Gathering, Translating, Enacting

A study of interdisciplinary research and development practices in Technology Enhanced Learning

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Declaration

I declare that I have composed this thesis by myself and that it embodies the results of my own research. Where appropriate, I have acknowledged the nature and extent of work carried out in collaboration with others included in the thesis.

Sanna Rimpiläinen

Acknowledgements

As Latour (1988) showed in his study of Pasteur, no-one alone is behind a piece of research. While this is an independent study that I have carried out, I could not have done it without the support and help of the extensive network of people and things that have gathered around this endeavour during the past three years.

It has been an extraordinary privilege to do a doctorate as part of the Ensemble-project and the Technology Enhanced Learning Programme. I wish to thank the UK Economic and Social Research Council for funding the studentship (grant ES/G032025/1) enabling this study to take place. I am forever grateful for everyone at Ensemble for being so co-operative, patient and helpful with my research topic. It has been a great pleasure to work with you and get to know you. Without your participation this study would not exist. This PhD is for all of you.

Out of Ensemblers I would especially like to thank my supervisors, Professor Richard Edwards, the Head of the School of Education at the University of Stirling, and Professor Patrick Carmichael, from Liverpool John Moores University; Richard for dragging me into the jungle of Actor-Network Theory, and opening up a totally new world to me in doing this. I have really enjoyed working with you! Patrick, my second supervisor and a former colleague, I am grateful for initially suggesting that I apply for this studentship, for all his support during the three years of it, and for being generally an inspiration.

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One of the effects of the PhD project - combined with the lengthy road works between Glasgow and Stirling and the confined household space - is my 'Shed', the office in the garden, where this study has largely been written. With the help of a functioning internet access and a crowd of friends within reach on Facebook the experience has not been so lonely. Thank you for keeping me company and egging me on.

Richard kept asking me once in a while during the first year of supervision if I was having fun. Being Finnish, I didn't think PhD should primarily be fun – it is a serious business! However, I can say whole heartedly, regardless of all the inevitable stress and anxiety, that I would not change the past three years for anything. Yes, it has been fun!

Abstract:

This is an ethnographic case-study of research and development practices taking place in an interdisciplinary project between education and computer sciences. The Ensemble-project, part of the Technology Enhanced Learning programme (2008-12), has studied case-based learning in a number of diverse settings in Higher Education, working to develop semantic technologies for supporting that learning. Focussing on one of the six research settings, the discipline of archaeology, the current study has had three purposes. By opening up to scrutiny the practices of research and development, it has firstly sought to understand how a shared research question is answered in practice when divergent research approaches are brought to bear upon it. Secondly, the study has followed the emergence of a piece of semantic technology through these practices. The third aim has been to assess the advantages and disadvantages of Actor-Network Theory (ANT) in studying unfolding, open-ended processes in real time. Through *critical ethnographic participation,* multiple ethnographic research methods, and by drawing on ANT as *theoretical practice,* the study has shown the precarious and unpredictable nature of research and development work, the political nature of research methods and how multiple realities can be produced using them, and the need for technology development to flexibly respond to changing circumstances. We have also seen the mutual adoption and extension of practices by the two strands of the project into each others' domains, and how interdisciplinary tensions resolved, while they did not disappear, through pragmatic changes within the project. The study contributes to the interdisciplinary fields of Science and Technology Studies (STS) where studies on the 'soft sciences', such as education, are few, and a new field of Studies in Social Science and Humanities (SSH) which is emerging alongside and from within the STS. Interdisciplinary endeavours between fields pertaining largely to the natural and the social sciences respectively have not been studied commonly within either field.

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1. Introduction

> Hundreds of ethnologists have visited every imaginable tribe, penetrated into the deep forests, listed the most exotic customs, photographed and documented domestic relations or the most complex cults. And yet, our industry, our technique, our science, our administration are still not well studied. –Bruno Latour and Steve Woolgar 1979, 15-16.

Studying the work of a team of scientists is not a new thing. There is an extensive body of ethnographic, anthropological, philosophical and sociological research carried out in the interdisciplinary fields of Science and Technology Studies (STS), and Sociology of Scientific Knowledge (SSK) focussing on the processes and outcomes of science, medicine and technology (e.g. Sismondo 2010, Callon et al., 1986), usually concerning scientists at laboratories (e.g. Latour and Woolgar 1979, Latour 1987, Rip 1986) or doing field work (e.g. Latour 1999). However, similar studies focussing on the 'soft sciences' – education, social sciences, humanities – are far fewer and more dispersed. The interdisciplinary field of Studies of Social Science and Humanities (SSH) is emerging from within, and alongside the STS studies to engage these issues (Mayer et al., 2008). The lack of STS-style studies in the fields of education and social sciences can be attributed to their relatively recent engagement in collaborative research activities. During the past decade education specifically has witnessed a heavy steerage towards research collaboration through the establishment first of the Teaching and Learning Research Programme (TLRP) in the UK in 2000, and the Applied Educational Research Scheme of Scotland (AERS) in 2003. Both initiatives aimed to improve the level and capacity of educational research in the UK by encouraging collaborative research and organising the participating researchers into topical networks spanning several institutions (Pollard 2005, Taylor et al., 2008, Furlong and Oancea 2005, RCUK 2010). The current Technology Enhanced Learning programme (TEL 2007-2012) is a

successor to the TLRP, with an explicit aim to support interdisciplinary collaboration between 'pedagogical and technological facets of research' (Conole et al., 2010, 2). One of the eight research and development projects funded by the TEL programme is Ensemble (2008-2011). The Ensemble is the focus of this ethnographic case study.

Ensemble incorporates the two multidisciplinary fields, education and computer sciences, one pertaining largely to the social sciences, and the other to the natural sciences/technology. The purpose of the study is threefold. Firstly, I have sought to understand and describe how a shared research question is answered in practice when divergent research traditions are brought to bear upon it. Secondly, I have traced the anticipated/envisaged emergence[1] of a piece of educational semantic technology through the heterogeneous research and development practices engaged in during the project. The third focus of the study is to assess the advantages and limitations of concepts and methods drawn from Actor-Network Theory (Latour 1987, Latour 2005, Law 2004), pre-assigned to be used as the theoretical approach in this study. The strengths and weaknesses of the approach are discussed along the way in relation to the research topic. The study is based on two and a half years of critical ethnographic participation in the life of the project. The examination has been anchored - but not restricted - to one of the six original research settings engaged by the team, the discipline of archaeology at the department of Archaeology and Anthropology, at the University of Cambridge. This study contributes not only to understanding of practices of educational research and technology development, but also to the general field of STS, specifically studies incorporating Actor-Network Theory, and the newly materialising field of studies in SSH.

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[1] It is possible to state only now, in retrospect, with certainty that something emerged; while following the unfolding research and development practices we were never certain of the outcome, and even now what finally emerged is not the 'final' endpoint of development.

There are two main layers of research interwoven in this study: firstly, the research and development work carried out by the Ensemble team, and secondly, my involvement in studying these multiple practices. Before I can discuss the premise for this study or the theoretical ideas informing it, it is necessary to introduce the Ensemble-project, its aims and participants, as well as discuss some of the key concepts related to the work of the project, for these constitute the research domain this study focuses on.

Note to reader

> How to talk about something, how to name it, without reducing it to the fixity or singularity? – John Law 1999, 10.

A lot of research is retrospective. We write about what *was*. While at the stage of writing up, in the autumn 2011, it will necessarily seem as if I am 'reporting' on what *was*, for the past three years I have been participating in and studying what *unfolds* in real time. Following a live research and development process has provided both a topic and an experience of studying that has been lively, unwieldy, largely out of my control, precarious and unpredictable. Now writing about it I am faced with the dilemma of how to avoid smoothing this messy, bumpy journey into a streamlined and clear cut narrative (cf. Law 1999, Law 2004). Although some considerable pruning will be unavoidable given the academic conventions of the exercise, my intention is to try and approach the empirical part of this study as if it would unfold before our eyes, including my increasing understanding of it. It would be convenient to write simply a teleological account of how a piece of semantic educational technology came to be, but the methodological approach I have chosen, and will explain in the next chapter, has allowed me to focus on the process of discovery as it meanders along winding paths, arrives at cul-de-sacs and returns to earlier discoveries to recalculate the direction it

should take. Doing this has required bracketing to some extent the now-known outcome, whose emergence highlighted the path that led to it.

1.1 Introducing Ensemble

Ensemble is an interdisciplinary research and development project bringing together researchers from two multidisciplinary areas of study, education and computer sciences. The aims of Ensemble are to study case-based learning at a number of undergraduate and postgraduate settings in Higher Education (HE), and develop semantic web tools and learning environments for enhancing and supporting the teaching and learning activities (Original bid 2008). Funded for three years 2008-2011 by the Technology Enhanced Learning programme (TEL), the project has been large, geographically distributed and expansive in scope from the outset. The original 16 team members, including two linked PhD students, were based at five UK universities, with partner institutions also in the US and in Australia[2]. The original two lead institutions, home to the different research settings, were City University in London (City)[3], and University of Cambridge (UC). Through re-location of some team members to a third HE institution, Liverpool John Moores University (LJMU), including the extension of the project activities there, LJMU gradually emerged as the key location for the project during the second year. The number of disciplines engaged by the team have fluctuated over the course of its existence, starting with six (archaeology, plant sciences and engineering at UC, and marine operations and management, journalism and business at City) across two institutions. This went up to eight disciplines across three institutions, settling finally to six (archaeology and plant sciences at UC, marine operations and

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[2] Apart from City and UC, partnering universities were University of East Anglia, University of Stirling and University of Essex, Massachusetts Institute of Technology (MIT) in the US and Sydney Institute of Technology.

[3] All persons have been given pseudonyms in this study following the proposed ethics policy of the study. All institutions have been named, as agreed with the team.

management at City and contemporary dance, educational studies and environmental education at LJMU) based across three institutions. The current study is interested in the work of the team in relation to the discipline of archaeology.

The originally proposed six research settings had been selected on the basis that they would employ case-based learning as their 'pedagogy of choice' (Original bid, 2008). The discipline of archaeology was reportedly using a lot of cases in teaching, assuming that these were 'case studies' used to:

> [...] look at how sites, materials and artefacts are classified, and how scholars have examined, classified, recorded and published particular sets of excavated material. This case study based approach is most informative when the students are able to examine material from the collections by hand and are then able to see how that specific set of material was classified, recorded and published. (Original bid 2008, 8)

The research proposal further detailed how the tools to be developed by the project were envisaged to support case-based learning activities in the discipline, when the students undertake case studies that require drawing together a range of evidence:

> [...] for example, based on results of hydrological monitoring of a buried archaeological landscape introduced in lecture/seminar format and supported by field trips to the site, and example analyses of thin sections in the lab. They also look at how previous scholars have interpreted data, engaged with data, published literature and with the research activities of staff members. Staff members' research work is

used to exemplify major issues in the field using taught classes in the lecture room and laboratory, as well as field-trips. (Original bid 2008, 8)

The online tools proposed by the project would allow students to engage with these rich and diverse data sources in order to support constructing their own cases and interpretations of these. The envisaged tools would e.g. enable the sharing of datasets across student groups, thus providing means for multi-method and cross-case analysis (Original bid 2008, 8). Each setting had a lead contact, who would provide access to the proposed setting. For the discipline of archaeology this was Matt[4], who quite unusually was familiar both with semantic technologies and Actor-Network Theory. He had become engaged in the project through personal contacts with the bid-writing team, and was based at the museum attached to the department.

There has been a large number of participants (both human and nonhuman) (cf. Sørensen 2009) involved in the Ensemble work but my research approach (see Ch 2 Methods) has led me to focus on those who have been involved in the work on the discipline of archaeology. This has highlighted the role played by some team members, research participants, technologies, objects and approaches leaving a number of others with less attention or completely out of the picture, even if their role in relation to other settings in the project is prominent. For this reason I would like to emphasize the importance of the overall assemblage of the networked context (cf. Edwards and Miller 2007) from which I have picked up strands of activity, while leaving others unattended. Despite the focus being on the work carried out in one of the six settings, the people, materials, ideas, decisions, technologies, developments, etc. necessarily flow in and out of all of the settings and institutions engaged by the project. Appendix 1 lists the main

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[4] All persons have been given pseudonyms in this study following the proposed ethics policy of the study. All institutions have been named.

actors/participants in this study – mapping out every single one would be impossible (cf. Strathern 1996).

The ambitious aims of the Ensemble-project have not been formulated strictly with a pre-set outcome in mind, as the project is innovative and developmental. The two challenges the Ensemble-project set for itself convey the domains they have been working on: the technological challenge of 'realising the semantic web in Educational settings' and the pedagogical challenge of 'enhancing case-based learning' (Original bid 2008, 2). Bringing together case-based learning and semantic technologies was an original idea of Jim, the project Principal Investigator (PI), who had previously worked on transforming research cases into teaching cases at another project, and who had connections to the Massachusetts Institute of Technology (MIT), where work on semantic technologies producing SIMILE toolkits had started recently[5]. Both of these domains were relatively open-ended to provide a research space able to accommodate possible innovations, as were the participatory design and Actor-Network Theory approaches, introduced to the project design by the participants from City[6].

The research bid, just like the project as a whole, is an assemblage of ideas, people, aspirations, theories, methods and past research findings, and it works to denote the (presumably) agreed positions of those team members who participated in writing it. The bid is marked by an inbuilt plurality that permeates each level; there are no 'hard truths' or ideas set in stone; each concept is articulated in a manner that recognises it as subject to change, open for exploration and in a state of flux, even the participating disciplines. The discussion about key concepts works to create a space within which each can be explored and developed further.

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[5] Personal communication with Jim, 25th Oct 2010.
[6] Personal communication with Lea, 5th Nov 2010.

The bid proposed also using Actor-Network Theory (ANT) as a 'frame and a guide' for the theoretical orientation of the project's work, helping to deal with the likely complexity of the study: 'research findings cannot be expected to stay stable over time'(Original bid 2008, 4), development of technology or research cannot produce consistent findings, or when contextual specificity is important. The ANT approach will be introduced in more detail later on. In the actual life of the project ANT has played a more contested and less central role than anticipated.

The Ensemble team set itself five research questions framed broadly by the discussion of the key concepts outlined below:

- RQ1: What are the nature, scope and role of cases and case-based learning across disciplines in higher education and their relationship to learning outcomes and expertise?

- RQ2: How do teachers and learners design, develop, describe and reconstruct cases, and how do these processes contribute to academic and professional outcomes?

- RQ3: What are the pedagogical affordances of using semantic web technologies in support of case-based learning?

- RQ4: What new tools can be developed to allow users (learners, teachers, researchers) to access, adapt and manage their case-based learning and that of others?

- RQ5: What are the theoretical framings for researching technology enhanced learning and informing interdisciplinary dialogues when knowledge, technologies and pedagogies are in a state of flux? (Original bid 2008, 5)

The research questions embody the two broad aims of the Ensemble –project: the study of case-based learning and the development of semantic tools for supporting that teaching and learning. It is the first research question (RQ1) that will be the starting point for my study.

The bid starts by characterising case-based learning (CBL) as 'the pedagogy of choice when knowledge domains are complex, unpredictable, politically or ethically contentious, or so rapidly changing and fluid that a curriculum defined in terms of knowledge or competences alone is inadequate as the basis of developing expertise' (Original bid 2008, 2). This is the case with many advanced university level courses and in professional learning (Eraut 1994), and is reflected in the range of research sites the project engaged from the different Higher Education Institutions. Drawing e.g. on Savery (2006) (Problem-based learning), Ragin (1992) (Inquiry-based learning), and others (see Original bid 2008, 2), the team acknowledges that CBL aligns with many other explorative learning approaches. With several studies already pointing out the problem with making 'universalistic claims generalised across diverse settings' (Booth et al., quoted in Original bid 2008, 2), the team suggest there is a gap between how the nature, scope and role of cases are understood and what these are perceived as offering for learning (Original bid 2008, 2).

A review of a range of conceptual literature relating to characterisations of 'case' and 'case-study' (See Original bid, 2008, 2) reveals a great diversity across disciplines on this, with an insufficient mapping of the conceptualisations of the actual pedagogical application of cases to case-based learning. Naturally some models of CBL, like the 'Harvard' model, are well documented and also employed in educational settings other than just business and management (e.g. Barnes et al., 1994). This variety of

understanding and practicing CBL forms the background, against which the six diverse research settings for studying the nature, role and scope of cases and CBL were chosen. The assumption is that while each proposed setting engages CBL, there will be disciplinary differences in the understanding and generalisability of cases, and their relation to other forms of knowledge. While there is a short section in the Original bid on the envisaged way of engaging the research participants, the practice has varied and been tailored to the needs and nature of the participants. Hence, the bid articulates a space within which research questions 1 and 2 can be explored.

The Semantic Web

Realising the semantic web for education is the Ensemble team's second challenge. The concept of a semantic web is fairly new (conceived in 1998 by Tim Berners-Lee, the founder of the internet). It refers to the vision of an internet where all information is stored in machine readable formats, enabling computers to process, retrieve and combine data across diverse sources available on the net, something that has been only possible by humans so far (Berners-Lee, Hendler and Lassila 2001). Semantic web also denotes tools, standards and interfaces that facilitate realising this vision[7]. There is a glossary for terminology used in discussing semantic technologies in Appendix 2.

The semantic web is characterised as a 'web of data' (linked databases). The internet, the 'web of documents' (linked documents), allows computers to locate information on the basis of search terms like 'orange'. However, they cannot discern semantically whether what is found is about a fruit, a colour, a mobile phone company or something else. By contrast, the 'web of data' allows 'content to become aware of itself' (Anderson and Whitelock 2004, 4), which enables combining different types of

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[7] W3C, Semantic Web Wiki, http://www.w3.org/2001/sw/wiki/Main_Page; accessed 11th Oct 2011

information, e.g. images and text, drawn from heterogeneous sources, including web services, legacy databases or content generated by users. Thus, in searching for 'orange' the semantic web would be able to differentiate bits of information relating to a 'fruit' from those relating to a 'mobile phone company', a capacity that would, among other things, enhance data processing. For this to be possible, the data need to be in a common, machine readable format, something that is achieved through the use of metadata organised in 'numerous interrelated ontologies', where 'information is tagged with descriptors [e.g. 'orange is a fruit' or 'Orange is a mobile phone company'] that facilitate retrieval, analysis, processing and reconfiguration' (Anderson and Whitelock 2004, 4). Thus, the semantic web entails encoding different data types into a machine readable format, something where various conversion tools, like Babel[8] used by the Ensemble project, are vital.

The semantic web is at a stage comparable to the internet before the introduction of the Mosaic Web Browser in 1993, which enabled the expansion of the use of the web purposes other than accessing and disseminating information, including uses in education and learning. At the time of writing the bid most applications of the semantic web were geared towards data discovery but the Ensemble vision for the educational semantic web was broader than that. Combining the ability to integrate user-generated content with that from digital repositories, web services and other available sources with some social media functionality, and being able to access that data through advanced search and visualisation tools, the team envisage that 'these technologies can provide a framework capable of supporting the individual and collective engagement in case-based learning*' (Original bid 2008, 3).

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[8] http://simile.mit.edu/babel/

The team emphasize that the 'project is **not** conceptualised as a technological 'solution' to a pedagogical 'problem'; nor is case-based learning simply a context for application of existing technologies' (Original bid 2008, 4). With the general fluidity of definitions and the effort to provide space for their exploration and development, the flexibility afforded by the semantic web and the diversity of application of case-based learning anticipated in the settings is a promising combination.

Research questions 3 and 4 address the technology development for educational purposes. *Exhibit* is a toolkit developed by the SIMILE project at MIT, and vital for the Ensemble –project to take the vision for developing educational semantic technology forward. This toolkit allows users to easily create 'web pages with advanced text search and filtering functionalities, with interactive maps, timelines, and other visualizations'[9]. Until the SIMILE toolkit was developed the semantic web technologies were really only within the reach of expert users and technology developers. Incorporating 'easy-to-use APIs and interfaces, and flexible and configurable representation and visualisation tools' (Original bid 2008, 3) in the toolkit was seen as opening up the potential of the semantic web to be investigated by teachers and learners[10]. As the team point out, it is not the existence of the semantic web in itself that is useful, but how the different elements relating to the technology (e.g. digital repositories, XML/RDF) can be used to enhance the case-based teaching and learning activities the users are engaged in.

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[9] http://www.simile-widgets.org/exhibit/ (accessed 20th Oct 2011).
[10] The Ensemble team have developed an easy-to-follow guide for anyone wishing to develop their own visualisations of data: http://ensemble.ljmu.ac.uk/wp/semantic-technologies/simile-exhibit/create-your-own-exhibit-in-5-steps (accessed 25th Oct 2011).

Interdisciplinarity and participatory ethos

The requirement for the project to be interdisciplinary was inbuilt in the funding calls[11], and enacted as an intention within the funding bid. The research questions were required to be formulated so that they would need collaboration from many disciplinary areas. However, 'authentic interdisciplinarity', as set out by the call, would entail going 'beyond mere collaboration', whereby the way that researchers think about their own disciplines would change through exposure to the concepts, ideas and methodologies of other disciplines (TEL call 2007, 9).

The Ensemble team responded to this requirement by formulating research questions that would require participation from not only education and computer sciences, but also the research settings pertaining to humanities, social sciences and natural sciences. Recognising the divergent disciplinary mix, the Ensemble team conceptualised the project as 'an interdisciplinary learning environment within which processes of participatory design, co-configuration and collaborative analysis and interdisciplinary exchange, together with seminars, conferences and dissemination activities are envisaged throughout the life of the project' (Original bid 2008, 5). As before, the bid creates space for activity to develop rather than pre-determining the direction that the project will take. Technology development and research are envisaged as intertwined processes, with engagement in an 'extensive process of field research and enhanced participatory design' in order to develop tailor made technologies for the needs of the engaged disciplines (Original bid 2008, 3). The team were committed to involving

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[11]The second call for the TLRP funding in 2007 stated: '2) To be eligible for funding under this competition, applications *must* be interdisciplinary and demonstrate significant added value from the *integration* of research perspectives from <u>both </u>the social <u>and </u>the technological sciences. Proposals *must* combine substantive inputs and expertise drawn from *across* the fields of research traditionally supported by ESRC and EPSRC to address one or more of the 4 key research challenges outlined in the full specification' (TEL call 2007, 1).

research participants from the different research settings as co-investigators and developers in the processes of research and design. Later we will see how these aspirations became materialised as research practices in the Ensemble-project.

While there is an extensive literature both on research collaboration (e.g. Katz and Martin 1997, Cummings and Kiesler 2005, Ritchie 2007) and on interdisciplinarity (e.g. Klein 1990, Weingart and Stehr 2000, Moran 2001), and while both are essential features of the work of the Ensemble-project, I will not delve into the history or the development of those concepts. Instead I will follow an ethnographic tradition (e.g. Law 2004) and start my investigation from the space within which the project itself will develop, and see how 'interdisciplinarity', the joining together of different multidisciplinary areas, becomes enacted in the practices of research and development. This will be discussed along the way with the examinination of the work of Ensemble. Issues to do with participatory research and participatory design are discussed in later chapters.

1.2 Research problem – studying interdisciplinary practices

My interest in the work of the team is three-fold[12]. Firstly, I have sought to understand and describe how a collaborative project bringing together social sciences and sciences

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[12] This studentship is one of two advertised by the Ensemble-project in 2008: one with emphasis on the education side of the project, the other on technology. While both studentships had a proposed topic for study ('Fluid cases' for this), we were not tied to these but could develop our own ones within certain parameters. Those set for this studentship stated, firstly, that the study should form a reflexive layer to the main project, and secondly, that Actor-Network Theory approach – a new one to me - should be used. My original intention, which emerged through engagement with ANT literature, was to follow an object through from an excavation site into a curriculum case (studied by the team) and onto museum. However, four months into the project a suitable object to follow had not materialised in the archaeology teaching. Working with a group of researchers from varying disciplinary backgrounds on the setting, I found myself become interested in the processes of trying to answer the shared research questions in practice, which led to my investigation gradually re-focussing on the research and development practices of the team. Hence it should be noted that my research problem emerged from a position of ignorance for the field of Science and Technology Studies, which did not feature in my initial reading of ANT literature, which focussed more on educational issues.

is carried out in practice. The Ensemble-project seeks to study 'the nature, scope and role of cases and case-based learning' at a number of disciplinary settings.

> Research question 1: How is case-based learning being investigated in one of the six research settings, the discipline of archaeology, when divergent research traditions work together? How does the concept of 'case' become settled in the process?

Secondly, my interest is on the process by which a research and a development project moves from a research question to an 'outcome'. The Ensemble-project aims to develop semantic web applications for supporting the case-based teaching and learning activities for those disciplines they engage as research settings. The second intention of this study is to trace the assumed/anticipated emergence of a piece of educational technology through the heterogeneous research and development practices engaged in the project.

> Research question 2: How does an envisaged idea proposed in the bid materialise into an actual semantic application?

These two questions align neatly to the two aims expressed by the project. The phrasing of these research questions (in the passive, without assuming who does the doing) is an attempt to make the questions more symmetrical (cf. Law 2004) freeing space also for the nonhuman actors to emerge as participants in the research and development processes alongside human actors. My intention has also been to avoid pre-setting any expected outcomes in the questions, for these have been unknown throughout the process to us all.

The third point of interest is to assess the advantages and disadvantages of using Actor-Network Theory as a theoretical and methodological approach in this type of case study.

It would be convenient to state that the Ensemble-project is interdisciplinary because it brings together the disciplines of education and computer sciences, but the situation is more complex than that: both fields are in themselves multi-disciplinary areas of study. For instance the researchers pertaining to 'education' have backgrounds for instance in sociology, cognitive psychology and plant sciences. The field of computer sciences is similarly diverse, incorporating programmers, developers, Human Computer Interaction specialists and more. Whether this is typical of the people working within those two disciplines, or just a quirk of those wishing to work in a complex area that the Ensemble-project explores, each member of the Ensemble-project has 'switched' disciplines at some point during their career. Some have moved between natural and social science research, others just crossing disciplines within one or the other field. In practical terms this means that each researcher has their preferred hinterland for carrying out research.

Therefore, as well as being interdisciplinary, the Ensemble-project is designed to be collaborative between the researchers and developers coming from different disciplinary backgrounds. An overview of definitions for 'research' suggests that this ultimately has to do with *producing new knowledge* through methods that pertain to certain validity and reliability requirements (cf. Brew 2001, 21-22), which in turn emerge from the respective hinterlands of scientific/research practices that have been shaped by their historical, organisational and social contexts (Law 2004; cf. Edwards and Miller 2007). Hence, there is a lot of variability in research methods and practices,

not only between disciplines pertaining to sciences and social sciences, but also within both fields (cf. Robson 2002, Sapsford and Jupp 2006, Law 2004). While research - particularly research *and* development - processes have other outcomes besides 'knowledge' (e.g. policies, recommendations, inventions, technologies) and while there is no universally shared understanding of what 'knowledge' is, every research approach is based on *some* assumptions about the nature of reality (ontology) and what kinds of knowledge claims can be made about it (epistemology). Whether these assumptions are explicit or implicit, they necessarily exist. This is where the real challenges in collaboration – and the study of that collaboration – within the Ensemble-project emerge: *researchers coming from a range of epistemological understandings having to work together*. This situation in practice means the existence of multiple, potentially competing or conflicting research approaches, (including e.g. ethnographic research, action and participatory research, and more structured, theory-led cognitive sciences research) as well as a mixture of epistemological assumptions and stances, which lead to expectations about the nature and format of the research findings. (cf. Knorr Cetina 1999, Latour and Woolgar 1979).

What we often see reported in literature or in the media are statements like 'research has found out X'. 'Research' in these statements is taken for granted, 'black-boxed' as Latour (e.g. 2005) would say. My intention is to open that black box up for scrutiny, and trace in real time the unfolding process of how an interdisciplinary and collaborative team get from a research 'problem' to an 'outcome'. This is not intended to be a blue print for every research process, for as the above characterisation of multiplicity of research shows, very few research processes in fact are the same. In sciences it is an *aspiration* for the research processes and findings to be repeatable, but

in social sciences research, as well as in research and development, no two projects can ever be identical even if they should be similar.

In terms of tracing the emergence of a piece of educational technology, most development projects start from an existing problem that needs solving (e.g. Nusebeih and Easterbrook 2000, Vinck 2003, Mer 2003). This is not the case with Ensemble. The starting point is what might be called 'a window of opportunity' a vision of what might be possible, with funding and willing participants to take the vision forward. This is a research and development project exploring a new terrain, which makes both the research and design processes uncertain and unpredictable. Hence tracing the coming into being of a semantic application is of interest.

An added layer in this study has to do with my researcher positionality in relation to the main project. Apart from dealing with a complex set of potentially conflicting roles, which I will discuss in conjunction with ethics later on, working in a collaborative team towards an individual piece of research left me with a methodological puzzle: *How will my research approach affect what I am able to say about the project?* It was crucial to find a way of studying the multiple research approaches without passing epistemological value judgement in terms of their validity or reliability as methods. Nit-picking between whether one approach is 'better' than the other is of no interest here. The focus is on how these approaches work in practice, that is, what happens when different hinterlands meet. While ANT was a pre-assigned approach to work with, given its diasporic and multiple nature (see Chapter 2, methods), it was challenging to figure out how to approach my data analytically *in practice*. A solution to this emerged from Annemarie Mol's work, and through a detour into John Dewey's Pragmatism (cf. Rimpiläinen 2011) which suggested that by foregrounding practices and by focussing

on the doing of things shifts the concern from epistemological questions onto ontological ones, to realities that are being produced through the research processes (cf. Law 2004, Mol 2003, Biesta and Burbules 2003). This forms the third aspect of this study – to explore the affordances of Actor-Network Theory as a method for a study of an interdisciplinary project.

Structure of the study

This study will proceed in seven sections. After the Introduction, Chapter 2 concerns the practicalities of researching researchers, including methods for data generation, and the ethical considerations. The main point of interest in the chapter, however, is on Actor-Network Theory as *theoretical practice* in doing research. I will account for how the approach has developed over the years, the variety of topics it has been used for studying, the types of criticisms it has faced, and how I have drawn upon it for studying the research and development practices in this study.

The empirical work ensues in four chapters. The third chapter tracks how the first research question is translated into practice of research as the team investigate case-based learning in archaeology. The questions about multiple realities, multiple perspectives and interdisciplinary collaboration are discussed in this chapter. The case in archaeology proves elusive, and the fourth chapter examines how the need for technology development to commence helps the case to crystallise simultaneously as a niche for a potential technology to be developed in archaeology is identified. This chapter begins with a closer inspection of the role played by an unexpected actor, a diagram nicknamed the Semantic Spider, and its role in helping to enmesh the two 'up-to-then' separate strands – educational research and technology development - of the Ensemble-project.

The fifth chapter commences with an exploration of a debate about the participatory research and participatory design practices that were on-going within the team, and how these two approaches mutually worked to tune each other to better suit the participatory ethos adopted by the Ensemble-project. We then return to pick up the research process after the niche for technology development has been identified. We will follow how a single researcher took the work forward and began to weave an assemblage that would allow her to actually begin to study the identified 'case', the Artefact-project, with a view of starting technology development. In doing this we see how the researcher becomes a spokesperson for technology development in the archaeology setting, for pedagogy in technology development and for participatory research in participatory design, and how this impacts the participatory design practices planned by the project.

In Chapter 6 we witness a near demise of the engagement with the setting: just as the project has gained access to the necessary resources and the technology development seems to be taking off, the precarious assemblage gathered around the setting starts disassembling. The research participants are not available or do not show much interest in Ensemble-project's work and the Artefact-project simply resists attempts to turn it into a piece of semantic technology. An unexpected intervention by a visiting scholar and a serendipitous concurrence of ideas suddenly take the work forward, leading to the emergence of a Data Aggregating Document.

The final chapter discusses the precarious and uncertain process of research and development, the resistance and assistance met in the research process, and how and why the intended plan was interrupted, diverted and had to be recalculated. Finally the chapter will also assess advantages and disadvantages of carrying out a piece of research like this drawing on Actor-Network Theory as a theoretical practice.

2. Practicalities of researching researchers

2.1 Multiple Actor-Network Theory

The approach informing this study draws on Actor-Network Theory[13] (ANT), sometimes denoted material-semiotics[14] (Law 2000, Law 2009) or the 'sociology of association' (Latour 2005). It is also linked with posthumanism[15] (Pickering 1995, Barad 2003) and the performative and practice turns in social science research (Dirksmeier and Helbrecth 2008, Law 2004, Barad 2003, Pickering 1995, Schatzki et al., 2001). The approach is an extraordinarily difficult one to explain, let alone make sense of, and attempting to definitely define it would work against the ethos of the approach (cf. Law 1999, Fenwick and Edwards 2010). Even talking of ANT as 'it' is misleading, for the approach is diasporic and multiple, being located in diverse case studies and drawing on a range of theoretical resources (Law 1999, Law 2009). However, it is necessary to try and characterise the 'monster' (as also referred to by Law 1999) and the ways we, ANT and I, have managed to accommodate each other, or

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[13] I have been in the curious position of having to work on this PhD with a pre-assigned theoretical approach, one that was unfamiliar to me before, and one that seriously challenged everything that I had ever thought of research until now. Coming from a strong humanities background accepting e.g. objects with agency and the principle of symmetry were hard to understand and internalise, as was penetrating the ANT jargon, which is very close in form to 'traditional sociology' but in practice carries very different meanings, consequently conceptualising the world in a very different way. Only finding post-ANT literature through reading Annemarie Mol's book Body Multiple (2003) did I find a comfortable way of working with ANT and my research topic.

[14] Law prefers to use the term 'material-semiotics' for it maps network relations that are both material (between things) and 'semiotic' (between concepts). The name also 'better catches the openness, uncertainty, revisability, and diversity of the most interesting work' (Law 2009, 142). This characterisation has been derived from his post-structuralist version of semiotics (Law 1999, 4; Law 2002b). Law has further criticised the term Actor-Network Theory for being an oxymoron, embodying a tension between a centred actor and the de-centred network. The problem with 'network' further is that it is 'deceptively easy to think'[about] (Law 1999, 6) and that it carries of a lot of metaphorical baggage (Law 1999). However, I have and will continue to call the approach Actor-Network Theory, for this helps the current study be better associated with other similar studies.

[15] There is no single history to this debate, but one that varies according to discipline. As Miah (2008) calls it, posthumanism is a detritus of perspectives spreading across the cultural, the political, the philosophical and the medical, and whose history has no clear beginning, middle or end point in philosophical thought. For a review of the history(ies) of posthumanism, see Miah, A. (2008), A Critical History of Posthumanism. In B. Gordijn & R. Chadwick, eds. *Medical Enhancement and Posthumanity*. Dordrecht: Springer Netherlands, pp. 71-94.

not. I will introduce the Actor-Network approach suggesting it might be best described as *theoretical practice* in research. I will discuss its origins and development through the four basic principles John Law (2009) has identified. I will then provide a more focussed look at criticisms ANT has faced before taking a glimpse at the range of disciplines and areas of study Actor-Network Theory has found its way into, thus trying to locate the current study within the existing field. Then I will discuss how this approach has informed the current study. I will account for the data at the end of the section.

2.2 Actor-Network Theory as a theoretical practice

The multiplicity of ANT manifests itself already when trying to understand its nature through reading works of two of the central developers of the approach. While Latour characterises ANT as a 'strong' theory 'about *how* to study things, or rather how *not* to study them – or rather how to let the actors have some room to express themselves' (2005, 142) (emphasis original), Law shies away from calling ANT a theory at all, characterising it as:

> a disparate family of material-semiotic tools, sensibilities and methods of analysis that treat everything in the social and natural worlds as a continuously generated effect of the webs of relations within which they are located. It assumes that nothing has reality or form outside the enactments of those relations. Its studies explore and characterize the webs and the practices that carry them. (Law 2009, 141)

To Law, ANT is thus *a research method* for generating data and *a method of analysis*, a way of making sense of that data; ANT studies 'how relations assemble, or do not' (Law 2009, 142). Latour's characterisation of ANT as a *theory on how to study things*

implies that he too takes it as a method. The subtle distinction here seems to hang on the understanding of what is meant by 'theory': for Law 'theories usually try to explain why something happens' and these explanations are foundational (Law 2009, 142), pertaining to the representationalist tradition[16] ANT wishes to diverge from[17]. In fact, Latour aligns with Law on this, emphasizing how ANT is *not* like the other social theories, which aim for grand narratives or explanations (Latour 2005). Both Law (2004) and Latour (2005) emphasize the empirical nature of ANT, and how it is best understood as part of research practice, empirical case studies, and thus how the practice is itself necessarily theoretical (Law 2009). This is in fact what I discovered in conducting this piece of research – the concepts of ANT come alive through empirical data, and help make sense of events and processes taking place.

In the light of this, then, I argue that ANT might be best described as 'theoretical practice', as an approach to the topic of study and the empirical data, both in terms of generating it and analysing it. As explained before, using an Actor-Network Theory informed research approach was one of the parameters set for this studentship. The

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[16] Since the Renaissance the defining characteristics of modern Western philosophy have celebrated the Human as thinker, creator and actor, and continue to do so (Schatzki 2001). Following this humanist tradition, the social constructivist and traditional realist stances have granted sense and language a disproportionate role and power, understanding it as mirroring – representing - pre-existing, underlying structures of the world. The representationalist stance further believes that things and individuals exist with inherent, given properties, independent of their representations and that while these may be many, depending on the on-lookers perspective, the underlying reality remains singular. This dualistic world view perceives an ontological distinction between what is represented and the practice of representation, leading to questions about capacity of the human mind (in-here) ever to know anything reliably of the reality (out-there). The interest focuses on the epistemological questions of whether or not, or to what extent the description corresponds to the underlying reality, which has led to paradigm wars between subjectivism and objectivism, the natural and the social sciences etc. (Barad 2003, Mol 2003, Law 2004).
[17] Particularly the post-ANT studies align with the performative stance. In Science and Technology Studies (STS), including ANT, the critical scrutiny of representationalism emerged only after the focus had changed from studying the nature and production of scientific knowledge to examining the actual practices and dynamics of science (Barad 2003). The performative alternative (emerged from a strand of post-humanis critique, see Miah 2008) suggests focussing on the practices of research, on doings and actions, and to understanding how realities – ontologies - are shaped in action instead of debating over epistemological validity and reliability of representations of reality. (Barad 2003, 802, Jensen 2004, 232, Mol 2003.) In STS performative approaches are used e.g. by Bruno Latour, John Law, Annemarie Mol and Andrew Pickering.

rationale for this was the capacity of ANT to map and trace human-technology relations (e.g. Tatnall 2005, Elbanna 2009), which were anticipated to be central to the research domain given the focus on development of educational technologies and the suggestion that the PhD project would form a reflexive layer to it. As my research topic settled on studying the work of the researchers, it became evident that an approach that could account for the complexity of the work practices and the heterogeneous participants[18] in these was necessary. As Latour puts it:

> in situations where innovations proliferate, where group boundaries are uncertain, when the range of entities to be taken into account fluctuates, the sociology of the social is no longer able to trace actors' new associations. (Latour 2005, 11)

What Latour means here is that the traditional sociological methods would not suffice when things are in flux, emergent and multiple, words that serve well to describe the Ensemble project as a research domain. Further, these would not attend to the materiality as part of the research practices, whereas ANT offers a means of mapping not only the social and the material relations but also those that are conceptual. This is important with regard to an interdisciplinary team where multiple theories and competing research approaches are negotiated on a daily basis and intertwine with the work that is being carried out.

The way I have chosen to approach my data with ANT has provided means for following unfolding processes in real time, as well as tracking a moving target as part of these. ANT entails approaching phenomena with ethnographic research methods,

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[18] By 'heterogeneous participants' I refer both to human and nonhuman actors that become entangled and enrolled in the research and development work.

which affords for the messy, multiple phenomena to emerge from the settings without assuming their nature or type in advance (Law 2004). ANT further offers a way of dealing with that multiplicity (cf. Mol 2003).

2.3 Origins and development of Actor-Network Theory

While the origins of ANT are most commonly traced back to late 1970s/early 1980s Paris to the work of Michel Callon and Bruno Latour in the field of Science and Technology Studies (Latour 2005, Law 2009, Fenwick and Edwards 2010), since its inception the approach has gone through various incarnations travelling through numerous disciplines, engaging different research topics and thinkers. John Law has divided the life of the approach to date into two main strands of development. The first he denotes *the Classic-ANT,* or *Actor-Network Theory 1990* (Law 1999, Law 2009), when ANT studies focussed on the issues of relationality and materiality, working to dissolve the essentialist and dualist categories (like the social and the natural) and understandings of reality. To achieve this, ANT drew 'ruthlessly' on semiotics, but applying that more broadly rather than just on linguistic matters, thus asserting that 'entities take their form and acquire their attributes as a result of their relations with other entities' (Law 1999, 3), as *effects* or outcomes of these relations, rather than these (subjects, objects, humans, nonhumans) being given categories (Law 1999, Law 2009).

The second strand of development, *After-* or *Post-ANT,* aligns with the performative turn in social theory (e.g. Miah 2008, Barad 2003) without forgetting the intertwined issues of relationality. While entities are effects or outcomes of the networked relations they are located in, they are simultaneously also 'performed in, by and through those relations' (Law 1999, 4).

According to Law (2009) Actor-Network Theory can be traced back to four main principles:

- The principle of heterogeneous networks
- The principle of generalised symmetry
- The principle of translation
- The principle of empirical post-structuralism

1st principle: Heterogeneous networks

The principle of heterogeneous networks emerged through Michel Callon's (1986a) study of the project which attempted – unsuccessfully - to introduce an 'electric vehicle' in France, leading Callon to ask how it was possible to describe fragile, yet inflexible, heterogeneous, socio-material systems. This brought networks consisting of humans and nonhumans to the centre of attention, and was the starting point for the idea of actor-networks. With the introduction of the principle of generalised symmetry[19], the role nonhumans played in networks, constituting the 'social' and other phenomena (cf. Latour 2005), came centre stage, bringing along various conceptualisations of objects, actors and actants[20], intermediaries and mediators[21]. In early ANT objects were seen as holding their shape both physically and conceptually,

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[19] The second principle of ANT, discussed in more detail further down the line.

[20] Apart from (human) actors ANT parlance includes 'actants'. The term was originally borrowed from the study of literature to denote the 'nonhuman actors' (Latour 1999, 303), i.e. things that have agency and cause an effect to states of affairs, thus making actors do things (Latour 2005). This relates to agency, which, as discussed earlier, is not a simple matter of human intentionality, but understood in ANT terms as an effect of the webs of relations between the heterogeneous participants. As we will see, the intention to develop a piece of software alone leads nowhere: the process needs collaboration of various heterogeneous participants to succeed.

[21] *Intermediaries* and *mediators* pertain more to the earlier ANT debates. The former is a mere carrier of information or force without transforming it. Its output is entirely defined by its input: A in, A out; this could be understood as dissemination. Intermediaries can be taken as *black boxes*, 'counting for one', even if internally these might be made of many parts (Latour 2005, 39). Mediators, however, transform, distort and modify meaning they are supposed to carry; A becomes B, or B, C etc. This is a translation notion of change. Being an intermediary or mediator is a quality assigned to or adopted by an object or an actor (cf. Latour 1999, Latour 2005).

and being able to move (or to be moved) across three dimensional space from A to B, like a ship, or a scientific instrument (Law 1986, Latour 1990, cf. Law 1999). These early theorizations of networks and objects came under criticism for taking the world as static and singular, allowing for a very narrow range of objects to exist (e.g. Law 1999, 2002a). The changes in the conceptualisations of objects and networks in ANT studies reflect the shift from the representationalist ANT 1990 to the performative idiom of post-ANT. That is, the journey along which objects (as well as subjects) started being seen as more fluid and dynamic, emerging as effects of those networks within which they were located, and being viewed as part of practices. Among other things, this allowed for the less tangible 'objects', like diseases or learning to become available for study, for 'many objects putatively located in physical space can only be detected *in a network of relations* that makes them visible' (Law and Singleton 2005, 4, emphasis original).

The first principle states that networks consist of heterogeneous participants. This is evident from the intertwinement of the concepts of network with actor/human/nonhuman/object. Networks have often been treated precisely as constituting *something* that can be described. However, going with the now familiar multiplicity of ANT, Latour takes 'network' as a *tool that helps describe* something. For him, network is 'a string of actions where each participant is treated as a full-blown mediator' (Latour 2005, 128). The difference is, he says, like that between a *depiction* of a pencil, and *drawing with* a pencil. Putting it in other words, the task is to trace a network that consists of *a string of actions* by heterogeneous participants, be it human or nonhuman. In this way, a network can emerge both as a 'thing', and something that helps to describe and characterise the emergence of that 'thing'.

The problem with the concept or the metaphor of network is its popularity with many other research approaches[22], and that it carries strong connotations both metaphorically and concretely in common parlance. This has made it become so ambiguous, that Latour (2005) suggests the concept should have been abandoned long ago. Yet, in ANT the term has a distinct, while not very unitary, tradition, and its usage continues. Recently terms to reflect the more dynamic understanding of networks are 'assemblage' and 'gathering' (see e.g. Sørensen 2009, 16-17, Law 2004, Fenwick and Edwards 2010). In this study I am tracing a network, or more precisely, the process by which a network, an assemblage, gathers, dissolves and enrols new members as other ones fall out; how the network dynamically lives in space and time. At times, I am calling this gathering a network, at other times an assemblage to avoid tautology.

2nd principle: Generalised Symmetry

The principle of generalised symmetry in ANT is one of the more difficult ideas to understand, and it appears often to be misunderstood (cf. Latour 2005, 76) or taken to extremes (cf. Sørensen 2009, not to say that hers would not be an interesting point to make). The principle originates from science studies from the work of Thomas Kuhn in the 1960s. He suggested that in terms of a successful theory, the question of the absolute truth of that theory is irrelevant – what matters is whether or not the paradigm works in practice. This led to a methodological dictum of 'principle of symmetry', calling for all knowledge (true or false) to be assessed in the same terms (Law 2009, Latour 1993). Being borrowed into ANT, the principle shifted to denote the idea of ontological *generalised symmetry* between human and nonhuman beings, stating quite controversially that in addition to human subjects, the nonhumans and objects are seen as having *agency*, a capacity to 'act' (Callon 1986b, Latour 2005). Seminal to the

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[22] E.g. social network analysis cf. Wasserman et al., 1994, or network analysis in computer sciences.

development of this idea was Michel Callon's study of scallops, scientists and fishermen, where he described the different entities, seen as pertaining either to the 'nature' or the 'social', in similar terms, without privileging humans over nonhumans in our understanding of the working of the world (Callon 1986b).

