproducible data, like the chemical composition of the material, provide additional information on the raw materials used in production which can lead to a much clearer understanding of provenance and cultural exchange (e.g. Jones 1986).

Provenancing, i.e. the assignment of a sherd to its production site based on chemical composition, relies on three basic premises:

1. The object under investigation is chemically homogeneous.
2. All objects within one group or provenance preserve and share their chemical composition.
3. Objects from a different origin have a clearly distinguishable chemical composition.

Reliance on those three premises is a challenge and provides an opportunity to go beyond the mere localization of ceramics. An important part of the first premise, the homogeneity within one sample, is that the sample size under investigation needs to be large enough to be representative of the sample as a whole and represent the bulk chemistry while ignoring surface contaminations. The second premise refers to the fact that different production techniques, or recipes that require e.g. mixtures or cleaning of raw materials, can potentially lead to different chemical compositions, allowing for more than one group or chemical fingerprint within a single production site.

Differentiation of changes to the chemical fingerprint due to changes in production techniques are usually small but systematic (e.g. Garcea et al. 2020; D’Ercole et al. 2017). Thus, recognizing such changes and correctly assigning analyzed ceramics not only to a production site, but to a specific production technique or period within the production site, requires statistical analysis of the compositional data specifically suited to detecting those minute changes. A ceramic-specific multivariate statistical filter that is able to reduce the variation introduced into the dataset by inconsistencies in the paste production was developed in Bonn in the 1980s (Mommsen, Kreuser, and Weber 1988; Beier and Mommsen 1994). Provenancing based on chemical composition as described above puts several restrictions on an appropriate analytical method to measure the chemical composition. The method needs to be able to measure a multitude of elements, especially many of the minor and trace elements, to be able to “see” such minute changes in the composition as would be expected from e.g. differing mixtures or the introduction of a coloring agent.