A lot of the criticism towards ANT culminates on this idea of treating humans and nonhumans symmetrically, and on the concepts of *agency* and *action.* For instance Collins and Yearley (1992) offered a sharp criticism of the principle of generalised symmetry between humans and nonhumans for disregarding the human capacity for language and other means of communication, and also the human capacity for taking action. In the same vein, Mutch (2002) also finds that ANT neglects the powers of humans. Whittle and Spicer (2008) suggest that ANT degrades our understanding of action by collapsing human political action and nonhuman repetitive action onto the same level[23]. What is at stake here is that *agency* and *acting* are commonly mistaken to be read in human-centred terms, whereby 'objects acting' is (mis)understood as *similar* to human intentionality*,* while what Callon and Latour intended is to abstain from making *a priori assumptions of asymmetry* that would automatically privilege the human as the source of action. Rather, the subject's agency is seen as de-centred and an effect of the networked relations they are located in (Law 2004), and the notion of actions is distributed to the networks, to all actors (Callon et al., 1986a). Objects are seen as 'acting' by *causing an effect in states of affairs* (cf. Latour 2005), e.g. by interrupting, diverting, assisting, preventing events taking place.

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[23] Given the diasporic nature of the ANT approach, it is necessary to remain critical of the critique, and read it in its 'context': which variant of ANT is being critiqued, who by and in what way? Collins and Yearley (1992) criticised ANT from the position of Sociology of Scientific Knowledge, a competing strand within the Science and Technology Studies, which finds the principle of symmetry absurd; Mutch (2002) was reading ANT against Margaret Archers Social realism with view of analysing information systems; Whittle and Spicer (2008) launched a full-bodied criticism on ANT in the contexts of critical political theory. What is common to all these strands of critique is that each addresses ANT as a unified approach, and the critique concerns works which primarily fall within the ANT-1990 category.

Latour would like to in fact abandon using the rhetoric of the principle of generalised symmetry between the social and the natural because of the degree it has been misunderstood by many readers[24]. Rather than proceeding to treat humans and nonhumans, objects and subjects equally at all times, thus presuming there *is* a division between the two, Latour quite emphatically states:

> ANT is not, I repeat is not, the establishment of some absurd 'symmetry between humans and non-humans.' To be symmetric, for us, simply means not to impose a priori some spurious asymmetry among human intentional action and a material world of causal relations. (Latour 2005, 76)

According to this, asymmetries among actors should not be assumed in advance, but the point indeed would be to look for how and where asymmetries occur, and how these are continually reproduced. In terms of this research I have sought to examine the events taking place by trying not to privilege humans as the sole source of action, but examining who and what participate in action, how that participation is enacted and what follows from that. Doing this will allow space for possible asymmetries to emerge (cf. Rimpiläinen 2011).

3rd principle: Translation

The third principle is that of *translation,* a concept that can be traced back to the philosopher of science Michel Serres (1974) via Latour and Callon. Serres used this metaphor to describe the overcoming of boundaries between two different orders, or

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[24] This is a point I struggled with reading various ANT studies and the various (mis)interpretations of what the principle of symmetry means in practical terms. I could not accept that the researchers should be treated 'equally' to e.g. digital recorders in processes which require thinking, making decisions and judgements (more of this discussion in conjunction with methods). An extreme application of this principle is the study by Estrid Sørensen, *Materiality of learning* (2009).

order and disorder. Translating between languages means making two words equivalent, but as Law (2009) points out, this is actually never entirely possible. Thus translations are also always about shifting and betrayal. Callon (1986b), using the principle of generalised symmetry discussed above, was able to 'domesticate' all the different actors (scallops, fishermen and scientist) in a process of translation which relates, defines and orders objects, humans or otherwise. Thus aligning with the first two principles, both humans and nonhumans are treated without *a priori* judgement of the role they play in the networks. Translations are also about studying relationality, the continual displacements and transformation of subjects and objects, and how they connect, disconnect and change. The processes are insecure, fragile and prone to fail.

Callon (1986b, 1) introduced four moments of translation as an analytic framework for 'sociology of translation' – (yet) another name for ANT - suggesting that this would be especially well suited for studying 'the role played by science and technology in structuring power relations'. He emphasized that translation– rather than being an outcome - is a process where the different phases may overlap. Further, he suggested that translation is the mechanism by which the social and natural worlds come into being, resulting in a situation where certain entities control others. The four moments of translation he identified are:

1. Problematisation – 'something tries to establish itself as an "obligatory passage point" that frames an idea, intermediary, or problem and related entities in particular way*'* (Fenwick & Edwards 2010, 14). In Callon's example it is the research team who seek to do this, defining the scallops and the fishermen as their desired allies.

2. *Interessement* – 'the group of actions by which an entity attempts to impose and stabilize the identity of the other actors it defines through its problematization*' (Callon 1986b, 8). In Callon's example the researchers introduced a technique invented in Japan to anchor scallops, which helped settle the identities of the desired allies, and 'corner the entities yet to be enrolled' (ibid.).

3. Enrolment – multilateral negotiations that might or might not lead to the formation of alliances between parties. This is a precarious and uncertain process. In Callon's example the enrolment of the scallops did not succeed because they failed to anchor themselves on the collectors; the fishermen also revolt and raid the protected fishing area, thus unravelling the alliance.

4. Mobilisation – 'will the masses follow their spokesman?' (Callon 1986b, 13). The moment of mobilization happens only if a network becomes durable enough, so that the translation can be extended to other locations and domains.

Translation, as is the case with most ANT related concepts, has become multiple (c.f. Latour 1987 differentiates five types of translation and ways to achieve these; Callon's original 1986b four moments of translation and Callon et al.,'s, 1986a four models of translation). The characterisation that works best with the work being carried out in this study is Callon's model of extended translation (1986b) where translation refers to 'all operations that link technical devices, statements, and human beings', leading to translation networks, which cover both the process of extended translation and their results (temporary achievement of stabilised relations). As discussed in conjunction with the multiplicity of ANT, studies from early ANT understood networks and realities as static and singular. My uptake of this concept will be applied to a dynamic

process of gathering, which is about 'extending a network', and where there will be momentary stabilizations of relations, but also unravelling and disjoining of participants from it. (cf. Callon et al., 1986a, 273). I do not wish to nail down a strict definition of 'translation', for I want to examine and discuss translations as and when they happen in the process of research and development, leaving space also for temporary stabilisations and other relevant issues. As Fenwick and Edwards summarise it:

> ANT's notion of translation helps to unpick practices, processes, and precepts to trace how things come to be. Translation focuses on what actually happened/is happening at each of the micro-connections among heterogeneous things that are holding together to form what sometimes appears to be an immutable pattern, or an object with properties. It is for this reason that in early ANT analyses translation was enacted as a form of heterogeneous engineering. (Fenwick and Edwards, 2010, 12)

The principle of translation faces criticism for being uncritically applied in other settings[25], thus critics assume that translation is something 'out-there' to be discovered. Whittle and Spicer (2008, 618) suggest instead that the four-stage model should be taken as an 'analytical heuristics or a sensitizing concept' in order to make sense of each individual case, something Callon had in mind in the first place.

4th principle: Empirical version of post-structuralism

The fourth principle Law (2009) puts forth is that ANT should be understood as *an empirical version of post-structuralism*. The reasoning behind this is that the intellectual tradition of ANT is concerned with 'precarious relations, the making of the

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[25] Such as 'academic publishing (Hardy et al., 2001), management fashions (Doorewaard and van Bijsterveld 2001) or corporate greening (Newton 2002)' (Listed in Whittle and Spicer 2008, 618)

bits and pieces in those relations, a logic of translation, a concern with materials of different kinds, with how it is that everything hangs together as it does' (Law 2009, 145). Similar matters of interest are found in 'parts of post-structuralism', yet ANT diverges from those forms of post-structuralism only interested in language (Law 1999, 4). This principle has received least explicit treatment in the available literature, but Post-ANT works such as Annemarie Mol's, John Law's and e.g. Emilie Gomart's (2002) fall into this category of works not only interested in language.

The variety of Actor-Network Theory studies

Actor-Network Theory in all its variants has engaged a great diversity of disciplines, scholars and subjects, an overview of which can be seen on a resource (running up to the year 2000) collated by John Law and available on the Lancaster University[26] website. ANT inspired and informed studies are arranged under 30 different, yet overlapping categories, for many studies treat not only the substantive topic but ANT itself comes under scrutiny conceptually, as well as a method or a theory. Based on assessing the numbers of studies listed in Law's online ANT resource, the main substantive areas engaging ANT are technology and medicine, while for instance educational issues do not feature on the list at all. The list, of course, does not pretend to be exhaustive, but by the same token, the uptake of ANT in education seems to have really taken off only towards the end of 1990s and in the first decade of the millennium, which is not covered by the resource (cf. Fenwick and Edwards 2010). This coincides with the shift towards the more fluid and post-structuralist post-ANT, which perhaps offered more tools for studying less tangible things like pedagogy (e.g. Mulcahy 2006 on salience of space for pedagogy and identity) or curriculum (e.g. Nespor 1994 on knowledge moving through trajectories in undergraduate teaching in physics and

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[26] http://www.lancs.ac.uk/fass/centres/css/ant/ant.htm#sci; accessed 20.10.2011

management, Edwards 2010 on curriculum enacted in practice). Estrid Sørensen (2010) approached both classroom and virtual learning from the point of view of materiality.

In medicine ANT studies often relate to human bodies and technologies or the multiplicities of diagnosing and experiences of living with diseases or disabilities. For instance, Annemarie Mol, John Law and Vicky Singleton are prominent scholars drawing on ANT in making sense of matters pertaining to the medical field. Studies have led to discussion about multiple realities and politics of ontology e.g. questioning the singular nature of diseases as objects in medical practice (e.g. Mol and Berg 1994 study of anaemia, Mol 2003 study of atherosclerosis, Law and Singleton 2005 study on alcoholic liver disease) and the experiences of living with disability (e.g. Moser and Law 1999 examining multiple materialities of (dis)ability). A recent edited collection,*Care in Practice. On tinkering in Clinics, Homes and Farms* edited by Mol, Moser and Pols (2010), gathers together a wide range of ANT-informed medical studies in the Post-ANT spirit.

ANT has naturally been especially popular, while not singularly accepted, in Sociology of Science and in Science and Technology Studies (STS) (e.g. Sismondo 2010). Most studies have focussed on following the work of scientists, technologists and technologies in their 'natural' settings. Other studies have treated ANT on a more conceptual level, but these always pertain to empirical issues. The study which helped launch the field of STS was Latour and Woolgar's 1979 seminal ethnography *Laboratory Life* concerning the work of scientists' at a laboratory, and how they socially constructed 'facts' rather than discovered them out-there in 'nature'. This helped re-shape the way we think about science and research, an idea Latour carried further in his 1987 book *Science in Action*, which emphasized the importance of

focussing on the practices of scientific work. *Pasteurisation of France* was a study Latour (1988) carried out on Pasteur, the scientist seen as the central figure behind the revolution in medicine and public health in France. Latour showed how a single human actor cannot be the only 'cause' for this, but that he had successfully managed to enrol a network of allies, including microbes, farm animals, health professionals etc. for this to happen. Michel Callon and Johan Law have been other central figures in forming the STS field. In addition to Callon's 1986b study on fishermen and scallops, a co-edited collection of articles published the same year *Mapping the Dynamics of Science and Technology: Sociology of Science in the Real World* takes the early conceptualisations of ANT forward. Callon et al., (1986a), for instance, suggest that the concept of translation is one model for the development of sciences. In the same book, Rip (1986) examined how scientific resources become mobilized through different types of texts, including funding applications or reports. A study that has been inspirational for the current project is Latour's 1999 study where he followed scientists, pedologists, doing field work in the Amazonian jungle, observing the series of translations soil samples went through in order to become data and findings.

From studying scientists ANT branched out to study technologies and technologists (Elbanna 2009). Many famous ANT studies on technologies appear to have examined unsuccessful projects e.g. Callon's (1986a) study of the abandoned electric vehicle project in France, and Law's early ANT study *Technology and Heterogeneous engineering* (1986) on the expansion of Portuguese domination in the world. In 1996 Latour published a study of the unsuccessful transport technology Aramis, which suggested that the demise of the project was due to the failure of the heterogeneous actors to accommodate each other in the changing social circumstances. Law carried out a study of a discarded military aircraft project, producing a series of related articles

(e.g. 1988 with Callon on *Engineering and Sociology in a Military Aircraft project* and 1992 a study on the aircraft engine *The Olympus 320 Engine*) before finally in 2002 publishing a Post-ANT study treating the problematic aircraft as a de-centred, fragmented, multiple object, discussing how this came to be. The book is as much about the concepts of Post-ANT (multiplicity, enactment, fragility) than about the technology. *Everyday Engineering* edited by Vinck (2003) is an excellent collection of ethnographic, ANT informed studies of practices of engineering and design.

Despite the variety of fields covered by Actor-Network Theory and STS, locating the current study within these is not straightforward. Although there is an interdisciplinary field of Studies of Social Science and Humanities (SSH) emerging from within, and alongside the STS studies (Mayer et al., 2008), it has been hard to find many published works engaging an STS-style ethnographic approach on these fields, let alone studies on interdisciplinary working between the sciences/technology and the soft sciences, something the current study entails. Published sources on the SSH field are very few. As Mayer et al., (2008) reported:

> besides numerous (reflexive) studies inside and across the SSH field themselves, we unexpectedly discovered quite a considerable number of publications on SSH within the broad field of STS and its theories and methodologies, which cover research on e.g. finance systems, markets and economies, urban studies, law, development studies, psychology, anthropology, history, sociology. - - These scientific fields (as research objects) however seem rather invisible in STS journals and at STS events. (Mayer et al., 2008, 1)

There seems to be a growing trend of employing social scientists and humanists to work at large life sciences projects e.g. in the Netherlands (cf. Stegmeier 2009 – reporting on a workshop on convergence work related to social scientists and humanists working as intermediaries/mediators within the life sciences Genomics programme) and in the UK[27]. The fruit these engagements will bear are only emerging now.

One reason for the lack of ethnographic studies on the practices of social scientists and those in humanities might be the very different nature of research in these fields, which lend themselves less easily to observation. In humanities, for instance, it is usually the solitary researcher carrying out work at archives or in the field. Gaining access to that internal and very private process of research, which entails primarily reading and writing, is not as easy (while not impossible!) as observing scientists *doing things* in laboratories. Further, there are different types of ethical issues involved in observing someone carrying out confidential interviews with their research participants as opposed to experimenting with for instance non-human materials at a laboratory. In fact, mere observation is not going to be enough for accessing the work of social scientists and humanists, but multiple ethnographic methods will be needed, including interviews, documentary analysis, visual methods etc. Furthermore, cross-disciplinary research collaboration has only very recently become more common in the field of education and other social sciences (cf. RCUK 2010, Taylor et al., 2008). So far I am yet to locate any other study with a similar scope to this study and I believe this to be the first study of this kind within educational studies.

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[27] Based on the recently advertised (autumn 2011) academic/researcher positions for social scientists to work with the scientists, e.g. at Edinburgh University and the University of Lancaster.

Criticisms of Actor-Network Theory

In as much as ANT has gained proponents in the past decades, its controversial and often counterintuitive (to Euro-American meta-physics, as Law 2004, puts it) claims find many critiques, the most fervent ones aimed at the first two principles. An example of such an account is offered by Andrea Whittle and André Spicer (2008), who review ANT in terms of its ontology, epistemology and politics within organisational studies. In what follows I have picked up the points of critique I feel relevant to this discussion. I would like to point out that the authors treat ANT as a unified approach. This leads them to assess ideas from early ANT studies with those developed later on as a result of critique within the approach itself[28], or from a position of misunderstanding.

The first point of criticism is aimed at what is called ANT's anti-essentialist ontology, which suggests that while ANT seeks to denaturalise 'actors' viewing them as continually emerging effects of webs within which they are located, ANT studies still appear to take actors as existing 'out there' with inherent properties. For example Whittle and Spicer discuss Callon's 1986a study of the French electric vehicle failure, suggesting that:

> In attributing the breakdown of the network (at least in part) to the failure of a catalyst within the fuel cells, Callon thereby ascribes inherent properties to the catalyst. (Whittle and Spicer 2008, 614)

Secondly, Whittle and Spicer review ANT's commitment to *anti-dualism*, to not making a priori distinctions between the social and the natural, humans and non-

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[28] 'Objects emerging as effects of webs within which they're located' is a characterisation suggested by Law (1999), while the authors contrast that with one of the earliest ANT studies by Callon in 1986b.

humans, claiming that this in fact works to *recreate* the dualism ANT seeks to overcome:

> While on the one hand ANT stresses that actors do not have fixed boundaries (Callon and Law, 1997), it continues to rely on precisely these assumptions when partitioning of the world into, for instance, hotel managers and guests (people), weighty fobs and keys (material artefacts) and signs (texts) (Latour, 1991). (Whittle and Spicer 2008, 615)

Both points Whittle and Spicer make seem to hang on a misunderstanding of one of the tenets of ANT - *relationality:* that things get their meaning in relation to other entities in the networks. Law's (2000) suggestion of calling ANT 'material-semiotics' highlights this issue. Regarding the second critique, ANT does not suggest that there are *no* distinctions in the world between entities pertaining to the 'natural' or to the 'social', 'objects' or 'subjects' – only that these divisions *should not be taken as naturally given states of affair*, but as results of our mutual engagement and entanglement in the world (Law 1999, Latour 2005). Attributing the failure of the electric vehicle to a fuel cell, or talking about 'hotel managers' and 'keys' should be seen as effects of the surrounding networks – in some other situation the effects of the network would configure differently.

The third point of criticism is directed at the deterministic nature of networks and the mechanical nature of enrolment in them. Even beyond some early studies of ANT (e.g. Callon 1986b, Latour 1990), many ANT studies within organisation studies have treated networks as stable and irreversible once they have come together, and Whittle and Spicer suggest it is difficult to account for:

a) actions that disrupt the network but are not responses to any translation process, b) resistance that is aimed at disrupting translation but ineffective, and c) the unintended effects of translation (Whittle and Spicer 2008, 616-617)

This critique again is valid with regard to early ANT studies. However, with the move towards the post-ANT understanding of networks and relationality, these issues dissolve. For instance, in this piece of research my intention is to trace how a network lives in space and time as a dynamic assemblage, where participants become enrolled into the network as well as resist being enrolled, ignore attempts to be enrolled or disassociate themselves from the network under scrutiny.

Epistemologically, ANT claims to be a reflexive, emic-oriented approach that takes into account the understandings of those communities it studies, but the two authors find ANT unreflexive and positivist (Whittle and Spicer 2008, 617): unreflexive because of its lack of awareness of itself as an approach; and positivist because the authors understand its view of networks as deterministic and the researcher's role as that of a detached observer, who can offer 'a true view' of the events. They further criticize the neologic terminology which leaves its accounts alien to the communities it studies, thus ending up offering an 'expert' view of events, something I find a relevant point. While the authors take ANT as a singular, clear cut approach, largely disregarding that there are variations to how it is being used, I find resonance with some of these criticisms. For instance, learning to understand and use ANT terminology was an effort, and while in this study I see my role as that of a *critical participant*, striving to take into account the views of my participants as much as possible, the ANT terminology used in describing these makes their actions *sound* more Machiavellian than they have in fact

been, something the team members have also commented on[29]. Furthermore, as it has not been possible to study the reasons of those participants who have not become enrolled successfully into the Ensemble networks, I can only speculate upon these, other than drawing conclusions based on 'residual information/data'. Hence I do not propose this to study to achieve an eagle eye view, for case-studies do not parade as grand narratives or generalisations. Regarding the reflexivity of ANT upon itself, this topic I aim to discuss in the methods section, and during the tracing process of the unfolding events.

2.4 Actor Network-Theory in and as practice of research

> What is called knowledge, cannot be understood without understanding what *gaining* knowledge means. –Bruno Latour 1987, 220.

Even if the various characterisations of ANT amount to viewing it as a method, there are very few attempts that try to spell out *how in practice* to carry out such research. Latour's *Reassembling the Social* (2005)[30] is meant as an *introduction* to ANT research, but it should be better described as a guide book to those already familiar with the quirky world of ANT. Instead, John Law's *After Method. Mess in social science research* (2004) resonated more in relation to the current research topic, given the complexity, scale and indefinite nature of the Ensemble–project. Law does not explicitly mean the book to be about Actor-Network Theory, but it clearly entwines around the ideas from ANT, and he draws examples from well known ANT studies. He starts from the position that most methods seek precision, disregarding how messy the world actually is, and how important it would be to allow for that multiplicity,

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[29]Personal communication, Ann email, Nov 2011.
[30] Latour's point is that social is not the 'glue' holding society together, but is made up of essentially non-social components (human, non-human, animate, inanimate entities) constituting networks of relations and being constituted by them (Latour 2005, 4-5).

fragmentation and mess to be enacted in research. His argument, which aligns with the performative turn, is that methods do not simply describe social realities but also *help to create these*. This makes methods political, leading to questions about what types of realities we wish to create. This shifts the attention away from epistemological questions to ontology and politics. With different methods creating different realities, Law suggests that the reality, in fact, is not singular, a statement that goes against traditional Euro-American metaphysics, which assumes that reality is independent, anterior, definite, and singular (cf. Law 2004). We need to remember that Law is discussing realities in particular in relation to scientific methods. As *individuals* we can experience the outside world as independent of us, singular and anterior, for no individual could bring a reality into being on their own. This is also true for particular sites of scientific production, Law explains. However, collectively, Law argues, the answer is different: *particular* realities emerge 'with and through arrays of inscription devices and disciplinary practices of natural and social science', making reality dependent on the 'apparatuses that produce reports of reality' (Law 2004, 31). Regarding the question about whether or not reality is 'out there', and whether it exists before we point it out, Law suggests that in specific circumstances, there is a 'backdrop of realities that cannot be wished away' (2004, 31) generated by a large hinterland of inscription devices and practices already in production. However, 'reality and statements that correspond to it are produced together in the disciplinary and laboratory apparatuses of inscription' (ibid). I agree with Law's statements in as much that the methods we choose determine the types of statements we are able to make about reality, be these statistical measurements, socio-material or human-centred realities or discourses exposing hidden power structures. These statements of 'reality' do not exist before the method has been applied. For instance, in the case of this study the

Ensemble-project research team would have been 'out there' going about its research work even without my involvement in studying it. However, taking interest in the research practices of the team, they have become enacted as a research setting. The reality of Ensemble *as a research setting* did not precede my engagement with it.

Law discusses the definiteness – how knowable the external reality is – in terms of '*sets of definite forms and relations',* which again very much depend on whether the scientific statements made about reality fit together and reinforce each other, forming objects with fixed forms, or not (Law 2004, 31). This definition interestingly skirts around the idea of a singular reality, which does exist out there *for sciences and scientific practices as produced through such statements*. In the case of social sciences and humanities, where plurality of methods is the norm, the answer would rather be that the world is *not* definite and fully knowable. Hence, the singularity of reality is *an achievement*: e.g. for Latour and Woolgar (1979) reality *becomes* singular, but only *after* controversies about the realities have been resolved, and statements reporting on nature have become fixed. Until this happens, the reality appears to be multiple, an effect of multiple inscription devices and practices, only to be settled onto a single reality through the stabilisation of related statements. Overall, Law underlines that *realities are made*:

> They are *effects of the apparatuses of inscription.* At the same time, since there are such apparatuses already in place, we also live in and experience a real world filled with real and more or less stable objects. (emphasis original) (Law 2004, 32)

Law lays out an *approach* to data, which understands realities as constructed, and multiple; results as fluid; objects as elusive; forms as non-conventional; accounts as

imaginative and narrative (Law 2004). While this is all well and good for allowing the necessary freedom for accounting for the fluidity, multiplicity and distributed nature of my research domain, the question remains: how, by which concrete means, should I start making sense of the research questions and the data?

There are four strands of ideas that became interwoven in helping to find a solution to making sense of Ensemble -project events and how to analyse the expansive myriad of data.

- Firstly, Annemarie Mol's work *Body Multiple* (2003) steered my interest to the *practices* of research and development at our team.

- Secondly, given that 'research' most commonly is understood to be about production of new 'knowledge' (cf. Brew 2001), and that 'knowledge' in ANT terms is seen as arising as an effect of the heterogeneous networks, I needed a detour into John Dewey's pragmatism and his transactional theory of knowing (cf. Biesta and Burbules 2003; for a detailed discussion see Rimpiläinen 2011) in order to understand *what happens* in order for that knowledge to emerge out of the heterogeneous networks. This detour, reading ANT through pragmatism, helped clarify some misunderstandings I had held about ANT, as well as showing what would be useful to pay attention to in ANT analyses: that is, to the *doing*, (trans)actions between the heterogeneous participants in networks.

- Thirdly, with the focus on practices and doing, I needed a way of studying these. Mol understood objects as things manipulated in practices. In order to foreground the practices of research and development in the project, the first

research question is conceptualised as a *token*[31] (Latour 1987; Gaskell and Hepburn 1998). This also offered a way to start analysing the data.

- Data is finally analysed by following the trails of translation (Callon 1986b) of the token in the practices of research and development. Critical or significant moments, when the token becomes translated, or a translation becomes stabilized, or a new idea emerges, are identified; examining who and what participate (cf. Sørensen 2009) in these moments, who and what are being enrolled in/disassociated from the research process, and where this leads the Ensemble-project.

While ANT has striven to move away from the dualist and essentialist understandings of the world since the early days, it is only with Annemarie Mol's (2003) ethnographic study of a disease, atherosclerosis or the hardening of arteries at a Dutch hospital that Actor-Network Theory really joined the performative and practice turns of social theory. Mol carried out a 'praxiographic[32]' study of how the disease was being diagnosed and treated in different parts of a Dutch hospital: for instance, at the GP's clinic or at a laboratory. Rather than taking different understandings and diagnoses of the disease as *multiple perspectives* on a singular thing, Mol foregrounded the *practices* within which the disease was being manipulated and thus *enacted[33]* into being. This required the co-operation both of the patient and the doctor – two humans – and their networked and heterogeneous practices. By attending to the lived experiences of the illness, the stories told about it, and the practices of diagnosing it, including the technologies and knowledge involved, the disease emerged as material and active,

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[31] Token is a concept from early ANT by Latour (1987), and it is used to refer to objects and discourses. Gaskell and Hepburn (1998) talk about the token as a 'focal actor', and argue that an Actor-Network can be traced by following the path of the token as it circulates in the network.
[32] An ethnographic study focussing on practices. Mol 2003.
[33] Mol (2003) preferred to use the term 'enactment' instead of 'performance' due to its links to social-constructivist/representationalist ideas.

appearing and disappearing from one practice to another. For instance, atherosclerosis becomes enacted as 'pain in the legs when walking' at the GP's practice, or as a 'white lumen on a vein sample' under a microscope at the pathology department. These diagnoses of atherosclerosis could not coincide as perspectives on a single reality, for in one situation, meeting the GP the patient is alive, and in another situation she no longer is with us. This has huge ontological implications: through these multiple enactments of the disease, it is not only the object, the disease that multiplies, but also that which *is*. *The reality becomes multiple*. No object, no reality, is singular, according to Mol, they are '*more than one, less than many*' (Mol 2003, 4-5). They hang together by associations that exist between the different enactments, for instance the shared procedures or vocabulary, translations of instruments from one setting to the next, x-rays, people moving between settings etc, preventing the multiple realities from falling apart.

I read Mol's book at the stage where I had already witnessed the multiplicity of research approaches enacted in the Ensemble-project in studying the teaching practices in archaeology, and when the original research idea was not going anywhere fast. Thinking about these practices as multiple enactments of the research problem helped me conceptualise the Ensemble-project research team as a research domain.

According to ANT (Law 2009) knowledge as well as other phenomena, emerge as effects of heterogeneous networks. Given that 'research' is understood to be about production of new knowledge, and if that is seen as arising as an effect of these networks, my puzzle was: if I was going to study research and development practices and their outcomes, and if the outcomes were effects of these heterogeneous networks, *how*, by which means, did they 'emerge'? There had to be some better way of

understanding this. In doing some undergraduate tutoring I came across John Dewey's pragmatism and his transactional theory of knowing (cf. Biesta and Burbules 2003, for a detailed discussion see Rimpiläinen 2011), which to me resonated with ideas put forth by Mol (2003) and Law (2004).

Simply put – according to Dewey's Transactional theory, knowing is an activity, something we *do*. The theory offers an anti-dualistic understanding of 'how we come to know'. The most important concept in Dewey's theory is *experience*, which derives from the transaction of organisms and their environments (cf. Biesta 2009b).

> The organism acts in accordance with its own structure, simple or complex, upon its surroundings. As a consequence the changes produced in the environment react upon the organism and its activities. The living creature undergoes, suffers, the consequence of its own behaviour. This close connection between doing and suffering or undergoing forms what we call experience. (Dewey, quoted in Biesta 2009b, 12)

It is through *experience* that living organisms transacting with their environment are connected – that is, in touch - with reality, rather than standing 'apart' from it (Biesta & Burbules 2003; Biesta 2009b). This implies that no fundamental gap exists between us and the world, and that our experiences are consequently directly 'of' the world. If *experience* concerns transaction 'as it is', acquisition of knowledge emerges from the combination of *transaction* of the organism and its environment, and the *reflection*, intelligent thought, upon the conditions and consequences of that action, including the possible relationships between our actions and their consequences. Subsequently, also *knowledge* is directly 'of' the world (Biesta 2009a, cf. Rimpiläinen 2011).

It needs to be pointed out that ANT terminology differentiates between 'humans' and 'non-humans', while Dewey's pragmatism thinks in terms of 'organisms' and 'their environments'. Although partly overlapping conceptualisations, 'organism' denotes all that is living. Among organisms, pragmatism further differentiates the experiences of humans and of other organisms in that humans' experiences are always mediated by culture - everything that is a product of human action and interaction, the most important being language. Dewey emphasized that knowing was a human enterprise: it is the capacity to reflect and think intelligently, that allows us to control, to plan and to direct our actions (as opposed to blind trial and error) (Biesta & Burbules 2003; Biesta 2009b).

Environment, on the other hand, implies 'everything else' in the context of the transaction, and is not given any specific attention in the transactional theory of knowing. Taking into account the principle of generalised symmetry in ANT and Dewey's emphasis of knowing as a *human* enterprise, these two theories seemed incompatible, leading me to investigate the principle of symmetry more closely[34]. Doing this led me to suggest conceptualising the 'organism-environment' in networked terms, and then thinking about the transactions taking place in the light of the principle of generalised symmetry, which asserts that as well as human subjects, the non-humans and objects are seen as having a capacity to 'act', *to cause an effect in states of affairs.* While the organism acts upon the environment according to its structure, it is also the environment that responds, *reacts back* upon the organism's actions, something the organism again responds to (Biesta 2009b, cf. Rimpiläinen 2011). This to me implies that 'environment', or rather its elements (the networks consisting of both the actions and effects of the living and non-living, human and non-human matter) participating in

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[34] See discussion on the principle of symmetry.

the transaction, have the capacity to cause an effect on states of affairs. Re-conceptualising the organism-environment in ANT terms, and extending the principle of symmetry to thinking of transactions taking place allows the transactional theory of knowing to illuminate the practices of knowing, of *how* we come to acquire knowledge, which in ANT terms is seen as emerging as an effect of heterogeneous networks. In order to analyse this, we need to focus on actions, on doings, taking place in these networks.

Reading ANT through John Dewey's pragmatism worked like a litmus test in understanding aspects of ANT I had been confused about before, one of these being the intended meaning of the principle of symmetry, which did not after all rob us humans of our capacity to think, reason, reflect upon previous actions or plan ahead, despite our constant entanglement with nonhuman actors. Having been focussing too much on the heterogeneous actors, pragmatism guided my attention to *actions,* to doings (something practices also imply), taking place among the heterogeneous participants (cf. also Sørensen 2009).

Dewey's way of conceptualising the world aligns with the earlier discussed performative turn in social theory, shifting concerns for knowledge, the search for knowledge and knowing from epistemological issues to ontological ones, something that helped solve a further conundrum in this study. One of my concerns had been regarding my researcher position, and how the multiple research approaches in the research team could be studied without having to pass epistemological value judgements in terms of their validity and reliability, which I might feel compelled to do depending on my own position. Biesta suggests that taking 'knowing' as arising from the transactions between humans and their environments:

does away with alleged hierarchies between the different approaches and rather helps make the case that different [research] approaches generate *different* outcomes, *different* connections between doing and undergoing, between actions and consequences- - . (Biesta 2009b, 19)

If we follow Dewey in thinking that the world *emerges* from the connection between our actions and their consequences (Biesta 2009a), and Law (2004) in thinking that methods help to create realities, then using different methods in research simply are different modes of transacting with the world, producing different connections between doing and undergoing, and different ways of reflecting upon those connections, producing different types of outcomes. As Biesta suggests above, this would do away with alleged hierarchies between different approaches, hence offering a way of analysing these without having to make epistemological value judgements in terms of their supposed validity and reliability in 'describing the world'. However, rather than eliminating the epistemological differences produced by divergent research approaches and the realities produced through them (cf. Law 2004, Sørensen 2009, Biesta & Burbules 2003), by asking 'what is happening here?' we are now able to explore *how* the differences emerge and manifest themselves through practices of research. 'Knowledge' – as well as other research 'outcomes' - become emergent, products of the research process rather than something that exists 'out-there', waiting to be discovered by a skilled researcher. This take would allow for multiple types of knowledges and outcomes to co-exist (c.f. Mol 2003, Law 2004). Thus, 'knowledge' is no longer about representing things 'as they are', but becomes concerned with the temporal and spatial (networked) context in which a given thing is situated and created. Knowledge is simultaneously a construct and *of* the 'real' world (cf. Biesta, 2009b, Edwards 2009, Fenwick and Edwards 2010, Rimpiläinen 2011).

Engaging these two theories with one another was an illuminating experience when I had got lost in the jungle of the multiplicity of ANT studies. Dewey's Transactional Theory of Knowing helped to shed light on how 'knowledge' could be understood as emerging out of networks, helping to focus on 'the doing' taking place between the heterogeneous participants involved, making *the process* rather than the outcome of that process the centre of attention. Now what was needed was finding a way to do this with the multifarious, ever expanding data set.

My interest was, among other things, on the practicalities of doing research when divergent research approaches were brought to bear on the same research question. Mol argues that objects are things manipulated in practices, and that by focussing on the 'objects' as part of practices, it is the *practice* that comes under scrutiny (Mol 2003). Mol uses the term 'practice' in a generic manner without discussing its nature further in her study. 'Practice' is commonly understood to be something habitual or normative (Knorr Cetina 2001, Rouse 2001), but given the dynamism and unpredictability of research and development work, this characterisation is not sufficient. Knorr Cetina suggests instead a concept *knowledge-centred or epistemic practice*, which aims to take into account scientific practices as complex and non routine, something that would account for the emotional side of research, the excitement and engrossment this work entails. This type of practice is 'internally more differentiated than current conceptions of practice as skill or habitual task performance suggest' (Knorr Cetina 2001, 175-6.)

The first research question '*What are the nature, scope and role of cases in archaeology teaching?*' is taken here as the object that is being manipulated in practices, and is thus conceptualised as a *token* (Latour 1987) to be translated into research activity. This suggested itself as a useful way to enter the data set. The concept

of a *token* comes from early ANT writings, denoting both discourses and objects. Latour (1987) used the notion of token to challenge more conventional views that ideas and objects diffuse through society. While many of the early concepts from ANT have undergone critique and development (Law and Hassard 1999, Latour 2005, Law 2009), it remains important to examine the work they can do in particular circumstances – to mobilise them in the enactment of research.

A token is usually not passed unchanged, but can be ignored or taken up and translated as different interests are invested in it, changing the token as a result (Latour 1987). In this thesis, the work begins by the researchers picking up the token, the first research question, and starting to answer it by carrying out observations of archaeology teaching, translating it first into classroom observations that produce sets of observation notes, or *inscriptions* (Latour and Woolgar 1979)*,* thus enacting each researchers' research backgrounds or *hinterlands* (Law 2004). As the token becomes continuously transformed through the research and development practices of the team, it establishes connections to other actors, subsequently transforming these. This happens if the actors take up and use the token, seeing the new possibilities offered by it, something that has a bearing on their actions and patterns of practice (Gaskell and Hepburn 1998), an example being a researcher who amends their view of research through being involved in collaboratively researching 'cases' in archaeology. Gaskell and Hepburn suggest that the path of the token depends on the:

> number and strength of the links that are established between it and a diverse group of other actors. It is not a product of an initial quality but of the subsequent actions of a multitude of others. (Gaskell and Hepburn 1998, 66)

This becomes evident at the later stages of the research and development process, when one of the researchers seeks to gather together a new assemblage of allies in order to progress the research plan. If these allies do not become enrolled, the path of the token comes to an end.

> Those associated with the token form a network through links with the token. The network is defined by the token but the token is also simultaneously defined by the network. The network and token co-evolve. (Gaskell and Hepburn 1998, 66)

This idea aligns with the term '*translation network*' used by Callon et al., (1986a, 273-274) to denote the gathering of inscriptions, statements, technical devices and variety of human actors that interact with each other. These networks may vary in size and complexity, but are always established by scientific activity.

What I have done with the dataset is identify 'critical' or significant moments, when something 'happens', when a decision is taken regarding the direction of the research process. This may mean the token transforms, or nothing may happen for a longer time. Being a participant in the midst of unfolding processes, I have ended up scanning the events back and forth in time and space. It is through reflection and the blessing of hindsight that I have been able to pick out some events as relevant for the translations of the token, even if at the time this event took place it did not seem important. Or why something that did seem important has turned out not to be. As I said in the beginning, in order to continue in the style of writing 'within the unfolding process', which was until end of 2010 when the Data Aggregating Document emerged, required me to bracket that outcome until we arrived at it in data.

Callon et al., (1986a) stated that in order to translate, we establish ourselves as spokesmen. By setting out to do this research I have become a spokesperson not only for the research team, but the token, Actor-Network Theory, myself as a researcher, STS and SSH research areas, and probably a lot more.

Multiple ethnographic methods

Given the commitment to ANT and the fluid nature already of the originally suggested research problem, it was clear from the outset that an ethnographic approach would be used for data generation and acquisition. Apart from being commonly used in conjunction with ANT (e.g. Latour and Woolgar 1979, Latour 1999, Law 2004), ethnography allows us to approach the topic without any preconceived theoretical constructs in mind (e.g. Hammersley 2007), and to see the relative messiness of practice, looking:

> behind the official accounts of method to try to understand the often ragged ways in which knowledge is produced in research. Importantly it doesn't necessarily distinguish very cleanly between science, medicine, social science or any other version of inquiry. (Law 2004, 18-19)

In most ANT studies on scientists and technologists, the ethnographer is found in the field or the laboratory for long periods of time making observations. In contrast, studying the work practices in a geographically distributed project, where multiple settings are being engaged at the same time, and work progresses at different paces, arranging a constant *physical* researcher presence in the field was not possible[35], something that affected the modes and types of data generation and acquisition in this study. Even if I was focussing my actual study on the work of the team in relation to

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[35] Being based in Scotland while the research sites were located across three universities in England.

one of the six research settings, the 'field' proved to be highly distributed, multilayered and fluid, and in addition extending also into cyberspace through the use of the Virtual Research Environment (VRE). Hence, instead of long observation periods, I have followed the work of the project through attending the regular monthly residential meetings and making other visits to the 'field', while keeping in touch with the team through email and up to date with their progress by following their activities online in between the face-to-face meetings. The meetings and 'field' visits have been a source of primary data, which consists e.g. both of active participation and participant observation at meetings, planning and executing events, and doing semi-structured interviews with the Ensemble-project core team members. Being physically removed from the 'field' I have largely had to rely on the co-operation and trust of my research participants to self-document their daily work, for example by keeping online research diaries, or digitally recording their meetings in my absence, which they have done diligently. This has not happened solely for my benefit, but rather became a practice adopted by the project as a whole in order to keep the distributed team informed of the progress of the work. A large part of my data has hence been accrued through *data accumulation* rather than actively generating it. Despite being physically distant from the 'field', being involved in studying the project created a kind of constant 'absent presence' (c.f. Law 2004), which manifested itself for instance in the researchers remembering to record their meetings and then talking to 'Sanna' on the digital recorder as part of their meetings. Further, a large part of the data for this study is *secondary*: any data or output generated by the researchers relating to the archaeology setting has become data for this study. For example, interviews which have been carried out in order to study the nature, role and scope of cases in archaeology in turn become my data for examining the research practices enacted through these inscriptions.

Studying an activity in which one is both a participant yet not quite, poses different challenges to doing an ethnography, for instance, of a classroom. In a classroom situation there are more pronounced differences between the researcher and the research participants in terms of age, role and status, which makes it easier to demarcate the role of a researcher than in studying one's peers. Even in studying scientists' laboratory work as an ethnographer (e.g. Latour and Woolgar 1979) will designate the researcher in a more clear-cut role in the *doing* of research than what has been the case in this study. Given the several potentially conflicting and shifting roles that I either adopted, had to adopt, or that I have been positioned into[36], as well as the resulting varying modes of participation in the life of the project, calling the research approach *participant observation* is not sufficient. Although this type of multiplicity of roles, and shifting levels of involvement may be part of our everyday experience[37], in traditional research the researcher is ideally to remain detached from their object of study, in order to not to 'affect' the topic, the events where the data is being gathered from and thus from the results of their study (e.g. Monahan and Fisher 2010, Sapsford and Jupp 2006). The underlying assumption being that there is a 'single reality' to be discovered, and which our engagement with the object of research might negatively affect (cf. Law 2004). However, if we take the view that research should allow for the messiness of reality, and that our methods help produce the realities that we study, then our participation also contributes to the existence of the research subject, something

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[36] The multiple and potentially conflicting roles had to do with being both a student as well as a researcher e.g. doing an independent piece of research within a collaborative team with participatory ethos, and where all output was expected to be collaborative; being accepted as a full member of the team participating in meetings and discussions, yet negotiating a slightly awkward insider-outsider terrain in doing this; being involved in some data collection, yet analysing it being collected; being a PhD student studying the work of professional researchers; being supervised by the same person who was also one of my research participants and the leader of the project; having been an expert in one field previously and now having become a novice in another; being in the midst of the activity, yet based hundreds of miles away.

[37] E.g. being both a mother and a daughter or learning yet having to teach, might not often sit comfortably together, yet they often have to.

that the more recent ethnographic and anthropological research acknowledges (e.g. Law 2004). I suggest that this type of engagement could be best called *critical ethnographic participation*, which would point to the use of ethnographic methods and the purposeful, critical stance in studying the setting, while allowing for the oscillation of 'presence' and the varying modes of participation and engagement with the research 'field'.

Ethical issues

Ethical issues in this study have revolved around my participatory role in a collaborative research project as someone doing an independent piece of research, and around the multiple and shifting roles that I found myself in, in relation to the many research team members I worked with. It has required a great deal of trust and confidence on the part of my research participants to allow such detailed access to their research processes and practices, something I am hugely grateful for and respectful of. That the PhD studentship, with a particular scope to study an aspect of the work of the interdisciplinary team, was inbuilt in the project plan has contributed to the general positive attitude towards such an endeavour. In some ways, it became a responsibility of the project as a whole to provide opportunities for data collection as well as access to the data that was collected by the researchers themselves. However, mutual trust needed building and this happened over time as we became more familiar with each others' ways of working and communicating, and as the researchers began to understand how I maintained the confidentiality of their data, and that they were being treated with respect and integrity.

Having started with one research aim in mind, and then having to change it to another[38] naturally led to a period of confusion about my role within the team and it took some time for the members, including me, to come to terms with the fact that it was *their work* that was the focus of my study. During the first year some members of the team were a bit wary of which 'hat' I was wearing at what point, and this manifested in questions and comments like 'Are you studying me now?' followed by nervous laughter, or 'But don't quote me on this!'. Given the nature of the project meetings, my role in them and the types of encounters we had, it was difficult to clearly switch from 'doing research' in one situation to 'not doing research' in another, for these situations could change within one conversation. In the end it felt that trying to consciously separate the two was a futile exercise, for as Latour (1987) states, the researcher becomes the instrument of her study. Once the final research questions became clear, my engagement became a sense-making exercise, being constantly alert to ask and reflect upon 'what is going on here?'

Managing the sets of shifting roles and relations required careful navigation at times. For instance, having a PhD supervisor, who is also one of the research participants, was sometimes a little awkward, and I have felt the need to stand my ground in certain situations where there may have been an issue at stake between these two roles. By the same token, I have needed to listen to the Ensemble-project members, when they have confronted me about certain pre-conceptions that I may have formed and operated on, for example taking the Semantic Spider diagram as a 'black box'. When this happened I had to revise my ideas by discussing the issue with the members and on the basis of data that I later generated. Being open about understandings and misunderstandings, and trusting the other party have been vital in this process. That I had actually worked

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[38] For the lack of an object to follow through archaeology teaching.

with some of the team members at another conjunction before helped in coping with the new situation.

Apart from becoming more familiar with each others' ways of working, spelling out my ethics policy in the information sheet and the consent form, which all my research participants have signed, helped too. These are available as appendixes 3 and 4 at the end of the thesis. The ethics policy stated that no personal details, whether obtained through an interview or at in informal context, would be disclosed in my research. Any conversation or interaction, whether informal or formal, would be treated confidentially. The team members would be offered an opportunity to read anything that would concern their work prior to it being presented in public. This carried a further promise that if a disagreement over something I had written should arise, this could be raised and discussed between the parties involved (me and those whose work it concerned). Should I feel no change could be made to my analysis of events, a footnote pointing out this disagreement would be added in the text. These decisions were well received and encouraged the researchers' trust in my research practice. They seemed to become more at ease with my inquiring presence and were happy to share and discuss ideas and data, etc. Further, the ethics issues engaged by Ensemble as a whole also applied to my access to the data from these. The archaeology staff were informed initially of my interest in the research setting and subsequently told that I was following the research team rather than the goings-on at the discipline. While we agreed on using pseudonyms for the participants in the study instead of real names, I have emphasized anonymity could not be guaranteed due to the public nature of the project and the limited number of roles occupied in it. The participating institutions have been named.

Next I will introduce the dataset before actually discussing how I approached it methodologically and analytically.

Primary data

- Recordings of team meetings
- Participant observation of and participation in meetings, events, field work etc.

In order to involve all Ensemble-project members in the work of the large and widely geographically distributed project regular, monthly 2-day residential team meetings were held for the first 15 months. Thereafter only the core team met monthly, with this team coming together bi-monthly, or as was deemed necessary. Further, large steering committee meetings were arranged once or twice a year. I participated in as many of the meetings as I could manage. A lot of the data and a general understanding of what was going on in the project arise from participating in these meetings and through participant observation of events taking place. The meetings enabled the distributed team members to get to know each other well, which has been contributed both in the work of the team, as well as with the trust and confidentiality necessary for this study to succeed. All Ensemble-project meetings are recorded, and available as data, mounting up to ca. 350 hours. This data forms a kind of backdrop to other more focussed data; I have used it only when the trail of the token has taken me to that piece of data.

- Online research diaries and the VRE

In addition to meeting up face-to-face, the team have used a number of shared online spaces set up in the Sakai Virtual Research Environment (VRE) run by BERA[39] for general project management, data organisation, storing and sharing information. VRE

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[39] British Education Research Association

allows every Ensemble-project member, regardless of their physical location equal access to centrally stored resources, data and information. (cf. Laterza et al 2007, Rimpiläinen et al., 2006). A collaborative authoring tool Wiki affords joint drafting of papers, brain storming, providing links to data, minutes of meetings, recordings etc. Wiki became the location where the research associates started keeping *online diaries* of their weekly work. This was by way of keeping track of the work being done in the complex project as well as allowing other remote Ensemble-project members to keep up-to-date with the work of the core team. These diaries, several hundreds of pages of text, have come to form the chronological back bone of the dataset for this research.

- Interviews

In addition to regular, informal un-recorded discussions, a *series of semi-structured interviews* was carried out with each core team member related to the work being carried out in the archaeology setting. The first series of scoping interviews was conducted in January 2009 with six members of the core team. They were asked questions about their professional backgrounds, education and research training, reasons for joining the team, their role in the team, about working in a collaborative setting, their aspirations for the project and preferred ways of doing research. Another two team members were interviewed at a later date, when it became apparent that the scope of the work being done in the archaeology setting was wider reaching than initially anticipated.

Follow-up interviews have been carried out on as-and-when-necessary -basis throughout the project. Some of these interviews were carried out from distance using Skype, which has an incorporated digital voice recorder. The interviews also include *focus groups*, where a selection of Ensemble-project members discussed questions and

issues posed to them, e.g. a focus group discussion on technology development in the project. In addition to these, a number of short *email-interviews* have been carried out with Ensemble-project members in order to clarify ideas, or get a view of the diversity of experiences on certain topics and events. All interviews have been transcribed. All interview data is confidential and stored securely on the hard-drive of my personal, password protected laptop and the external hard-drive, and not shared with the rest of the team.

- Ensemble-project members' meetings on archaeology

A further data set consists of any *meetings and negotiations held between the Ensemble-project members* regarding the archaeology setting. The meetings could concern data collection, be a follow up discussion after a visit to the setting or be about the possible design for the technology. These recordings were taken by the team members for me in my absence, and exemplify how the absent presence (Law 2004) is affecting the researchers working practices. This data provides access to interdisciplinary negotiations, ways in which decisions about the course of the research work are being taken, how technologies, opportunities, events, knowledges etc participate in the process of research and design.

Other data generated by the team members as part of their work on archaeology includes:

- Email correspondence regarding archaeology
- Conference papers, posters, presentations and their drafts
- Diagrams, sketches, white board drawings
- Screen prints, websites

- Technology prototypes; paper prototypes etc

This data allows investigation about the enactment of the research process practice; how the messiness of research process becomes translated into a more or less stabilized form in a paper or a poster, however momentarily, and how the project and its work are enacted, performed in the process. The data also relate to technology design and development.

Secondary data

In terms of data accumulation, all *data generated by the Ensemble-project members* relating to the archaeology setting have become my data. These include:

- Observation notes on archaeology teaching
- Interviews with members of staff and students in the archaeology setting
- Recordings of meetings with representatives of archaeology
- Photographs of objects, photographs of sketches and text written on white boards etc.
- Drawings, diagrams
- Lesson plans, course documentation, websites
- Sample assignments (Artefact-projects)
- Other discipline related documentation
- Notes taken at events

This data enables investigating the ways in which the researchers approach and research the setting, which methods they have adopted and how their researcher hinterlands are enacted in practice, what types of materials, people, data and information are gathered as a result. All of the data sets listed above participate in the

process of studying the research practices and the emergence of outcomes, expected or not, of the process. They also form part of the assemblage which has enabled me to act as a researcher in this project.

Being geographically distant from the research setting does not mean that the data necessarily becomes thin or patchy. It has been fortunate that the team members have largely embraced the participatory and collaborative ethos of the project, sharing their thinking and work with each other, including me. Being physically removed from the daily work, yet spatially close through technology, has also acted like a methodological and analytical device, making me ask questions that I might not have thought to ask otherwise. It has helped me not to take things for granted but to question decisions and directions taken, or simply clarify issues that might have become clear to the core team but not for the rest of us. This has also helped the Ensemble-project members to reflect upon their own practices. The disadvantage of being geographically remote becomes tangible when things happen in rapid succession and the flow of things takes the researchers almost by surprise; this is when the documentations of events started lapsing a little. The task at hand, naturally, takes over. Catching the moment in retrospect becomes a challenge.

The changes in the organisation of the work in the project and the engagement with the setting are reflected in the types of data that are available. During the first part of the project with several researchers engaged in studying the same setting, much of the data is derived from small meeting discussions, or is generated with the setting and through email correspondence. In the beginning of the second year the project became even more dispersed as a result of re-location of some Ensemble-project members to a third institution, engaging more research settings. This meant that each researcher

concentrated on their respective research settings, and it is at this stage that the role of online diaries and reporting at Ensemble-project meetings come to the fore. At the latter stages of the project, it is the email correspondence, interviews, course documentation and their analyses, participant observation, screen prints, technology prototypes and meeting recordings that become more important, with the pace of work picking up and writing of online diaries falling to the background.

Apart from the interviews I have conducted with the core team members, all data is stored in the Virtual Research Environment, accessible to all Ensemble-project members. Email correspondence is stored in individual email inboxes, or sometimes is pasted into the online diaries. The list of 'Unpublished sources' details the types and amounts of data sources used in the study.

Given the unfolding and indefinite nature of the research topic, initially *everything* potentially became data! In order to manage the huge data set I created a word-table detailing all research events (meetings, interviews, observations, negotiations etc) that took or were taking place either at project level or in relation to archaeology. I noted down the location and type of related datasets (whether there were related interviews, meeting recordings, photographs or other data), including a short description of what each event was about. This enabled locating any event chronologically with the associated data. I transcribed all the interviews I carried out with the research team members, all the recordings of smaller and larger team meetings that were relevant for my study and the interviews and meetings the research team's members carried out with the staff and students at archaeology. These were subsequently uploaded into the Atlas.ti together with copies of the researchers' diaries and organized and tagged for events, relevant quotes, happenings, etc. This made them easy to locate and helped with

remembering what each piece of data was about. Similarly I collated all archaeology domain related email correspondence chronologically into a single word file, stating who the correspondence had been with and what about, and which other event and data these might relate to. In terms of analysis, the data usually came in clusters (e.g. interview + meeting recording + diary entry + email correspondence), and entailed shifting between several data sources located in different places, crawling through each event, piecing the story of the translation of the token together. Until 'the something' finally emerged from the research and development process it was not possible to say which bits of data were relevant and which bits could be left out.

3. What is a 'case' in Archaeology?

> How are we to follow these moving objects that are transformed from hand to hand and which are made up by so many different actors - -. Bruno Latour 1987, 107.

Quoting Latour (2005, 123) we, as researchers, always start from the middle of things, in the middle of action that has always started before we become engaged in it. The Ensemble-project had been gathering for quite some time before the project officially started in October 2008, and I have decided to 'cut' the network following Strathern's (1996) advice and pick up the research process from a point in time when the discipline of archaeology was already engaged as a research setting[40] for the project. The team had settled on observing undergraduate ceramics practicals, MPhil zooarchaeology classes and World of Goods lectures accompanying the practicals. These were selected from a range of courses where 'cases were being used in teaching', as recommended by their contacts at archaeology. The observations took place between January and March 2009 at the discipline of archaeology. In this chapter we will first follow two members of the research team who set about translating the first research question into research activity by observing the teaching of a ceramics practical. We will examine inscriptions (Latour and Woolgar 1979), the observation notes produced during the first observation session, and how these enacted the researchers' respective hinterlands (Law 2004), leading to questions about the 'unified' nature of observation as method.

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[40] Enrolled as a setting in as much that the team had engaged with their lead contact, Matt and the contacts he had introduced the team to, to decide upon which teaching and learning settings to focus on, and negotiated access to these. Conceptualising the archaeology discipline as a 'setting' at this stage was the case really on the part of the project.

After that we will pick up the research process in early April 2009, after the series of observations had finished at the end of the first term. The researchers held a data-meeting where the token is being discussed. Here we will see four researchers with divergent research backgrounds reflecting upon the work carried out, with the purpose of assessing whether enough is known about case-based teaching and learning in archaeology in order to answer the first research question. They also want to decide what the next steps in the research process should be. The team arrive at two conflicting interpretations of data, and we will examine how the team can proceed from that position. The chapter finishes with a discussion of three interim stabilisations of the token - a power point presentation, a poster, and a conference paper – each of which enact the work of the project and help translate the token into a tension, leaving it open for further investigation.

3.1 Research questions in the practice of research

> The appearance of direct representation is the effect of a process of skilful deletion.
> – John Law 2004, 88.

The originally articulated form of the first research question – the token whose translations we are following - for the Ensemble project is:

> *What are the nature, scope and role of cases and case-based learning across disciplines in higher education and their relationship to learning outcomes and expertise*?

As well as the research questions, the bid also lists methods to be engaged in the project, one of them being 'rich observation and description methods, drawn from

ethnomethodology' (Original bid 2008, 7), which, in short, attends to people's interactions and their own accounts of reality and how they make sense of this (e.g. Lynch 1993). Observation as a research technique belongs to the core of ethnographic methods. It can be seen as a purposeful sensory activity – seeing, hearing, touching, sensing, noticing, feeling – being translated into an inscription of some description (a written note, audio file, a photo, video, drawing etc), usually field notes. Simons (2009, 56) characterises the mode of observations most commonly used for case studies as descriptive, interpretive, 'using both intuitive and rational means of capturing the essence of what is observed and are reported in accessible language'.

The team members had not discussed the sequence of research methods, but stated in the research interviews I carried out with them early in the project life that approaching the research problem through observing the archaeology teaching practices seemed like a 'natural thing to do', which was an acceptable course of action for the participating disciplines. There were in total four members[41] of the team, with an additional stand-in researcher, carrying out the observations, attending eight sessions of ceramics practicals, one zooarchaeology class and two World of Goods lectures between them. It was agreed at one of the team meetings, with the collaborative ethos in mind, that as far as possible, two members should attend the classes to take observations, so that the best possible idea of what was going on would emerge. Archaeology proved to be a popular 'setting', with several team members volunteering to do the observations, making sure there was always someone attending the classes. Two members of the research team, Tom and Will, went along to make the very first observations of a ceramics practical. The rationale for zooming in on these notes is that while both were carried out through

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[41] Including me, given that the initial suggestion was that I should study 'fluid cases' as they emerged in archaeology teaching. It was suggested that I should follow material from a wet land site 'Star Carr', which some of the ceramics classes were supposed to draw material from, but this did not happen.

engaging observation as method, the notes produced were very different from one another, yet evidently from the 'same' situation. Focussing on these two sets of observation notes allows me to illustrate the concepts of token, translation, diverse research practices and hinterlands.

The data in this section consists of not only the two sets of observation notes but also semi-structured interviews, where the researchers were asked to talk about their professional backgrounds and their experiences of doing observations in the setting. In order to analyse the two sets of observation notes I created mind maps using an online tool FreeMind, describing each set of notes in terms of their format, style and content – what was being observed and how this was described. This analysis made it possible to ask questions like 'what was the purpose of the notes'; 'what type of information do they convey and what do they do?'; 'what do they reveal about their creator as a researcher and observer?'. This enabled comparison of the two sets of notes as inscriptions and enactments of the researchers' research practices, which were further investigated through the researchers' accounts of their professional backgrounds and their experiences of working within the research project explored in the interviews.

The ceramics practicals, a couple of which I attended as an observer, were arranged as part of the undergraduate archaeology degree, and took place in a multipurpose room on the ground floor of the museum adjacent to the department[42]. The room was long and narrow, lined with drawers and shelves full of archaeological objects and artefacts. In the middle of the room there was a table able to accommodate a large number of people and provide maximum work surface. High legged chairs were arranged around the table. When the chairs were occupied there was hardly any room left to move from

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[42] This chapter is based on a conference paper 'ANTics of educational research' given at CRESC 2009 conference, presented jointly with Richard Edwards. All research and analysis of data was mine.

one end of the room to the other. The room was being used for storage and teaching as well as research. The lecturer would stand at the far end of the room where all the teaching technology (PC, data projector etc) was located and where there was enough space to do so, while students gathered round the table. The observers usually sat farthest away from the lecturer giving the students priority to see the objects and artefacts.

The purpose of doing observations in the classroom situation was to convey to the other team members what went on in the class: what was being taught and how? What were the role, scope and nature of cases in ceramics teaching? This activity was partially 'economic' in nature, as the team works collaboratively, but not everyone could be present in the class at the same time. The notes – first hand written with pen and paper and then typed up on computer and thereby further translated - were shared with the rest of the team through the virtual environment[43].

Let us look at extracts from observation notes taken on 22nd January 2009 by Tom and Will.

> **Example 1- Tom's observation notes**:
>
> '[13:55] [*Lecturer Jane*] shows how to carry pottery [vessel C]: "with both hands, attached to torso".

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[43] Once shared with the team, the notes start a new life: they can be read, analysed, debated, interpreted and decisions may be taken based upon them. Or they can be ignored, as Latour (1987) pointed out with the token. Once shared electronically, the notes can be printed out, stored on a memory stick or emailed and thus transported to new locations. Were these left hand-written in the observers' note books, this would not be possible. Observation notes become 'data', which become enacted as fragile and are subject to further negotiations, interruptions and contestations, something we will see happening later and something this chapter exemplifies. Making the observation notes into an immutable mobile (Latour 1990) inscription that can be moved, has enabled the translated token to enter into interaction with other tokens, actors and actants present in the networks accessible to it They exert an influence and can be influenced, acting across space and time within the overall work of the research project, including this thesis.

Intro to course: 'the course is to give you some sense of the physical reality of working with ceramics in real archaeological sites'.

Students introduce themselves one by one pointing out their speciality (e.g. Greek, Roman, etc.). They are given the task to bring pottery of the specialty into the class in the next weeks. Practical is divided into two sections:

- The practice of working as a ceramist in live archaeological sites
- Properties of ceramics

Layout (figure next page). 9 students, [*lecturer Jane*], Tom, Will and [*lecturer Jack*] (teacher, specialist in particular ceramics).

A-D (in figure): pottery (D brought in later during the lesson). All Egyptian pottery (teacher's specialty).' (Tom's observation notes, 22nd Jan 2009)

The researchers have started the process of translating the token, the research question, into research practice through observing the unfolding ceramics practical. The notes taken by Tom are well structured and report-like. He describes the events in the class on an abstracted level, using a language that locates him outside of the events as an 'impartial' observer. He has summarised the content of teaching and uses thematised headings to structure the observations. He has also taken photographs of the pots to complement the notes, which are shared with the research team. It is quite difficult to get a sense of what the class was like or what the teaching was like, while his notes deliver a detailed analysis of content of what was taught, what equipment was being used (vessels A-D, for instance) and who was present. His notes overall, including typed notes, contain a lot of reflections (e.g. on learning and problem solving) which may have been added in the translation of the pen and paper notes to those placed in the

electronic environment. They provide evaluations regarding teaching students to describe and classify vessels:

> 'This form of teaching appears to be a kind of 'cognitive apprenticeship' (showing students how to think and guiding them in their own thinking) and very close to the real work of future ceramicist'. (Tom's observation notes, 22nd Jan 2009)

Example 2 - Will's observation notes:

> 'As we start [*lecturer Jane*] is keen that we should all sit close to the pots (it is a narrow room and this is difficult). She carries a large pot to the front from a cupboard at the back, holding it close to her with both arms around it. *You carry a pot like this so that if you trip over luggage* (steps over student backpacks), *you won't fall and smash it.*
>
> [*lecturer Jane*] gets us to say who we are and what our interest is. People have interests in different regions and periods. One student, K, is interested in W Europe and in early Bronze Age/Neolithic, which may be useful for Sanna.
>
> [*lecturer Jane*] starts: *I don't work with slides. I work with pots.* (She repeats this. Are slides the usual medium in this field? Is this a subject convention or is [*lecturer Jane*] making a point about her preferred way of teaching? She says it as though it is something important). *And especially with Egyptian pottery* (indicating the three pots on the table in front of us) *because I am most familiar with these.'* (Will's observation notes, 22nd Jan 2009)

Will's observation notes are more descriptive in style and through the language he uses he emerges as a participant in the events he describes. While he too has picked up on a number of key issues from the observed session and presented these arranged under headings as a reflection preceding the actual notes (added while typing up the notes), his style is narrative. He notes down gestures, movement, locations of the teacher and students, tones of voice, teacher's interaction (or lack thereof) with pottery and with her class. The reader can imagine, for instance, the lecturer carefully carrying a valuable pot, stepping over bags, giving a first lesson in handling pots - 'you need to hold it close to your body... etc'. The notes succeed in transporting the reader into the class situation by evoking and enacting the experience of sitting in the class and listening to the teacher taking it. The pots become 'alive' in his account:

> 'Teacher indicates the shape of the red bowl with her hands...*"closed" – "open" – the maximum diameter of the rim*- -' (Will's observation notes, 22nd Jan 2009)

Read together like this, the notes complement each other, but as stand-alone ones they enact the practices in answering the questions in different ways, producing divergent inscriptions.

So far, Tom and Will have translated the first research question into research practices through an act of observation, producing two divergent material inscriptions of the situation. How is it then that the two sets of observation notes, produced through the 'same' method, and which clearly relate the 'same' sequence of events, are so different? Doing observations is never a neutral activity, but is influenced by the values and beliefs of the observer (Monahan and Fisher 2010). Law (2004) has introduced the concept of *hinterland*, which relates to his discussion of ontology, methods, and how

these help produce particular scientific realities. He emphasized, that the 'backdrop of realities' which appears to be 'out there' independent of us, is in fact produced by 'large hinterlands of inscription devices' and disciplinary practices of social and natural sciences already in production (Law 2004, 31). To me this means that each researcher is in fact both an enactment of and enacting their respective disciplinary hinterlands, practices and ideas in their work.

To Latour and Woolgar (1979) science is about the *manipulation of inscriptions and statements.* A similar practice exists in social sciences research. The concept of *inscription* pertains to early ANT, to the work of Latour and Woolgar (1979) observing scientists at the Salk laboratory. *Inscription* refers to all forms of transformation through which an entity (cf. Latour 1999), or phenomenon when talking about social sciences research I would add, becomes materialised into a sign/archive/document etc – something the observation notes have become. According to Latour (1999) inscriptions are always mobile, allowing for new translations and articulations while keeping some relations intact. Translations result in displacements through other actants whose mediation is indispensable for any action to occur. There are numerous actors that will have a bearing on the process of inscription[44], most are self evident like the purpose of taking notes, available equipment, aims of research and the question that is being answered, or the conditions within which the inscriptions are generated (e.g. level of lighting, noise, temperature etc). Latour and Woolgar also talk about *inscription devices*:

> an inscription device is any item of apparatus or particular configuration of such items which can transform a material substance into a figure or a

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[44] Talking now specifically of taking observation notes, even if making inscriptions could refer to any research method or practice.

diagram which is directly usable by one of the members of the office

space. (Latour and Woolgar 1979, 51)

Inscription devices and translations are about transforming material substances into a figure or a diagram. The idea is applicable in social sciences research, but here we are talking about creating an inscription of a phenomenon, process or an event, in this case a teaching and learning situation that the researchers participate in as observers. Taking observation notes is a research technology- just like Latour at the Salk laboratory, the researchers in this study sit and observe what is happening in the classroom. Law (2004, 29) does call an inscription device just this, a technology or an instrument, a 'set or arrangement for labelling, naming and counting'. It is a means of converting relations, he says, 'from non-trace-like to trace-like-form'. This is a set of practices that shift material modalities. Here Latour's (1987) idea of researchers as the instrument of their research comes into its own: the researchers *are* the inscription devices, sitting in the classroom, observing what is going on, translating this experience and activity in notes with pen and paper, thus shifting material modalities. In this way the observation notes (inscriptions, objects) and other materialisations of research activity (including interview recordings and transcripts, meeting notes, photographs, sketches etc) offer a way of accessing the researchers' research practices and their hinterlands. We will explore short professional biographies[45] to illuminate the entanglement of networks where Tom and Will's research approaches, understandings and practices stem from and how these have a bearing on their differing engagement with the token .

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[45] Which are naturally selective. What we need to take into account is that these interviews were carried out in the early stages of the project, in February 2009, when only two or three classroom observations had been conducted in the ceramics class, and the project as a whole was not very far advanced. The researchers' ideas and understandings of issues discussed here have undergone changes in the duration of the project, through engagement with the settings and other researchers with different ideas and approaches.

Tom and Will both classify themselves primarily as educational researchers within this interdisciplinary project. However, their disciplinary expertise draws on a wide range of backgrounds both from the social and natural sciences. What comes across from Tom's interview (18th Feb 2009) is a strong sense of identity as a learning scientist, and his preference for structured research approaches in his work. He joined the team by applying for a position, wishing to move into educational research for career reasons. Tom had just completed a PhD in cognitive science at a computing department, studying initially case-based learning, but moving later towards collaborative or group learning. He also has a degree in cognitive psychology and computer sciences. His interests lie in theory, theorising and in building systems and models. He would ideally study learning in more structured, pre-arranged settings by applying some systematic method of analysis. He describes his methods as qualitative, but 'resists applied research'. In the past, he has primarily worked in solitary projects, but finds that the (collaborative) project's day-to-day work in practice is not much different from the way he used to work before. It also transpires that Tom is a novice to observational methods, which he has not needed to engage in his previous research (Interview with Tom, 18th Feb 2009).

Will is a very experienced researcher in education, especially in case study research. His professional background extends also to other fields in the social sciences, while his original training was in bio-chemistry, from where he moved into sociology and criminology. His interview conveys a keen interest in ethnographic and qualitative research methods, which he says he got into 'out of dissatisfaction with quantitative methods'. Will is an original member of the panel that put the research proposal together, but has no especially designated role within the team. This has left him fairly free to follow his own interests within the project, which is why he is focussing on the

archaeology setting, having an interest in museums and education. Will has a broad experience of working in collaborative projects, ranging from small and medium sized ones to projects at least as extensive as Ensemble. Observation as a method is very familiar to him, and the model Will says he has in the back of his head on observations is like making a documentary film:

> *'It's something that's a believable account that respects the actual events and circumstances. But it is *necessarily* biased. But where the bias is, is... it doesn't get in the way of somebody else coming in and re-seeing it again you know in a different way...'*. (Interview with Will, 19th Feb 2009)

I also enquired about what the researchers' aims in working in archaeology were. Tom's aim is to understand the role of the artefacts in the process of learning; whether they cause change, and if so, how and what the teacher's role is in the process. He explains the idea of a vessel as a case:

> *' -- so this idea of this vessel, which then would be a case is extremely powerful and so that the learning outcomes could be very diverse, you know, also in terms of identity, roles, and obviously then cognitive knowledge and other stuff, you know so this idea, this is really something. Even, it could even be understood as being a catalyst you know... it's there to change things and then it gets thrown away. But the change can be massive. And I would like to know -- what is the role of the vessel during that. Whether it is the vessel that changes, to what degree is it the vessel itself and to what degree... it is what the teacher does with the vessel... and if this, <u>if we can fix that then we have a really</u>*

good idea of what cases do, *how cases have the same, they have the same sort of structure... you know there something comes in and does sort of a broad change'*. (Interview with Tom, 18th Feb 2009; emphasis highlighting Tom's research approach)

Will's emphasis in studying archaeology is on trying to gain an understanding of what is going on in the setting, or as he put it: '*trying to defer doing anything while trying to understand what's going on*' (interview with Will, 19th Feb 2009). This includes seeing what type of teaching and learning is undergone and what people hope to get out of it. Will adds that developing such an understanding of the practices in this subject area might help the team to think of other potentially helpful forms of intervention.

The two sets of observation notes examined at the beginning of this chapter can be taken as materialisations of the researchers' respective hinterlands, their expertise and familiarity with observation as method. They show how the two researchers started the process of answering the research question by translating it into research activity following practices that they are most familiar with, and which work best for them in order to reach the aim they have in mind when entering the setting. Tom is very focussed on 'solving the problem with the case': are cases being used in teaching and if so, how? Could a vessel be treated as a case, and what is its nature? Tom seems to have a clear conception of what case-based learning is, or should be. Will's approach is to take things more slowly, getting to know the setting and what is going on in there allowing the phenomena to emerge from the setting itself and documenting it for the other members of the team. As instruments, the researchers enact observation as a method in diverse ways.

Through exploring the researchers' hinterland, from which their current research practices emerge, and through finding out about their reading of the research question and their aims of engaging with the research setting, we can see a complex entanglement of networks that the researchers (just as everyone else) operate in, and how these come to have a bearing upon the resulting enactments of the observation method and the objects and inscriptions produced. It is really the interconnection of all these things that contextualises (in the networked sense, Edwards et al., 2009) Will and Tom as team members and as researchers that impact upon their translation of the question into practice.

Multiple perspectives or multiple realities?

The two sets of observation notes could be taken as two interpretations of the same underlying reality of the ceramics practical. However, if we follow Annemarie Mol's articulation that objects are things manipulated in practices, and that by examining objects as part of these practices, the 'single' object - here the 'manipulated' research question, the token – multiplies[46] (2003, 4-5). Mol's argument goes further and states it is not only that the observation notes (as materialisations of two divergent research practices) are multiple but that these could be seen in fact as enacting two different realities, as experienced and enacted by Tom and Will. All the human actors participating in the ceramics practical – the lecturers, the observers and the students – experience it differently within the nexus of their backgrounds, their hoped-for futures, their interpretation of the purpose of attending the class, their personal interests, their actual location in the class, the physical conditions etc. In this way the realities of the ceramics class become multiple. Yet these experiences can be seen as pertaining to the

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[46] In addition, the observation notes could also be seen as enactments, and mobilisations of educational research, as well as collaborative and interdisciplinary research project and the aims of such project.

'same' situation, which hangs together through associations, making the reality of the ceramics class 'more than one, less than many' (Mol 2003, 54-55).

In addition to objects multiplying by being manipulated in practices, it is also the *practice* that becomes enacted, becomes visible, is reinforced, reproduced. It becomes linked to other series of enactments of the practice, be it on a personal level or more widely, here and now, in the future or in the past. Yet at the same time as it is being enacted, the practice may also change (cf. Rimpiläinen 2009). If we think about Law's argument that (scientific) realities are made, that these are the 'effect of the apparatuses of inscription' (Law 2004, 32), then Tom's hinterland, drawing on more systematic research approaches would seem to be creating a more structured version of the reality of the ceramics practical, while Will's ethnographic approach would be making this more fluid and emergent.

What would happen to these translations (and educational realities) if the two researchers could freely follow their respective research interests and practices, rather than trying to work out the next steps with the rest of the interdisciplinary team? This is a question, which has implications for the nature of 'knowledge', and for realities produced through interdisciplinary research practices.

3.2 The elusive 'case' – Interdisciplinary tensions

Above we followed the way in which two researchers with different disciplinary backgrounds translated the research question, the token, into two divergent inscriptions - a process which not only enacted into being their different hinterlands but also their understanding of 'observation' as a method, and of the research question as a token. We were left with a question of multiplicity of enactments, and of reality, and how to deal

with this within the framework of a research project. Now we will move forward in time and pick up the research process when the first series of observations of archaeology teaching had finished at the end of the first term, and the team decided to take stock of the situation. A data-meeting between those who had participated in observing archaeology teaching was held at the beginning of April 2009. The purpose was to assess if the team could already answer the first research question - did they know what the nature, scope and role of cases was in the practice of teaching in archaeology? - and to decide what the next steps in this line of inquiry would be. At this point my research question had started coming into focus and I wanted to capture the researchers collaborations, negotiations and practices so I could begin to follow the gathering of the network and the way the translations of the token happened. The meeting was therefore recorded for my benefit in my absence, which, with its transcription and the observation notes from the classes, forms the data for this section. The data also include notes written by the two researcher associates, Ann and Tom, after the meeting, their diary entries regarding it, as well as the interview data on researcher-backgrounds.

Four researchers – Tom, Will, Ann and Mia - participated in the meeting. Ann is a member of the research team, while Mia had stepped in to do some of the observations when none of the team members were available. Like Tom and Will, both Ann and Mia have multidisciplinary backgrounds. Ann originally studied Plant Sciences up to doctorate level, but moved into educational research through post-doctoral work, when she also completed an MEd in Educational Research. She prefers qualitative research methods, and is an advocate of participatory research approaches. Like Tom, Ann had joined the project through applying for a position with the project (Interview with Ann, 17th Feb 2009). Mia also has a science background with a degree in museology. She has

carried out a lot of empirical qualitative research in projects on education and educational technology[47]. While the Tom and Will's observation notes were very distinct from one another, the rest of the researchers' notes aligned more with Will's ethnographic narrative style.

The meeting takes place six months into the project, at the research centre where most researchers at this point in time were still based. All participating researchers are expected to have read each others' observation notes in advance of the meeting, and reflect upon the first research question and whether they are in a position to answer it. The four discuss their impressions and experiences of the classes, and what the 'case' in archaeology teaching might be. The meeting starts by Ann recounting her latest experience of observing a World of Goods lecture series, and in doing so, illustrates the challenge they face in trying to pinpoint *the* case in archaeology:

> ' -- And, in the second lecture she said 'I'm going to do the case study'. Talk about the case study. Specifically. And I didn't quite put my finger on, I *think* the case study in fact was the *role* of women in the Aztec empire. And *that* was the case. - - But she did at one point specifically say 'Now I'm going to introduce the case study' and she started talking about one specific researcher's work on it. Briefly. And then started talking about it more generally. So whether or, whether it was *that* researcher and what that researcher found, was the case study, or whether it was the case of women in the Aztec empire, which would be a *much* bigger case, than what we've ever really seen before.' (Ann, 3rd Apr 2009 data meeting)

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[47] Personal communication, September 2009

During their deliberations, the team come up with several suggestions from across the different observed classes for what a case in archaeology teaching might be. It might be a 'topic', like the role of women in the Aztec society, 'a specific researcher's work', a 'personal experience narrative' - an anecdote, an entire 'excavation site', or perhaps a 'single object', like a ceramic pot. The difficulty in pinpointing '*the* case' used in teaching makes it harder to think about its nature, scope or role specifically, although the researchers speculate on this too, enacting their preliminary understanding of cases used in case-based learning. Rather than setting in stone how 'cases' and 'case-based learning' should be understood, the project bid had defined a space within which these could be explored, and this is how both Will and Ann approached the research settings, hoping to find out what would emerge from the settings rather than approaching it with pre-conceived ideas of cases or case-based learning (emails from Will and Ann to Sanna on 21st April 2011).

Having studied case-based learning as part of his doctoral studies in cognitive sciences, Tom in contrast, departed from a deductive, a more theory-led stance, conceptualising cases e.g. as 'narrative recounts of professional practices, presented with as little 'meaning' (e.g. mentioning of 'causes') as possible, but only in the spatio-temporal occurrence of events- - ' (email from Tom to Sanna 23rd April 2011). Keeping this position in mind, Tom now asserts that he cannot see 'case-based learning' in archaeology. In his view '*cases can be very powerful*' but using objects to illustrate and exemplify things, as he sees it, '*is a very poor view of using cases*':

> '*If we look at for instance how, just to go back to the idea of various*
> *dimensions, soft case cutting across [Lecturer Jane], how she wants*
> *them to learn, she asks them to look and touch and feel and teach them*

how to look at things, on a very perceptual level. So the pot there is really a way to practice. Nothing more. She seems to tell them, these are the dimensions, now use them to look at the pot. The pot itself has no information, any *particular* information, all the knowledge is already in the dimensions. Which is a very *poor* view of using cases, I would say. Because cases can be very powerful. This is our starting point. When they teach you something that is not codified. That is abstract. That where there are no dimensions essentially, as yet.' (Tom, 3rd Apr 2009 data meeting)

All others disagree with Tom on this point. Will points out the complexity of the context or networks around the 'objects', which go into different directions while Ann suggests they should not get too tied up about the nature of the case. In her opinion there were other things going on too, like a person's 'experience of working in the field' as a case, or 'site' as a case, as Will reminds them. Ann agrees with Will, saying:

' - - the site is the case. That *definitely* was there as well and that aligns better with teaching in a complex environment where there are no hard and fast rules, which is the kind of thing that we are interested in.' (Ann, 3rd Apr 2009 data meeting)

Ann, Will and Mia further assert that they should take the lead on the matter from the setting rather than from theory – if the people at archaeology say they use cases in teaching, then they should take that as given, rather than applying their own preconceptions on the topic. This is the first juxtaposition that emerges during the meeting - researchers enacting divergent researcher hinterlands arrive at opposite findings despite the shared dataset.

The meeting has come to a point where the researchers have jotted down a few possibilities of what the case in archaeology teaching might be, and they all agree that they do not know enough in order to answer the first research question about the nature, scope or role of cases in archaeology teaching yet. The researchers wonder if they have been observing the 'right' types of classes, or if there are any other classes they should consider. All agree, however, that as their next step they need to talk to the staff and students at the department to find out more. Ann will get in touch with them to arrange interviews. Now they are all leafing through papers in silence, when Tom prompts Ann in good-humoured arrogance (meant as a joke), '*so, have you written down any questions*?' Ann laughs responding in similar vein '*Well that's the joy of having this thing here*' (meaning the laptop/the VRE, where she's typing into). The exchange that follows is about *how* to go about taking the next steps and it serves to illustrate another type of interdisciplinary tension that has arisen in the work of the team:

> '*Ann: I've written down that we are going to ask [Jane] and [Jack] about two different types of cases we saw, and might have been used in teaching, and why. Erm. Because, Ensemble research questions is 'the nature, scope and role'-... (laughs) so that would be what we are trying to get at in an interview with them.*
>
> *Tom: But we have already a few ideas about that, haven't we?*
>
> *Ann: Yeah.*
>
> *Tom: So the question is - should we confirm, try to confirm these ideas? At least I have two ideas about cases.*
>
> *Ann: I-I think we should try and erm, inspire *them* to talk about it by telling them what we...*
>
> *Tom: ok*

Will: yeah

Tom: But first we ask them, and then we inspire them? (2sec)

Ann: Erm. It depends.

Tom: Ok

Ann: (laughs)

Mia: It depends how it goes (all talk at once over each other in agreement with Ann)

Will: ... lot of thing. I don't think they're going to hesitate to say 'you got it all wrong'.

Tom: ok

Ann: I'm sure if we asked [Jane], what do you use the pots for (laughs). Why do you have to have pots there? She could tell us all about it. And then if we said, so why do you use so many personal... stories, and she could probably tell us...' (3rd Apr 2009 data meeting)

Ann has noted down that they have decided to interview two named Archaeology staff more about the *two* different types of cases they had identified, (but it is not clear which ones she has noted down!), and that might have been used in teaching. What follows brings to the fore yet again the differences in the team members' research approaches, this time about *how* to proceed with their research. Tom's research approach derives from a more 'systematic' way (striving for systems, models, testing theory) of carrying out research, and he suggests that given that the team have identified these two cases, they should now confirm whether this is so or not by talking to the people at the setting. This is clearly not what Ann and the others had in mind, as the suggestion is met with hesitation by Ann. Her take would be to 'inspire' the lecturers to talk more about the topic by telling them what they had discovered. Tom's response shows he is mulling

this over, while Will's 'yeah' is in agreement with what Ann has just said. These two researchers thus align in their approaches, and set themselves on the same 'side'. In contrast, Tom however presses on with his point, half-jokingly, as if trying to understand what Ann has just said: '*But *first* we ask them, then we inspire them*?' This is met with a short silence, ending with Ann saying crisply: '*Erm, it depends*', in reply. There is a slight tension in this exchange, with Tom responding again with an 'ok', as if 'put in his place', faced with an opposite way of proceeding but not quite understanding how or why. Ann laughs briefly following her response, to release the tension of the situation. Mia quickly offers an explanation ('It depends on how it goes'), further aligning herself with the position enacted by Ann and Will, all of them resulting in talking over each other in agreement with Ann. Will concludes that the people at the setting are not going to hesitate to tell them if they got it wrong, as if reassuring Tom, and pulling in his point of view into the plan. Again Tom only responds 'ok'. He does not sound aggrieved but takes the backseat on the next few minutes in the discussions about how the team should proceed.

The meeting ends with the following action points (from Ann's diary):

Action plan

- Meet with [Matt, the contact at museum] and [Phil, a lecturer at archaeology] again to tell them what we have seen, and ask if we have missed anything. What do they think about our ideas about cases?

- Meet with [Jane] and [Jack] [archaeology lecturers, whose classes have been observed] to ask about how they use cases and why. 'What is it that you want the students to learn from the anecdotes that you tell?'

- Get access to ceramics students through [Jane] and [Jack]. Interviews or focus groups to ask: how this class fits with the overall curriculum, what does the term 'case' mean to them? Do they think their teaching is case-based? Ideas for technological support? What are their future plans? How has the proximity of the museum and the McDonald institute influenced them?

- UROP [Undergraduate Research Opportunity programme] student

(Ann's research diary, 3rd April 2009)

The token was first translated into research practice resulting in sets of inscriptions in the form of observation notes, which were taken as enactments of the researchers' hinterlands. The inscriptions formed a set of data, which were considered first by individual researchers and then collaboratively at the meeting. Here the divergent research approaches enacted by the researchers were brought to bear upon the token-translated-into-data. Juxtaposition built up between the different hinterlands – the deductive and the inductive, the ethnographic one – on two instances. Based on the same data set, the deductive approach came to the conclusion was that there is no case-based learning in archaeology, while the conclusion with the inductive approach suggests that there is and that cases might in fact be multiple.

The second juxtaposition concerned the way in which the team should engage their setting in order to take the research forward. The deductive approach would proceed by confirming or refuting the early findings of cases. The ethnographic, participatory one would take the findings back to the setting and use these to inspire more discussion around cases and case-based learning. The diversity of the research approaches stem

from the researchers' varied disciplinary backgrounds, which is afforded and enforced by the multidisciplinary nature of education as a field.

While decisions for future action had been made, the translation of the token still seems pending at the end of the meeting. The team have arrived at a kind of half-way house, where two opposite types of 'translation' are still waiting to happen. Crucial here is to note that following either translation from this interdisciplinary tension onwards would lead to very different outcomes for the setting: go with Tom's ideas, and the setting should be dropped as not showing evidence of case-based learning; follow the others, and the idea of a 'case' might multiply.

Being such incompatible, mutually seemingly exclusive findings, how should this tension be dealt with? Would one of these interpretations be correct, with the other one incorrect? This question might be valid if realities – and objects, here cases - were understood to be single, definitely knowable and anterior (cf. Law 2004), or understood to be diverging interpretations of that reality. However, in the performative turn the multiplicity of 'findings' relates to the realities being produced by practices (Mol 2003), by engagement of different methods (Law 2004), that is, the different ways in which we transact with the world. While the internal validity and reliability of any research method is naturally a concern, the question about the 'correctness' of differing findings becomes a political one (Mol 2003, Law 2004): whose reality is it that the findings are representing or creating? How the team will deal with these tensions is another question, and that is what we will examine next.

3.3 Interim stabilizations– negotiating the nature of 'case'

Michel Callon et al., (1986a, 272) describes science as a vast enterprise of writing, where moving from an inscription - in this study e.g. an observation note or a digital recording of a meeting - to a statement, 'requires embodied skills and/or technical devices'. While technical devices used in translating inscriptions into statements in social science research are probably simpler and fewer than in certain sciences (cf. e.g. Latour & woolgar 1979), the (analytic) skills embodied by researchers become more important in this type of activity, as the researchers approach the data from their respective research backgrounds. Statements emerge from the 'constant interaction between inscriptions, technical devices, and embodied skills' (Callon et al., 1986a, 273). Again, while this describes the process in sciences, with the caveats given above, the principle can be applied to social sciences research too. However, while 'statements' in sciences are about constructing 'facts', the nature of statements in this piece of research is more temporary and open for negotiation. Hence I prefer to call these statements 'temporary stabilizations' or 'interim findings'.

Archaeology challenges the notion of case

The April data-meeting had led to a conclusion, due to differing research approaches producing conflicting findings, that the team could not answer the first research question yet and that they needed to carry out more research, starting with talking to the people at the archaeology setting. While Ann was arranging these interviews in April 2009, the project was also preparing for a Steering committee meeting in June 2009, including a seminar to showcase the work of the project of the preceding months and to disseminate interim findings to research participants and the wider team. A series of posters on each research setting, including archaeology, were to be created for this

purpose, detailing background information, findings to date, and what the future plans for action in each setting might be. One step towards creating the posters was a power point presentation entitled *Studying CBL in practice. Settings report. What are cases?* prepared by Tom and Ann for the team meeting held at the turn of April-May 2009, when the June event was also being planned. The researchers presented an outline of the work in each of the research settings they had engaged to date, presenting the research problem – studying case-based learning – in the context of recent research, which called for more investigations on 'how CBL is produced' and 'what do learners DO?' The team's current understanding of cases in each of the three settings they had worked with throughout the winter was presented, listing for each of them the data gathered to date, how each setting contributed to answering the research question, and what the future steps in each setting would be.

Information from this summary of work was assessed against existing literature on case-based and problem-based learning. How the 'case' was viewed in each instance varied: in marine operations and management cases were considered to be '*classical cases*'; in plant sciences there was '*not a case but definitely CBL*', and archaeology was deemed to '*challenge the notion of case-based learning*'. This was also noted as the contribution from the archaeology setting to answering the research question. Hence, the juxtaposition that had emerged between the different research approaches and the researchers' hinterlands, evident at the April data-meeting, had become translated into tension. Had Tom's hinterland been shared by all, the team would likely have deemed that there was no case-based learning at this setting, and that it was not worth taking the project further. Had he not voiced his view at the meeting and the ethnographic approaches had been in harmony, would the researchers have concluded that cases were multiple in archaeology? At that moment, the collaborative nature of the project, and

the need for a public enactment of the project's work pushed the team to find a shared statement between the two opposite interpretation, translating the findings into this 'tension', which works to leave the research question open for further scrutiny.

New questions about cases

The interim findings became further translated, and temporarily, yet more formally, stabilised, as posters for the June seminar. The event itself was a requirement of the research programme, a kind of audit or accountability mechanism, which made Ensemble take stock of the progress of its work to date, and disseminate its findings to the anticipated audience. Ann took the lead in creating the archaeology poster with the help of the project administrator and the members of the core team, especially Will who actively emailed suggestions for re-working the drafts. Posters were created also for the Plant Sciences and Marine Operations and Management.

The archaeology poster went through three major incarnations. The first draft was based on the discussions of the April data-meeting and Ann and Tom's power-point-presentation discussed above. This version, which was very tentative with bullet points, provisional sentences and 'place holder' terms[48] for actual content, was re-worked into a second draft jointly by the team. This one was taken along to the first follow-on meeting with Matt and Phil (the archaeology staff who had directed the team to observe the ceramics classes), which had a major impact on the content of the poster with many changes made to the third version. A comparison of the second and third version of the poster is in Appendix 5. The only change in comparison to the final, and fourth version, is the caption under the photograph telling the location where the photo was taken.

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[48] For instance: 'enter info on cases here'

The aforementioned follow-on meeting, where the poster was discussed, took place at the museum on the 8th May 2009 with Ann and Will present. Tom was unable to attend being engaged elsewhere. With Tom absent, the other two were free to approach the meeting from their preferred ethnographic, participatory research stance, which meant that the poster was used for discussing what the team had found out to date, for getting feedback and for inspiring conversation over cases, rather than confirming pre-existing findings, as Tom had suggested. At this meeting, Ann and Will use the second version of the poster to feed back to their initial contacts Matt and Phil what classes the team observed during the spring, what they had found out, and to explain the conundrum they were facing with 'the case' in archaeology – is it an object, a study carried out a particular site, or perhaps an anecdotal story? Matt picks up on the last term stating that anecdotal stories are an important part of training on how to become a professional archaeologist: *'Anecdotes are part of the *real currency* of true professionalism'*. According to him they prepare students for a 'state of mind', to be able to cope with complex situations, both in the field or analytically – *'they don't panic as they know it's going to take a week or two before - - they start seeing the features'*. This response seems to encourage Ann that they are going in the right direction in their thinking with cases, and in her next comment she weaves into the idea of 'anecdote as a case' the potential it might offer for technology development (*'we're trying to consider how that could be build in'*):

> '-- *I mean, what we have taken from it [the research process] *so far* is this idea of 'anecdote'. That, you can have the data, in its full form, but it takes the expert to say, "well, what you need to do is to take that data, and compare it to that data, and in that time period, erm, with that weather condition and then you've got this". And you need to have*

several... different anecdotes going through the data, that students can look at and compare, make their own, make their own path, we're trying to consider how that could be build in'. (Ann, the follow-on meeting, 8th May 2009)

This idea, of having multiple stories and no set interpretation finds echo with the two archaeologists, even if they do not pick up on the technology aspect here. According to Matt, anecdotes also create a shared sense of knowledge, a sense of discipline, and make the mechanical teaching matter more subtle. Even if the 'anecdote as case' and its potential for technology development is not discussed much further here, it is noteworthy that while 'cases' have been the focal point of inquiry until April, it is from now on that the search for a potential opening for technology development in archaeology starts to emerge and becomes a more central concern.

The conversation moves next onto case-based learning in archaeology. Ann asks: '*a question which keeps coming up, in our research group is, yes, we can see that the cases are being used. But is it case *based* learning*?' This question rather throws the two archaeologists, who retort '*it rather depends on how *you* define case-based learning!*' underlining that to them it is case-based learning, while recognising that their understanding of it '*probably gets the wrong end of the stick in terms of your definition - -*' (Phil, the follow-on meeting, 8th May 2009). Ann explains this being exactly the reason why she prefers not to have pre-existing definitions for the term. According to Phil cases in archaeology are based on a particular period or type of material or data, which is subsequently built on. Cases are thus cumulative, and best examples of practice are designed collectively: "*You know...- - to *us* it is... a sort of, based on *greater* knowledge gain from more approaches to the same kind of *stuff* or*

problem - -"(Phil, the follow-on meeting, 8th May 2009). Matt adds that cases change all the time as the discipline, staff and research problems change, even if there are some internal 'checks and balances', like in every discipline, staff plan what they feel is appropriate to be taught or not. Furthermore, the location and nature of the university with its global scope in archaeology research means that it would be '*absurd not to teach through using cases*' (Matt, the follow-on meeting, 8th May 2009) which are based on first hand research. This includes direct access to a massive collection of archaeological objects from around the world in the adjacent museum, almost a unique situation anywhere in the world.

> *'So by the very fact that most of us do do stuff in the field in the different parts of the world it, it essentially *is* case-based... teaching. Examples are best related to us, rather than having other texts, half, second hand all the time, other people's stuff, to actually showing people examples of our own stuff what we're up to'.* (Phil, the follow-on meeting 8th May 2009)

The researchers ask for feedback on their poster, wishing to know whether the team have misunderstood anything they have seen, or if there are any other types of teaching or learning situations they should observe. Both Matt and Phil believe that the team have observed '*all the usual stuff*', but Phil suggests it might be a good idea to visit an excavation site, telling them about a field trip he is organising in the autumn. He promises to let the team know when this takes place. The researchers also inquire how best to arrange interviews with students, and it is recommended that they get in touch with a particular student club in the department, which Ann will chase up. Finally they briefly discuss various types of semantic applications.

Afterwards Ann sends round a short email with the meeting recording attached, suggesting the team meet up to discuss what they had found out from talking to Matt and Phil. A date for this is found only after the poster dead-line will have passed.

The meeting with Matt and Phil leads to significant changes in the poster's contents, as detailed by an email sent by Will to the team on the 12th May. In the email he, for instance, suggests changing the title just to 'Archaeology', as the team do not work in anthropology and having that in the title would be misleading to the wider audience. He also suggests finding a photo that would include someone's hands handling pottery to reinforce the idea of tactile knowledge (however, the team do not have a photo like this available), and that they would not call the incorporation of techniques from other disciplines a 'new' development, but change that to 'recent' as the archaeologists had pointed out. He further suggests adding or changing paragraph titles under headings to 'The learning context', 'What we have learned' and 'Tools for support'. Ann adds these suggested changes, as well as some earlier suggestions Will had sent just before the meeting with Matt and Phil to the Wiki-page in the VRE where the poster sits. (The two versions of the poster are compared in Appendix 6).

The very tension that translation had identified in the token, created by virtue of the two divergent research approaches, was precisely the 'thing' that was driving the research activity forward. The approaching project event in June 2009, as well as the looming SemHE[49] conference in September pushed the team members further to commit to temporary stabilizations of their findings. The first stabilization emerged through various drafts of a poster, and through feeding the team's findings back to those

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members of staff at archaeology, who had directed them to observing the ceramics classes in the first place. While the team had formulated an interim finding:

> '*The way in which cases are being used in this Faculty challenge the traditional notion of case-based learning as defined by cognitive science*' (archaeology poster, version 2)

This left the field open, allowing the team to continue researching CBL in archaeology, the feedback received from the setting led them to further soften, and focus the formulation of the finding more precisely on the ceramics classes:

> '*Our observation of teaching, especially ceramics, have raised new questions about case-based methods that do not figure in the cognitive sciences literature*' (archaeology poster, version 3, including the final one).

In addition to the inscriptions, technical devices and embodied skills that Callon et al., (1986a) named as participants in the translation and production of statements in sciences, here also *the research participants* have their say in the process of translation, leading to significant changes in the content and form of the poster[50], and the way in which the nature of cases is being described. Unlike 'facts', these statements are provisional and have become more tentative in the final version, leaving more room for manoeuvre in the later stages of the project – these are, after all, interim findings.

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[50] An academic poster is not simply a gathering of text and images. It is a culmination of various networks, and has to serve several purposes and satisfy the needs of many stakeholders. An academic poster has to, for instance, acknowledge the institutional affiliations in the form of logos and university crests – leave these out, and the poster *and* the project ceases to take them into account, which is an academic *faux pas*. It has to communicate who has been doing the work and who is responsible for the project. What can be conveyed in a poster is also restricted and determined by its physical affordances, i.e. size, where it is intended to be used (online, on a wall), requirements for visibility (only so much text fits visibly in text boxes), who the intended audience is etc. The poster becomes an enactment of the project's identity and work, but also a gesture of academic conventions and good practice.

Case-based learning is now notably referred to as 'case-based methods', this also features in a further translation and stabilization produced by the team, a conference paper, discussed in the next section.

New ways of using cases

The conference paper entitled *Case Methods, Pedagogical Innovation and Semantic Technologies* (Ensemble 2009, paper 1) was being drafted soon after the posters were created, at the end of May 2009, (diary entry, Ann, May 2009) to be given at a Semantic Web in Higher Education (SemHE) conference in September in France. An event feeding into this new translation was another data-meeting between the researchers on the 14th May 2009, following the meeting held with Matt and Phil. While this meeting took place after the posters had been sent for print, its traces are visible in the conference paper[51]. The purpose of the meeting was to reflect upon the first follow-on meeting with the archaeologists on the 8th May that Tom had missed. Tom had listened to the recording of the meeting. As the researchers' data-meeting proceeds, the contrast of the enacted research approaches builds up again between Tom and the others, while it is also evident that his position in relation to cases has changed since the April data-meeting. The tension arises in how the researchers have interpreted what had been discussed during the interview – how cases were seen by the archaeologists and whether or not they understood what case-based learning was about, both in their own context and in relation to 'main stream' CBL – and in how the researchers themselves understand 'learning'. The researchers also negotiate the nature and importance of 'anecdotes' as suggested 'cases'. It is here that the importance of

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[51] Unfortunately I do not have access to the drafting process of the paper, as this is not documented in the VRE, so I will only discuss the meeting and the final output.

'embodied skills' (and knowledges) and their role in the translation, the production of statements, becomes evident (cf. Callon et al., 1986a).

The meeting begins, and Tom, enacting his preference for structured research, sets off from a clear cut definition of a case, assuming that this understanding is shared by the others, while recognising that this is not so at the research setting: '- - *we* [the researchers] *can obviously rely on some really structured notion of case. But that evolves in archaeology, their cases are very fluid, they're built, and re-built, in a way, here the case becomes something conceptual*' (Tom, meeting on 14th May 2009). However, Tom's view of cases has changed since the last data-meeting, and he sees cases now not only as something of the mind (the cognitive sciences way) but also as educational, something that 'hits' you. To him, the setting is a case too, '*and the way they* [the archaeologists] *see cases, is a case in itself, which challenges our notion of cases.*' Saying this he juxtaposes the theoretical view of cases held by, in his view, the research team on the one hand, and that arising from the archaeology setting on the other. This to him is the second view of cases, and in stating this, he has moved to align more with the stance taken by the other researchers, something he was opposing earlier. Will interrupts Tom to check that he has understood his point correctly – does he mean that one view is of a 'case study' and the other is of 'case *in* learning', i.e. what the case means for the teaching programme? This point has initially been confusing Will, but now he is satisfied that the confusion 'lies in the discipline', not in his misunderstanding of it. According to Will, the archaeologists had been 'quite happy' that the case could be any number of things (a pot, a site, a time period etc). Ann, (also talking of 'us', the team), tries to offer that they have really '*hit the nail on the head with the case being the experience of an expert being relayed in an [anecdote]*'(Ann, meeting 14th May 2009). Tom finds this dubious, but Will agrees with Ann: *'something*

about the knowledge of the archaeologist that is different from other forms of knowledge' (Will, meeting 14th May 2009). Ann then continues explaining that when asked about whether their teaching was case-based, Matt and Phil had not known what CBL was, and that it did not mean anything to them. Tom disagrees with this, relaying the few points of cases they, in his view, had listed:

> *'Yeah, but Phil gave a 3-4-5 point thing on cases... he said, "yes, to us it is, but we realise that we are not in the main stream". And that's why he said there is a 'main stream' idea of CBL, the Harvard one. So... it is CBL because teaching builds on case studies done previously, that is what he says. It is CBL because there are more approaches to be seen the kind of stuff I imagine, more interpretations of an object?- - There is continuous change... and also there are cases that are best examples of something. So this case is being used as a teaching case because it is a best example of something. Cases are used to demonstrate a certain major things in archaeological practice. They say a lot about CBL actually.' (Tom, meeting 14th May 2009.)*

The token as an object being manipulated in practices multiplies here. The researchers' respective approaches and ways of transacting with the data generated with the research participants enact the object in multiple ways. Tom, coming at the data with a theory led approach that seeks to explain (cf. Biesta 2010), finds characteristics of case-based learning, while Ann, using an ethnographic approach that seeks to understand what emerges from setting assumes that the archaeologists' have expressed that they have no set conception of CBL: *'Yeah, I think Matt made it clear that they didn't know.... what case-based learning essentially was - - But they would make an argument for, saying*

'yes, we use cases in our teaching, in these ways' (Ann, meeting 14th May 2009). Will agrees with Ann, saying the situation where the archaeologists tell the researchers what they meant by cases was 'good', desirable, rather than having the researchers telling them that *'they weren't doing what they should'* (Will, meeting 14th May 2009*)*.

The researchers further disagree over the nature and importance of anecdotes as cases for archaeology teaching. To Tom these appear essential in archaeology teaching but effectively do very little, containing no factual information or knowledge, *'they simply give you a sense of things'*. Others agree with this aspect of anecdotes, as conveying to students a sense of things, but what they disagree on is their importance in teaching, and whether they could be cases. Knowledge content is a vital characteristic of a case to Tom, and given that anecdotes do not convey factual knowledge, he does not conceive them as good cases. Will offers in response that learning through anecdotes reminds him of Lave and Wenger's (1991) idea of 'legitimate peripheral participation', whereby a new member of a professional community gradually learns the ways of the main community, thus becoming more and more integrated into it. '*That it's almost like an initiation into being an archaeologist, once you share the fond of anecdotes, you're like a member of the community. And it's that kind of process of professionalization'* (Will, meeting 14th May 09). It is at this point that Ann wonders aloud if their differences in perceiving the anecdote as a case comes down to the fact that her, Will and Tom have different views of what learning is. She admits 'reacting' to Tom saying '*this is poor in knowledge acquisition'* when to her the anecdotes are a very important part of learning, social learning. For Tom, the knowledge content is essential. While Ann agrees that anecdotes are not good in passing on factual information, to her the importance of anecdotes lies in how that factual knowledge acquired in the classroom should and could be applied in practice, something that is far more complex than what you can

learn from books; it is about socialisation. Tom's argument, however, is that it is only once you have understood what the teacher meant by the anecdotes, that you have become so skilled as an archaeologist that these stories are redundant. They do, nevertheless, guide you through the training, he adds.

This exchange in fact answers the question posed by Ann in terms of their divergent understandings of learning, and how that reflects upon their takes of the importance and nature of anecdote as a case, though they do not explicitly comment on this themselves.

Before the team invite the technologists who are to join them in the meeting to discuss what potential there is for technology development in archaeology, Ann asks if the others have any other points to think about. Tom admits he is finding the setting really troubling for cases, and adds that if they go with the idea of 'anecdote as a case' then they should go back to a structural definition. Will interrupts his train of thought saying he was not sure that they had in fact come '*that far so as to say that anecdotes are a case*', but Tom says it could be an example. He then wonders how this idea emerged in the first place during the follow-on meeting and Will explains how Phil and Matt picked up on it when looking at the poster draft taken along, '*so it clearly resonated and they started talking about it. And we confronted them about it, but it's as if a light went on 'ah, I know that'* (Will, meeting 14th May 2009). He wonders to what extend should they strive for a definition?

> '- - *I mean there are such a wide range of cases and use of cases in this setting that we could only rely on the setting actually to find the answer, that's why it really confuses me. But it's very interesting. - -*' (Tom, meeting 14th May 2009)

Tom's last comment enacts his firm position within his preferred and familiar research approach, where he has not (yet) got used to doing research in 'wild settings'. While being confronted with a different way of carrying out research is a learning curve for all the members of the team, for Tom it seems to be steepest, as he is in the minority with his approach. Further, currently he resists being enrolled into the ethnographic 'network' of research. Looking at these negotiations over issues of case, learning, anecdote as a case etc. show how each researcher embody and is enacting their research hinterlands, something that could be conceptualised as 'research technologies' (cf. Callon et al., 1986a). While these are 'abstract' and conceptual, acquired through learning, and something the researchers enact into being through engaging with the research setting, the generated data, the research questions and each other's research approaches, they are 'tools' for making sense of the messy realities.

The meeting finishes with the technologists joining the researchers to get an update on the setting work and to discuss the potential for technology development in that. The researchers summarise their findings, suggesting 'anecdote' as an example of cases in archaeology, and the team consider how they might build a semantic tool to support these. It is a surprise to all that cases in archaeology emerge multiple and fluid, and that the semantic tool would be based on anecdotes, which are not structured, but changing and changeable, depending on by who, whom and when they are told. These are also very personal and thus building an application based on them would be challenging, as no ready-made ontology exists for such an eclectic set of data. The idea is taken away to be mulled over and is not developed further here.

If the researchers enacting such divergent approaches and understandings did not have to collaborate, both their research, and mine, would look decidedly different. Callon et

al., (1986a, 277) points out that all controversies 'depend upon a tacit agreement about what is important and what is not'. Here the researchers agree on the importance of finding an answer to the first research question (the nature, role and scope of cases); that the nature of learning is at stake in the setting; that they should work collaboratively and towards a common goal, and in doing that, strive for robust, quality research. These are essential for dialogue to take place, where the controversies surface. However, the next translation, the statement on the conference paper, enacts the team and their research approaches as unified and singular.

The Ensemble conference paper 1 for September describes the team and their approach to 'conducting research leading to technological development that is grounded in detailed empirical research and participant engagement' in order to argue for 'developing technologies in parallel with empirical research about current practices' (Ensemble-paper 1 2009, 1). The paper accounts for their working practices and findings to date in four of their research settings engaged by then. After introducing the setting as well as their research activities, the team's findings in the archaeology setting are described as follows:

> '*Our observations, especially of the ceramics practicals, <u>have shown us new ways of using cases that diverge from classical case-based learning practices</u>. Case studies were explicitly used to look at how sites, materials and artefacts are classified, and how scholars have examined, recorded and published particular sets of excavated material. An important element of teaching on the ceramics course is that artefacts are physically present for students to experience their visual and tactile elements. These artefacts are also often used to demonstrate expert*

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'ways of seeing' or of interpreting ceramics. The lecturer describes their observations and explains their interpretations in order to pass on knowledge and interpretative skills to the students. <u>This may be another type of case whereby the object itself constitutes a case by representing a story and demonstrating the complexity of real life</u>.' (Ensemble-paper 1 2009, 9)

The paper further states that the pedagogic approach used in archaeology represents a 'significant challenge for the development of any semantic technologies' (ibid.):

"The knowledge base for the ceramics course has foundational and stable elements and there are examples of 'real-life' data that could be integrated into a semantic tool. However, expert accounts of research practices in the field are an important element of teaching that represent the additional complexity and contested nature of knowledge. A semantic tool would have to allow for multiple interpretations of artefacts to be developed and progressively elaborated with support from expert 'points of view'". (ibid.)

In writing the conference paper, there is a unified, collective 'us – the team' that is presented to the external audience. The paper has been authored collaboratively, with several people contributing to it, taking leads in respective sections, and commenting on each others' contribution. This could also be thought of in terms of adopting the role of a spokesperson for different settings – Ann, for instance has been working on the archaeology section of the paper as well as the project. While I can't trace the exact steps as to how the team have arrived at this cohesion, constituting agreement in the extended translation, metaphor arises from alignment of translation networks (Callon et

al., 1986a). Even if every member in the team would not agree with every single turn of phrase in th conference paper, they do, however, agree with the overall text enough to stand behind the paper and have their names printed on it. Further, in comparison to the poster, the conference paper takes the translation of the token another step further – the claim has become bolder: rather than merely 'challenging the traditional notion of case-based learning' or 'raising new questions about case-based methods that do not figure in the cognitive science literature', the paper states that the researchers have encountered in archaeology in fact 'new ways of using cases'. The nature, role and scope of cases, however, are still unclear. While the team enact a unified public front in the article, in their day-to-day work the divergent approaches and interpretations of data continue in their negotiations.

Chapter 4.

Co-emergence of the case with a niche for technology development

The April 2009 data-meeting was a turning point in the work of the research team in archaeology, which until then had focussed on the 'nature, scope and role of cases and case-based learning'. The concept of 'case' in archaeology resisted being defined, which in conjunction with the collaborative and shared nature of the project work pushed the team to translate their respective 'findings' into 'tension'. This translation meant that the research work could carry on, while the team could remain open in terms of what 'case-based learning' was in archaeology. While the investigation into cases continued, we start seeing a gradual and increasing intertwinement of the technology strand in the work of this setting. Until May-June 2009 the two elements of the project had been developing in relative isolation from one another in all of the settings, but by late spring the researchers and the technology developers respectively were far enough advanced in their own new fields so that they were able to offer guidance and advice on these to each other. It was also at the behest of the leaders of the project that the technologists started attending meetings held by the educational researchers and their research participants, and the educational researchers became more involved in discussing the potential applications with the technologists, as well as with their research participants at the settings. The pre-requisite for this was a sufficient mutual understanding of each others' fields, something that did not happen overnight. In order to examine how this happened, we are first going to zoom in on an unexpected actor and participant in the process, a diagram nicknamed the *Semantic Spider*. We will see how the diagram has worked in mediating and negotiating practices between the two

strands in the project, ultimately extending these practices into each others' areas. The time period covered by this examination runs approximately from January 2009 to spring 2010, from the first appearance of the diagram to the time when the two strands had found a way of working together. The interviews for this section were carried out in the summer 2010. After this we will return to April 2009 to pick up the research process again, and follow how the researchers carry out 'further research' (which the token now is) in the quest for the elusive case in archaeology. We will see how 'the case' in archaeology finally emerges simultaneously as a niche for technology development in the setting is identified.

4.1 The 'Semantic Spider' diagram in negotiating practices

Conventionally software development starts with a more or less clearly identified need or an existing problem that needs solving (e.g. Nusebeih and Easterbrook 2000, Kandt 2003). With Ensemble the situation has been more complicated. Working with an emergent, new technology the research settings engaged by the project rarely have an existing problem that could be readily solved with a semantic web solution. Indeed, the challenge is to identify a problem or imagine a possibility that could be solved with an as-yet-non-existing technology. For this reason part of the project's work has entailed educating the research participants about the semantic web and its affordances in order to help them envisage how these could be used for supporting and/or enhancing case-based learning in the setting. Many of the non-technologists in the team only came to learn about the semantic web through participating in the project themselves, meaning that we too have had to learn about this new field. Perceiving what might be difficult about the semantic web for the non-experts has been an illuminating experience for the technologists. Learning about previously unfamiliar practices and new knowledge

domains is a common issue in interdisciplinary work, and reaching shared understandings and a common language to discuss issues at stake takes time and effort (e.g. Haythornthwaite el al. 2006). Given that during the first few months of the project the two strands worked relatively independently of each other, but over time they gradually drew closer together to work more collaboratively, how did this happen? In looking into this question it became evident that communicating the concept of the semantic web and of related technologies to those previously unfamiliar with these has been of crucial importance in the process. The actor that has been influential in this is a diagram named the 'Semantic Spider', which over time turned into what could be called *a practice negotiating artefact* (Jordan and Rimpiläinen 2010) that worked to enrol both human and non-human participants from both strands of the project into the practices of the other.

The Semantic Spider[52]

Since the earliest days of the conception of the semantic web in the late 1990s (Berners-Lee 1998), diagrams have been employed in the task of explaining this abstract, yet technological concept. Several different diagrams have been used for this purpose in the course of the project life, but after the initial variation one type of diagram became the most commonly used version - the '*Semantic Spider*', a version of it depicted below (Jordan and Rimpiläinen 2010.):

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[52] This section draws on a conference paper 'the Many phases and faces of the Semantic Spider' written jointly with Katy Jordan and presented at EASST –conference (European Association to Studies in Science and Technology) in September 2010 in Trento, Italy. The original idea for the paper was mine, but being the first author on two papers was not allowed by the rules of the conference. I have carried out all the interviews relating to this section; KJ dug up the various versions of the Spider diagram as well as did a lot of the transcription of interviews. This is a re-write of the paper, which takes ideas presented in that paper further.
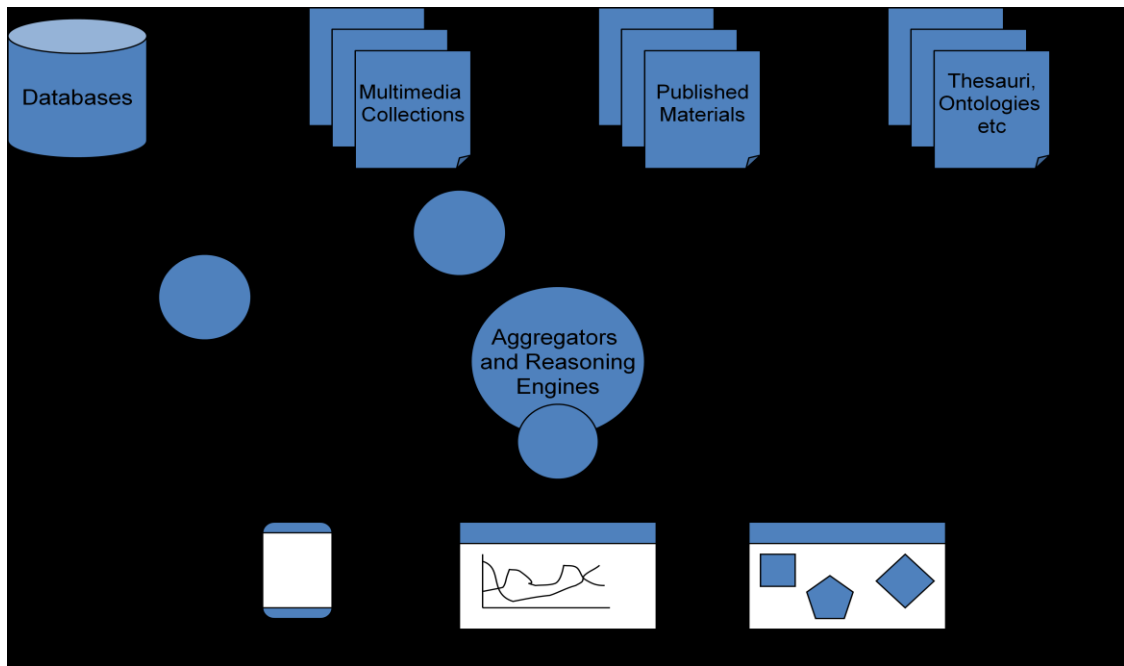
Image 4.1. This is the version of the Semantic Spider diagram that was first shown in public. The later diagrams vary, but changes in these are mostly cosmetic in terms of arrows, boxes and colours used to depict it. All variants share the same three layers: the top tier depicts heterogeneous data-bases, middle tier the conversion tools necessary for translating that data into machine readable formats for the aggregators and reasoning engines, and the bottom layer the various user interfaces for accessing and displaying the semantified data sets (Jordan and Rimpilainen 2010).

The diagram can be conceptualised as a translation and an enactment – a materialisation - of the technologists' thinking, but also as a simplified representation of the technologies comprising semantic applications. The regular appearances of this object in different parts of the project (in public events, in team meetings, in private conversations etc), in different formats (as email attachments, print-outs, doodles, power-point presentations, posters and websites) made it interesting to investigate further. I was curious about how and why it changed – or seemed to do so. In interviewing five of the core team members around the diagram it soon became clear that rather than focussing on what the diagram was and meant for each of them, it was more useful to examine the practices where the Spider was being enacted and ask what was it that the diagram *did* as part of these practices. The Spider has surfaced as an

unintentional and contested, yet significant participant in the work of the team. The diagram has enabled the team to discuss technologies, technology development, and to understand what others may find difficult about these. This initially suggested that the Spider could be a *boundary object* (Star and Griesemer 1989, Bowker and Star 1999, Lee 2007), a mediating artefact between the two strands of the project, but the situation was more complex than that (Jordan and Rimpiläinen 2010).

Here I will briefly outline the background to the Semantic Spider, and will then discuss the practices where the Spider became enacted in the project, what is meant by a boundary object, and suggest that it might be more feasible to call the Spider a 'practice negotiating artefact'.

Given the multiple variations of the Spider diagrams that had been aired over time in the team, it was only natural to ask a question about the original version. An anecdote circulating in the team suggested that the Spider originated from a scribble drawn on a napkin at a Spanish cafe, but this was never verified. The most important source for locating the different diagrams used by the team is the Virtual Research Environment (VRE), which enabled the creation of a chronological collection of diagrams used by the team for depicting and communicating the idea of the semantic web either in public or within the team (see Appendix 6, with thanks to KJ who carried out this piece of work and created the chart). The first public appearances the Semantic Spider made were at a meeting with a group of librarians, followed by the large project launch in January 2009. The purpose of the Spider, employed alongside a number of other conceptual tools in those events, was meant to help engage a very heterogeneous group of people, many of them potential research participants, and enrol them into the work of the project. It is worth mentioning that the main function of the diagram in this context

was to communicate '*a single organizing concept – data aggregation*' (Interview with Jim, 8th Jun 2010), and to stimulate discussion as well as help prospective research participants to envisage what these technologies might offer in their own contexts. In this way the Spider diagram was used as an interessement device, which also enacted the team as the '*obligatory point of passage*' (Callon 1986b, Latour 2005, Star and Griesemer 1989), whereby the potential research participants were hoped to become sufficiently interested in the work of the project and the potential offered by the semantic technologies for their own practices. Different versions of the Spider have since been deployed in various forms and contexts. To discover more, interviews with five core team members were carried out.

The first to be interviewed was Jim, the PI and a member of the team who is involved both in the computer sciences and the educational research strands of the project, and widely credited for creating the Semantic Spider. Rather than confirming the assumptions of an existing original version of the diagram, he warned of the dangers of falling into a '*trap of assuming that there is some grand narrative, whereby some scribble gradually became elaborated',* pointing out that in fact he and his technologist colleagues draw diagrams all the time:

> '- -*This is just one of the things that we do while we're sitting round with a piece of paper. You know, and we draw, we've got *countless* diagrams, and scribbles, and little... flow charts.*' (Interview with Jim, 8th June 2009)

Jim cannot point to any scribble or diagram as the very original version of the Spider, for sketching diagrams is simply part of his day-to-day work; it is a practice, a way of thinking. In discussing complex systems it is often easier to convey ideas with boxes

and arrows than just with words. For him, the communicative aspect and the temporary nature of these doodles are important - if he could convey his meaning through gestures, he would do that instead. The discursive context where the diagrams come to exist is intrinsic to them: looking at them removed from this could miss essential ideas, or lead to misunderstandings, Jim explains. He wishes to emphasize that the Spider diagram is not in fact linked to the work the project carries out in the settings, but would help explain the semantic web in any other context. Amy, a computer scientist, agrees with Jim on the practice of doodling diagrams. However, her first encounter with the Spider was on her arrival to the project, as a sketch during her job interview with Jim (Interview with Amy 11th June 2010). In contrast to Jim and Amy, the other core team members pertaining to education, tend to recall becoming aware of the diagram through presentations:

> *'I remember kind of starting to have a conversation with [Jim], and then I stopped for a bit, and I was incommunicado, and the next thing I knew there was a set of slides and with spider.'* (Interview with Lea, 11th June 2010)

> *'This section came very early in the project, I think it was a talk of [Jim].'* (Interview with Tom, 11th June 2010)

> *'It was probably presented within introductory kind of talks about the Ensemble project, probably [Jim] would've presented it'* (Interview with Ann, 16th June 2010)

These interviews explicated the fact that the Spider diagram, while seemingly a shared object in the project discourse, is in fact a creation of the computer science strand of the interdisciplinary team. The education researchers do not share the 'ownership' of the creation of the diagram. They simply acknowledge their role as part of the 'audience' to which it is being presented. This relates to how stable or fluid the diagram is perceived and enacted.

Stability and fluidity of the Spider diagram

The Semantic Spider diagram can be sketched on a white board or a piece of paper; arrows here and there might appear, or disappear, boxes added and removed depending on whom the semantic technologies are being discussed with and what the needs and interests of that party are. In the technologists' hands the diagram is fluid and temporary (cf. de Laet and Mol 2000), it lives according to the discursive and socio-material contexts of which it is a part.

While Jim emphasizes the fleeting and unstable nature of the Spider diagram, the rest of the team members perceive and enact it as more stable. This includes Amy, typically the other party involved in the conversations which feature diagram sketching as a 'thinking practice'. Amy has had a special role in selecting semantic technologies: it has been her job to determine which types of repository and triple-store[53] the project would use. Since making these decisions, Amy sees the diagram as more stabilized:

> *'It has changed in the sense of... now definitely we have a much clearer idea about the type of technologies we are now working with. So that's why I think - - we have like a more stable diagram- -.'* (Interview with Amy, 11th June 2010)

[53] See Appendix 2, Glossary for semantic technologies

In the educational researchers' use, by contrast, the diagram becomes a static object, an immutable mobile (Latour 1990, Star and Griesemer 1989). For instance, as Ann's understanding of the technologies increased, she became able to identify what might be missing or added in subsequent diagrams, but she has never changed anything on them herself. She prints out a paper copy of the Spider diagram, or pulls it up as a digital slide on a computer in order to share it with those with whom it is being discussed.

Although the diagram might not have been intended to become a permanent object, it is the act of presenting it in public that appears to have facilitated its stabilization. For the purposes of engaging different audiences, ideas enacted in doodles become translated into a tidied up diagram; presenting that as part of a Power point presentation, orprinted on a poster make it appear stable in the eyes of the audiences. The Semantic Spider presented at the January 2009 Launch event had indeed been intended to be a temporary, one-off thing used to engage external participants. Unforeseen to the computer scientists, the non-technologists of the team found the diagram very useful, and soon it was being requested to be pulled up at team meetings to help discussion around technologies. As it continued to be aired at various public conjunctions, it became a point of discussion within the team – how has the Spider changed now and why? Why are we talking about the technology in these terms? There is a new arrow there, what does that mean? Different audiences continued to prompt slight changes in the Spider in terms of number of arrows or type and colour of boxes used, but these proved to be largely 'cosmetic', serving the purpose of communicating a particular idea to a particular audience. In time the Semantic Spider further solidified in form and shape, becoming first translated into html-format displayed as a webpage, and later on, into an Exhibit tool. This made it richer and more interactive – more of an object, a piece of semantic technology rather than a mere representation of it. This was the point

at which *'it all clicked to place'* for Ann in terms of understanding the technologies (Interview with Ann, 16th June 2010). Having the possibility to play around with the exhibit helped her to realise concretely how it all linked together. Through coming to understand how the semantic technologies work and how these relate to the work carried out by the research team as a whole, Ann became enrolled as a spokesperson (Callon 1986b, Latour 1987) for the semantic technologies in the research settings. As Pels, et al., (2002, 11) put it, 'objects need symbolic framings, storylines and human spokespersons in order to acquire social lives'. Similarly, 'social relationships and practices in turn need to be materially grounded in order to gain temporal and spatial endurance' (ibid). With Ann's increased understanding of the technologies, she could now expand her role to encompass some aspects of the work originally covered by the technologists. She became more independent in discussing technologies with her research participants, for instance, explaining with the help of the diagram the types of data required of the setting for the technology to work:

> *'it's quite recently that I've actually taken to having the diagram with*
> *me when I go to interviews and stuff, um, I did it on purpose for the*
> *participatory design workshop with the Dance students, because I*
> *wanted to explain to them why we were doing the design workshop, what*
> *kind of information we wanted to get from them - -.'* (Interview with
> Ann, 16th June 2010)

To sum up, for the computer scientists the Spider diagram is, or was initially, a temporary object, arisen from their everyday practice of diagram sketching. However, it seems to have started stabilizing in form after some core technologies were decided upon. The other team members have seen it as a more stable thing from the beginning,

and used it as a more static object. The perceived stability of the Spider only grew as it was translated from a Power Point-slide into html-format, and further, into a piece of semantic technology.

The doodles could be conceptualised as enactments of the technologists' understanding and current thinking of the semantic web. However, the Spider diagram is a *deliberate simplification*, a representation, of *some of the aspects* of the technology, Jim explained – a '*cartoon*' of the semantic web, as he put it (Interview with Jim, 11th June 2010). It was created for a particular purpose to communicate a particular aspect of the semantic web. The doodles Jim and Amy sketch on a daily basis are far more complex than anything that finds its way into a Power Point presentation. It is a language they communicate in, quite inaccessible to non-experts. Due to their expertise, it is they who decide which aspects of the complex technology are necessary to be presented to the non-experts, be it the other team members or the external audiences. For Jim, this highlights the *pedagogic nature* of the Semantic Spider. He likens his role in deciding 'how much of this do I need to tell you' to a teacher simplifying a very complex area in order to stimulate discussion around it. In this way the Spider is used deliberately for translating the interests of the prospective research participants. Apart from conceptualising the Spider as a pedagogic device, Jim and Amy also use it for planning their work:

> '-- *we're using it as a planning tool, we're using it to plan out and map out our progress, you know, it's more useful to us than a Gantt chart, it's more useful to us than a structured text.*' (Interview with Jim, 11th June 2010)

'it's like a way of structuring your work really, and it's quite useful because you identify the different technologies, you make categories there, and from the point of view of defining a process of development I think it's been quite useful - - it's, like a planning tool. That's how I see it.' (Interview with Amy, 11th June 2010)

Other team members further describe the diagram as e.g. a thinking or information tool, or tool for engaging participants. All of these characterisations would not be possible without a good degree of understanding of what the diagram is about and what the semantic technologies are. The common thread running through all of the uses, however, is *communication*. Although there are significant differences in terms of who is communicating what to whom through the Spider, it has come to enable communication between different parties, and thus has created connections between these parties. Lea, the other PI in the project, for instance, explained how the Spider had helped her to discuss the development of semantic technologies with technologists (external to our project) at her institution:

'- -there's techies there, who are familiar with the layer cake [another type of diagram] *and 'cos they couldn't see that in any of the Ensemble rhetoric - - then seeing the Spider and having those abstractions - aggregation, visualization, and so on initially - and then different sorts, different kinds of data sources later on - - it became a tool for conversation, a tool for thought.'* (Interview with Lea, 11th June 2010)

Engaging the Spider made discussing technologies with non-experts easier for Amy:

'- - before just talking about the things or showing some applications I had the impression sometimes it wasn't enough to communicate, maybe sometimes because of the too technical language or maybe just because of the complexity itself and - - I have to say after starting using it [the Spider diagram] I was finding - - the process of talking to social scientists much easier.' (Interview with Amy, 11th June 2010)

Considering the origins and the fluidity or stability of the Spider diagram, as well as the purposes of what it has been used for highlights several things. First of all it highlights the nature of interdisciplinary teams and of interdisciplinary work between parties who do not share the same working practices and the importance of communication in these (e.g. Haythornthwaite 2006). This is related to the notion of expertise. It is commonly acknowledged in the team that the computer scientists are largely in the role of the 'teacher' and educational researchers in the role of the 'learner' (Jordan and Rimpiläinen 2010). Since the Spider was first introduced, and subsequently adopted by the team, it is possible to evidence an increasing understanding about semantic technologies on the part of those who were unfamiliar with it.

'We've been talking a lot about the actual problems about how projects understand interdisciplinarity. Once we were using this diagram in this workshop we realized how even for members of the team it has been really useful to start talking to people from the settings, teachers, students. And then - - actually they I think in, for example in Ann's case - - she has now got a much better understanding of how these, and she says well actually this diagram has facilitated her through the task of

talking about technologies with teachers and students.' (Interview with Amy, 11th June 2010)

Expertise leads also to a notion of 'ownership' of the diagram. The technologists create diagrams; the others use them, and perhaps replicate them, but do not create their own – simply for the fact that they might not know the technology well enough to do that, or because that is not part of the work remit or practice. In some instances this has led to divergent expectations of what the diagram can or cannot do, or should be able to be used for, creating some tension within the team. For example, a couple of the educational researchers would have liked to have seen a more interactive version of the Spider to be taken to completion in order to better engage research participants in the process of technology development and design.

Among the interviewed researchers there was one who appeared to be relatively untouched by the Spider diagram, Tom. To him the idea of the semantic technology was clear even without the diagram – it is simply about encoding heterogeneous sources into a common format – making the Spider redundant. He also perceived the diagram as 'representing the technical side' of the project, which excluded him and his work, given that his research interests focus on pedagogy, which the diagram did not touch upon. In response to a question about whether he was talking about technologies in the archaeology settings at all, he replied:

> *'Not really. I think what we point out is heterogeneity, which is obviously in the diagram ... and I am a bit reluctant to talk about visualization and so on, because... yes that's possible and so on but then it becomes really a kind of a pedagogical question, the whole thing - -, what do you give to the students? OK, because they are shielded from all*

that, what is going on behind the interface, so I talk little about technology, I think only about heterogeneity and the possibility to aggregate resources and to reuse them in some way. ' (Interview with Tom, 11th June 2010)

In addition, rather than using the Spider for enrolling participants or for talking about the technologies Tom guides the research participants into thinking what it is they would like to teach, what different types of resources to use, in order to consider how these could be encoded in such a way that the semantic technology could read them. Therefore he did not find the Spider useful for his own purposes, nor does he engage with it beyond 'consuming' it as a member of an audience, or as a participant in discussions about it at meetings. In other words, the Spider diagram had failed in enrolling Tom as a spokesperson for the technology. He remained a spokesperson for pedagogy in the project.

When thinking about the variety of uses the Spider has been put to, it is useful to consider Annemarie Mol's (2003) formulation of objects multiplying when enacted as part of practices. Rather than seeing the Spider as a singular 'thing', examining how it is being enacted as part of different practices brings forth its multiple nature. The computer scientists materialise and organise their thinking about technologies as doodles, out of which the Spider diagram is created as a simplified version for particular purposes. It is enacted as a communication or an instructional device with particular external audiences, but also within the team. Adopted by the educational researchers, the Spider diagram becomes a static object, something that can be taken along and shown to people in a different location. It becomes a communication tool, a device to think with or to stimulate thinking, envisaging possibilities, or means of

teaching about technologies. The computer scientists also enact it as a planning tool for their own work. But it also emerges as 'not my thing', as not useful for one's work. Through these practices, the Semantic Spider surfaces as a multiple object.

Given the role the Semantic Spider has played in communicating aspects of the semantic web both for *external* audiences as well as within the team, could the diagram thus be conceptualized as a boundary object (cf. Star and Griesemer 1989, Bowker and Star, 1999)? Star and Griesemer (1989) define boundary objects as follows:

> Boundary objects are objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. They may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable means of translation. The creation and management of boundary objects is key in developing and maintaining coherence across intersecting social worlds. (Star and Griesemer 1989, 393)

This issue was discussed at one of the team meetings (team meeting, Feb 2010). There seems to be several characterizations of a boundary object that the Semantic Spider would seem to meet: it is 'robust enough to maintain a common identity across sites'; it can be both 'abstract' and 'concrete'; it appears to have a different meaning in different social worlds, including those of the prospective and actual research participants. There is plasticity to the diagrams in the doodling phase, where boxes and arrows might appear and disappear, but in contrast to the Star and Griesemer definition, the diagram

becomes stabilized *as* it *crosses* the internal 'boundaries' – a problematic concept, more of which below - within the team. Another divergent point about the Spider as a boundary object is that it has not deliberately been developed to play the role of a boundary object, nor is it being maintained as one – it was *adopted* as one by the educational researchers, unexpected by the technologists. The educational researchers have not participated in creating the Spider, while it is actually their engagement with it that has helped to maintain its stand as a more static object in the project. With the differing expectations of its capacities and the varied uses it has been put to, it would be hard to characterize the Spider diagram as an overall point of convergence within the team. However, it might work as a more traditional boundary object *between* the computer scientists (cf. Beckhy, quoted in Lee 2007). A concept which might work better with objects like the Semantic Spider diagram are called *boundary negotiating artefacts*[54] *(BNA),* a concept introduced by Charlotte Lee (2007), who studied a newly established museum-design team. She critiques boundary objects for having become overused, a 'catch-all for several theoretical constructs' (p.335), pointing out that especially in multi-disciplinary collaborations it is often clear that shared artefacts do not fit this description. To critique and enhance the concept of boundary object, she hence proposes five different types of boundary negotiating artefacts, which are used to:

> record, organize, explore and share ideas; introduce concepts and techniques; create alliances; create a venue for the exchange of information, augment brokering activities; and create shared understanding about specific design problems. (Lee 2007, 333)

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[54] Charlotte Lee (2007) talks of *artifacts,* yet the team discuss *artefacts.* The difference of spelling must be an American English vs. British English issue. I have chosen to use the spelling 'artefact'.

This description seems to connect well with the different usages surrounding the Spider diagram. Further, the description of a sub-type of BNA called *borrowed artefacts* seems to resonate with the story of the diagram as well:

> Borrowed artefacts that are taken from its creator in one community of practice and used in unanticipated ways by those in another community of practice. Designers use borrowed artefacts to augment their understanding of design problems. The practice of borrowing occurs when communities of practice are in close proximity. (Lee, 2007, 331)

Lee further explains that the BNA are enmeshed in sets of practices that may or may not be agreed upon by participants. The computer scientists have the practice of doodling, in which the thinking about the technologies in enacted through doodling diagrams. The presented Spider diagram was subsequently adopted by the other team members in a static form as part of their practices e.g. of making sense of the technologies, and of engaging research participants, uses the technologists did not anticipate. In addition, some team members engaged the Spider as a tool in technology design activities, while others insisted this was not what it was meant to be used for.

Boundary negotiation artefacts are fluid, changing from one type to another, when the context of use changes (Lee 2007), as the Spider has done in this project. The BNA also help to transmit information across boundaries, as the Spider does. According to Lee, they also work to establish and push boundaries, and they can be physically incorporated or transformed into other artefacts, something that resonates with the Semantic Exhibit Spider. Lee (2007) further suggests that these BNA could be predecessors of boundary objects (c.f. Pennington 2010), something that remains to be seen in the case of the Semantic Spider.

The Semantic Spider diagram would seem to fit the description of a boundary negotiating artefact, but in the case of the team it would have to be an *internal* one. This would assume however, that our team is conceptualised as a community with clear set boundaries, which is not the case. It would not even be conceivable to conceptualise the team as consisting of two separate communities, given the disparate nature of both 'strands', and the changeable, and distributed membership of the project as a whole. Rather than a community, and in concert with an Actor-Network Theory approach, it is more befitting to conceptualize the Ensemble team as a fluid and heterogeneous assemblage, where drawing of both internal and external boundaries is more problematic (cf. Edwards et al., 2009). This being the case, it would be better to think of the Semantic Spider as negotiating and mediating different types of work practices engaged in the team. In doing this it has helped to push respective practices and extend the roles engaged by team members into each others' areas, emerging as multiple and contested, yet maintaining a common identity across these. Hence a better characterisation of the Spider would be a *practice negotiating artefact*. It has helped to clarify who is engaged in what kind of practices (the technologists create diagrams – researchers do not or the team members 'know' technology – the research participants learn about it). Yet it has blurred differences between these by expanding existing roles to encompass aspects of work previously inaccessible to the researchers and the developers (the educational researchers now can discuss technologies more independently with their research participants; the technologists understand what might be difficult about technologies for the non-experts and the research participants have learned to envisage the possibilities offered by the new technologies for their teaching). In order to achieve this, the Spider, the unexpected actor in the process of meshing the two strands of the project has indeed participated in the work of the team, by helping to

record, organise, explore and share ideas, introduce concepts and techniques, just as Lee (2007) listed. It has worked to create alliances and venues for exchanging information, acted as a broker in creating shared understandings. In addition, as a research tool for the interviews carried out around the Spider, the diagram surprised again in unearthing unexpected multiplicities and differences in opinion, practices and types of expertises within the team.

The significance of the Spider was in helping to bring together the two strands of the project, and expand the technologists' and educational researchers' mutual understanding of each others' practices. The Spider did not make a further appearance in engaging research participants in archaeology, nor did any other object or thing find a similar position as a practice negotiating artefact within the project as that of the Semantic Spider.

4.2 Artefact as 'the case' in Archaeology

In the previous section we familiarised ourselves with the work that the Semantic Spider diagram, conceptualised as a *practice negotiating artefact*, has done in the Ensemble-project in helping to enmesh the practices of its two strands. In order to gauge the potential niche for technology development in archaeology and the other settings, those team members who are not experts in technology have needed an understanding of how the technology works or could work, what its affordances are, what type of data it requires in order to function, as well as a way of conveying and discussing these with their research participants. We will now go back to spring 2009 and pick up the path of the token after April 2009.

After the April 2009 data meeting the team moved onto what could be characterised retrospectively as an *exploration period*, when the team put into practice their plan for further research into cases. In the archaeology setting the team faced a double challenge: not only was the 'case' elusive, but this made identifying the niche for technology development harder. This ambiguity led the researchers to explore various options for 'case' and follow a far larger number of leads for identifying the niche than was the case at other settings. Several archaeology lecturers and the staff at the museum[55] and the adjoining archive[56] were interviewed during the summer and autumn. The team attended open lectures at the department[57] as well as one field trip[58], tried to contact students for interviews (in vain) and joined departmental mailing lists to be in the loop for information. Each encounter yielded suggestions for 'the case' in archaeology and thus a niche to develop technology, but none of these were viable. Either because: there was not enough available data to work with (e.g. Iranian pottery data[59]); the technology was not (yet) ready for the type of data available for a tool or proved too cost and resource intensive to create (e.g. anecdotes used in teaching[60]); solutions like the suggested one already existed or could have been realised without the semantic web or might not have added anything to the existing practice (e.g. over-laying of site data on a hand held device[61]), or might have altered the practice altogether, which was not the intention. Considerations in each case were the available resources of staffing; the available time and the cost of production; affordances of the semantic web; the nature and availability of data and the technological know-how of the team; the nature of archaeology as a setting, including the degree to which the

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[55] E.g. interview with Matt and Phil, 8th May 2009 and with Matt 9th Nov 2009.
[56] E.g. interview with Mary, 28th May 2009.
[57] E.g. lecture on using aerial photos in Archaeology, 15th Oct 2009.
[58] The Flag Fen field trip, 8th Oct 2009.
[59] E.g. interview with Jack, 28th May 2009.
[60] E.g. interview with Matt and Phil 8th May 2009.
[61] E.g. the Flag Fen field trip notes, Ann, 8th Oct 2009; interview with Matt, 9th Nov 2009.

setting was enrolled and committed to the project; envisaged usefulness of the finished product for the intended cause; and the openness of the setting for innovations. The list is not exhaustive, and each point could be opened up and interrogated further, but this will only be done in relation to the actual 'case' finally identified, later on in the chapter.

The exploration period lasted from May to early November 2009, during which there was also a considerably long lull in engagement with archaeology during the summer, when the research participants moved away from the reach of the project: teaching wound down and the archaeologists were away at field trips, with students leaving the university for holidays. One of the interviews during this exploration period (on May 28th), was with the museum archivist Mary, who is a link person between the students and the objects at the museum, and who also is responsible for objects used in teaching. Let us visit this meeting, which has in retrospect become significant as the first encounter with what later on emerges as 'the case' in archaeology, but at the time of the interview it was not yet seen as such.

Ann, Will and Tom meet Mary at the archive of the museum adjacent to the archaeology department, talking for an hour. The initial topic of conversation concerns the types of teaching Mary has seen taking place in the museum. The first example she gives is of a class where objects are '*just passed around*'. The working principle of the museum is '*that the stuff is there to be used. But if it gets broken, it's better that it gets broken when it's being used rather than in the store room where no-one ever sees it*' (Interview with Mary, 28th May 2009). From this point of view having the teaching setting next to the museum is unique. The other teaching example is of an Artefact-project, which is a piece of work the second and the third year undergraduates are

doing. It entails selecting an object, usually from the museum, and writing a complete report on it: what the object is, what its properties are, where it was found, what circumstances it was found in, who gave it to the museum, what research has been carried out on it etc. In order to get access to the objects in the museum, the students need to approach Mary – she will arrange access to the object selected by the student, or even help them in choosing one. The Museum has vast collections of objects from around the world, 80% of which have never been studied until a student takes an interest in them. Currently the completed Artefact-reports end up stored as hardcopies at the archive after the lecturer has seen them, but ideally Mary would like to see them linked to the museum's database, given that at that moment there was no accessible record of objects previously studied, and occasionally the same object may get studied again. In addition, linking the Artefact-projects to the database would add value to the collection, given that only one fifth of the collection has ever been studied at all. Ann asks about the contents of that database in relation to the objects it lists. Mary explains that this varies: sometimes the database contains all data on a given object at the museum, sometimes only random pieces of information. Most of that data is also available through the internet, apart from the objects' exact location and value. Ann suggests that linking the student projects into the museum's database sounds like a good idea, something with which Mary readily agrees.

Apart from learning about the Artefact-project and the museum archive, this interview, together with another interview with one of the archaeology lecturers (interview with Jack 28th May 2009) the same day, the researchers start getting a sense of the fragmented nature of archaeology as a discipline, as well as a setting, at the university they work at. There are several different institutes and centres, museums and sub-disciplines involved both in archaeology teaching and research; the discipline itself

ranges from humanities of archaeology to science of archaeology. It is not possible to form a unified image of the 'setting' given that the discipline itself is dispersed into so many different sections (Interview with Archivist 28th May 2009; interview with Jack 28th May 2009; email correspondence on 29th May 2009 between Ann, Will, Tom and Sanna).

Later on that day Ann reports the interview with Mary in her research diary, noting especially the artefact-project:

> '[The Archivist] has seen artefacts being used in teaching Archaeology in many different ways. - - She also tells us that all 2nd and 3rd year students have to write an artefact-project. This is a report of all the information they can get about one object from the museum, including who donated it and where it has been used. These reports are printed and stored as hard copy in her office. She would like to be able to link them to the database of artefacts the Museum has but she doesn't have the time to do it. She is thinking of getting a student to do it in the summer. The artefact database for the museum is available on the web; there are certain data fields that are left out of the online version like where it is stored but otherwise all is available to see. There are also subsets of collections that are created online and these have descriptions associated with them...or they are working on descriptions anyway.' (Ann's research diary, 28th May 2009)

Will added a comment to her entry:

'This seems like a good candidate for a UROP[62] project. We should not lose sight of it. Do we need a section somewhere on the Wiki to place potential UROP bids for next year?' (Will's note, no date)

Unfortunately, no UROP student will be involved in the archaeology setting that summer, given the selected students' personal areas of interest. However, it is noteworthy that the Artefact-project has come up during research and that the researchers make a note of it. Ann is also noting down things like availability and accessibility of online data, that this relates to undergraduate teaching, and that there exists a problem needing a solution.

During the summer there is a lengthy quiet period in engagement with archaeology due to absence of research participants at the setting. At the beginning of the second year of the project, in October, a number of related turns of events take place that have a bearing on the work of the project. The main catalyst is that Jim, the PI of the project, takes up a post at another institution, Liverpool John Moores University (LJMU), relocating there with Amy, the technology developer of the team. Until then the PI, the technology developer, the two research fellows and the project administrator have worked in close proximity in the same office, creating a core team, yet sharing their time also with the other PI and the research settings located at City. Now the project team becomes even more distributed. The overall emphasis of the project gradually shifts to LJMU over the following year both administratively and research activity-wise. A number of new research settings become engaged at LJMU, increasing the pressure on researcher and developer time in the existing settings. The effect of this is that rather than having several researchers working collaboratively on a smaller number

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[62] Undergraduate Research Opportunities Programme. Undergraduate students are employed by different departments to carry out small research projects lasting a couple of months. The pilot projects for Ensemble were carried out by the UROP students.

of settings, each researcher now takes responsibility for work being carried out in a couple of settings each (Email discussion between Ann, Will, Tom and Sanna 20th Nov 2009). This pragmatic arrangement (while it does not erase the multiplicity of research approaches engaged in the project) works to release the interdisciplinary tension evident earlier on e.g. in the archaeology setting. It is Ann who will take responsibility for the work in archaeology.

The hunch and the emergence of a niche for technology

Having entertained a range of suggestions for developing a semantic application over the summer, the idea, a hunch, that Ann personally has '*high hopes for'* in the autumn (Interview with Ann 21st Sep 2009) is the Artefact–project and the possibility of linking these to the museum's database. There were two major reasons why the Artefact-project appeared more promising (cf. Scardamalia and Bereiter 1993) than the other suggested niches: first of all, there was *an existing online database* of artefacts at the museum. The project had identified as the 'first three areas for research and development':

1. Identifying and gaining access to online resources;

2. Converting these into appropriate formats;

3. Aggregating data and meta-data (so that these can be incorporated into teaching and learning environments) (Ensemble 2009b paper 2, 4.)

Until now the suggested openings (according to the ethnographic stance that had by now marginalised the theory-led one) for technology development, and hence, the case, had always lacked an existing database of online resources. For example, for the

anecdotes this would have needed building from scratch, beginning from collecting the stories. The Iranian pots were in a static database on paper, but the team had no access to it during the summer, and subsequently it turned out too narrow a resource. Now that the online resource was identified the team needed access to it. This could potentially be gained through the museum, which is why Ann wanted to talk to Matt.

The second reason for the 'promisingness' of the Artefact-projects was an existing and *identified need* for something to be done in order to link the student Artefact-projects to the museum archive: the archivist had regretted the fact that student projects ended up sitting in hard copy in the archive, with no-one being able to access and use them, or even find out if a given object had already been studied (Interview with Mary 28th May 2009; Ann's Diary entry 28th May 2009). The problem thus was: *How to make the student Artefact-projects more accessible and available online?* This would benefit the students creating Artefact-projects by allowing them to see previously carried out work and would enable them to add to that. It is noteworthy that these cases are related to the teaching that takes place in the museum.

Hoping to discuss the 'hunch', as well as the team's progress with the setting since their meeting in May, Ann arranges to interview Matt at the museum in early November 2009. Will joins the meeting a little late. Ann updates Matt on what the team have found out during the spring and summer since their last meeting with him, including the recent attendance on an archaeology field trip and their unsuccessful attempts at getting in touch with the students. Ann then leads the discussion to her interview with Mary at the archive, who was '*telling us about the work she does with the databases and also about the teaching that she does with... drawing, no, sketches'* (Ann at interview with Matt 9th Nov 2009). Matt and Ann discuss the importance of sketches for

archaeologists, how these, as inscriptions, differ in terms of form and information content from photographs, and how realising this is helpful in thinking about technologies. The second issue of interest that had come up in the interview with Mary was the Artefact-project:

> *Ann: 'Another thing that pricked my ears up during that interview was that she said that second year students do a project on an object, and they find out everything that they can about that and write it up. They write a project, which is hard copy, and it's given to her and put in the office. And I thought "how interesting would that be if it was associated with the database"?*
>
> *Matt: Yes, that would be interesting. Very, very interesting.*
>
> *Ann: that's a very semantic-webby kind of thing'.* (Interview with Matt 9th Nov 2009)

Bringing up the Artefact-project works like 'clicking a switch' with Matt, who gets very excited, starting to explain about work that he is doing with people around the world with databases, and how the department will be re-doing the archaeology classes in the next few years. This is linked to the museum's re-development plan, which would allow for more on-line access to the museum's collections through a cloud of resources. This work would enable interaction with objects via masses of '*of intersecting, non-intersecting, commensurable and incommensurable narratives and accounts and descriptions and representations'* (Matt at interview 9th Nov 2009). Achieving this would entail bringing in a large, interdisciplinary team of researchers, media theorists and designers etc, something Matt is 'very keen' in engaging Ensemble in, to support that project, '*obviously according to your own needs.'* Ann replies that

the team are very eager to start the technology development side of things, and that they wish to keep '*getting to know cases in archaeology, doing observation along the lines like that.*' Matt explains extensively and enthusiastically about this plan, which will incorporate several other funded projects. The ultimate goal appears to be the creation of a single, large museums' super-database. Ann agrees that the project sounds interesting, saying that the Ensemble-project '*would be interested in the structure of the database, how links are made, how data is being searched etc*'. Matt explains this to be '*very simple MYSQL[63] with API[64] access*', adding that they could grant the project access to it, (a pre-requisite for the team being able to develop anything) and that they would be happy for the project to use it to their own needs. It is at this point that Ann directs their discussion back to the artefact–project, which she is interested in pursuing:

> '*If somehow we could get involved linking this up to the projects that the student are doing on the objects, assuming that they are still doing them?*' (Ann at interview with Matt, 9th Nov 2009)

In saying this, Ann, with her increased understanding of technologies, enacts the role of the spokesperson, not only for the Ensemble technology development in the archaeology setting, but also for the museum database, the archaeology students and the artefact-projects that would mutually benefit from being linked to each other. Callon et al., (1986a, 274) write: 'When a network is established, scientists talk not only on behalf of electrons or DNA, which they translate in their laboratories, but also for the countless external actors they have interested and that have become the context for their actions.' In following the promising 'hunch' for a niche Ann is acting as a spokesperson for the interests of the project. However, the participatory ethos of the

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[63] A popular open source database.
[64] Application Programming Interface – 'a way of interacting with a Windows environment' (http://www.applecore99.com/api/api001.asp accessed 20th July 2011).

project also implies the team will have their research participants' interests at heart, which is why Ann now also represents them (even if they are at this stage as-yet-only-potential-research- participants) while simultaneously working to enrol Matt and his networks in the plan. She is carrying out her work *as if* these participants already were enrolled and she was representing them. Callon et al., (1986a, 274) further adds that the '- - ability to act as legitimate spokespersons is due to the series of representations that have been set up'. The more actors and actants they can represent as a spokesperson, the stronger they are as a researcher/scientist. As her work carries on and she succeeds in enrolling various allies in her plan, Ann's position as a researcher strengthens, and she is able to achieve more and move further in the assemblage she is gathering together.

Matt is very excited about his project and would be keen to enrol Ensemble as a potential partner in his endeavour. Ann however is keeping her eye on her own agenda, and on that of the project she works in, resisting to be diverted from the research focus by Matt's enthusiasm. Instead, she adds another reason why the student Artefact-project would be a useful addition to the database, referring to Matt's earlier elaborations of his projects and of digital objects: ' - *there are a lot of hard copies which could be turned into digital objects and linked into the data base'* (Ann in interview with Matt 9th Nov 2009). Matt immediately sees the potential in this, identifying an already existing database that the student Artefact-projects, as digital objects, could be linked to. *His* wish, as a spokesperson for his own project and the museum, is to make that database richer in terms of 'richer relationships' between digital objects, something that he thinks the Ensemble project could be helpful with.

It is in these exchanges that the ephemeral space for the niche for technology development begins actually to form: to Ann the Artefact-project has seemed 'promising' in terms of technology development, and she set off to pursue this hunch (Scardamalia and Bereiter 1993) by talking to Matt, who is responsible for the archive the team would need access to in order for this plan to move forward. Matt, on the other hand, happens to have his own project underway, for which he sees Ensemble as a potentially beneficial partner, whom he is happy to engage with. Until this meeting took place, the germinating idea and the envisaged space for technology development had not been able to grow or begin to materialise. Even without his related projects, Matt would be the gate-keeper for helping the embryonic idea to develop: he has the necessary know-how about the museum databases and he can arrange access to it for the Ensemble-team. Furthermore, he is positive about the value that the student Artefact-projects, once linked to the database, would add to it. The interest and needs of the research project now enact Matt as an obligatory passage point they have to get through in order to gain access to the online resource, which was identified as the first step in developing a semantic application (Ensemble 2009b, paper 2).

Ann and Matt both see a mutual benefit in taking this suggestion forward, with the caveat that the Ensemble-team have not seen 'everything' that is going on in the archaeology setting. However, *provided* they were thinking of 'objects-as-cases', and cases had multiple meanings, engaging the Artefact-projects and the museum database in technology development would be 'ideal', Ann suggests. Having said that, the plans are still tentative, and Ann still needs to discuss these suggestions with her team. Matt promises to arrange for the Ensemble team to have access to the museum archive's

API[65], which according to Matt affords two contradictory things: on the one hand, it provides descriptive, meaningful content about the object, and on the other it is being used as a '*primary managerial tool for managing and preserving the objects'*. These two functions are often in conflict – maintaining the catalogue means high levels of security, while the information itself should be shared with other people and linked to other tools. Matt offers to show the team the API access and its structure, '*you can write code and modify and pull out and improve that API access'*. To Ann this sounds good, for that is exactly what the semantic applications the team have been building do: they link to existing data bases, retrieving the information and linking it to some other databases, which means that data can be added in two different ways without altering the original data. Matt is very excited about this prospect, and Ann reminds him again that the project should be associated somehow with the case-based undergraduate teaching. The meeting finishes with talk of contacting students.

Ann writes in her diary that day:

> 'Had a catch up meeting with [Matt]. I filled him in on what our most interesting leads have been with regards to technology development. He told me about three new projects that he is PI for that we may be interested in. The first sounded very interesting, a large project that links databases from 8 museums and makes them interactive with the museums themselves. This also includes the refurbishment of the museum. I saw potential for us being involved in linking this to undergraduate teaching, specifically the student projects mentioned by [Mary, the archivist] on single objects where a report is written and thus

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[65] Application Programming Interface

far unlinked to the Museum archive. [Matt] says we can have API access

and that the collections management system is PHP with MySQL behind

it. - -' (Diary entry, Ann on 9th Nov 2009)

The niche – and hence also the problem-to-solve - is becoming clearer with Ann now articulating in her diary the potential she sees in the Artefact-project for technology development. However, the niche has not quite 'emerged' yet. Ann needs to enrol other allies behind these suggested translations: that artefact/object is a case and that the niche for technology development lies in linking the students' Artefact-projects into the museum's database.

Later on the same day, 9th November 2009, Ann, Will and Tom meet to discuss the interview with Matt to reflect upon what they have learned and to discuss where to take the project from there. Ann briefly recaps the meeting with Matt for Tom's benefit, explaining what she had told him about their activities since their last meeting, before coming to the three projects Matt had told her about. Ann highlights the project that aims to link eight different museums' databases and make them available to the public[66]. This was what Ann identifies as promising for its 'sem-webby-ness'. While the project is large and public, Ann's suggestion is that it might be '*possible to make links between that, or rather the database created by *that*, and some of the teaching we've seen take place in archaeology',* specifically the students' Artefact-project.

By reflecting upon previous work, and comparing the potential offered by linking the student projects with what else the team have discovered, Ann is enacting her role as the 'instrument of her research' (Latour 1987). She speaks with confidence about her

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[66] Ann discusses also the other two projects Matt had introduced, but these do not have any bearing on their work on archaeology.

'hunch' – the mutual benefit for the research project as well as the setting that would arise from connecting the two, to date, separate issues: the student Artefact -projects and the museum's database. Will wonders how linking the student produced work to an existing authoritative and expert created database would work in terms of ethics, rights of access and confidentiality of data. Ann explains that adding to the actual database is something Matt had specifically said that the team would not be able to do:

> *'We *don't* have access to the official archive. We can *use* the data and that is what the semantic applications are about, being able to link to the data. You could add to it within a different application, but it won't change the original archive. And so we can make an application that* mirrors* it and* links* to it, so when the official one is changed – officially - those changes will be seen in our applications.'* (Ann, Post-Matt interview meeting 9th Nov 2009)

The student projects could be overlaid on the museum archive, which means that the actual database would not be 'contaminated'. The students would benefit from getting both an access to past student reports in the knowledge that these were created by students, as well as easier access to data that they need for writing the reports. Making the reports semantic would enrich these and make them more interactive as well as available to other students. The Ensemble team could help not only by arranging access to this database but also with 'semantifying the reports' in order to link them to this (Ann, Post-Matt interview meeting 9th Nov 2009). This is the first solid articulation of Ann's suggested plan for technology development in archaeology.

Will asks if currently the projects are just 'paper on the shelves', which Ann confirms, thinking (quite optimistically) that the team could *actually turn those paper reports*

into digital reports, straight off''. Will adds they should see if the future reports could be submitted directly to the database as well as in paper, which Ann agrees with. This, however, would require collaboration by those who teach or support the writing of those reports – another ally that needs enrolling – which might be challenging if introducing a change to the process would mean changing the curriculum, which the setting is *'resistant to'*, as Will puts it. However, proceeding with the plan is only possible if Will and Tom are happy to go along with what Ann is suggesting. As the meeting goes on, the two have gradually aligned themselves behind her on this:

> *Ann: 'Yes. I think a way into this would be if we could get access to those pre-written reports, turn them into something digital, show it off as something interesting...*
>
> *Will: Perhaps something manageable that would demonstrate. (Tom agrees in the back ground)*
>
> *Ann: And actually it does not have to *replace* the hard copy, it just has to take place as well as hard copy. And we could see which is more...*
>
> *Tom: They, don't they already exist digitally?*
>
> *Ann: No*
>
> *Will: No, from what [Mary] said, no. I don't think. - -*
>
> *Ann: They're printed out and handed over, and that's... they get sat in the office and that's the end of it.*
>
> *Tom: Wow.'* (Post-Matt interview meeting 9th Nov 2009)

The three researchers go on to discuss how they could progress with Ann's plan: do the students have copies of their reports? Will suggests that it would be a good idea to see what the reports look like and how long they are, something Ann agrees with. Tom

wonders about the practicalities of linking the reports to the database – would they describe the reports semantically, '*kind of code them*'? Ann envisages them to be able to find different ways of linking to the database based on the different bits of information contained in the reports – images, locations, facts etc. She is able to visualize this having an understanding of what the reports are like based on Mary's descriptions of them, and how the museum database operates based on discussing this with Matt, as well as having an understanding of how the semantic technologies work, what types of data they can use. Will wonders aloud how curious it is that such a rich resource just sits unused in the archive. Both Ann and Tom agree, with Ann then pausing and thinking a moment before continuing:

> '- - And I think we could say that this is a 'case', right? (Will and Tom: yes, yes) And we're going that way in archaeology a lot of the time, which is that object is a case. And so that is like a case report, really. And I guess we could call that case- based learning?' (Ann at Post-Matt meeting 9th Nov 2009)

'*And I think we could say this is a case, right?*' suggests Ann, with the others agreeing in the background. If an Artefact-project is a case, then courses including these projects could be conceived of as enabling 'case-based learning'. Finally, it seems, '*the case*' in archaeology has emerged, however pragmatically. Out of all the suggested options, it is the object/artefact that *emerges* as *the* case in archaeology, in this set of circumstances. According to Callon, 'the notion of translation makes it possible to understand how context and content are simultaneously reconfigured' (Callon et al., 1986a, 273). Ann finds support for 'object as the case' from their earlier work and discussions, where this idea has kept surfacing time after time. Both Will and Tom agree with this - even Tom

who has been critical of this suggestion before does not voice dissent at this moment in time. The team had been on the trail of this translation earlier in the year in their conference paper (Ensemble 2009a, paper 1). In the paper the importance of having the artefacts physically present in the ceramics classes, in order for the students to experience the 'visual and the tactile elements' of the objects was considered, as well as their use for demonstrating 'ways of seeing' or interpreting ceramics. In addition, the paper states:

> The lecturer describes their observations and explains their interpretations in order to pass on knowledge and interpretative skills to the students. This may be another type of case whereby <u>the object itself constitutes a case</u> by representing a story and demonstrating the complexity of real life. (Ensemble 2009a, paper 1, 9; emphasis added)

While it is the students, rather than lecturers who are dealing with the case here, and while the question is of *constructing a case* around the artefact in the Artefact-project, it is nevertheless the object/artefact, which has crystallised as 'the case' simultaneously with the artefact-project emerging as the niche for technology development.

The long quest for 'the case' in archaeology seems to have come to an end, of sorts at least. The research question 1 was first translated into research activity, research activity into conflicting findings, these into interim stabilisations and further research through a period of exploring various types of cases with a view for technology development. Now the team have finally arrived at their so-far-the-most-important translation of all: 'Object is a case in archaeology'. How did this happen? What happened to all those multiple alternatives to case that were explored along the way – were they mistakes? Did they disappear? How did the team settle on this rather than

some other suggested case in their investigations? What is certain is that the 'case in archaeology' has not been lurking in the shadows waiting patiently for the researchers to discover it.

Let us start by looking at the participants in the process of translation: as stated earlier, the most important actants in that process have been firstly, the *RQ1*, which has guided the researchers' work, and secondly, the researchers' respective research backgrounds, their *hinterlands* (Law 2004). Now another two important actants have joined these: time, and the technology development work. Or more precisely: *the pressure produced by passing time in relation to the duration of the project* – we are into the second year - *to move onto the technology development phase in this setting*. 'Technology development' is not only an aim of the project but is also a skill, ability or awareness, meaning that even those team members who are not specialists in technology understand how these work and are able to envisage how or where there might be scope for a semantic technology to be developed in that setting.

The Semantic Spider diagram has played a role in helping to bridge the gap between the experts and non-experts in technology, enmeshing and extending their respective practices, hence feeding into this process of translation as well. Furthermore, the to-date-accumulated experience and understanding of the setting, *interim stabilizations* and the *preliminary findings* have participated in the translation. Hence, rather than being looked at as a static set of relations, the translations are *emergent* in space and time (cf. Pickering 1995). Participants weave into or disengage from the research process as it progresses. This does not happen smoothly and linearly from A to B through time, but through occasional successful leaps forward followed by reflective pauses, or pauses caused by adverse, unexpected turns of events; sometimes the team

have ended up on explorative detours leading to dead ends forcing them back to square one to re-calculate their direction. Working in a developmental project like this is like orienteering through an unknown terrain without a compass, trying to find the best way 'there' by only following the Sun and the stars, yet not exactly knowing where 'there' is.

It was the growing pressure to make progress in the archaeology setting, combined with recognising the potential of the Artefact-project for its pedagogy and affordances for technology development that urged Ann to contact Matt again. She wished to discuss the potential in linking the student Artefact-projects to the museum database. While there were also other suggestions for technology development, this one was by far the most *promising* – worth pursuing further. This *impressionistic knowledge,* which manifests itself as 'hunches, gut feelings, 'I just know'-feelings', is acquired through experience. In order for Ann to spot the 'promisingness' (Bereiter and Scardamalia 1993, Bereiter 2002, 330) of this particular suggestion, she had to have an understanding of how semantic technologies worked and under what circumstances; of what case-based learning might be like in archaeology; a hunch of how bringing these two things together might benefit the setting as well as the project and of how *realistic* the suggested idea was - was there enough suitable data to start with, and was it accessible? A dose of luck was also involved in the process leading up to the translation: Matt happened to have three separate projects under way, one of which was directly relevant to the suggested niche for technology development that Ann had in mind. The prerequisites for even considering technology development – to have access to the necessary online resources, in this case the museum's database - were met by Matt's needs: he was keen to work with Ensemble by arranging for them access to the database, and in return, to receive technical help on making the future database richer.

Furthermore, Matt's attitude to having user-generated data - generally considered inferior or of less quality to authoritative academic data - linked to the museum's database was positive.

While Ann may have been able to detect the emergence of the niche and the 'object as a case', the translation is still not finished until she has successfully enrolled allies (Callon 1986b, Latour 2005) who agree with her: she alone cannot proceed with this 'hunch'. Callon et al., suggests that 'translation leads to the identification and shaping of allies and to seeking their support' (1986a, 273), exactly what is happening here. She will have to convince a number of others – her fellow researchers and technology developers, as well as the gate-keepers of the databases (like Matt) and teaching staff of the Artefact –projects (e.g. lecturers supporting it) - that this suggestion is worth pursuing. Enrolling non-human participants (such as copies of the Artefact-projects or databases) as allies is vital for the success of the plan, too. During the data-meeting following the interview with Matt, Ann works successfully to enrol her fellow-researchers as allies onto her plan. The lack of dissent in that meeting in comparison to earlier ones is notable. Perhaps this is due to the fact that time is pressing and there is a real need to move on. Perhaps Tom has come to see Ann and Will's point of view, or perhaps it is because at this point in time it is Ann, who is responsible for the archaeology setting, and the others let her 'get on with it'. The competing interpretations of cases in the archaeology setting have not been forgotten by the team, as we will see later on. Yet, in order for the work to move on, a decision that settles on *something* that the technology development can work with is imperative. Had the team only been looking for the 'nature, scope and role of cases' they might have been happy enough to live with the multiplicity and tension arising from the multiple research approaches. However, given that the research strand is now enmeshed with technology

development, the nature of that process has altered: in order for the team to develop a meaningful piece of technology, it has been essential that they identify a niche for it. The moment that marks the turning point in the process of co-emergence of a niche and the case happens precisely when Ann is able to *pinpoint a problem* that the team could help solve: 'How to link the student projects into the Museum's database?' In order for the problem to be as significant for the project as it proved to be, it had to be located in a suitable teaching setting, one that employed case-based learning. Again, this was open for interpretation, and depended on how cases and case-based learning were understood. The debates around whether or not these exist in archaeology highlight the precarious and performative nature of research, and that research outcomes are both constructs yet based on 'reality' (cf. Rimpiläinen 2011).

By the end of the data-meeting multiplicity has become reduced to pragmatic singularity: the three researchers are agreed that 'Object is a case' and they are ready to start a new phase of research leading towards technology development, which will also open up avenues for answering the other four research questions in time. They finish their meeting with Ann articulating a plan forward:

> '- - ... ok, so I follow up student links. I am going to get in touch with [Mary] and probably meet with her again and talk it through with her again, and through her get a link to the person who teaches or supports this thing, and then try very hard to get a proper collaboration with that. (Will suggests it might be good to interview students as they are working their way through the project, Ann agrees, adding talking to them at whatever stage would be good.) - - And I hope that the person who is teaching this subject, would be very open to that we are trying to

develop a piece of technology and that it would be linked to this course in particular. Trying to get some buy-in there, that'd be good. And to contact [Amy] and [Jim] very soon, and see if I can get them access to the local museum archive. Apparently we can have an API access via [a computer programmer at the office']. (Ann, Post-Matt meeting 9th Nov 2009)

The team now have identified 'the Case' in archaeology and a niche for which to start developing a technology. The tension here is that the project network currently engages the museum and the archive, but not yet the teaching and learning settings where the Artefact-projects are being created. It is imperative for the project to enrol these as part of their assemblage as soon as possible. The plan personifies on Ann, who clearly is taking a lead in the developments in this setting. The research activity now moves to a different plane, something we will follow in the next chapter.

5. Gathering a new assemblage for technology development

So far we have followed how the research team have translated the first research question – the token – into practice of research, and how the 'object/artefact as a case' in archaeology emerged together with a niche for technology development from a lengthy exploration. Settling on a pragmatic singularity in terms of 'case' is a necessity for technology development to move forward sensibly within the given resources of the project, but simultaneously the 'token', now the Artefact-project[67], multiplies. It becomes enacted both as 'the case' in archaeology and 'the niche' for technology development. The two enactments of the token will be referred to, in short, as 'Plan', which the 'hunch' solidified into once Ann amassed the support of her colleagues for taking it forward. The 'Plan' is to find a way of developing a piece of semantic technology around the Artefact-projects, in order to link these to the museum database as well as to support undergraduate archaeology teaching.

Identifying 'the case' and 'the niche' marks a turning point in the research process in the archaeology setting on several levels. First of all, the research process becomes more focussed. It is only really now, having established the artefact as the case that the team can study its 'nature, role and scope'. This also opens up the possibility for starting to answer the second research question: *'How do teachers and learners design, develop, describe and reconstruct cases, and how do these processes contribute to academic and professional outcomes?'* Secondly, now Ann alone takes the work forward in archaeology given the proliferation of the research settings and the need to spread the projects' resources wider. The implication of this is that any immediate

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[67] As a reminder, an Artefact-project - a piece of course work required of 2nd and 3rd year students as part of a number of courses – is a comprehensive, structured report on a chosen object, usually selected from the Museum, describing everything that is possible to find out about it. Writing reports like these are part of professional practice of archaeologists working either at a museum or on excavations. (Interview with Mary, 28th May 2009; Ann's diary entry 28th May 09; post-Matt meeting 9th Nov 2009)

tension arising from conflicting approaches no longer exists, while these might still be a point for discussion among the team members at team meetings etc. Thirdly, the technology aspect of the project comes to the fore. All research and development work carried out from here on is aimed at finding a way of translating the Artefact-project into a semantic tool.

The dual token is the main actant driving the research work forward from this point on. The token enacted as 'the case', the Artefact-project, is, of interest to the team materially, pedagogically and in terms of technology development. However, before it is possible to begin to study these at all, the team needs to gain access to those networks that enable this to happen. Crucially, they need to succeed in gathering and enrolling 'gate-keepers' (cf. Callon 1986b) to further resources and information on the Artefact-projects and successfully weave these into their project-related heterogeneous assemblage. Only after they have successfully done that can the team move onto studying the Artefact-project and translating it into a piece semantic technology.

The multifarious data for this chapter consists of Ann's research diary and email correspondence with the team and with the staff at or associated with archaeology; interviews with members of the archaeology setting and a computer programmer working with them; team-meeting recordings; my interviews with Ann; various course documents; examples of Artefact-projects; notes from seminars and meetings; photographs, posters and conference papers. While the mode for data analysis in Chapters 3 and 4 was to follow the token and the series of translations it went through, and to examine the heterogeneous participants involved in those translations, the focus now is initially on the process of gathering. I will be asking who and what are being gathered, how do these become, or fail to become, part of the network Ann is gathering

and what emerges as a result of these enrolments? By following Ann's work, we will be able to examine her multiple roles as a spokesperson for the various stances that she represents, as well as discuss the issue of enrolment (Callon 1986b, Callon et al., 1986a).

5.1 Enrolling allies

> Who is authorised to make whom talk? Who may ally herself with whom? Who speaks on whose behalf? The answers to these three questions define the space for the development of translation networks. –Michel Callon et al., 1986a, 280.

The process of moving onto technology development is as much about gaining access to people, resources and knowledge as it is about generating data and analysing it, something that Ann sets about doing. She is skilful in orchestrating this emerging assemblage, keeping the momentum going and her colleagues informed of possible developments, while managing work in a number of other research settings simultaneously. Following the meetings on the 9th November 2009 Ann is otherwise occupied with project duties in these other research settings until a week later when she picks up the archaeology setting again. She first talks to the computer programmer Gary, who has built the current museum archive Content Management System (CMS). He works for Matt and will be involved in the project that aims to link the databases of eight museums, envisaged to begin in April 2010. Their goal is to make the databases more adaptable by having multiple descriptions of objects added to them, including descriptions produced not only by qualified museum staff, but also non-experts and members of the public. This is a point worth noting: opening up the museum database to the wider public means that having students contributing to it would not be seen as a

problem in terms of the quality of that database. Gary is keen to work with the Ensemble-team '*to make links between the archaeology archive and the undergraduate teaching*'. He promises to arrange the team access to a live XML[68] feed of the archive, something Ann is going to talk to the technology developers about(Ann's research diary 17th Nov 2009; email from Gary to Ann 18th Nov 2009). Engaging Gary as an ally in Ann's Plan has been easy, because his interests align with those of his employer. Had Matt been opposed to being involved in Ann's Plan, it would not be possible or likely to enrol Gary's help either.

Having talked to Gary, Ann feels '*inspired to revisit*' Mary's interview from May in order to see how she described the student projects back then. In doing this, she is aiming to further ascertain the promisingness of the Plan. She transcribes parts of Mary's interview, and becomes encouraged from her findings that the Artefact-project '*has real potential for us to develop a way of integrating the new Archaeology Museum database with the Undergraduate student projects*' (Ann's research diary 17th Nov 2009). It is worth noting that the emphasis of engagement is with the museum archive rather than with the discipline at this stage. Ann emails Mary, whom she has not been in touch with since May, to ask for a meeting and to update her about the exciting developments that have taken place in the project (Email from Ann to Mary the Archivist 17th Nov 2009).

It is now that Ann 'officially' introduces Mary to the idea that Ensemble could help the archive to link the student projects into its database. Mary's reply is positive and she would be happy to meet up with Ann. Unfortunately the provisionally agreed meeting gets rescheduled because of Mary's tight timetable and they are unable to agree a time

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[68] XML stands for 'Extensible Markup Language', which is a set of rules for encoding documents in machine-readable form (Wikipedia, accessed 10th Aug 2011). This would mean the semantic tools could readily use the feed without conversion.

to meet before May 2010. Mary however gives pointers to further contacts regarding the teaching of Artefact–projects.

Before the Christmas break Will and Ann interview an archaeology lecturer called Clare. While Will has been interested in talking to her for reasons of his own, meeting her is important for the work in the archaeology setting in two respects. Apart from being pointed to two more lecturers who assign Artefact-projects in their classes in the coming term, the two come to understand something essential about their setting. Will expresses this realisation in an email to the team, writing that this interview had 'shifted' how he and Ann view archaeology as a setting. Will writes:

> '- - To date we have talked mainly with [Matt] and [Phil] (as key informants) but it seems now that their Museum location means that they are somewhat peripheral to the UG Teaching Program. To understand this we have been directed to two of the professors and two UG course coordinators.
>
> I can see the advantages of taking the Museum (and its objects and catalogues) as 'cases'. This lends itself to ANT work and to the organisation of cases in research. There is a link to aspects of the teaching here but I am not sure how central it is to the UG program. Students, we suspect, do not use the Museum as a central site for their studies. With hindsight I think I can see why we were directed to ceramics workshops - because they exemplify the role of the Museum as a teaching site.

I think what we need to do next is to get closer to the UG program. To talk to key people and to students and see if we can fill out the picture. [Archaeology] provides us with an excellent case of research-led teaching but it seems to be organisationally quite fractured - and getting a grip on the context is not easy!

(Email from Will to Jim, Ann, Tom and Sanna 18 Dec 2009)

The 'settings' engaged by Ensemble vary a lot. For instance in Marine Operations and Management the team are studying a single module, which is led by one lecturer, whom the team have managed to enrol as part of the project. In Dance there may be a couple of separate groups, but again there is a single, enthusiastic member of staff involved. In Plant Sciences a single course team is involved. Archaeology, in comparison, consists of various sister- and sub-disciplines, institutes and museums (c.f. interview with Mary 28th May 2009). Denoting 'archaeology' as a whole a setting becomes problematic, for reaching every tentacle of the networks constituting it would take more human-power and work than the team are able to enlist. In addition, while the contact person for archaeology has been enthusiastic and helpful, it now appears that the aims of the project and the networks the contact person has access to have not fully coincided, and the team have been directed to teaching settings possibly not quite central to the undergraduate curriculum. This is something the team now need to move closer to by talking to 'key people' and students. The diverse specialisation and fragmentation of the discipline combined with their particular entry point into it has led the team to engage with a much greater numbers of actors in different contexts compared to other settings. Had the team understood the disparate nature of archaeology earlier, they

might have approached it differently. Whatever the case, gaining this understanding at this stage helps the team to work in a more focussed way from now on.

By the end of December 2009 Ann is confident enough about the viability of her Plan. It becomes clearly formulated and stabilised, as enacted for instance in emails Ann sends out to request interviews with members of archaeology staff, and for permission to attend a meeting at the department, both of which are granted (e.g. email from Ann to Mark on the 18th Dec 2009; from Ann to the members of the Teaching Committee 18th Jan 2010).

> 'As the Museum redevelopment project gets underway we would like to be involved in helping to make links between the Museum online archives and the Undergraduate teaching in the Department of Archaeology. We can see potential in the use of semantic technologies to help make these links. In particular I can see potential in supporting the student Artefact-projects by integrating them with the museum archives. Would it be possible to meet with you to discuss these ideas and to get further insight into teaching and learning at the Department of Archaeology?" (e.g. email from Ann to Mark on the 18th Dec 2009; from Ann to the members of the Teaching Committee 18th Jan 2010)

The email enacts the Plan that weaves together the Museum redevelopment plan and Matt's projects, the Ensemble-project with its aims, the archaeology staff, the museum archive, the museum online archives, undergraduate teaching, Artefact-projects, archaeology students, the semantic technologies and the promise these offer in supporting archaeology teaching, learning as well as the archive and the museums

involved. Simultaneously, the concise piece of text enacts Ann and the team as gate-keepers and brokers for something that only they could offer, while in order to do that, they need access to archaeology teaching, where the members of staff stand as gate-keepers. Ann needs them to *want* to become enrolled into the project's network. Enrolment is a mutual process (Callon 1986b).

At this stage of the project there are two slightly different, yet related, types of translation happening in Ann's work. Firstly there is the gathering process, where Ann is enrolling allies to gain access to the Artefact-projects. In doing this she is building a heterogeneous assemblage which Callon refers to as a 'translation network', 'a compound reality in which inscriptions (and, in particular, statements), technical devices, and human actors (including researchers, technicians, industrialists, firms, charitable organisations and politicians) are brought together and interact with one another' (1986c, 273-274). The length and complexity of these networks vary. Ann is creating a 'compound reality' by translating the interests of the prospective participants/allies to align with those she represents (c.f. Callon 1986b, Latour 1987), by representing her Plan, the token, and the prospective solutions to it. Gaskell and Hepburn (1998, 66) explain that the actors 'actions and patterns of practice are changed as they see new possibilities with the token. Those associated with the token form a network through links with the token.' That Ann has succeeded in enrolling a number of necessary allies has happened not because they all want the same thing precisely, but because being involved in Ann's plan is something that will benefit them all in one way or another: for instance the team will finally be able to move onto technology development; Matt, in return for access to the online resources, will benefit from the technical expertise offered by Ensemble. Ann has, in other words, succeeded in catering for the actors' respective explicit interests, something Latour defines as 'what lies in-

between the actors and their goals, thus creating a tension that will make actors select only what, in their own eyes, helps them reach these goals amongst many possibilities' (Latour 1987, 108). I would see the gathering process consisting of series of smaller translations, each of which, when successful, link allies behind Ann's plan, thus enabling her to get closer to studying the 'case' in earnest. The enrolled allies see different opportunities with the token she represents. In doing this Ann is very much creating the reality that she is studying!

The second type of translation are the transformations of the token (c.f. Gaskell and Hepburn 1998, Latour 1987) through research and development practices. It is only once the network Ann is gathering becomes extensive and substantial enough that the translation of the Artefact-project-as-token into a semantic tool can even be attempted.

Stabilized case – elusive technology?

In January 2010 a Steering Committee meeting takes place[69]. At the June 2009 Steering Committee meeting the major translation and enactment of the team's work were the settings' posters, but for this meeting the progress of the work across settings has been translated into a huge Excel spreadsheet. The effort of creating this has been a focus of collaborative activity for the team during weeks preceding the meeting. This has involved creating relevant subject headings to reflect the work carried out and the aims of the project, gathering the necessary information on each setting, and enacting it very succinctly, in a sentence or two. The work on this has been driven by Jim, the PI, but the spreadsheet has been available to be worked on in the Virtual Research Environment. There are 16 column headings in total for each of the currently engaged

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[69] These are platforms for collating together and enacting the progress the team have made in the past six months' of the project's activities.

eight settings[70]. Apart from listing the 'personal details' (name, scope, level, location, co-investigator and researcher involved, key contacts etc.) for each of the settings, the columns include information about the following topics: 'Nature of Cases', 'Data collection', 'Design process', 'Data sources' and 'Potential technologies' and a 'One sentence description'. Apart from enacting and temporarily stabilising the work at the setting, the spreadsheet is also a projection and a plan for future research and development activities at the setting. The archaeology column[71] reads:

> *Nature of cases: Artefact, locality or narrative as case; artefacts may be focus for case which is illustrative, but not predefined. Artefact or locality as multiple 'case-of'*
>
> *Data collection: T1 Interview; Observation; Documentation*
>
> *Design process: Demonstrators; Iterative Redesign*
>
> *Data sources: Publications; Course materials; Web resources; Databases; Prior student work*
>
> *Potential technologies: Legacy Database; Database Conversion; Taxonomies and Ontologies; Web Services; Web Service Conversion; Digital Repository; Semantic Triplestore; Clients; Inferencing; Web Applications; Mobile Devices*
>
> *One sentence description: Extending the reach and impact of research, including student research*
>
> (Source: Settings spreadsheet, document 2, Steering Committee meeting 14th and 15th Jan 2010)

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[70] Academic Practice (City), Archaeology(UC), Dance (LJMU), Education (LJMU), Environmental Education (LJMU), Journalism (City), Marine Operations and Management (City), and Plant Sciences (UC).
[71] Column headings are underlined, listed here without the 'personal details'.

This is the state of affairs in archaeology as they stood in January 2010. The nature of cases is fairly settled - the definition in the spreadsheet is broader than simply the 'artefact being a case', reflecting better the earlier findings of cases as being multiple in archaeology. 'Design process' is meant to produce 'Demonstrators' followed by iterative redesign, with 'Data sources' for these being publications, course materials etc. as listed. However, I would draw the reader's attention to the section detailing the 'Potential technologies', which number up to 11 and vary in terms of nature. The listed technologies include those that could be used as data sources for a potential application (e.g. linking legacy database and web services into web applications), existing technologies developed by the Ensemble team that might be used for storing large datasets needed for an application (e.g. Digital Repository or Triplestore), ideas for types of technologies to be used in various contexts (e.g. fieldwork – Mobile devices) and types of metadata (taxonomies and ontologies) that might be possible to visualise through web applications like timelines or maps (cf. Email from Jim, 9th Aug 2011). Having this diversity of technologies, both in type and in function reflects firstly a shift in emphasis from studying cases to focussing on technology development, but also reveals that there is still a great uncertainty as to what type of technology the archaeology setting might give rise to - any type of technology is at this stage a possibility. This has now become the location for exploration and search for direction.

Being a spokesperson and the nature of enrolment

In January 2010 Ann attends the Teaching Committee Meeting for Archaeology[72], after which she has an opportunity to interview Mark, the chair of the committee and a specialist in Prehistoric Archaeology. This interview proves a breakthrough for the

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[72] The committee meeting notes are confidential (Ann's research diary, 22nd Jan 2011) but Ann reports that the significance of this meeting was gaining an insight into the organisation of teaching in archaeology (email from Ann to Will, Tom and Sanna, 25th Jan 2010).

work in archaeology in several respects. Mark is enthusiastic about Ann's suggested plan, and through him Ann gains access to resources, materials and contacts that will enable her to start studying the Artefact-project itself, moving thus towards technology development for real. Talking to Mark, Ann finds out how the Artefact–project is being taught, what is expected of the students creating these projects, what types of resources they use; Mark also arranges for her access to actual examples of Artefact-projects as well as to students who have completed these projects in the past. Furthermore, Mark recommends other lecturers who have the Artefact-project on their teaching plan that Ann might wish to talk to.

The interview begins by Ann asking about the teaching of the Artefact-project. Mark explains that the students are expected to be working on three components in doing these projects: describing the object using an appropriate language; drawing the object; and setting the object into a wider context by carrying out a piece of research using the Museum archives and the library. The objects need to be described in accordance with a set of standards the students have to learn and recognise. This goes also for drawing the artefacts, something for which Mark arranges practicals. The important things to convey in drawing are how the object was made, and what its shape and size are. How the third, the research component is done, depends on the available data – some objects may have rich museum records, while others merely state the location of the find. The resources used in constructing the reports are either from the museum or the library; web-resources are used to a lesser extent. In terms of their form, the reports include a narrative summary of the topic in the introduction, placing the project into a context. This narrative is usually returned to at the end of the chapter. The main section of research on the artefact forms the middle part of the report. The discussion will include

available interpretations of the object itself and how these might fit in with the site where it was found etc.

Ann directs the discussion to the issue of archiving the Artefact-projects. She suggests it is a shame that the hardcopies of the Artefact-projects just sit in cardboard boxes in the archive, without linking to the main archival database. Mark agrees this is so, saying it has been his plan for the past 10 years to sort that out but he has not found the time for it yet. This gives Ann an opportunity to tell him about her Plan, and how it could help with archiving. While linking word documents to the existing archive might be a good start, Ann explains, there are different ways of doing this. She pulls into the conversation Matt's museum re-development plan as an interesting example where the aim is to enable linking multiple narratives on a single museum object:

> *'-- and I know that each object obviously has its official classification but there seems to be a move towards having that opportunity for other interpretations linked in, but those interpretations would be tagged up with the source, so therefore you can make your own decisions about the validity of it. So if there was a concern about undergraduate students adding to this, I think if there was a way of labelling it as 'this is an undergraduate students work' then actually there shouldn't be too much of a problem with that.'* (Ann at interview with Mark, 22nd Jan 2010)

In the quoted excerpt Ann works to convince Mark about her suggestion. She quotes Matt whom Mark knows and works with – it is him who has talked about multiple narratives on a single object. In saying '*I know that each object obviously has its official classification- -*' Ann draws upon her previous experiences and enacts her existing knowledge of the practice of archaeology and of museums, and of their validity

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and reliability criteria, reassuring Mark that she knows what she is talking about. She pre-empts Mark's possible worry about the quality of the archive database, assuring him that while the interpretations would be student-constructed, there would be a way of labelling these as such, and not mixing them up with authoritative interpretations. Mark asks if they should need to get students' consent in order to link their work in the archive. This is something the students would have to know from the beginning, Ann explains, and in order to introduce this new practice, they would have to integrate it into the teaching plan. Given that in the research team's experience suggesting any changes into existing practices in this institutional context are often met with suspicion and reluctance, Ann hurries to express the benefit the future generations of students would gain from having the project work added to the museum's database, and pointing out what a shame it would be if the additional information was not feeding into the museum. Mark absolutely agrees with this, and Ann repeats that there are different ways this could be done, for instance through a separate application which takes the data from the archive as a live feed:

> *' - - and we could add the student information in a separate site so it doesn't feedback but it maintains itself linked with the official archive database. And then we could probably manipulate it more to suit the undergraduate project itself possibly. But I mean there are lots of options. And it would be really interesting for me just to find more about how the project is supervised why students decide on different dissertation topics.'* (Ann, interview with Mark, 22nd Jan 2010)

During the interview Ann shifts positions in her role as a spokesperson (Callon 1986b). In carrying out the interview she is first and foremost a spokesperson for the research

project. However, here she is also more specifically speaking for her Plan, the ephemeral niche for technology development. In doing so she also becomes a spokesperson for the archive, the 'forgotten' hardcopies of the Artefact-project, as well as future students who would benefit from accessing these online. She moves from being a spokesperson for her Plan to speaking for the technology development in the setting: '- -*and then *we* [the team] could add the student information in a separate [database] - -'.* Speaking for technology development is a position Ann would not have been able to assume a year earlier. During the year her understanding of the technologies has increased, which has allowed her to gain autonomy in discussing these confidently with her research participants. This is reflected in her actions as well as in her research diary[73]. At the end of the quote we see Ann re-directing the discussion back to the Artefact-project, having justified why it is important for her to find out how it is being supervised, and how the students decide on different dissertation topics. This prompts Mark to explain that usually it is him who selects the objects students will study in his course. He explains that he chooses collections of flints – boxed according to the site they were found at – from the archive and lets students make their choice from that. The supervision is carried out by the lecturers. It is explained to students what is involved in the project, and they are shown in practicals how to go about studying the objects (interview with Mark, 22nd Jan 2010).

Some of the students will also select objects themselves from the museum archive through Mary. As Mark talks, Ann remembers her interview in December with Clare, who teaches Medieval Archaeology, and who had explained how an Artefact-project might be written about a building or an archway, 'objects' not often found in a museum

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[73] To further demonstrate this development, Ann is, in fact, giving an invited lecture on case based learning and the semantic web later on that week at her university.

archive. Ann realises that there are in fact different types of Artefact-projects depending on the topic of the lecture, and she asks about the range of topics Artefact–projects might be written on, and whether the nature of the project changes accordingly. Mark suggests this would vary from *'paper to paper in terms of what projects they [the students] have been doing'*. Each option should have a written description on it, something Ann could find in a course syllabus. Mark will ask the departmental secretary to email to her a link to that, adding:

> *'- -yeah, we just need to see how much similarity or difference there is in terms of how these things are set up.'* (Mark, in interview 22nd Jan 2010)

How can we know if someone has become enrolled into a network? This is most likely a gradual and fickle process, just as holding a network together takes a lot of work and energy (Latour 2005). Throughout this interview Ann has been working to persuade Mark to want to enrol and be part of her network, and to become enrolled into the teaching and learning one that he represents in return. She has done this through having Mark talk about – represent – the Artefact-projects and their pedagogy, how these are taught, as well as through referring to people she has engaged with in Mark's immediate network. She has gauged Mark's interest in the Plan, in having the Artefact-projects linked to the museum database, to which his response has been positive. In effect, what Ann has been doing is gathering, weaving, a prospective network, prospective state of events – 'if this and this and this came together, then...' (cf. heterogeneous engineering, Law 1986). It is not enough simply to agree that the idea is good; what Mark, as the gate keeper and the spokesperson for the teaching of Artefact-projects, has to do is to see the potential – the promisingness (Scardamalia 1993) - of this vision, and want to be part of it. Only this would enable the Artefact-projects,

students, the teaching and learning practices etc to be enrolled into Ann's Plan, and the project network, and vice versa. His interests have to align with those that Ann represents. The plan that Ann had proposed was something Mark had thought of himself, but had not got round to doing. This is a good start. At this stage of the interview we find that Mark is already beginning to talk of 'us', counting himself into those who need to know about how much variety there is in the different types of Artefact-projects. He is eager to help Ann by providing access to further resources through the secretary, and later on, he agrees to recommend a number of students and lecturers Ann could get in touch with to interview them. Does this mean that Mark has become or is becoming enrolled in the network Ann speaks for? What does it mean for networks if enrolment is taken as a black and white matter: either one is part of a network or one is not? Contrast that with seeing enrolment in terms of various degrees of being enrolled[74]. For instance, Ann could be conceptualised as a 'fully-enrolled-five-gold-star-participant' of the Ensemble network, while Mia, who stood in to take observation notes, could be a temporary participant, in which case Mark could be seen to be a prospective participant. He may or may not become 'fully' enrolled to the extent that for instance Ann is, or Mia was, but at the moment he seems amenable to the idea. According to Callon et al., (1986a, 279) 'the creation and development of networks depend on a set of conditions that either facilitate or hinder the deployment of translations'. In attempting to translate Mark's interests to align with those that Ann represents, speaking for a need that he already has identified himself is a condition that facilitates the process; conditions that might hinder the enrolment might be his thorough involvement in his existing networks of work, family, institutional duties etc. which would compete with any time and resources he is able to devote to this network.

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[74] Cf. Lave and Wenger (1991) *Communities of Practice and 'legitimate peripheral participation'*.

With this view of enrolment, I would argue that networks are fluid and dynamic (cf. deLaet and Mol 2000), they emerge, evolve, mutate or dissolve and vanish – and they could not change and evolve if the nature of 'enrolment' was an either-or issue, it has to be more complex than that.

Whether enrolled or not, Mark definitely takes the stance of an ally. Ann is keen to talk to as many people as possible, something Mark promises to help her with, listing the names of five other lecturers Ann could contact, and promising to arrange for Ann to see some examples of actual Artefact-projects as well as recommend students talk to her. Mark turns out to be an important gate-keeper, without whose support and help it would take Ann and the team much longer to gain access to further contacts, resources and information which are relevant for the team to carry out their work. Furthermore, Mark is able, as well as happy, to act as a spokesperson for the team in his discipline (Interview with Mark 22nd Jan 2010).

5.2 Studying the Artefact-project

The interview with Mark gives the team access to further contacts at the setting, as well as resources and materials relating to the Artefact-project, which enables the team to start disassembling and studying the Artefact-projects pedagogically, materially and with technology development in mind. By 'disassembling' I mean deconstructing the Artefact-project to its constituent parts through research and analysis, in order to again assemble it to be translated into a semantic tool. Concurrently with the work in archaeology there are three new research settings being engaged at the new institution, Liverpool John Moores University, a lot of travelling between the different settings and coping with work that is at various stages of advancement across the board. Ann has to accommodate the work in archaeology in among all the other tasks she is involved in.

This means that the work concentrates in clusters of activity, followed by longer periods of lull, when Ann is engaged elsewhere.

A couple of weeks after interviewing Mark, in early February 2010, Ann takes stock of the progress of work in archaeology. She examines the course documentation displayed on the archaeology departmental website to gauge which courses have the Artefact-project as part of their option papers. She also plans the next steps for the research. She does this alone, for now Tom is focussing on other settings; Will is involved, but more peripherally through discussions and by commenting on Ann's online diary. The main source of data for this section is Ann's research diary.

Ann reports having discovered the following documents of interest on the departmental website:

- The Archaeology Undergraduate handbook
- Lecture Lists for part II option papers that say they have artefact projects as 20% of their assessment:
- European Prehistory
  - Mesopotamian Archaeology
  - Archaeology of Anglo-Saxon England
  - Ancient South American Archaeology (Ann's research diary, 4th Feb 2010)

The highly specialized and fractured nature of archaeology as a setting emerges again. Pouring over the documentation Ann becomes frustrated with how complex the course structure is. She discovers, for instance, that the second year students have up to 25 optional papers to choose from and that the Artefact-project is a method of assessment

only for a small number of Part II option papers, forming just a fifth of the whole grade. The other courses are assessed either by a practical assessment with a laboratory report, or by a written exam. This to Ann indicates that the'20% element of the different options has the flexibility to be designed to suit the skills used in this area (they are almost like sub-disciplines). It could be an introduction to research skills in each of these sub-disciplines' *(Ann's research diary, 4th Feb 2010)*. In other words, the Artefact-project as a means of assignment offers room for manoeuvre within the curriculum to suit the specialised options. This would support the emerging understanding Ann has at this stage of the variety of types of topics the Artefact-projects are written about, and the challenge this might propose for technology development. Furthermore, the Artefact-projects do not appear as a particularly central means of assessment (Ann's research diary, 4th Feb 2010).

Given the complexity of the curriculum, the early specialization of the students on areas/topics and what that implies in terms of teaching and assessment, Ann expresses surprise that the course documentation is not more comprehensive and wonders if she might be missing something[75]. Further, teaching is research based, which means that most 'optional papers' are taught by a single academic. Acknowledging how this presents a challenge to her as an external researcher, she states: 'This setting rejects generalisation at every turn' *(Ann's research diary, 4th Feb 2010),* adding that every academic teaching an option paper will offer a view of archaeology teaching and learning that is based on that specialist experience, and that only a few lecturers might have a wider overview of the discipline. Ann translates her reflective session into the following plan for action in archaeology:

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[75] She discovers later that she has access to all relevant documents.

- Interview each of the lecturers with option papers that claim to assess using artefact projects. Try to develop a semi-structured list of questions for these interviews to allow for comparison of answers to the questions for each different topic.

- Talk to students! How do they make choices about which papers to take? What do they think the artefact projects are all about? Do they use the museum? How do they research for the projects?' (Ann's research diary, 4th Feb 2010)

In the session described above Ann has been reflecting upon action that she has taken since the artefact-as-case was identified together with a niche for technology development, to decide what to do next. This is an exercise of data-analysis like the team have done collaboratively several times during the course of the project. Now however Ann is engaged in a similar translation on her own. She is evaluating the course of action in light of what she has found out to date and where she envisages the work should be going. This is an interesting shift in research practices engaged by the team: while the collaborative researcher meetings following a period of data-gathering/generation were the main vehicle for taking the work forward in the beginning, we now have internal reflections on the process by one person. While this activity per se is solitary, it opens up new ways of engaging with the reflection process by the other researchers. In analysing the data-meetings the main source of data were recorded discussions, where the respective researcher hinterlands became enacted into practice. Now the main sources of information, and thus of data, is Ann's research diary, available to the rest of the team online. This means that the potential tension between approaches, interpretations and decisions do not surface, or at least not immediately. There is dialogue with colleagues, but this happens with a slight delay,

e.g. in 'margin discussions' through the commenting function of the Wiki-tool, where the diary is kept in the VRE, or sometimes via email. The role of online technologies in supporting and enabling collaboration has increased since the project expanded to encompass another lead institution, enabling the now more geographically distributed team to still work together, or at least be informed of each others' progress. Work at the settings is also discussed at the monthly team meetings, which serve as another platform for keeping the research team in the loop and offering everyone a chance to participate in the way the research is being carried out in the settings. The issues may also be discussed privately, but these discussions are not documented, and thus will not feed into the analysis.

There are other changes to Ann's research practice as well: Ann puts her increased understanding and skills of semantic technologies to use in order to make sense of the complex selection of courses by creating a small Exhibit tool based on the 25 courses on offer in order to see more easily which of these have an Artefact-project as an option and which do not (Ann's research diary, linked on 5th Mar 2010):

Archaeology and Anthropology Projects

25 Items

Option	Part	Project		Link	Student Interview	Lecturer Interview	Project Example
A05 The archaeology of early human development	IIA and IIB	No			No	No	No
A08 European Prehistory Foundation course	IIA and IIB	Yes			No	Yes	Yes
A09 Special Topics in European Prehistory	IIA and IIB	No			No	Yes	No
A13 Aegean Prehistory	IIA and IIB	No			No	No	No
A14 The art and archaeology of Roman Britain	IIA and IIB	No			No	No	No

Image 5.1. Archaeology and Anthropology Projects exhibit, linked to Ann's research diary 5th Mar 2010. (The term 'Anthropology' has been added back to the title of the department used by the team, after feedback from the lecturers in May 2009. Anthropology does not feature in the work of the team.)

This semantic Exhibit tool (image 5.1.) allows Ann to search and sort the course options according to the lecturer giving the course and whether or not the course option includes an Artefact-project. To see which courses have an Artefact-project, Ann simply ticks the 'yes' option in the faceted search box for 'Projects' (image 5.2.):

Archaeology and Anthropology Projects

5 Items filtered from 25 originally (Reset All Filters)

Option	Part	Project		Student Interview	Lecturer Interview	Project Example
A08 European Prehistory Foundation course	IIA and IIB	Yes		No	Yes	Yes
A24 Mesopotamian Archaeology II: Territorial States and Empires	IIA and IIB	Yes		No	No	No
A25 Europe in the 1st Millennium A.D. I: Anglo-Saxon Archaeology	IIA and IIB	Yes		No	Yes	Yes
A28 The archaeology of medieval Britain	IIA and IIB	Yes		No	Yes	Yes
A33 Ancient South America	IIA and IIB	Yes		Yes	No	"Classic Zapotec Funerary Urn - 'A.1908.13'"

Image 5.2. Archaeology and Anthropology Projects exhibit, faceted search showing the course options that include an Artefact-project. Linked to Ann's research diary 5th Mar 2010.

During the first year Ann actively embraced learning about semantic technologies, the skills and understanding she now enacts by creating an Exhibit tool for making sense of the confusing data from the setting. Without the mutual extension of practices and skills of the two strands of the project this would be a less likely situation (see discussion on the Semantic Spider). Ann updates the Exhibit as her work progresses, for instance, by inserting columns for whether a student or a lecturer from a given course option has been interviewed, and titles of any Artefact-project examples that she has obtained copies of[76] (Ann's research diary 8th Mar 2010). Effectively the 'confusing' data has been translated into a tool that helps Ann organise and keep tabs on the progress of her research at the setting, as well as keep the other team members informed[77].

Artefact-project and students

As a result of her review session, Ann decided she needs to interview all lecturers teaching Artefact-projects in order to compare the pedagogical differences and similarities between the different types of Artefact-projects. She also needs to talk to students about the experience and practice of writing the reports. She is able to resume work at the setting a month later in early March 2010 by reviewing instructions for the 'Interpretative assignment' Mark had emailed her for his course on European Prehistory. The 'Interpretive assignment' is what the team have been calling the 'Artefact-project', a term I will continue to use in this thesis. In addition to Mark's explanation of teaching the Artefact-project during the interview, Ann now has the

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[76] These 'changes' are evident in the current screen shot of the Exhibit tool, but they are later additions.
[77] Creating the Exhibit is an interesting series of translations: Ann has taken the course documentation found on the archaeology department website, extracted the necessary information and organised it in a Google-spreadsheet under suitable column headings, like 'option' or 'project' etc. Using a Google-spreadsheet, rather than Excel, means that the data already is in a machine readable format (XML). With Excel the data has to be converted into a suitable format first using a conversion engine, like JSON. The data from the Google-spreadsheet is fed directly into the Exhibit tool through a URL generated by the tool. This means that the data updated in the spreadsheet will immediately show up in the Exhibit, too. Adding the faceted search is useful for Ann's purposes of organising and searching the data easily.

same information enacted as an official course document, which contains written guidelines for the students about doing the Artefact-project. The objectives and assessment of the practical project are the three points Mark explained in his interview: description of an object, drawing of an object, and comparative background research on it (European Prehistory Course Structure 2010 document). The guide-lines for the students are in Appendix 7.

Will had taken up Mark's interview transcript setting out to 'extract Mark's pedagogic position' for his (Mark's) course, writing a document that summarises his (Will's) analysis (Email Will to Ann, 19th Feb 2010). This is reviewed here in relation to the 'official' course documentation created by Mark for the Artefact-project Option Paper in Prehistory of Europe. These 'enactments' of the curriculum help the team to understand the pedagogy of the Artefact-project, and how the students are instructed to write these. An extract from Will's analysis:

> **Summarising [Mark] on teaching description and interpretation.**
>
> The basic data that Archaeologists work with is 'stuff that has come out of the ground', material from a site that has then been 'counted, weighed, described, tasted and measured'.
>
> [Mark] says, *'I want students to get experience in what is involved in that process. That is taking a set of objects and turning it into descriptions and measurements.'*
>
> This involves students initially in 'deciding what data actually are', and understanding how Archaeologists define and describe 'the stuff that comes out of the ground'. Next they have to use the data to 'support a particular interpretation'. [Mark] says this might sound like a standard

process but that having the resources of the Museum to hand means that students can work on material that has not been extensively studied before – ' they are learning something new that they didn't know before, and in all likelihood they are learning something new that nobody knew before'. This is important, [Mark] says, because it means that this is not just an exercise in description. It has *'both real excitement as well as risk'.'* - - (Will's analysis of Mark's interview, 29th Feb 2010)

According to Will's analysis, the pedagogical purpose of doing an Artefact-project is to offer students an opportunity try out the process of carrying out archaeological research, with the professional practices and standards that are involved, including describing objects both in writing and in drawing, and to a lesser extent, interpreting these in light of available data. This process is very much learning by doing, and Mark hopes the students experience the challenges of the process, its routine nature and the joy of discovery. The report has to be written in a form of a narrative summary, important for the nature of the exercise (Will's analysis of Mark's interview, 29th Feb 2010). The pedagogical purpose and aims of the Artefact-project, as well as its narrative format have to be taken into account in technology development, and may pose challenges to it.

During the spring Ann tries (in vain) to get in touch with a number of lecturers who teach Artefact-projects as part of their course in order to compare instructions given and the teaching of it, but only one of the lecturers replies to her request. Katy is an expert in Anglo-Saxon Archaeology and her account of teaching the Artefact-project largely echoes Mark's, although her students select their objects more independently than in Mark's course, and she does not emphasize the importance of drawing quite as much as

Mark. From this interview Ann learns also that the Artefact-project had been introduced as an '*alternative to practical exams that involved identification of objects*'. Like Mark, Katy is amenable to the idea of having the Artefact-projects linked to the museum's database. She presents Ann with several examples of Artefact-projects, pointing out 'good ones' and 'bad ones', lending her six of them[78] (Interview with Katy, 7th May 2010; Ann's research diary, 7th May 2010).

Ann has more luck engaging students for interviews. Mark had recommended a number of students to contact, three of whom agree to be interviewed at the beginning of March (Ann's research diary, 5th Mar 2010). In preparation, Ann creates a semi-structured interview plan:

ARCHAEOLOGY STUDENT ARTEFACT PROJECT INITIAL INTERVIEW PLAN

- What project did you do in your 2nd year?
- How did you choose the topic?
  o What kind of support did you get in choosing a topic?
- Where did you get the objects from?
  o Were you able to handle the objects? Is that important?
- How did you find out information about the objects?
  o Did you use the Museum archives at all?
  o Did you use the internet?
  o What kind of information was it?
- Was there anything you couldn't find out?
- What were the main elements of the project write up?
  o How did you represent the objects?
  o How much interpretation did you do?
- Was it a useful exercise for you?
- How do you think it relates to academic Archaeological practices?

(linked to Ann's research diary 5th Mar 2010.)

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[78] Ann later reports in her diary having 'anonymised', photocopied and converted into Pdf-files three of these, with the selection criteria being how easy they were to photocopy. The objects the reports were written about were a gilt Frankish buckle, three disc brooches found in Anglo Scandinavian York, and an Anglo-Saxon grave assemblage discovered in Cambridge (The Ensemble-team VRE, Resources folder, accessed 29th Aug 2011).

The interview plan is an enactment of Ann's research practice, and centres round the Artefact-project, its construction and students experiences of it. Ann wants to know how the students chose the topic and where the objects and the information relating to them were obtained from, and how the report was written. Asking about the practice of writing the report, Ann gets closer to deconstructing the actual reports and is gauging what types of data-sources and data-types the students have used for the reports. These are questions relevant for the technology development.

The interviews with the students take place on the 8th and 9th of March 2010 (Interview with student A, 8th Mar 2010; Interviews with students B and C, 9th Mar 2010), and are discussed at length alongside the progress at the archaeology setting more generally at the April 2010 team meeting[79]. This works as reflection upon action and by way of assessing where the work in archaeology should go next. Ann, as spokesperson for the archaeology setting, starts by relating what she has found out through interviewing a number of students and lecturers: that there is a great diversity in terms of topics the Artefact-projects are being taught within (from paleo-archaeology to medieval, for instance), of how students are being supervised, the range of objects these projects are written about and what the lecturers hope the students will learn through writing the reports. In light of this it is surprising that the final outcomes, the actual Artefact-project reports, end up being very similar in form across the board. One reason for this, Ann explains, is that the objects are often selected from a '*fairly well organised but very static archive of museum artefacts*'. Secondly, creating the Artefact-project is seen very much as a process that the students are guided through: while some students pick the objects themselves, most are supported in the selection of these. Further, the

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[79] The March team meeting had concentrated more on a Participatory Design vs Participatory Research debate, discussed in more detail in the next chapter.

students are not expected to create the data associated with the object themselves, but they are directed to look for that in journal articles, library books and other sources associated with the object, such as the related time-period, the area, or the person who found the object.

There is very little steerage towards interpreting or making your own conclusions about the object: '*The report is *not* about telling a narrative about the object*[80]*, it is systematically saying there is this data and this data and this data and it all relates to this object*' (Ann, team meeting, April 2010). The students' own input and influences on the project work would in many cases come from representing the objects in drawing. Basically the objects used as cases are authentic, and the activity that the students engage in is seen very much as an authentic professional research activity a professional archaeologist would do, Ann concludes. Lea asks if the Artefact-project could be an assemblage, but Ann sees this rather as a process of '*assemblage*': some of these objects the students study have never been studied – '*nobody has ever assembled the information associated with it before*' (Ann, team meeting, April 2010). Lea suggests this might thus be a new assemblage and Ann offers a term '*case-record around that object*': all of the information already is there, but it has '*never been pulled together in a full explanation associated with a single object*' (Ann and Lea, team meeting, April 2010). This is the latest articulation of the nature of case in archaeology. The team members discuss how the process reminds them of the practice of '*writing those little pamphlets you can buy in county museum for £1.50*' and how those are not very interpretive. Hence linking the Artefact-project to the case-record idea is '*really quite interesting*' Jim points out: '*It's a structured, not highly interpreted, not even*

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[80] This is interesting thing to note at this stage of the project – the Artefact-project is not seen as a narrative of the object. Yet, a crucial insight regarding its structure later on is to see it as 'narrative'. This also shows the changing understandings the researchers have of the 'object as a case' in archaeology.

highly academic... bringing together an assembly of stuff that gets produced by county archives' (Jim, team meeting, April 2010).

In studying the Artefact-project Ann has discovered both diversity but also unity – the topics and processes of teaching and creating the Artefact-project vary, but the outcomes are similar. With this in mind, the next steps will be to start thinking about the possibilities for technology development. While the Plan is to introduce a technology that would link the Artefact-projects to the Museum database, at this stage the team are not clear how best to do this in practice. The team still needs to understand more about the pedagogy of the Artefact-project, how these have been written, what types of resources are used, and how the future piece of technology could also support the process of creating Artefact-projects. The envisaged semantic application has to work with the structure of the museum's database including the permissions and practices of dealing with and contributing to the museum data. It also has to align with the pedagogy and the learning objectives of the Artefact-project, the practical process of creating these and the types of resources used in the process. Finally, what emerges depends also on the affordances of available technology and the know-how of the team members. These define the space within which the technology can take shape.

The team move on to discuss various options in which the technology development could be taken forward and what the implications might be. One suggestion is a tool that would help the students locate information more easily, while another would involve the archaeology students using the MIT Exhibit to actually construct their Artefact-projects online. The students would still gather the information from publications, images and drawings, which would mean acting like a professional archaeologist, but they would upload the information onto the web, Jim explains. The

academic practice of archaeology is changing with the incorporation of more and more digital technologies, why should the students not have the opportunity to use it too? Going with this option would depend on the degree to which the staff in archaeology are willing to take a risk, as well as the number of students who would actually want to do the Artefact-project as a web-based exercise (Jim, team meeting, April 2010). Ann thinks she could find students willing to do this, but most lecturers might be too traditional for that, with the exception of perhaps a lecturer called Jack who deals with technologies anyway. Ann agrees to contact him to see if he would be interested in trying this out with a small cohort of students. Assessment of a web-based project would not differ much from how these projects currently are evaluated, Ann envisages, given the individual lecturers have a lot of say over how these projects are carried out and evaluated. Having said that, doing a web-based project would considerably change the way the Artefact-projects are currently done, Ann points out.

In light of what has been just discussed, Ann poses a question relating to the technology development:

> *'My question here is - if we were going to make it easier for them to *find* the information, would they be able to go further into the interpretation, and linking to theories that come up in their lectures? Would that be... something that lecturers would see as good? Or would that just change the nature of the project beyond what it was meant to be?'* (Ann, team meeting, April 2010)

This is a relevant question. The students are expected to learn something about the authentic practice of working as an Archaeologist through creating a report on an artefact. How would the introduction of a piece of semantic technology into the process

change the existing teaching and learning practice? This would naturally depend on the nature and purpose of the technology. While the general aim of the project is to review and hopefully enhance the pedagogic practices of the settings by engaging participants in research into technology development, to what extent is change beneficial, or even possible in the institutional and disciplinary context of the archaeology setting? This is an added aspect to take into account in the development of the future technology. A vigorous brainstorming session about how to do this follows, various ideas are suggested, assessed and dropped or picked up. These include for instance using consultancy money for support from MIT, 'resuscitating' an 'easy-to-edit' Exhibit tool PotLuck and turning that into a '*a citation manager type of thing*' that would enable the students to draw in quotations found in books. Various ideas are floated excitedly in the discussion but Ann reminds the team that they have to remain realistic, with a view of the project coming to an end they do not want to introduce something into the archaeology curriculum that is not sustainable in the future. While the suggested ideas offer interesting opportunities to see how the semantic technologies would cope with unstructured data, Ann takes the stance of spokesperson for the project duties, urging the team also to keep in mind their commitment of maintaining the links with the museum archive (Jim, Ann, Lea and Mia, team meeting, April 2010).

Jim suggests it would be a useful exercise to take one of the Artefact-projects, dismantle it to see where '*all the bits came from*' and then put it together as an Exhibit[81], which could be shown to the staff and students in archaeology as a demonstrator. The Artefact-project should be carefully selected to have '*bits and pieces on it*', in order to afford interactivity as a demonstrator, as there is '*no point in producing something that is effectively a static web page*'. Doing this should not be

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[81] The Exhibit has been used as the template for technology development at most settings so far.

massively complicated, Jim envisages, while the unstructured data might make it a bit more challenging. Ann reminds them that the students were keen to come back for a workshop, and suggests that they talk to them in order to find out how best to represent the Artefact-project digitally. Jim agrees, saying that the team also need to understand how difficult the process of writing the Artefact-project actually is in order to think of a technology to support that. In addition, there is a missing step in the process Jim notes: once the students have collated all the data together, they go through a process of selection, of deciding what goes into their report and what is left out. While there is diversity in terms of selection of objects and topics for the Artefact-project, there appears to be some kind of 'funnelling' in the process, given that the projects end up looking similar. '*So no matter what, various things are obviously left behind, and they're trying to pluck a kind of similarity of output out of all of these different contexts',* Jim says. The work in archaeology seems to be moving on swiftly, the topic has been discussed sufficiently, and Jim directs the discussion onto other topics (Ann and Jim, team meeting, April 2010).

Here it useful to introduce the concept of 'tuning' suggested by Pickering[82] (1995, 22), which denotes the continuing socio-material negotiations taking place within the scientific goal-oriented, goal-revising practices. Pickering calls this the 'dance of agency' or 'the mangle of practice', or a *dialectic of resistance and accommodation* between human intentionality and material agency[83]. The goal of the team in the

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[82] Pickering's work aligns with the posthumanist and performative turns in social thought (Pickering 1995). Pickering suggests a real-time understanding of scientific practice, something that is an aim in this study, which is to be contrasted with 'retrospective approaches that look backward from some terminus of cultural extension and explain practice in terms of the substance of that terminus'. (Pickering 1995, 10) Pickering's work is being introduced here, because I only came across it when dealing with this part of the data.

[83] Pickering draws parallels between his work and ANT, but has criticised the ANT notion of principle of symmetry for being static and too simplistic. His criticism focuses on early-ANT writings, which, as I see it, have moved on or clarified their position in relation to the principle discussed in Chapter 1, hence

archaeology setting is to develop a semantic application that would allow student Artefact-projects to be linked to the museum database, and which would also support the process of creating these projects. The plan is developing in the push and pull and the dialectic of resistance and accommodation of the disciplinary and institutional assemblages; the affordances of the technology; the learning objectives and pedagogy of the Artefact-project; the physical characteristics of the Artefact-project and the variety of objects these are being written about; the know-how of the team; available data; time and resource constraints; the willingness of the research participants to co-operate with the team etc. When material agency, as well as social agency I would add, resists human intentions, people are forced to revise their plans or course of intended action to accommodate the opposition.

> Scientists do not simply fix their goals once and for all and stick to them, come what may. In the struggles with material agency that I call tuning, plans and goals too are at stake and liable to revision. And thus the intentional character of human agency has a further aspect of temporal emergence, being reconfigured itself in the real time or practice, as well as a further aspect of intertwining with material agency, being reciprocally redefined with the contours of material agency in tuning. (Pickering 1995, 22)

To Pickering the world is filled with agency, be it material or social, and these are temporally emergent and intertwined, for it is impossible to know in advance 'what precise collection of parts will constitute a working machine, nor do we have any idea of what its precise powers will be' (Pickering 1995, 24-25). As the work of the team

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clearing out the issue Pickering pointed to, and in fact aligning better with the dialectic position taken by Pickering.

progresses we will see that it is not only the material agency that resists or assists the emergence of the semantic technology but that also the social agencies which play an important part in that process. Change happens over time, and lacks the 'comforting causality of traditional physics or engineering or sociology' (ibid).

Semantic technology and the affordances of the museum database

Following the decisions and suggestions raised at the April 2010 data-meeting, Ann turns her attention to the museum database, which the team think will form the primary database for the future semantic technology. To learn more about it, Ann has arranged to interview Gary, the computer technician working with Matt on the museums' project. In preparation Ann familiarises herself with the museum website and the museum's archive principles. Asking '*how can we work with this system*?' she suggests the following options:

1. Take the data and make a totally separate system;
2. Relate objects in the catalogue to external resources that we develop;
3. Allow students editing rights under their own names and work with the system as it is. (Ann's entry in the Tech Dev Wiki, 4th May 2010)

Ann and Gary meet on the 5th May 2010. The meeting is quite long, but as a result of it Ann and Gary are able to identify the best way for the project to access the museum's data base in order to develop a semantic technology around the Artefact-projects. Gary has helped to develop the museum's Content Management System, and is able to explain how it can be accessed by students and archivists alike. The different user groups are given tiered access, which means that while students and other external users would be able to find out if an object exists at the museum, only the archivist would be able to see its exact location in the database. The Ensemble-team will be given access to the database through a 'get-feed', which would 'push' the data from the

database to an external online space for students' work to be incorporated into, rather than linking these directly to the database itself. The team would be given a user account as 'an XML[84]-client' in the system. Doing a search in the Content Management System would retrieve the necessary data in structured XML-format, and store this in the client's XML-account. The user would be given a URL with a client username and passkey to access that data, and this would also allow the user to perform simple searches on that data[85] (Interview with Gary, 5th May 2010; Ann's entry in TechDev wiki 5th May 2010).

The project now has permission and means to access the Museum database through a get-request, which they are free to update as often as they need to. The available data is already in machine readable format, in XML, which is required by the semantic Exhibit tools to work. Ann remarks that the database does not appear to be added to all that often so updating would not be a problem. Tiered user access might prove a challenge to technology development because it will grant outsiders, which the Ensemble-team members and other prospective users of the future technology are, only a limited access to the information in the database. Having found out about the structure and access of the museum database Ann is able to form and articulate a clearer plan of how to proceed with creating a piece of semantic technology. Her preferred method would be to use the data and produce an *external application* for students, rather than trying to 'mess with the Content Management System itself, which is very controlled and inflexible' (Ann's entry in TechDev wiki 5th May 2010). Should the applications be 'associated with an object in the CMS' the team could link a URL to that through a

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[84] Extensible Mark-up Language
[85] The alternative to this would be a 'data-pushing' exercise, which is a very new system. The advantage of this to a data feed would be that the dataset they have access to would automatically update as the museum database is updated. In the older system the client has to perform a new search periodically to get up to date data.

relations tag, which Gary had shown her during the interview. In this way the object and the related data could be found by curators who have wider access rights to data in the CMS (Ann's entry in TechDev wiki 5th May 2010; Interview with Gary, 5th May 2010). Creating a semantic application in this way leaves the team two options, Ann writes:

> 1. 'Make an application that includes all the data in the database and enables 'project' style reports to be made by students linking objects to references and images etc.
> 2. Help students to represent their artefact projects as semantic applications similar to those made by UROP students[86] and link the URLs of those applications into the [Museum] CMS.' (Ann's entry in TechDev wiki 5th May 2010)

The first option would mean retaining the report-like structure for the project, and linking that to various available data in the database. The second option would entail the students creating a self-standing semantic application from their Artefact-project, and then linking *that* to the database. These two options form the basis of the three planned prototypes Ann and Jim create during a brainstorming session in early July 2010.

With these two options, Ann is left with two questions, which require engagement with lecturers and technologists:

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[86] A Pilot-project preceding Ensemble had a number of Undergraduate Research Opportunity (UROP) students working with Exhibit tools, creating small applications for a number of disciplines, e.g. the Plant Distribution Timeline.

- 'What would be the pedagogical advantages and disadvantages of each of these?

- Would we be drawing on the full potential of the 'semantic web'? Or is this a linked data exercise? Does it matter?' (Ann's entry in TechDev wiki 5th May 2010)

A few days later Ann emails Gary to ask for the get-feed and a bit more information on how it works for the purposes of technology developers, and in order for the team to look at it in the forthcoming team meeting (Email from Ann to Gary 10th May 2010). Gary emails the team as an example a subset of 42 records relating to Medieval Archaeology, explaining that granting access to the entire collection of 2.5 million records would be problematic. The museum currently issues XML access based on what data the client needs (Email from Gary to Ann, 10th May 2010).

Mapping the resources

As suggested in the April team meeting, Ann decides to dismantle one example of an Artefact-project and map out all of the sources related to that. Katy, the archaeology lecturer Ann interviewed on the 7th May, had leant her copies of several Artefact-projects, one of which Ann now starts working on. This Artefact-project was about a hoard of coins found using a metal detector in Norfolk. Ann translates the paper copy of the 25 pages long report into a digital map using a MindMap software (see Appendix 8). She first maps out the sources, which include different types of maps, figures, references to numismatic books and journals, local history sources, museum records, images and data from the person who had made the find. Ann then searches online to determine the availability of each source used, marking those accessible with blue hyperlinks, and data referred to online, but not accessible, with green. The mapping

exercise begins with the 'object', the hoard of coins found in Norfolk, in the centre, and the structure of the map follows that of the report. The first tier of branches consist of data types, listed from the top and going clock-wise, as: comparative studies of patterns of coins (4 sources), Fitzwilliam museum (1 source), founder (3), coin use (4), coin identification references (7), local sources (5) on where the coins were found and student produced data (2). It is possible to see at a glance that the Ordnance Survey Map is the only source readily available online. Most of the coin identification references (five out of seven) are available online but have restricted access. In total, only seven out of 26 sources are online. The conclusion Ann arrives at is that the lack of availability of data online might pose a problem for technology development:

> 'As you will see the sources used were mainly only accessible through the [H] Library or from purchasing online. There is a move towards opening up data in Archaeology but most records, journals and books are only identifiable online rather than accessible. Does this restrict what we can do? It is likely to be the same for many of our settings?' (Ann's entry on the [Museum] Semantic Web App wiki page, no date, May 2010)

The map is further discussed at the team meeting on the 14th May 2010. The resources from a local museum and from the person who made the find are not available online, similarly to those resources from libraries and old journals associated with the use of coins. Ann states '*So if we're talking about things online, it's not looking... very promising'* (Ann, team meeting, May 2010). However, while the sources used are not available online, this does not mean that there would not be *any* useful resources online – it is only a matter of locating these. This raises a question of how much direction the

students are given by the lecturers or supervisors on what sources to use, given that most of those used had been from local museums and libraries, Ann asks. She ponders about the implications of opening this project work up to the 'whole internet' - would the team then be leading the students towards what is available online at the expense of off-line sources? This would restrict their project work, and ideally Ann suggests they would do a blend where '*we are not restricting by what is available online, but we're opening up more than what it is that they've got available at the moment, which is just what they can get their hands on in the library*' (Ann, team meeting, May 2010). This is an interesting tension: how much could the team intervene in the existing work practices without changing them too much? And, by designing a semantic tool for use in making the Artefact-projects that require the use of online resources, would this restrict the types of sources the students could use in their work? (Ann, team meeting, May 2010) In order to assess this issue, Jim points out that the team should almost be '*intervening at a point where the subject and scope for the project*' are being decided in order to influence the types of sources the students would engage with. The question the team need to answer is to what extent do the students decide for themselves what sources to use, or to what extent it is the lecturers. Answering this question would assume collaboration from lecturers. Jim thinks aloud of a possibility where the Artefact-project might be re-focussed to be in fact a totally new collection of online data relating to the object they study, but Ann, speaking for the Artefact-project and the teaching of archaeology, reminds everyone that while it would be possible to do this, that is *not* the focus of the project. It is the object that the students are meant to make sense of by finding sources related to it. Jim finds this interesting, referring back to the notion of case in archaeology actually being more *an assemblage* than a single artefact or an object as they have discussed before. The Artefact-project has turned out to be

about *structuring* the 'case' around the object, rather than an object itself, and that is a different task (Ann and Jim, team meeting, May 2010).

Jim wonders if it would be possible to follow up the project Ann has dismantled with a digital assemblage, and whether Ann would like to do it. She hesitantly agrees. Discussing how this might be best done in practice, and where the data for the Artefact-project comes from leads the project team to realise that having access to the data base of the single museum would not be enough. It would be useful to be able to have get-feeds from the other local museums and archives. Ann says she is in the right place to find out about this, and while she agrees doing this would be 'cool', she warns she does not want this endeavour to become a huge thing. Accessing resources at other museums online would support the students in their work, but the issue with this has to do with the practicalities of doing this technologically (Team meeting, May 2010).

On the 19th May Ann finally meets with Mary, the archivist, whom she had wanted to interview in the previous autumn. A whole year has passed since their last encounter which inspired Ann to follow the hunch about the Artefact-project. In brief, not very much that is new transpires from this interview. Ann explains the developments of the past year, which Mary welcomes enthusiastically. The main issue Ann wants to find out about is to what degree it is Mary's role to support students during the process of research into the selected objects, and whether she thinks a semantic application would be useful in this respect, in guiding students to further resources and information. This is another strand of thinking around the future technology: to support the students in the process of research, rather than representing the end product of it. Ann enquires if her suggestion sounds helpful or would the team be trying to replace something that already works fine? Mary is unsure as she does not quite understand the concept of the

semantic web. In terms of supporting the students Mary does this but only if they ask for assistance, she explains. Ann tries to explain about the semantic web saying that it is simply a better way of linking up online data, so that it would be possible to make relationships between for instance, a time period and a dig site and show links to other related sources of information. Currently the team are looking into the idea of making a mirror copy of the museum database (CMS), '*a bit like the catalogue that's online'*, that would give a glimpse of the museum database, she goes on. The idea is to layer new data on top of it, without affecting the museum database itself. Doing this would enable the team to steer the database better for undergraduate uses. Mary picks up on this saying that a lot of people find using the Museum online database really hard – it is very hard to search as you cannot sort the objects, a single search term may bring hundreds of hits. Mary's explanation of how you have to reason (e.g. they do not use plurals in search terms) as you search for objects in the database makes Ann think about semantic tools and their affordances: she envisages that the filtering facets, '*on the side, like drop down lists'* would help users choose a time period or an object, and it could show the them what the potential options for filtering down the search are. The only issue is that it would not work with hundreds of options. This might be a problem generally with developing a functioning piece of technology, as it turns out that archaeology does not use a keyword system very much. In semantic technology terms it means that archaeology lacks a robust ontology:

> '*In Anthropology they do use the keyword system a lot, we just don't do that in Archaeology. I am not quite sure why, it's just a tradition that we haven't done. It's very difficult, because if you have a sword that was found in a watery deposit, which is probably a virtual object, so it comes under weapon and magic and religion, so you would have the two key*

words in there. Emm. And you might, in Archaeology we would find that aspect, those keywords, confusing. But if there was a way of filtering out... then it might be useful for people, yes.' (Mary, interview 19th May 2010)

Ann has to leave for another appointment, but before she does Mary lends her a number of Artefact-projects. On the basis of Mary's interview it looks like the way the museum's database is structured might propose another challenge to the developing technology.

Plurality underlying assumed singularity

Ann's hunch about technology development solidified into a Plan through alignment of her colleagues behind her idea. What Ann has been doing is working to extend the project assemblage into archaeology teaching through gathering and enrolling gate-keepers to further resources, participants and information in the archaeology setting. This has enabled her to gain access to study the actual Artefact-projects, their materiality, pedagogy and processes of creating them. Dismantling examples of Artefact-projects to their constituent parts and gaining access to the Museum database have allowed the team to start assessing the mutual affordances of the Artefact-project and the semantic technology, and what could be developed based on these.

One issue that has a bearing on technology development is the high degree of internal specialisation and fragmentation of archaeology with its various sub-disciplines, institutes, museums and archives. Archaeology teaching, which is research based, reflects this diversity making the curriculum very varied. The Artefact-project is a means of assessment in diverse types of courses, for instance in Paleo-archaeology and Medieval Archaeology. The types of objects the Artefact-projects focus on can vary

from a single glass bead or a piece of flint to an entire set of buildings or an excavation site. Hence there has to be large degree of flexibility in the developed piece of technology. While there is multiplicity in the materials used as 'cases', the outcomes, the actual Artefact-projects prove surprisingly uniform, something that makes the development of the technology easier.

Having identified the Artefact-project as the case for technology development, the exploration shifted to the nature of the technology. The purpose, scope and form of the future semantic technology is not clear and this remains the point of discussions and negotiations. Artefact-projects bring together the museum, the museum archive and archaeology teaching, while the Ensemble-project's engagement needs to emphasize the case-based learning aspect of the Artefact-project. The team are also starting to think that the case is not in fact the object that the Artefact-project is being written about, but the assemblage of materials gathered around the object.

The technology development would have to cope with the variety of lecturers and types of courses, the multiple materialities present in this assignment, the flexibility of the Artefact-project as a means of assessment, lack of digital resources and the purpose of offering the students an 'authentic' experience of working as an archaeologist and teaching them standards and guidelines of the practice of archaeology. When the researchers settled on the Artefact-project as 'the case' that seemed like a triumph of pragmatic singularity over multiplicity. However, starting to work with that 'pragmatic singularity' has unearthed huge variety, diversity and multiplicity within that 'singular case'.

6. Translating the Artefact-project into a Semantic Tool

6.1 Participatory Research and Participatory Design

Concurrently with Ann's gathering and disassembling activities around the Artefact-project the wider Ensemble team are moving onto technology design at some of the other settings. Throughout the duration of the project issues and practices of participatory design (PD) and participatory research (PR) have surfaced as a focus for debate. This became more pertinent towards the end of 2009 – early 2010, when work at one of the research settings, Dance, reached a point when the team could move onto the actual design of technologies. What is interesting about this debate is how the iterative and flexible ethos of participatory research worked to mould the structured participatory design approach making it more responsive, while the PD approach helped PR to become a little more instructive, giving direction, in turn. Opening up this debate is necessary, because it had such a significant impact on the team's working practices and had a bearing on the plans for engagement with archaeology. What we need to keep in mind in reading this section is that not all team members were quite as wedded to the PD and PR approaches as Ann, Lea and Jim, for instance, despite these being laid out in the original bid. The space does not allow for a very detailed exploration of the negotiations, which were less unanimous than this account might let the reader conclude. By including this section I wish to show that a) this debate and mutual tuning of the two approaches took place, and b) how it affected plans for design activities in archaeology and Ensemble more generally.

The rest of the chapter carries on following the research and development process and how the Plan was translated into three possible designs for a semantic application, how

the Artefact-project resisted these attempts at translation and how finally a number of events came together, leading to the emergence of the 'Data Aggregating Document'.

The Ensemble-project is explicitly committed to participatory approaches, both in researching the settings as well as in the design of technologies (Original bid 2008). The research participants – the lecturers and learners – from the various settings have thus been treated not just as mere 'respondents' but as actively contributing to the direction of the project e.g. through discussions with researchers, through co-interpretation of data or by suggesting new research participants (Ensemble 2009, paper 3, Original bid 2008). For technology, the project bid proposes to use a 'repertoire of participatory design techniques' listing approaches such as pedagogical scenario-building, paper prototyping mock-ups, simulations, story boarding, and rapid prototyping. The development process is planned to be iterative, with the implementation, evaluation and reconstruction of problems not being limited to software design, but also to taking into consideration the pedagogic processes that the future technology is going to support (Original bid 2008).

While participatory design (PD) methods are not uniform (Olsson 2004), the common ground that these approaches share are: the ideas that computer applications need to better befit the actual skills and working practices of the computer users; that work by nature is social and that it involves the interaction of a variety of groups of people; and the importance of communication between the users of the prospective technology and its developers during the design process (Greenbaum 1993, 27).

Regarding participatory research, Ann has been a particular advocate of this approach, whereby she has wanted not only to understand what is going on in the settings but also to include her research participants in directing the course of research through co-

interpreting the findings (Interview with Ann, Feb 2009). PR entails a flexible, responsive research approach, with the adoption of potentially multiple research approaches (Ensemble 2009, paper 3). Lea (the other project PI), on the other hand, has been vocal about the importance of Ensemble-project members planning the participatory design approach. I will pick up this debate from February 2010, when Ann sets about familiarising herself with PD resources, articles and worksheets that Lea had uploaded in the VRE. The backdrop for this event is that work in the Dance setting, which Ann is also involved in, has moved very rapidly over the autumn, and the team now need to engage the participants in the design of technology. While the debate over PD has surfaced and re-surfaced at different points of the project, it is only now that the significant developments take place. What I will focus on around this debate is following how Ann acts as a spokesperson for participatory research methods to be used in design; how PD and PR approaches work to mould each other; and what kind of method for technology design the team finally settle on. I will not go in detail into the PD workshops taking place during this debate for these relate to another research setting, though I may refer to these in passing.

Practice as 'stable' or as a 'moving object'?

In February 2010 Ann spends time reviewing the PD materials uploaded in the VRE[87], discovering that each description treats the practices the technologies are being designed for as static or stable. This does not correspond with her experience of the settings:

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[87] She reviews ten different PD activities, including Affinity Diagramming (Gaffney 1999a), Card Sorting (Gaffney 2000a), Contextual Enquiry (Gaffney 1999b), Scenarios (Gaffney 2000b), Walkthroughs (Gaffney 2000c) and Participatory Design Workshops (Gaffney 1999c).

What I find missing from all of this though is the concept of the teaching and learning practice we are designing a tool to support being a moveable object. Our research involvement in the settings has already had an impact on the practices without any technology being involved! It also seems to be a real missed opportunity to spend that time with students and teachers reflecting on their practices without it involving pedagogical development as well as technological development. How can this be integrated and supported by design workshops? (Ann's research diary, 15th -17th Feb 2010)

Ann further reflects on the nature of participatory research and participatory design stating/concluding that as a more iterative and involved activity PR appears in tension with PD, which assumes that researchers/designers do not have an impact on participants' opinions:

- - But maybe if you structure a participatory research activity too much then you make it less participatory (what a good question!)? Of course the converse question then is, if you integrate pedagogical development with technology development do you mess up all of your PD activities and make the results useless for directing the person doing the development? (Ann's research diary, 15th -17th Feb 2010)

The tension between PD and PR becomes the focus of discussion in the February team meeting. Ann starts off by presenting a particularly well structured PD technique, the Participatory Design Workshop (Gaffney 1999c). She treats this as an example of a 'classical representation of what PD might be like' (Ann, at team meeting, Feb 2010), suggesting that discussing this provides a way of teasing out differences between

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classic PD and the more iterative participatory research method adopted by many in the team. Ann hopes that this will help the team discover what they might retain from PD for their purposes. In assuming that practices are stable and can be fully understood, the structured PD approach contains no awareness that the practice itself might be affected by the process of design at all. In classic PD the real life practice 'out-there' is suggested to be observed using more structured observation methods, and the produced data is interpreted and classified. User scenarios or 'personas', which form the basis of a participatory design workshop, are created based on these assumptions (Ann, at team meeting Feb 2010, Gaffney, 1999c).

> '--And the reality, what we've actually found, is that we're designing for moving, changing, adapting object. And that actually you would want that to be the case, because you would want there to be pedagogical improvement at the same time as doing technical design.'
> (Ann, at team meeting, Feb 2010)

This is the point Ann wants the team to discuss: how to ensure that the changing practice, the moving object for design, is taken into consideration in the PD methods that the team will adopt? While the Ensemble team have also approached the settings by carrying out observations, the main difference between the observations carried out by the team and those suggested by the classical PD method is that 'observation' is not understood as a neutral data gathering activity by the team, but as reflective, generative activity and as an agent for change.

'- - I think that what we have to acknowledge, is that if we're doing participatory research, the process of gathering the data and the process of getting people at the settings to gather the data, is a reflective process. We've already seen that it causes people to change their teaching and learning practices. So we are *causing* that development to happen by using those mechanisms, which is something that is not acknowledged in the participatory design practices. So that's what I think we should feed into this first level here, the vision of things.' (Ann, at team meeting, Feb 2010)

Having said that, the team have, after all, started off by observing practices, as Ann points out, which could provide them with a decent point of departure for their design activity. But how to move onto the second level of engagement - the actual design of technology - from these types of observations? In classic PD the vehicle for this is the production of a scenario, a generalised view of the practice, for which the technology will be designed. Given that the team's approach and understanding of the settings are not geared for production of generalised scenarios, Ann suggests they would write descriptive vignettes: '*the kind of thing that we've seen taking place in the settings, where we might design the technology for'.* This, she proposes, would be done with the understanding that these situations would not remain the same throughout the process, but that the design would happen in iterations. This process would also produce data to compare the iterations, and evidence for the changes in practice as the technology develops, something a reflective feedback-review process would help uncover (Ann and Jim, at team meeting, Feb 2010). Lea joins the discussion pointing out that classical PD assumes that all parties involved – the research participants, researchers and designers as well as their respective practices - are 'neutral', and that they have no

influence over each other or the events taking place. The team's experience of this is completely the opposite, which is why Lea suggests they should explore the flexible role of the researcher in PD (Lea, in team meeting, Feb 2010.) Ann agrees with this noting that as participant researchers the team members are not 'people at the setting' but 'outsiders', yet they are becoming more and more integrated into and enrolled as part of the life of the settings through their engagement. Ann is aware and acknowledges her own transformative impact upon the settings, especially in archaeology. In some PR circles the researchers' active role in impacting the work at the settings is frowned upon but in order for any participatory development to happen, an outside person with an understanding of the technologies and of the practices taking place is necessary (Ann, at team meeting, Feb 2010).

The team move onto discussing the evolving roles of research participants and of researchers. This debate relates to the earlier discussion about spokespersons and enrolment: who has the right to speak for whom (Callon 1986b) and to what extent do the networks of the researchers and those of their participants enmesh? Or: given the transformative impact of researchers' involvement in the settings, is the question in fact about the enmeshing of the two respective networks into a completely new extension or fold? That would seem the most likely description of the situation, given that the aim is to develop and introduce a new technology for supporting the teaching and learning practices, and with that, the development and introduction of a new practice altogether. Ann, for certain, emerges here as a spokesperson for participatory research methods, and critical engagement with the settings in technology design.

On one hand the unstructured PR approach offers very little guidance for how to proceed with technology design. On the other hand, treating data generated through PR

methods with a structured PD approach would not do justice to the ethos of the project, and would work to stabilise the practice.

The team treat this problem by discussing the practicalities of the forthcoming PD workshop with the Dance students for the rest of the meeting to negotiate a way of how this should be carried out in practice. The team need to strike a balance between PD and PR. Ann explains that they have already had a focus group meeting with the students to discuss their existing teaching and learning practices with technology used in their classes. Some issues and wishes for improvement relating to these practices have already emerged, and Ann wonders if she should bring these up in the PD workshop, or if this should be left to the students to introduce? Jim thinks that it would be a good idea to list the issues that have come up in an informal manner, while Lea suggests that Ann should introduce her findings for instance through a presentation, and then give the participants some space to think about this. After that they could brain storm, where the participants would come up with a variety of ideas in an unorganised manner. After a lengthy discussion about how to go about doing this, Jim recaps the situation: they will present the Dance students with an understanding of what their current technology needs are based on observations and focus group discussions carried out by the team. '*We then ask them to think about what components or features etc. of all those existing technologies, but also other ones, that they would like to envisage, might we put together*' (Jim, team meeting, Feb 2010). Jim then explains that relating these technologies, or combinations of technologies, would generate discussion and ideas for scenarios. Here I assume that the 'scenarios' Jim is referring to are understood as less 'general' than in classic PD. Ann wants to know how they would work from those

scenarios to produce a rapid prototype[88]. To Jim this is another stage altogether. What he suggests is to ask the PD workshop participants to rate the different scenarios: *'out of all these scenarios what do you think are winners*?' (Jim, team meeting, Feb 2010). There are various techniques for doing this. Ann confirms that it is after producing rankings that you would produce the paper prototype, adding: '*But I think we are probably in a position where we could produce a real life prototype'* (Ann, team meeting Feb 2010). Jim agrees with this, saying paper-prototyping might in fact be a general state (Team meeting, Feb 2010):

> *'And because we don't have any designer - - I would see us jumping straight to the slightly rough-and-ready-let's-use-what-ever-APIs-we've-got, and look at how we would use the repository, SPARQL, youtube APIs, Google APIs, public webservices to get something going.'* (Jim, team meeting, Feb 2010)

Ann points out that here their proposed approach diverges from classic PD again: the team are planning to have several iterations of the design, they might want to repeat design workshops, discuss the structured data sets at the settings, and continue to observe teaching and learning practices, and discussions of scenarios over a period of time (Ann, team meeting, Feb 2010). Jim enthusiastically agrees with this.

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[88] 'Prototype' is a term used in different conjunctions in technology design. In this context it refers to the earliest functioning version of a piece of software/application, which is subsequently presented to the participants in order to get feedback for its improvement. 'Paper prototyping' is used in Human-Computer Interaction as well as in participatory design, and at its simplest it means a design created on a piece of paper, detailing the functions desired from the future software. This can be for instance a sketch, a design drawing or a collage. A prototype is then created based on the paper prototype. Paper prototyping is often the first step in 'rapid prototyping', which means quickly (within hours or days) creating a functioning piece of software based on users' wishes and requirements. (Wikipedia, http://en.wikipedia.org/wiki/Paper_prototyping, accessed 29th Jan 2011). The Ensemble-team have been able to move onto rapid prototyping also directly from talking to their research participants thanks to the SIMILE Exhibit-toolkit.

Towards the end of the meeting Jim articulates a broader issue that he feels needs addressed by the team. He proposes that rather than '*getting hung-up about what participatory design in information systems is about, we should be thinking about this as participatory research, which happens to be about the design of technologies*' (Jim, team meeting, Feb 2010) Lea agrees with him, though it concerns her that there is another professional community, one that her hinterland aligns with, HCID[89]s, who will have questions about the methods the team are using in research design. She currently feels that by adjusting the methods they are using they might not be able to define a method or a theorisation that 'stands up' in the eyes of the HCID community (Lea, team meeting, Feb 2010). In reassuring Lea that this should not be a problem, Ann is pushed to express their current approach more clearly:

> '*We are mixing methods from participatory research and participatory design and participatory rural appraisal[90], and I think we should say that*'. (Ann, team meeting, Feb 2010)

Later the debate is taken further with a view to generating a plan of action for PD/PR for the whole Ensemble project. This happens by mapping all PD/PR activities across settings, something Ann does on a white board at her office. She then meets up with Lea and they devise a general plan mixing approaches from PR and PD, but enact this 'general' plan in a flexible enough manner so as to suit the diversity of settings, technology needs, relationships, degrees of enrolment and available data. The outcome of this is the enactment of these PD/PR plans in action, something Ann is planning to undertake in the archaeology setting.

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[89] Human-Computer Interaction Designers
[90] This is a lesser discussed addition to their approach, and I will not go into it further in this thesis.

After the February team meeting the first PD workshop is held with Dance students. It is by all accounts successful (Ann's research diary Feb 2010, team meeting March 2010). The PD versus PR debate however, continues, the ideas coming into focus over the following month. In this section we will be looking at three further translations and enactments of this debate, which move the discussion towards a stabilization of this debate into an official 'plan' for carrying out design. The first translation to be considered is a chart sketched on a white board, this is translated into an 'official document' (the second translation). The third translation is a team meeting discussion of this official document. In March, Ann and Lea meet to discuss how the PR and PD activities map across the settings. In preparation for the meeting Ann 'attacks the whiteboard' in her office creating a huge grid detailing her thinking (Ann's research diary, 9th Mar 2010).

The first column relates to the archaeology setting (see image 6.1). The row-headings from top to bottom are:

1. Participatory research activities/ Ethnography/ PD, Contextual enquiry, Cultural roles Identity issues [RQ1 and RQ2] /Theoretical framings [RQ5]

2. Participatory research activities/ PD workshops, paper prototyping, card sorting, Affinity diagramming / PD/PR design [RQ 3 and RQ 4]

3. Participatory research activities/ rapid prototyping, PD evaluation, (spiral) cyclic evaluation and prototyping [RQ 3 and RQ 4]

4. Project evaluation/ Participatory, Ethnographic, PD/Toolkit production [RQ3]

Image 6.1 Chart created by Ann on whiteboard detailing methods of engagement across the settings.

Ann explains in her diary that the darker text refers to things completed; the lighter script is what is planned for the future (Ann's research diary, 9th Mar 2010). From this chart it is possible to see at a glance the progress of work across the settings, which shows that archaeology is lagging a bit behind at this stage. She has also aligned the different activities with the research questions of the project, dividing the process into four phases. The first phase for instance contributes to RQs 1, 2 and 5. The PR activities for archaeology include '*Getting to know people, interviewing, attendance at*

seminars, wider disciplinary field'. For ethnography Ann has written down '*observations*'. PD, Contextual enquiry and Cultural roles have been carried out through '*documentary analysis*'. Identity issues are covered by '*scenarios*' and Theoretical framings by '*CBL expertise*'.

In the second phase the PR activities include '*feedback interviews*' and '*meeting more people*'. From this point on the spreadsheet moves onto projecting future activities: PD workshops, paper prototyping, card sorting (etc.) are envisaged to engage a '*student group.*' Ann would also like to have '*teacher input*' but sees this as more problematic, indicated by the question '*how?*' added after it. The third phase involves continuing PR activities through '*interviews with other Archaeologists*' and '*involvement in Museum (development?)*'. She further envisages a '*small group meeting with people at setting to evaluate prototype*', which would presumably involve the students and hopefully teachers engaged in phase 3. The cyclical evaluation activity proposes to find out if the prototype is '*useful for other museums?*' The fourth phase, Evaluation of the technology, entails getting feedback from '*students, teachers and Archaeologists*'. Ann also envisages the team carrying out more observations and then producing '*scenarios*' for a Toolkit to aid the development of a semantic tool for archaeology.

This spreadsheet is both an enactment and an analysis of Ann's research approach[91]. While there were a few people involved initially in developing these activities in the archaeology setting , the activities have been 'filtered' through Ann. The same applies to all other settings. Ann is aware of this 'personal slant', for she points out the 'I' in

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[91] What is interesting to note here is that when looking at the archaeology teaching Ann translated a complex data set into a semantic tool to make sense of it, here she 'resorts' back to pen and paper. I would expect this simply to be easier at a brain storming phase, when the data is not complete; perhaps the next stage from this could be a semantic application.

the charting, and that what she has written is open for debate (Ann's research diary, 9th Mar 2010). What this chart also reveals is the understanding that we in fact 'create' the realities we study. In planning future activities Ann is both enacting the aims of the project but also *seeding* these future activities, which would not take place otherwise, such as design workshops, which she is subsequently going to study and evaluate.

On 10th March 2010 Ann meets with Lea to discuss this chart in order to translate it into a '*more formal document describing our methods across the settings*'(Ann and Lea, meeting document 10th Mar 2010). Ann and Lea start off from the understanding that all activities they have engaged so far seem to be PR/PD but that '*this needs teasing out*'. The activities include pre-planned PD workshops, which need to include other PR/PD approaches to enrol participants from the settings. '*It seems that the more engaged the people are [in the research project] the less structure is needed for collaborative design*' (Ann and Lea, meeting document 10th Mar 2010). In practice this means for instance, that in Dance the design process becomes 'naturally' iterative, with the students and lecturers, who are excited about being engaged by the project, feeding back to the designers regularly, who in return very quickly respond to this by tweaking the application/design. On the other hand, in Marine Operations and Management the team needs to work harder to enrol, and keep the participants enrolled, in the design process.

In the document Ann and Lea list different stages that are needed for engaging a setting. These include '*getting entry and champion*', which are then engaged in '*informal and formal conversations*' in order to get to know the discipline and '*how things/artefacts are interpreted and moved around in the setting and beyond*'.In addition the team build relationships using '*initial information and observations*' to

expand the network of connections by '*reflecting back researchers' (interpreted)*
understanding of network in the settings'. They then propose to engage the people at
the different settings into participant observation along the themes of the project in
order to open up dialogue of tacit assumptions at the relevant setting. This, they state,
will help the researchers, ideally supported by the research participants, to identify '*an*
appropriate practice' for technology development. Ann and Lea name a few examples,
the archaeology one being:

> [Archaeology]– artefact project. Case is information around the object,
> semantic affordance is better integration of student research with the
> museum archive and better integration of museum archives with external
> data sources. (Ann and Lea, meeting document 10th Mar 2010)

The stages Ann and Lea have identified above are mapped out across settings for phase
1 (as identified in the white board drawing discussed earlier). These activities have
largely been carried out. In order to move onto phase 2, the actual technology
development, Ann and Lea propose that the team need to know and agree the following
points:

1. Technology already using

2. Practices that could / need to be supported and the limitations /
   frustrations of these

3. Identify a cohesive group of students and lecturers who will sustain the
   engagement with the Ensemble research process

4. Has an initial idea of kinds of data sources and structure. (Ann and Lea,
   meeting document 10th Mar 2010)

For the actual design Ann and Lea list a number of set activities (which overlap the ones listed above) that are necessary for technology development. Firstly this includes knowing the available data sources and their structure. This has a bearing, for instance, on whether or not API access can be arranged to the dataset. Also, the stability of the data set impacts the stableness of the technology. Secondly they need to understand the possible technological limits of the data: do taxonomies and ontologies exist, and do they need to be formed or adapted? The third issue has to do with defining rules and inferencing (reasoning) across the datasets. These phases need not be sequential, nor do they need to follow the same pattern across the settings, as they can be adapted to suit circumstances, the available data and technology needs. The important thing to remember, Ann and Lea note, is to continue the enhancement of the pedagogic activities at the settings.

Ann and Lea conclude that there *'seems to be a constant resolving of tensions/ebb and flow of conflict between engagement /enrolment/ mobilisation/ participation/ PR AND 1 – 4 which are necessary for decisions about construction of the technologies'* (Ann and Lea, meeting document 10th Mar 2010). In other words, technology design is necessarily an iterative process. In translating the more detailed chart into an official document, Ann and Lea have worked to 'abstract' a set of general instructions or a plan for PD/PR across the settings. What is noteworthy is the in-built flexibility and responsiveness of the instructions to the diversity of settings that the activities need to apply to.

With this list in mind it is possible to say that the archaeology setting is ready to be moved onto the Phase 2, technology development, (as identified on the chart on the whiteboard): While there is no existing technology that the archaeology students use for

their Artefact-projects, there is an identified practice (the teaching of the Artefact-projects) with an articulated frustration (that the Artefact-projects are not linked to the museum's database and made available to other students and the public). Ann has managed to identify a group of students and a couple of lecturers who have shown willingness to be part of the project's activities. In addition, the team have an initial understanding of, and API access to, the necessary data sources and structures of the museum.

The large Methods chart and the official document Ann and Lea have created are discussed by the team at the March meeting the following day (Ann's research diary 12th Mar 2010). In comparison to the team meeting in February, Ann is now better able to articulate the approach that their interdisciplinary project has adopted: that they are trying to blend the structured PD with the less structured PR, which alone might not offer the team enough guidance, and '*pitch [it] to use different methods and different tools, and the influences that we have in the group'* (Ann, team meeting, March 2010). Lea remarks how they have learned to work by responding to the settings, despite the fact that in the document the research and development process is presented in a sequential way (Lea, team meeting, March 2010). Ann agrees with this: their approaches have had to cope with the diversity of settings, the people they have been working with, the variety of points of entry to the settings and how far the team have wanted to diversify at the settings. The approach has also been affected by who and what they have managed to engage in their project. Despite this variety, the team have tried to identify a *'praxis or activity to focus on each of these settings'*, something that follows a common pattern of engagement (Ann, team meeting, March 2010).

The team discuss how the types of relationships they have created with the settings might impact the design activities. In Dance, a setting which approached the project for advice, for example, they could jump straight in with their practice, a performance that they do with the video conferencing software. As participants, the staff and students have been very keen to engage with the project. In archaeology the team have had to spend a lot of time trying to enrol participants, explaining what the potential benefits of participating in the research project would be for the discipline. Identifying a suitable practice took a long time, something the technology design requires in order to be possible. This in turn enables pin-pointing those who engage in that practice and are able to inform and participate in the process of design from the point of view of their expertise.

The next stage Ann wants to talk about is evaluation and prototyping and how these might continue with the PR activities. Ann describes how PD would work when producing a paper prototype: the participants would do documented 'walk-throughs', which would allow analysis of their performance as the task the prototype was produced for. This is something the team are not doing, because there is no set task that the participants perform, Ann explains. With Dance the technology team is co-located at the same institution, and they have actually produced a 'rapid prototype' of the real thing, rather than going 'via' a paper prototype. The prototype is not perfect, but functions more or less as intended. Jim refers to this method as 'bricolage', and explains that creating rapid prototypes is possible because of the team's access to the MIT Exhibit framework. This is a real advantage, as it shortens the design process considerably by enabling the production of small 'Exhibitlets' with bits of data very fast, in a matter of days or just hours. Mapping out data sets, doing data entry and conversions for the real thing might still take months afterwards. Jim explains that the

evaluation of prototypes can also be documented with these rapid prototypes, the 'real thing' (Jim, team meeting, March 2010).

It is here, when a largely (while not entirely) shared understanding of the nature of the ensuing PD workshops has been reached, that I will drop the general PD vs. PR discussion, and return to follow the 'actors' of the research and design process in archaeology. Before that I will summarise briefly why this debate took place and why it is significant.

While 'observation' is the method of choice for both classic PD and PR in approaching the practices they wish to design technology for, their philosophical points of departure are radically different. PD treats reality as 'objective' and 'out-there', and the researcher's role is to uncover 'facts' about that reality for the production of generalisable user scenarios, which are used as the basis for design. The practice is assumed to be stable and known by all involved. The researcher and designer are seen as detached from the practices that they are studying and designing technology for. PR on the other hand understands the researcher as generative of the reality that she studies, through participating in and affecting the process of data generation. The design situation is affected by the participation of the researcher in it, and they are seen as agents for change, which means that the practice is being affected by the process of design. However, while the research approach is participative, the researcher's role in some PR approaches is strictly meant not to guide the direction of the research or design, but help the participants in articulating these. Ann's experience of this is that while the classic PD approach is too structured and instructive, the PR approach offers very little guidance for design. Applying a classic PD approach to design using data generated through participatory methods will not work. As Ann remarks, this would

simply fix the practice and the team would '*have missed the moving target, and produced something that is out of date by the time it is out*' (Ann, team meeting, Feb 2010). Hence the team end up mixing influences from PR and PD. Another one of Ann's concerns revolves round the role and agency of the researcher and designer in the research settings: to what extent do they manage the process of design? In some PR approaches this would not be acceptable. The team become agreed that it is useful to have an 'outsider' in the setting, who understands the technology, as well as having an understanding of the practices taking place. This changes the role of the researcher to become more involved both at the setting and the design of technology. The role they adopt varies depending on the nature of setting the team are working with - the better enrolled the setting is in the research project, the less structured design activities need to be. Again, the approach needs to be adjusted to the setting, the types of participants they work with, their technology needs, available data etc.

By comparing the practices of classic PD with those of PR the team have managed to mutually tune (cf. Pickering 1995) both approaches. PD to become more responsive to the diverse settings and circumstances they have to work with, yet make PR adopt some of the directionality of PD to support the less engaged settings. In March 2010 a PD workshop is being planned for the archaeology setting.

6.2 Resistance to translation

Now we will return to follow the work in archaeology. In mid-May 2010 the space for the development of a semantic tool for archaeology is taking shape and there is enthusiasm and energy in the team around these developments. A Participatory Design workshop for archaeology is on the agenda. The team have access to the museum's database and they have an understanding of how it works and how to access it, what the

data is like and how it is structured. Ann has managed to interview lecturers and students, gaining an understanding of the nature of the Artefact-projects pedagogically, how these are being taught and what writing them entails. The interviewees have also expressed interest in Ann's Plan for moving into technology development in archaeology, and in being involved in taking it forward. The team now have several examples of Artefact-projects, which help in understanding the diversity of objects these are being written about, and allow mapping of the resources used in constructing these. Dismantling and mapping out the Artefact-projects' resources has implications for the team's understanding of the nature of the 'case' in archaeology, making them feel that the 'case' might more accurately be described as 'an assemblage', or a case record gathered round an object, rather than being the object itself. They have also discovered that the resources used for constructing an Artefact-project might entail enrolling other local museums into their project in addition to the museum with which they have been working. Hence the scope of the exercise seems to be expanding, proposing new challenges as well as opportunities.

Ideas about the future piece of semantic technology within the space created by the Artefact-project as a-niche/the-case are also starting to emerge: rather than adding directly to the museum's Content Management System the team are planning on taking a section of that data and creating an external application using the data stream. How that application is going to look like is still unclear, for the actual purpose of the technology has not become stabilised yet. The envisaged possibilities include one which would entail the students creating a self-standing Exhibit, an online version of the Artefact-project in lieu of the written report. The other suggests 'translating' the current Artefact-projects into digital ones and making links to resources online, being thus able to link to the museum database, while the third idea is to steer the application

towards supporting the students in the process of researching the object (Interview with Mary 19th May 2010). A problem facing each suggestion is the limited use of digital or online resources. Further, while there is an existing need for innovation in the setting, the envisaged ways of doing this would inevitably change the nature of the exercise of creating reports. For instance, while the introduction of a semantic tool might make the 'the entire internet' available for locating sources for the Artefact-projects, this might simultaneously restrict the students from using any of the classical sources only found in museums and archives, something that professional archaeologists are expected to be familiar with. Hence the novel tool would have to also be able to cope with non-digital materials. Otherwise the exercise of creating the Artefact-project would lose its objective in terms of teaching the students skills and knowledge necessary for professional archaeologists, a point also emphasised by Katy, the lecturer Ann had interviewed in May: the students need to learn how to get hold of resources from archives and museums.

> '*They cannot just turn up and say "show me the object". You have to write to the correct person and arrange a time and be there at the correct time and that is all part of the process of them doing this project. So it needs to still relate to that reality of being professional academics.*'
> (Ann about Katy's interview, interview on the 17th May 2010)

What must remain unaffected by the introduction of a technology relates to what needs to be learned by creating the Artefact-project – gaining experience of the professional practice of archaeology. Students need to learn for instance how to sketch an object and describe it according to agreed standards and how to study it; how to find classical sources, where to go and who to contact, with what time scale, how to fill in forms to

find particular sources etc. Furthermore, the participatory ethos of the project means that the design process has to involve the intended users - the lecturers, students and the curators (who extend the project network beyond the originally intended teaching and learning setting).

Following the excited plans for future engagement in archaeology Ann emails the students she interviewed in March requesting they participate in a PD workshop on the 26th May 2010, but unfortunately, none of the three students reply. The timing of the request is not ideal given that the term is finishing and during the summer the activities at the Archaeology department generally quieten down. The staff leave for excavations and research leave, with students going on summer holidays. Ann also tries to make contact with the other local museums to start enrolling them into the project's network as suggested in the May 2010 team meeting. She emails two of them on the 14th June 2010 but gets no reply. Over the summer this lead dries up and the idea is dropped.

At the beginning of July 2010 Ann and Jim get together for a meeting[92] to discuss the progress of work in archaeology and '*what potential Exhibit structures there might be for supporting the artefact projects*' (Ann's research diary, 2nd July 2010). The Exhibit toolkit has been the starting point for thinking about technology development at all settings so far, and in May 2010 the team had envisaged three types of semantic application that could be potentially created in archaeology.

Ann had been mapping out the resources and references across a number of Artefact reports since the May 2010 meeting, only to confirm the major restriction for technology development, the general lack of online resources. This is the starting point

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[92] The meeting was not recorded, but there is a photograph of the white board sketches, which I used for interviewing Ann on the topic on the 27th July 2010.

for Ann and Jim's brain storming session, during which they sketch three different proposals for an Exhibit/semantic web application on the white board. Each diagram describes an envisaged relationship between the Artefact-project and semantic technology.
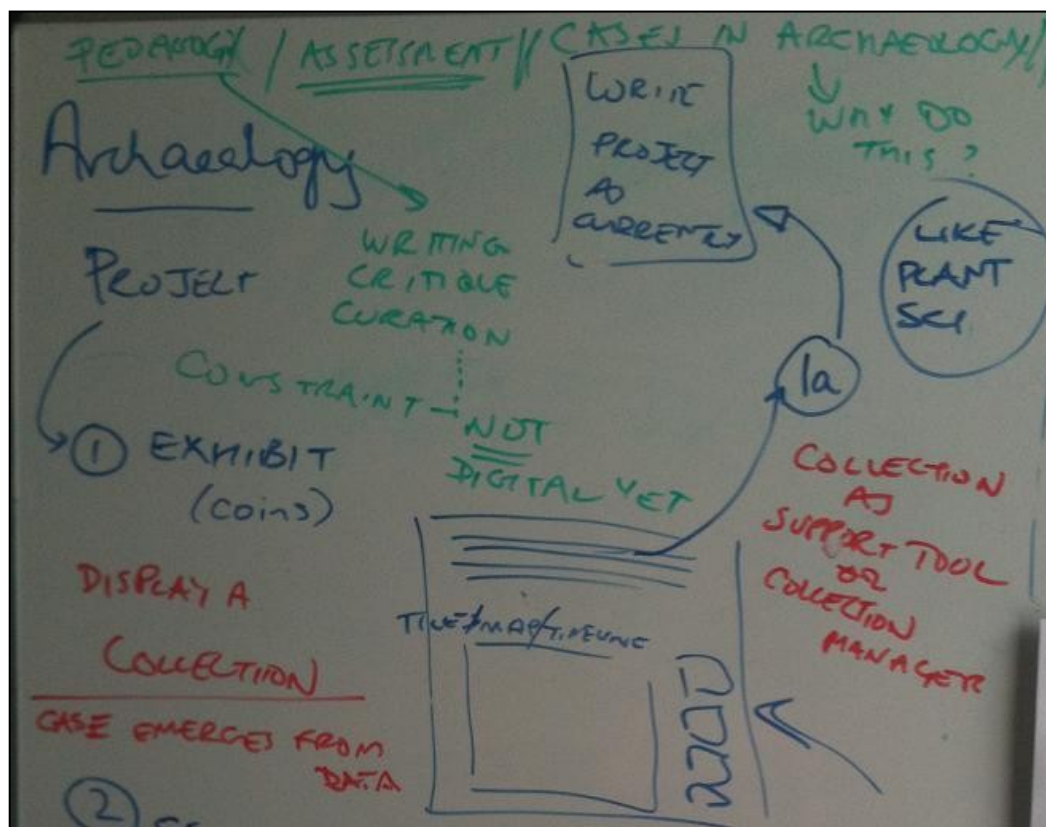
Image 6.2 Section of the white board drawing from meeting on the 2nd July 2010, showing the first Exhibit plan, a Collection Manager. (Image from Ann's research diary 2nd July 2010.)

The first sketch depicts the Artefact-project as translated into a 'usual type' Exhibit tool with the data in the middle and searching facets to the side, displaying a collection of data related to the object in the middle (see image 6.2). This collection could also be viewed as a timeline[93] or a map (c.f. Mackinnon and Jordan 2009) which would assume a degree of structure to the data and a shared vocabulary in order for this type of searching to be possible. In this version the 'case' would emerge from the collection of data gathered around the artefact.

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[93] http://www.ensemble.ac.uk/projects/plantsci/timeline/

This application could also work as a collection manager and a support tool for making the Artefact-project. A related option (with the arrow pointing to '*writing a project as currently*') would be to keep the projects as word documents, and use the Exhibit tool for organising them so that they could be searched for and linked to the museum archives. At the top of the image (in green writing) there are questions about pedagogy and assessment in relation to cases in archaeology, something that will affect what is required of the technology. Pedagogy links to issues of '*writing, critique and curation*'. Furthermore, realising this option would require quite a lot of investment in terms of time and effort on the part of the discipline (Ann, interview 27th July 2010; Email Ann to Sanna 3rd Oct 2011). The translation is only possible within the technological, social and material limits.

Image 6.3 Section of the white board drawing from the meeting on the 2nd July 2010, showing the second Exhibit plan, the Semantic Wiki Text. (Image from Ann research diary 2nd July 2010.)

The second design (image 6.3) suggests that the Artefact-projects could be translated into a Semantic Wikitext, something that the team have considered using with Plant Sciences. In doing this, the case would emerge as a rich narrative, which would be tagged and linked to other texts and sources through keywords. The advantage of this tool is that it would make the Artefact-project much more searchable, but would involve a considerable effort to create on the part of the student and have implications

in terms of teaching (Interview with Ann, 27th July 2010). This version gets discussed in more detail at a later meeting (22nd Nov 2010) between Ann and Jim leading to further thinking about how to translate the Artefact-project into a semantic tool.

The third suggestion (image 6.4) is that the Artefact-project is translated into an application involving a focal artefact:
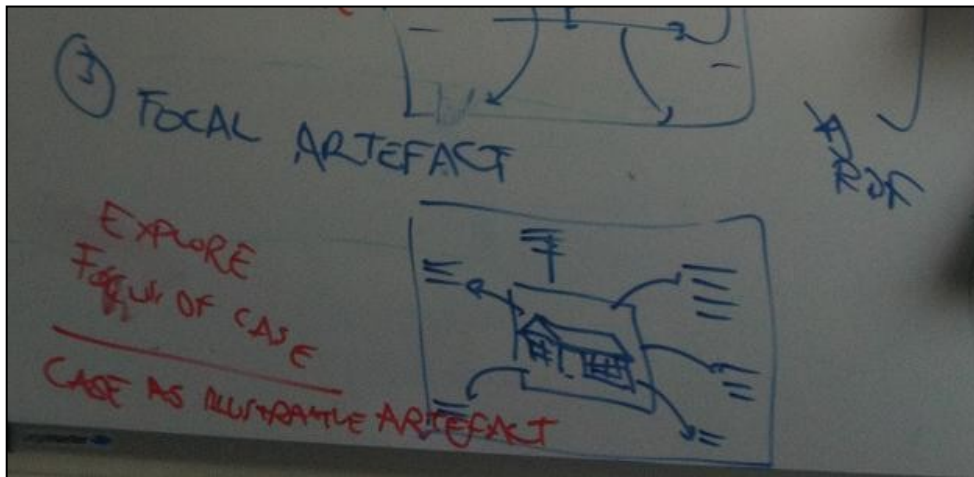
Image 6.4 Section of the white board drawing from the meeting on the 2nd July 2010, showing the third Exhibit plan, the Focal Artefact. (Image from Ann research diary 2nd July 2010.)

Here the artefact would be explored as the focus of the case, '*case as an illustrative artefact*'(Ann, interview 27th July 2010). This differs from the other two in that the artefact is the 'case', rather than the collection of data, or the narrative where the 'case' emerges from.

The three designs would create different types of assemblages leading to different types of possibilities for pedagogy, and for linking the Artefact-projects to the museum archive. As these proposed translations would necessarily impact the way the Artefact-projects are being taught and created, it would have to be ultimately up to the lecturers to decide how the technology might best support their teaching, and thus what the best practical solution would be. Hence Ann plans to show these designs to the lecturers in the autumn, hoping to have mocked up versions of Exhibits to show them. In July 2010

it is planned that the new technology developer Sam, who joins the team in the summer, would produce something based on these plans before the term starts and lecturers return in September/October 2010 (Ann, interview 27th July 2010; Ann, team meeting, 16th Sept 2010).

Gradual unravelling of the assemblage gathered around Archaeology

The team had originally hoped to engage archaeology students in a PD workshop to develop prototypes for translating the Artefact-projects into a semantic form. Lack of participants meant these workshops did not take place, and the team moved onto planning designs without them. Given that each proposed design would impact the teaching of Artefact-projects, it was necessary to get feedback from lecturers (who during the summer were unattainable) before these could be progressed further. The only (documented) event related to archaeology before November is that the plans made in the brainstorming session get reported to the wider Ensemble team at the September team meeting (team meeting, Sept 2010). The plan for creating mock-ups lives quietly on the side and there is some intermittent email correspondence around e.g. metadata standards between Ann and Gary (Emails between Ann to Gary 10th Sept; 4th Oct and 6th Oct 2010).

In May 2010 it had seemed that things were developing rapidly, but suddenly the progress with archaeology more or less comes to a standstill. What happened? Or – what did not happen, more to the point - what interrupted the flow of activity? One actant to this development is *timing*. Ann had only just managed to enrol the necessary allies behind her Plan, and gain access to study the Artefact-projects, their teaching and the process of creating them, when the summer term starts. Just as the team are ready to move onto the PD phase in archaeology, the archaeology staff and students are no

longer available for interviews or workshops. Trying to engage them after the long pause over the summer meant that the momentum gained during the spring was lost. The only participants that remain on the scene are the hard copies of the Artefact-projects.

Contributing to *timing* are the multiple demands on Ann's researcher time, and the mutually competing settings. While the settings are not meant to 'compete', each of the several, geographically distributed sites Ann works with demand her time and attention. This impacts also the other researchers' involvement, which has become all the more marginal in this setting. If archaeology had been the only setting Ann was responsible for, she might have been able to engage with it more intensively and make things progress faster, thus keeping the momentum going, which in turn would have helped maintain the network she had been gathering. Furthermore, as things start happening in some settings and the activity in these intensifies, these networks require more and more of Ann's (as well as everyone else's!) involvement, leaving less time and energy to devote to other settings. With the arrival of Sam, the new technology developer, things take off e.g. with the Dance setting, where the ground is more fertile for innovation and technology development than in archaeology (Interview with Sam, Jim and Amy, 22nd Oct 2010).

In October 2010 Ann too moves to LJMU where the emphasis of the project has shifted over the course of the year with a number of team members based there. She applies for, and gets, a lecturing job, which means that apart from now being physically removed from the archaeology setting she has even less time to devote to the project as she starts her teaching duties. This has a further impact on the types of data available for this study. The diary entries become more infrequent and less informative at this

stage. In terms of data, this study now relies on email correspondence and recordings of meetings, as well as interviews. Ann is involved with the project until the end of the year, when a new Research Associate is employed in her stead, but this has no bearing on the developments in archaeology over the autumn.

With all these issues and the lack of response and participation from the archaeology staff, students and related institutions, Ann becomes very frustrated with the slow progress at archaeology. During an informal discussion in the October 2010 team meeting she pre-warns me that if things do not improve in terms of participation and interest from the setting, archaeology may have to be dropped. It further transpires that my involvement in studying the team's work in this setting makes Ann feel partly responsible for my PhD study[94], which highlights the impact a researcher can have on their research setting. At that moment in time, anything and everything were still potentially data to my study and should the setting be dropped, that would become part of the data too. While it is the intention of the project to carry on their work with archaeology, things are not looking very promising at this stage.

6.3 The Emergence of Data Aggregating Document

In early November 2010, after things have settled down following Ann's move, she picks up the work in archaeology again where she had left it in July. She aims to develop some mock-ups or prototypes for the three designs she and Jim created in the summer by trying to '*tease out the resources that might be online and allow for the project to be turned into an Exhibit*' (Ann's diary, 10th Nov 2010). Knowing how difficult it is to get hold of people archaeology, she emails a number of contacts in

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[94] In terms of offering opportunities for data generation and accumulation, and for me to be able to follow the travels of the token to a point where a semantic application has emerged.

good time, suggesting meetings in late November, early December, in order to show a *'small number of prototypes associated with the undergraduate student artefact projects'*, and to get their feedback on the designs. She contacts Gary (the programmer) and Mary (the archivist), both of whom agree to meet her. Of the three lecturers she emails, only one, Jack, gets back to her (Emails from Ann to Gary, 1st Nov 2010; Ann to Mary, 2nd Nov 2010; Ann to three Archaeology lecturers, Mark, Kate and Jack 2nd Nov 2010).

Ann starts her re-engagement with archaeology by dismantling to its constituent parts an Artefact-project written about a medieval building. The same issues as encountered with the other Artefact-projects emerge: the lack of online resources and the fact that the attempted translations are tied with the format and the pedagogy of the Artefact-project. However, this time the process of classifying the resources leads Ann to a significant realisation, which has a bearing on the events that follow: noting that the statements or the narrative in the projects are linked to references, she understands that the '*references were unlikely to stand alone without the narrative attached to them*' (Ann's diary 11th Nov 2010). This is when the importance of retaining the narrative structure for the project dawns on Ann, something she will continue to ponder over the next days:

> *'Well I had sat down and tried to actually translate this project into those different types of Exhibits and had got stuck on the idea... if you turned this into a single Exhibit you'd lose all the narrative which is really important in this project - - '* (Interview with Ann, 26th Nov 2010).

The importance of keeping the narrative had been noted by the team earlier in the project but the long time span in engagement and the use of Exhibit, which does not support a narrative structure, had clouded that insight during the summer. These engagements also lead Ann to question the nature of the 'case' in archaeology, leaning towards it being the entire project.

Ann revisits the three designs created in July, trying to 'work them up into current versions that include the different themes that run through the projects that I made a note of previously' (Ann's diary 16th Nov 2010[95]). The expansion of Ann's skills and capacities as a member of the interdisciplinary team means that she, the educational researcher, is taking the design and development of the semantic application for archaeology forward, rather than the dedicated technology designers. The semantic technologies have enrolled her as part of their network in as much she has managed to embrace these as part of her work.

Coming together of ideas and things

Just as Ann has understood the importance of retaining the narrative structure of the Artefact-projects in the future semantic application and that the case is an assemblage of information around the artefact, Ensemble-project is visited by a consultant, Danny, from the Massachussetts Institute of Technology (MIT). He is working with the project team at LJMU during the week beginning 22nd of November 2010 helping with technology development in various settings, especially Dance. On Monday (22nd Nov), walking back from lunch, Danny, Jim, Ann, Sam and Amy discuss other planned Exhibits, including those for the Plant Sciences and Archaeology. It is during these discussions that a technological solution for realising the semantic application for

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[95] There are no images or further data on this.

archaeology emerges. Danny, who is also interested in embedding small Exhibits in blogs, had asked if Jim was familiar with a paper by Shotton (2009) about semantically rich documents that incorporate live data. This led the researchers to discuss Stenhouse's (1978) idea of case-record[96], sparking a further idea of how to work with the archaeology data (Email Jim to Sanna 7th Dec 2010). Ann reported in her diary on 22nd Nov 2010 that the idea for the Data Aggregating Document (DAD) emerged through these (unrecorded) discussions.

While Danny was working with Sam on developing a prototype for Dance, Jim and Ann get together for a meeting inspired by the lunch time discussions and Ann's recent notes and paper prototypes (Ann's diary 22nd Nov 2010). The two engage in rapid prototyping of a semantic application. Essential for this development to happen is an understanding of the capacities of the semantic technologies, and the limitations set by the pedagogy of the Artefact-project; its learning objectives and association with professional practice; the importance of retaining the narrative structure of the report; the available, potential and essential resources (texts, images, maps, tables etc.); the structure of and access to the museum database etc. While there has not been input by the students or the lecturers at this stage, the plan is to present this prototype to them for further development.

The meeting starts with Jim explaining to Ann the difference between a hypertext and a Semantic Wiki Text by drawing on the white board (image 6.5):

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[96] Stenhouse (1978) distinguished between case record, case data and case study. Case record is, according to Rudduck is a *'Cautiously edited selection of the full data available, the selection depending on the fieldworker's judgement as to what was likely to be of interest and value as evidence'* (1984, 22 quoted in McKernan 1996).

Image 6.5 Difference between Hypertext and Semantic wikitext; white board drawing by Jim 22ⁿᵈ Nov 2010.

This idea is one of the three prototypes (see image 6.3.) planned in the summer. Jim explains how a hypertext would have links, normally appearing in white or blue, inside a normal text, leading for instance to images or other web pages. Looking at the html of these pages these links would appear in format <a href > between '*what is called the anchor*' and a reference. This is what a typical static web 1.0 web page is like. With the Semantic Wiki Text, however, the page becomes a description entity, taking as an example an Artefact-project on cruciform brooches found at Girton College[97] written by Mary, the Archivist they have been working with. The Semantic Wiki Text would have links '*written in ordinary English*', e.g. 'Girton College was founded in 1869', where the predicate 'was founded' links 'Girton College' to '1869'. That equates to a set of triplets[98] or assertions (as in the Mulgara Triple Store[99]) (Jim, at meeting with Ann, 22ⁿᵈ Nov 2010). While the relationship between the 'anchor' and the 'reference' is

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[97] Ann has already selected this as *the* Artefact-project to work on, given that they already have a meeting set up with Mary, and thus will have a chance to hear also her opinion on this as a 'student' who created the project work, rather than just as an Archivist.

[98] Triple is data in format subject-predicate-object stored at Mulgara Triple Store.

[99] Mulgara Triple Store is a metadata manager – data imported and exported is in RDF triplets (i.e. in Machine readable formats). Mulgara communicates with Semantic web applications.

not defined in hypertext, this, by contrast, is well defined in Semantic Wiki Text. Jim explains in detail how this would work technically:

> '*So, you're really doing a rigorous breaking down of the text into assertions. And *then*... as that then comes through as triples, you would be talking about being able to have facets[100], which says things like... show me the site as a whole – in fact, what we might like to do is the hierarchical facet (draws) Grave 1[101], Grave 2, click the one you want. And now you just get information about Grave 1, and you get it showing up on the map and Fedora[102].- - '* (Jim, at meeting with Ann, 22nd Nov 2010)

The two explore how the Semantic Wiki Text would work in relation to the Artefact-project in hand, finding out that '*it is full of triples'*, and could work. The purpose of this type of interactive Exhibit would be useful for the author of the project in making their text more searchable.

Jim takes a photograph of the white board, wipes it clean suggesting a different tact: rather than the starting point being the author, their '*concern may be giving the reader of that text an enhanced experience*' (Jim, meeting with Ann, 22nd Nov 2010). '*This is where we move into the DataPress model[103]*', Jim says, referring to creating blogs – html-texts - with small Exhibitlets embedded in them. This is really where the first contours of the Data Aggregating Document, a semantic application for archaeology,

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[100] A search facility in Exhibit, allows sorting data according to a selected aspect or feature of the phenomenon.
[101] The example Artefact-project deals with Anglo-Saxon cemetery finds.
[102] Fedora is a digital repository that can contain vast varieties of different types of digital data, as well as metadata in RDF.
[103] DataPress relates to a blog engine WordPress, and allows bloggers to include rich, interactive data presentations with their content. WordPress has been used by the team.

start taking shape. Naturally, all research the team have carried out at archaeology is feeding into this, including Ann's work on dismantling the Artefact-projects, her recent insight about the importance of retaining the narrative structure, the three designs from July, understanding the implications of translating Artefact-projects into a semantic format for teachers and learners; the visit by Danny from MIT, his expertise and the Shotton paper he summarised; they even mention the sandwiches on offer at the local refectory which made the team to go for lunch further afield, thus giving them time to discuss the project work more broadly. Another contributing event is the non-participation of the archaeology setting, for the design now proceeds without the planned PD workshop. Through the entanglement of these strands an idea has started to take shape and come into focus. Jim reviews this vision in relation to the Artefact-project on cruciform brooches – how to give the reader an enhanced experience? The first obvious step would be to translate the Artefact-project into html. After that the data embedded in the text could be abstracted out.

The dates, descriptions and events within the narrative of the Artefact-project, e.g. 'Girton College was founded in 1869' or excavation 'work began on the 25th March 1881', could be presented as a timeline and images online provided they have URLs. Other things that could be made 'live' are maps. The vision Jim is putting forth is of a '*kind of enhanced text*', where by the data within the text could be represented as small semantic 'Exhibitlets', rather than as static images, maps or timelines. This is the first articulation of the idea for a Data Aggregating Document (DAD). While all the previous designs have aimed at translating the Artefact-projects into a semantic form, now Jim has turned the idea on its head and suggests instead keeping the narrative as it is, creating small semantic Exhibits based on bits of data contained within that text. This idea emerged there and then, through thinking about the capacities of the semantic

technologies in relation to those of the Artefact-project in question and the purpose of enhancing the reader experience.

Jim and Ann proceed to list out the various options for visualisations there might be within the projects, including data lists, lists of coins, maps showing locations and distribution of finds in a particular location, timelines, time plots, bar charts, scatter charts, photos, images, thumbnails, drawings. The possibilities are numerous. The only not-insignificant issue he raises is the support students would require in order to create these types of semantic applications. The project would have to be done with the semantic outcome in mind from the beginning of the creation of the Artefact-project. If creating the project could be made into a similar form as the blog-engine, WordPress, Ann envisages this to be a reasonable expectation.

Materialisation of Data Aggregating Document[104]

Jim takes the Data Aggregating Document idea forward overnight. However, suddenly faced with urgency for a demonstrator at another setting, Marine Operations and Management (MOAM), he focuses on that instead of archaeology. A suitable dataset is available in the MOAM setting allowing Jim to develop the first version of a semantic application aggregating several datasets into one document through embedded Exhibtlets. Thus the first materialisation of 'Data Aggregating Document' (DAD) emerges not for the archaeology setting, but for the MOAM Deep Water project (at 3am on the 23rd Nov) (Email correspondence between Jim and the core team on 22nd and 23rd Nov 2010). Jim produces a number of versions of the Deepwater DAD, finally collating them all into a single document:

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[104] From here on I feel it is necessary to impose more structure to the writing of this section, as the gathering and translation process becomes more wieldy and difficult to follow.
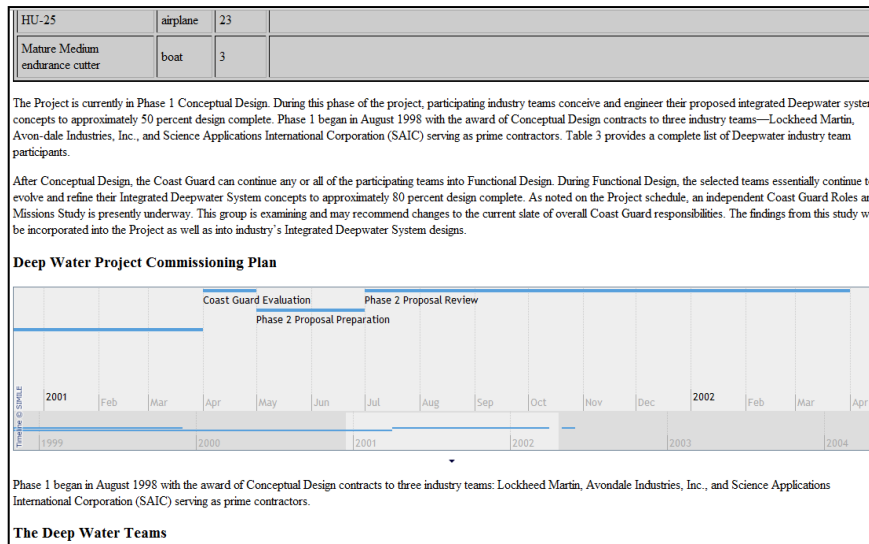
| HU-25 | airplane | 23 | |
| Mature Medium endurance cutter | boat | 3 | |

The Project is currently in Phase 1 Conceptual Design. During this phase of the project, participating industry teams conceive and engineer their proposed integrated Deepwater system concepts to approximately 50 percent design complete. Phase 1 began in August 1998 with the award of Conceptual Design contracts to three industry teams—Lockheed Martin, Avon-dale Industries, Inc., and Science Applications International Corporation (SAIC) serving as prime contractors. Table 3 provides a complete list of Deepwater industry team participants.

After Conceptual Design, the Coast Guard can continue any or all of the participating teams into Functional Design. During Functional Design, the selected teams essentially continue to evolve and refine their Integrated Deepwater System concepts to approximately 80 percent design complete. As noted on the Project schedule, an independent Coast Guard Roles and Missions Study is presently underway. This group is examining and may recommend changes to the current slate of overall Coast Guard responsibilities. The findings from this study will be incorporated into the Project as well as into industry's Integrated Deepwater System designs.

Deep Water Project Commissioning Plan

Phase 1 began in August 1998 with the award of Conceptual Design contracts to three industry teams: Lockheed Martin, Avondale Industries, Inc., and Science Applications International Corporation (SAIC) serving as prime contractors.

The Deep Water Teams

Image 6.6 The first Data Aggregating Document for MOAM Deep Water case. Source: VRE TechDev Site resources.

The new developments with archaeology and the other settings are reported to the wider team at the 25th and 26th November team meeting, including the Deepwater DAD created for MOAM, and the early stages of Exhibits created for archaeology.

On the 26th November Ann sits down to go through the Artefact-project page by page, discussing the translation process with me. We sit in her new office, which she shares with a number of other researchers. She has a printout of the scanned copy of the Artefact-project on the desk, and an OCR[105]-translated version of it on the screen of the desktop computer. Her laptop is displaying the Virtual Research Environment. Looking into this process shows the processes of gathering and translation that go into producing a Data Aggregating Document.

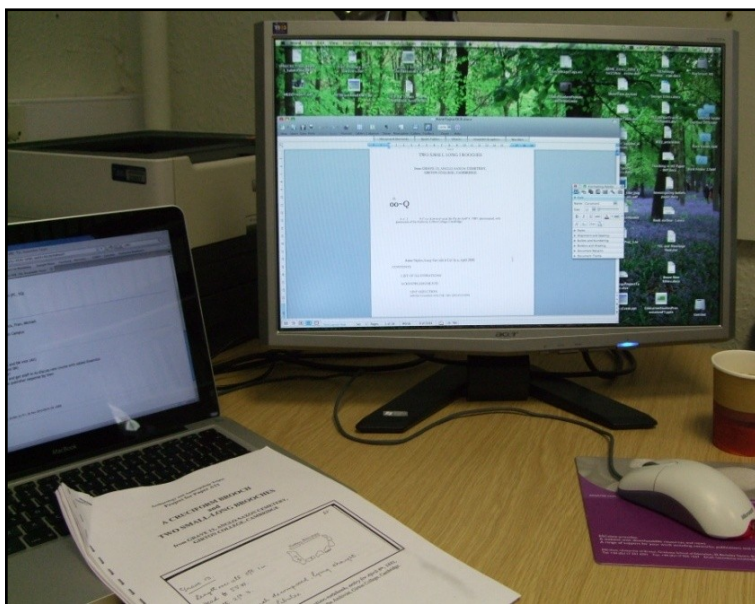[105] Optical Character Recognition; will be explained later.

Image 6.7 Different degrees of translation: photocopy of the Artefact-project with the OCR version on the big screen, and the VRE up on the laptop. Photo taken 26th Nov 2010 by Sanna

The Artefact-project is written in 2000 by the archivist Mary, a student at the time. The reason for this selection is the opportunity to show the project back to the student who made it. The study focuses on three objects found in one Anglo-Saxon grave: a cruciform brooch and two small-long brooches. The study is 24 pages long, divided into five main chapters. These include the Introduction focusing on Girton College where the brooches were found and the excavations took place; the second chapter focuses on the cemetery and the grave the brooches were found in; the third chapter introduces the brooches; and the fourth chapter discusses how jewellery was worn in Anglo-Saxon times and what evidence could be found to support this from the brooches. The last chapter presents the conclusions. In addition there are four appendices and a bibliography. The study contains four maps, some of which are from books, others from the Ordnance Survey (OS); eight photographs, mostly of the brooches and one of Girton College; sketches of the brooches; and one data table.

1) Using a template[106]

Ann is not going to start making the Data Aggregating Document from scratch but she utilizes the one created by Jim for the MOAM Deepwater case as a template (see image 6.6), which is essentially an html-page with embedded Exhibitlets. This offers Ann the structure she needs. '*I am going to replace the text and the little exhibit-bits with data from archaeology ones from [Mary]*' (Interview with Ann, 26th Nov 2010).
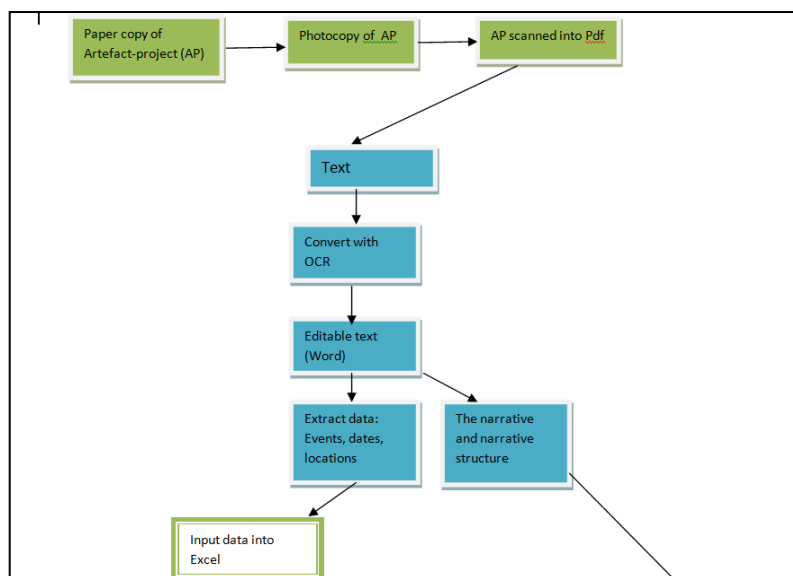
2) Converting an image of text into editable format

Image 6.8 Diagram showing the conversion process from Pdf to editable text[107].

The scanned copy of the Artefact-project has been saved as a Pdf-file, which means that the text contained within it is not in editable format. Jim has hence further converted the Pdf-file made back into a Word document using an OCR-programme[108], which

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[106] In order to make the translation process easier to follow I have decided to add subheadings in the next section.

[107] During the interviews on the Semantic Spider diagram, the technologists commented how it was often easier to communicate ideas with boxes and arrows rather than with words. I find the same thing now moving onto explaining the translation process from the paper copy of the Artefact-project into a piece of semantic technology – using diagrams with boxes and arrows enable to explain the process easier.

[108] OCR stands for Optical character recognition. This programme translates scanned images of handwritten, typed or printed text into machine-encoded text (Wikipedia, 5th Oct 2011), which can then be edited like e.g. a word document.

converts an image of text back into editable text. '*So now I should be able to cut and paste... the text from this*', Ann continues.

3) Digitising images and making these available for the Exhibit tool in the correct format

Jim has already digitised images contained in Mary's project. Doing this has required several translations of the original work.
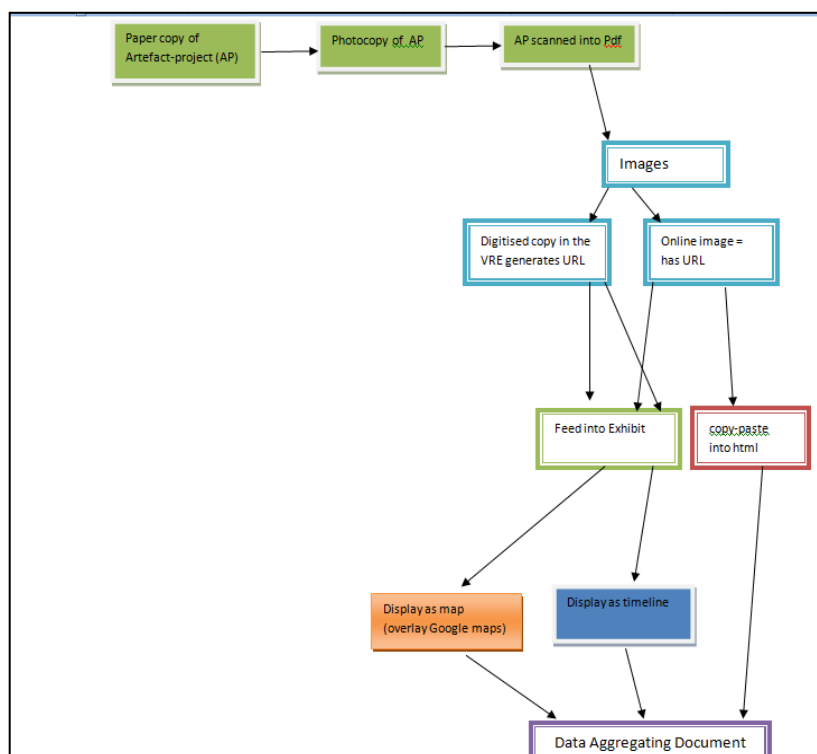

Image 6.9 Diagram showing the translation of images from original paper copy into Data Aggregating Document.

As with the text, there is the photocopied version of the original project, which has been scanned and converted into a Pdf-file and saved on a computer. Accessing the digitised version, Jim has taken copies of the images it contains, saving these individually in a folder in the VRE, a process which generates URLs for the images making these useable by an Exhibit tool and on a html page. Mary's project contains 12 images in all. One of these depicts the Girton College. Ann has tried to locate similar photographs

online, finding one in Flickr[109], but unfortunately this does not relate exactly to the same part of the College as shown in the existing photograph. Hence Ann decides she cannot '*replace this picture as such, but I can give the suggestion that you could feed in Flickr pictures of Girton College with a certain search term attached to it*' (interview with Ann 26th Nov 2010). *Technically* it would be possible to pull in photographs from online services. This is one of the rare situations when the technology would be up to date and available but the content might not. The lack of a suitable online image means that as a work-around the one used in the DAD is a digitised version of the already photocopied photocopy of the original:
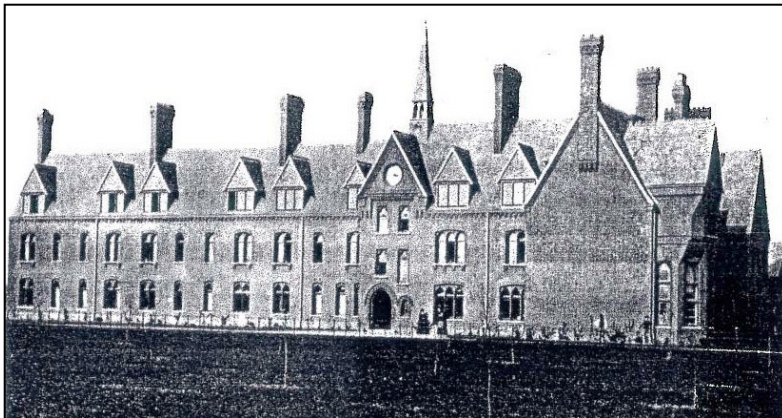
Image 6.10 Photograph of Girton College taken in 1874, showing the 'Old Wing' and the 'little rough field' which proved to be the site of the Anglo-Saxon cemetery (from Jones 1913, 23). In: Artefact-project on Anglo-Saxon brooches (2000).

4) Extracting and converting data into RDF and displaying these as Exhibits

Ann had already created spreadsheets in Excel for excavation events and locations for Anglo-Saxon cemeteries in the area. She had extracted these from the Artefact-project by combing through both the text and the photocopied maps (Ann's diary, 24th Nov 2010; Interview with Ann, 26th Nov 2010). The Excel sheet contains columns for 'label', 'type', 'title', 'parish', 'location', 'source', 'description', 'subject' and 'period'. Ann had then mapped the grave locations found in the Artefact-project onto available

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[109] An online service for sharing photos and videos.

online sources through the English Heritage Gateway website. This had given her the exact latitude and longitude for each grave, which enables displaying these on the map.

	A	B	C	D	E	F	G	H	I
	label	type	title	parish	latlong	source	description	subject	period
1		location	Inhumations, Queens Way, Oakington	Oakington and Westwick, South Cambridgeshire, Cambridgeshire	52.260472, 0.071849	http://www .heritagegat eway.org.uk /Gateway/R esults_Singl e.aspx?uid= MCB12822& resourceID= 1000	Rescue excavations recovered Saxon inhumations and grave goods	Inhumation Cemetery	Early Sa (501AD 650 AD)
2		location	Saxon Cemetery, St John's College cricket field	Cambridge	52.208587, 0.107490	http://www .heritagegat eway.org.uk /Gateway/R esults_Singl e.aspx?uid= MCB5955&r esourceID= 1000	multiple excavations at St John's College Playing Fields suggesting a cemetary site	Mixed Cemetery	Early Sa to Middl Saxon (AD to 70 AD)
						http://www .heritagegat eway.org.uk /Gateway/R	A variety of Roman, Saxon and		

Image 6.11 Excel sheet with location data for graves. Source: The VRE, TechDev site resources

The Excel-files are not directly usable by Exhibits, so Jim has translated these into the desired JSON-format[110], using a data conversion tool Babel[111], making them machine readable.

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[110] JSON stands for Java Script Object Notation. Designed for 'human-readable interchange'. The JSON format is often used for serializing and transmitting structured data over a network connection. It is used primarily to transmit data between a server and web application, serving as an alternative to XML. (Wikipedia, 5th Oct 2011) If a file is already in XML format, the Exhibit tool can read it without conversion. All other files need to be run through a conversion tool, like Babel (see below).
[111] Babel is a conversion tool that translates digital, i.e. human readable data into machine readable format (into RDF –triplets). It can translate between multiple data formats. Babel is an MIT Simile tool. Website for Babel: http://simile.mit.edu/babel/.
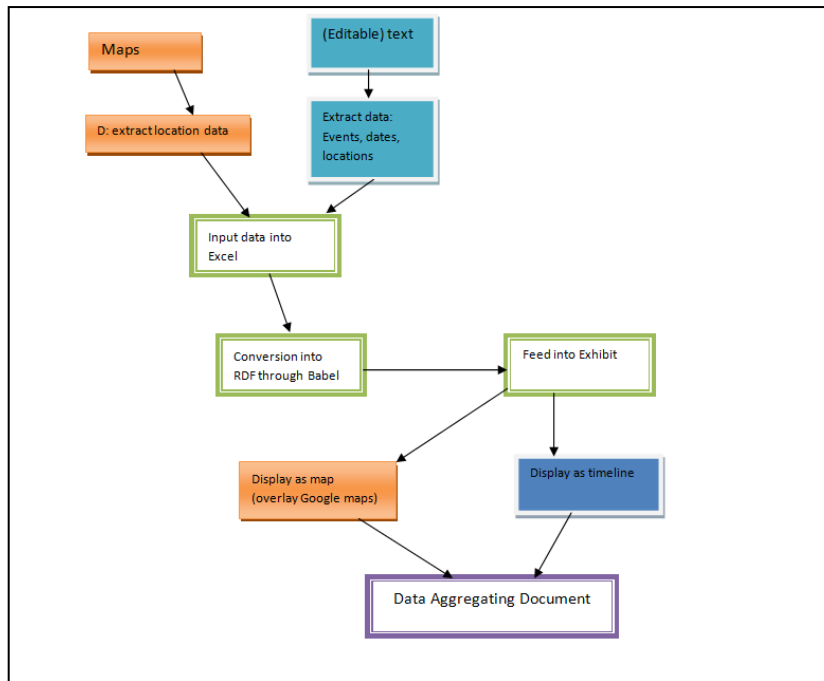
Image 6.12 Diagram showing the data conversion process for use in Exhibits within the Data Aggregating Document.

Timelines can be created through a similar conversion process. Ann clicks open the file displaying the two Exhibits created by Jim, a timeline of the excavation events, and a map displaying the locations where the brooches were found. It is these that Ann now needs to insert text in between. (Interview with Ann, 26th Nov 2010)
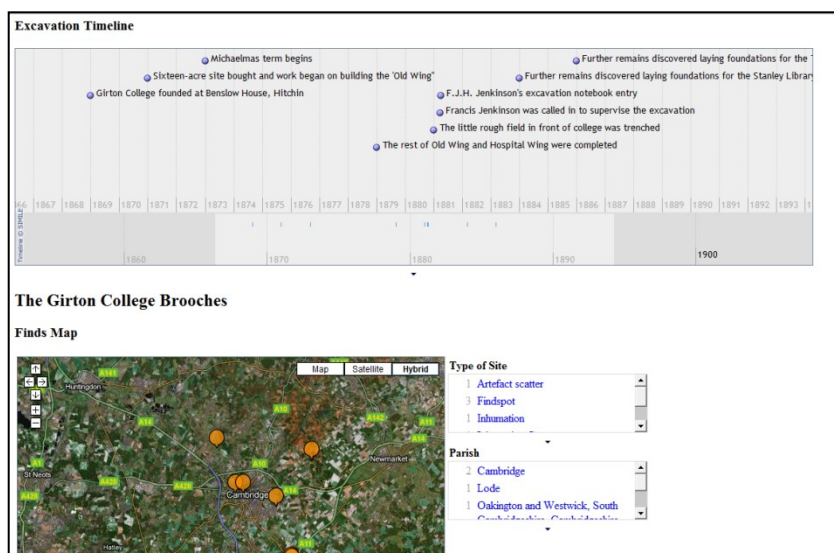

Image 6.13 screen print of the first girton_brooches.html exhibit version.

5) Translating static maps into interactive or online ones

The Artefact-project contains a number of maps, which could be converted into Exhibits or at least replaced with digital ones. The project contains a map from 1947 showing the area around Girton College. Ann had planned on replacing that with an Ordnance Survey map found on the British History online site. However, the maps are not downloadable, which forces Ann to find a work-around. She has to resort either to taking a '*naughty screen capture*', or simply linking to the map from the DAD, which she ends up doing (Interview with Ann, 26th Nov 2010).
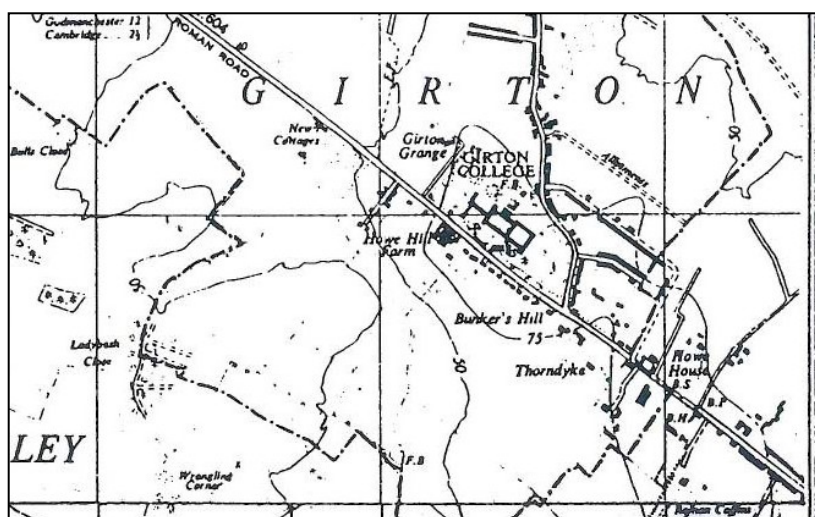
Image 6.14 Section of the Map of the Girton Parish -reproduced from 1947 OS map (from Bashford and Bolgar 1977). In: Artefact-project on Anglo-Saxon brooches (2000).

The other map within the Artefact-project has been turned into an Exhibit already. The map is a photocopy from a book published in the 1996, showing the locations of Anglo-Saxon cemeteries found in Cambridgeshire marked with x's.
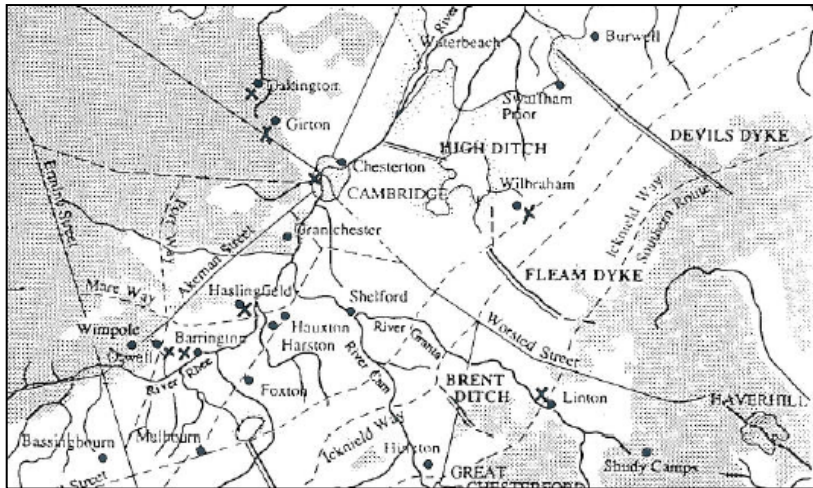
Image 6.15 Section of the map showing some of the early Anglo-Saxon graves. (from: Malim 1996, In: Artefact-project on Anglo-Saxon brooches (2000).)

As the map was relatively recent Ann and Jim had reasoned that it could be easily updated. The necessary location data was found from the English Heritage website, which publishes all excavation reports. This had allowed them to make the map live. The downside of this service was that while the data in principle was readily accessible, there was no opportunity to download it in XML-format (Interview with Ann 26th Nov 2010). The nature of technology has made Ann take a detour cutting and pasting the necessary information into an Excel-sheet by hand. Jim had then converted that to the map-Exhibit seen earlier (see image 6.12). Ann explains about filtering the data on the map:

> '*for which parish the artefact was found in, and there were categories for type of site as well, so... So for instance 'find spot' actually means someone with a metal detector found it there. So they might not judge that to be as important or interesting as a proper inhumation ceremony or cemetery or other*'. (Interview with Ann, 26th Nov 2010.)
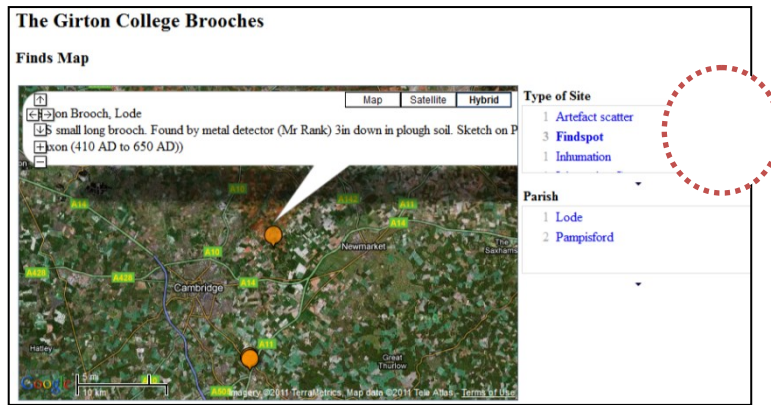
Image 6.16 Screen print of Map Exhibit showing the faceted search for 'Find spot' and the results on the map. One spots lens has been clicked on to show more information.

Ann and Jim plan to add data 'sucked in' from the museum archive through the XML-feed, and add that together with the English Heritage data in the map Exhibit. This is in fact the first opportunity for aggregating data from two diverse sources, Ann explains *'which we would be able to do live, if we had live feed in, but we can't (laughs)'*. The possibilities offered by the new technology are thwarted by the practices embraced by the old ones – while the data in principle is openly available, in practice there is no useful way of getting it easily from the database.
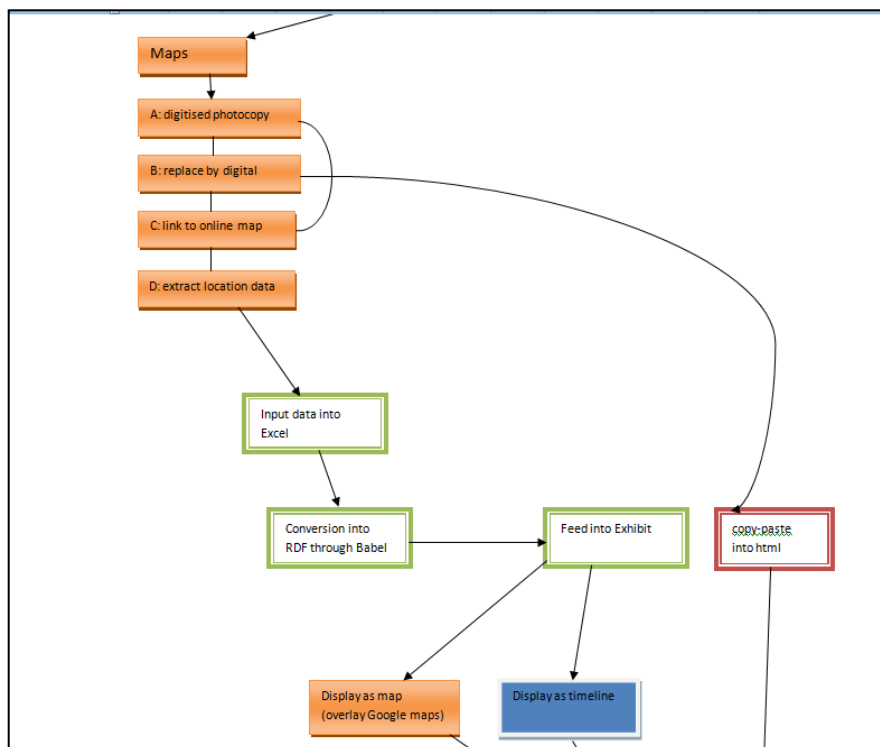

Image 6.17 Diagram depicting the translation process of maps for use in DAD.

6. Static content

Ann continues to leaf through the Artefact-project explaining how it gets quite descriptive about each of the three brooches, which the author has described according to the classification table. The associated images, some of which the author has sketched herself will not be replaced, but simply scanned and added in. Further, she does not see any reason to change any of the standard descriptions within the report, which are part of the practice of doing this project. Ann thinks however that it might be possible to put those descriptions into a table. This would mean linking these to images of cruciform brooches would make the descriptions more searchable.
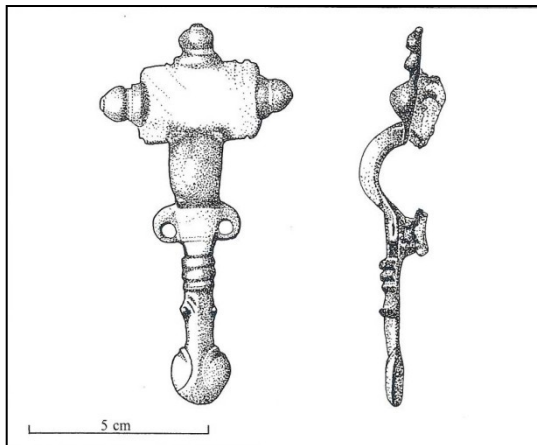

Image 6.18 The originally hand drawn inscription of a cruciform brooch after several translations as a digitised image. Source: Cruciform Brooch Artefact-project.

Towards the end of the project the narrative moves from simply compiling information to theorising about the social use of the brooches, how these were worn and what types of textiles are still attached to these brooches, *'so this is the kind of thing that we would want to remain as text, as it is very much like an essay. So I'll just cut and paste that through. We've got photos that she's taken herself, and there's meaning in how she's displayed them, so we wouldn't want to replace that at all'* (Interview with Ann, 26th Nov 2010). After that there are only the conclusions and appendices left. A full diagram of the translation process is below.
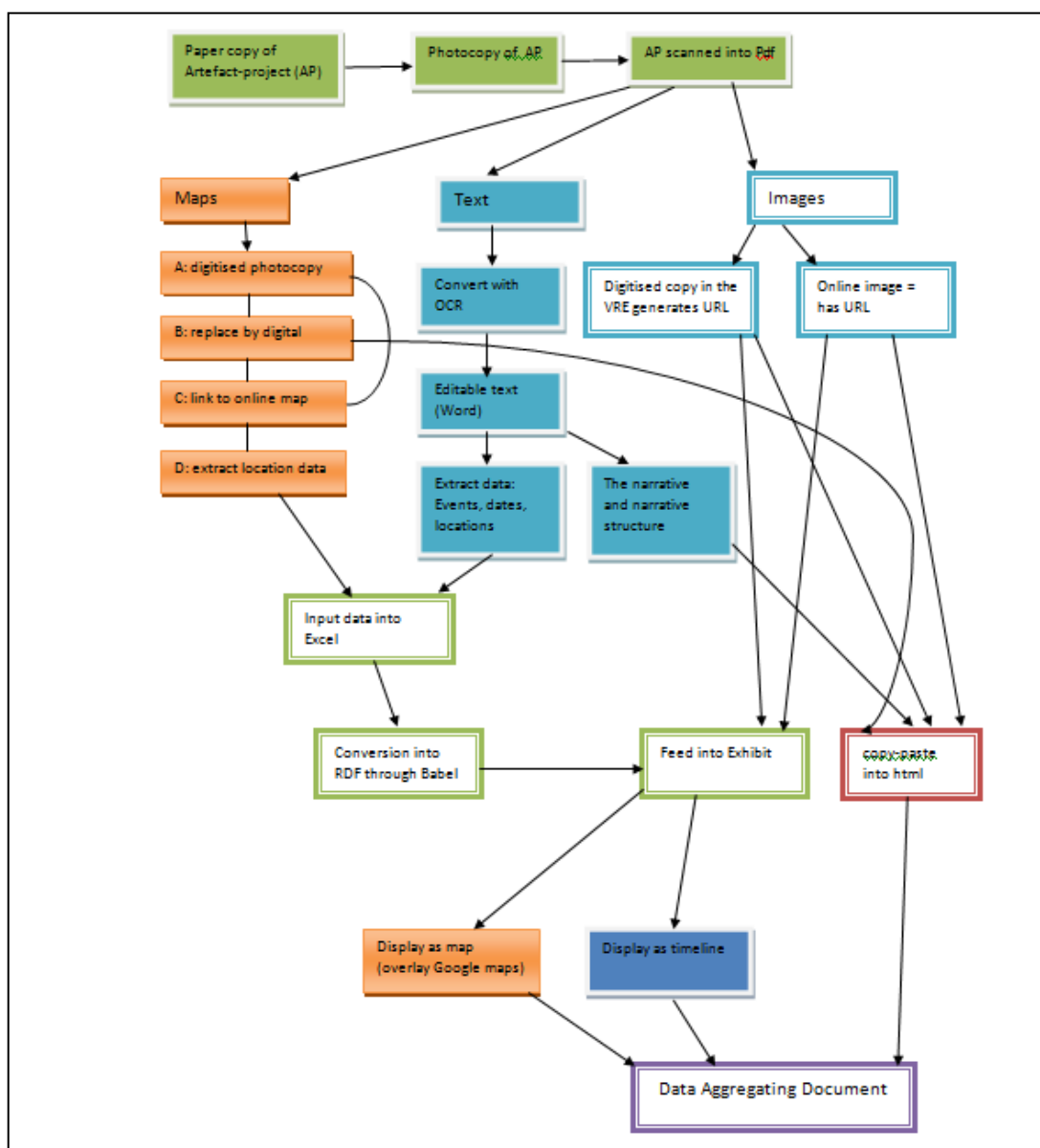
Image 6.19 Diagram of the translation process from an Artefact-project into a Data Aggregating Document.

The plan for translating the Artefact-project into a Data Aggregating Document is ready. Ann is clear about what can be done in terms of technological and material capacities and within what kinds of parameters. At this stage the practices embodied in the various data sources proposed diversions to directly using digital resources. The most urgent need is for the map Exhibit to aggregate data from two different sources, the Heritage Gateway data with that from the museum archive. Jim takes this upon himself to do. Ann wishes to show the DAD made on the Brooches project to Mary, the

author of the report, and see '*if she thinks it is a good representation of her project, and whether it has given her any ideas about how online data could be used*' (Interview with Ann 26th Nov 2010). However, she would also like to take it to the Open Knowledge Foundation Special Interest Group (SIG) for Archaeology, for making archaeology data open, so that they could use it perhaps for making data more available. In addition, Ann has discovered - looking online on different reports on cruciform brooches - that the student Artefact-project is similar to a basic archaeology excavation report, which is '*more of a case record type of report*'. This has made her think that these must have a standardised format, and that people could use several different case records to make a case study, e.g. on '*social use of brooches in Anglo-Saxon days*'. Given this, Ann suggests that having these reports within integrated exhibits could be potentially relevant to the whole field of archaeology generally, something she hopes the team are able to explore in the future (Interview with Ann, 26th Nov 2010).

Enacting the Data Aggregating Document

Ann had arranged to meet Mary originally to show her the three paper prototypes for designs she and Jim had created in July 2010, to get her opinions on these. Now, however, she has an actual piece of technology, a result from rapid prototyping based on available data, sufficient technological know-how and understanding the nature of Artefact-projects pedagogically and materially. Creating the Data Aggregating Document on Mary's Artefact-project also works by way of getting student feedback on the prototype. In this section I will focus on the Data Aggregating Document and on what has emerged, for this is as far as I am going to follow the research team and the translations of the token, even if it is clear that the project is not finished and will still

continued for another year. The academic conventions of doing a PhD force me to 'cut the network' here and take stock of the whole process. However, before we leave the token and the team, let us examine what the token has been translated into.

Jim and Ann have worked over the weekend (27-28th Nov 2010) to create a functioning version of the DAD based on the plan Ann had articulated on the Friday (26th Nov) to have it ready on time to show Mary the following Tuesday 30th November. The day Ann and Jim meet Mary is her very last day of work before she retires[112]. She will thus also be leaving the network in which she has been a crucial participant. In addition to the Data Aggregating Document, Ann and Jim also present to Mary the other two proposed designs explaining why these did not work.

The first paper prototype displays a common Exhibit type, with data displayed in the middle, and search facets located on the side (see e.g. image 6.2). The idea behind this is to create a semantic tool that would allow the students to search, filter and locate existing Artefact-projects easier. Mary's immediate reaction is to think about the practicalities of this suggestion: who would this be useful for, and who would do all the scanning? In terms of usefulness, Ann explains how this tool would make it easier for students to locate previous work, which currently exists as hardcopies held by the lecturers. Doing this would enable them to '*see some examples and place those in relation to other ones, and they'd be able to go online to do that*' (Ann, meeting with Mary 30th Nov 2010). Regarding scanning somebody would have to do it, and from now on, the students should also hand in a Word version of their projects. Jim adds that with this example, in addition to filtering down the topics, there is also the option of widening the search out from the existing topic '*- - you've also got the option of 'now*

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[112] The meeting is recorded, and also videoed, but unfortunately the video recording has been lost. This would have shown the computer screen to accompany the voice recording of the event.

go and find me other things that are like this'; 'now go and link these to museum collections' (Jim, meeting with Mary 30th Nov 2010). In order to do any of this in practice, however, the students should be made to tag their project works, but in order for this to work, a systematic vocabulary –an ontology – should be used, for it is essentially the tagging which links these projects up to other museums (Jim and Ann, meeting with Mary 30th Nov 2010.)

Mary ponders over this suggestion. On the one hand she is worried that putting the Artefact-project online, '*the whole creative process of making it loses out',* for the advantage of making these projects is to go through the process of finding snippets of information from museums or archives, and then pulling that information together. But on the other hand, '*if all those documents are online, then that would be an excellent thing. Cos then people would have all that information'* (Mary, meeting 30th Nov 2010). Ann reassures Mary that the team are not proposing this as an *'online replacement'* for writing Artefact-projects, but the advantage would be related to the movement in all disciplines for making this type of information more open and accessible.

The first prototype relates directly to the original Plan of creating a tool that would link the Artefact-projects into the museum database, thus increasing the available knowledge base on objects, and making previous Artefact-projects more available to future generations of students. The plan to link the projects to the museum was quietly abandoned during the year, as doing this in practice this would require a lot of work on the part of the archive and as well as changes to teaching of the Artefact-project. The biggest challenge would be the ontology, without which an agreed set of key terms is not possible, which is vital for this tool to work as planned.

The second design starts from a focal object, exploring the possibility of converting the Artefact-project into a single Exhibit. However, the problem the team discovered with trying to translate a written project into a single Exhibit is that much of the descriptive, narrative content within the project is lost. This would affect not only the nature of the exercise of creating Artefact-projects, but also what is learned by creating them. Hence, keeping the narrative structure of the Artefact-projects was essential, and for this reason this design would not be an ideal solution.

The third example, the Data Aggregating Document, is closest to the original Artefact-project. Jim explains how they had started out from the paper version of the project, and thought of different ways of turning that into a technology, only to end up coming back to the original paper version to explore '*what we could do to make that an online document*' (Jim and Ann, meeting with Mary 30th Nov 2010). The DAD contains the main sections of Mary's Artefact-project, but its format resembles a long html-page. As Jim puts it, whereas the paper prototypes Mary saw earlier were '*effectively trying to turn the whole document into a kind of web presentation*', this tool is '*turning it inside out, and saying, keep it as a document, but put the web bits into it*' (Jim, meeting with Mary 30th Nov 2010).

Ann begins by explaining the translation process Artefact-project has gone through to become the one online (as explained above), moving then over to the top section of the DAD on the computer screen. Here we see the title of the project, the author's name, the course title and a hand drawn image of the grave outline where the three brooches discussed in the report were found:
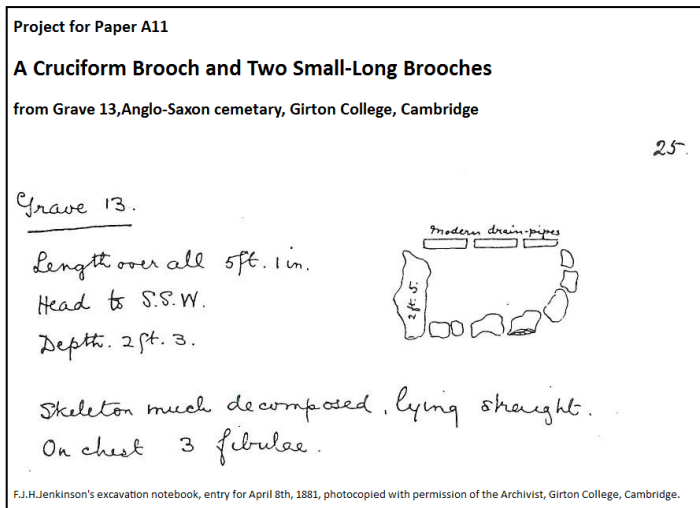
Project for Paper A11

A Cruciform Brooch and Two Small-Long Brooches

from Grave 13,Anglo-Saxon cemetary, Girton College, Cambridge

25.

Grave 13.

Length over all 5ft. 1 in.

Head to S.S.W.

Depth. 2ft. 3.

Skeleton much decomposed, lying straight.

On chest 3 fibulae.

F.J.H.Jenkinson's excavation notebook, entry for April 8th, 1881, photocopied with permission of the Archivist, Girton College, Cambridge.

Image 6.20. Top section of the DAD version girton_brooches_5.html.

The contents page has been made interactive, consisting of hyperlinks that take the reader directly to their chosen section of the report. The smaller hyperlinks lead to the related Exhibits (e.g. see the link under Section 1 'Introduction, Girton College and the 1881 Excavations').
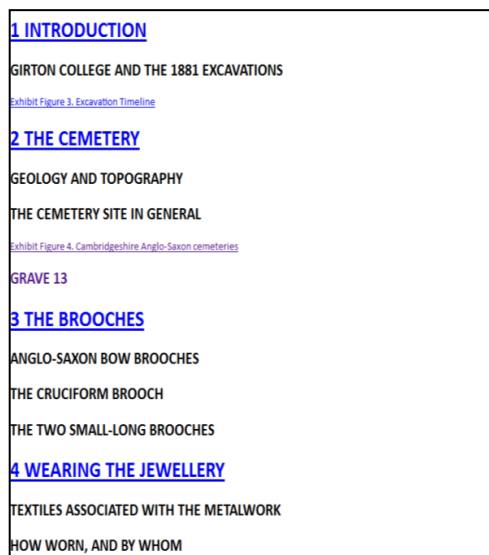

1 INTRODUCTION

GIRTON COLLEGE AND THE 1881 EXCAVATIONS

Exhibit Figure 3. Excavation Timeline

2 THE CEMETERY

GEOLOGY AND TOPOGRAPHY

THE CEMETERY SITE IN GENERAL

Exhibit Figure 4. Cambridgeshire Anglo-Saxon cemeteries

GRAVE 13

3 THE BROOCHES

ANGLO-SAXON BOW BROOCHES

THE CRUCIFORM BROOCH

THE TWO SMALL-LONG BROOCHES

4 WEARING THE JEWELLERY

TEXTILES ASSOCIATED WITH THE METALWORK

HOW WORN, AND BY WHOM

Image 6.21 Screen print of the contents section of the DAD version girton_brooches_5.html.

Clicking on the 'introduction', Ann comes to the narrative section of Girton College and excavations, including a static map showing the area of Girton College in 1947.

While Ann had not been able to convert that into a digital format, she had been able to add a link to an online OS map from 1889:
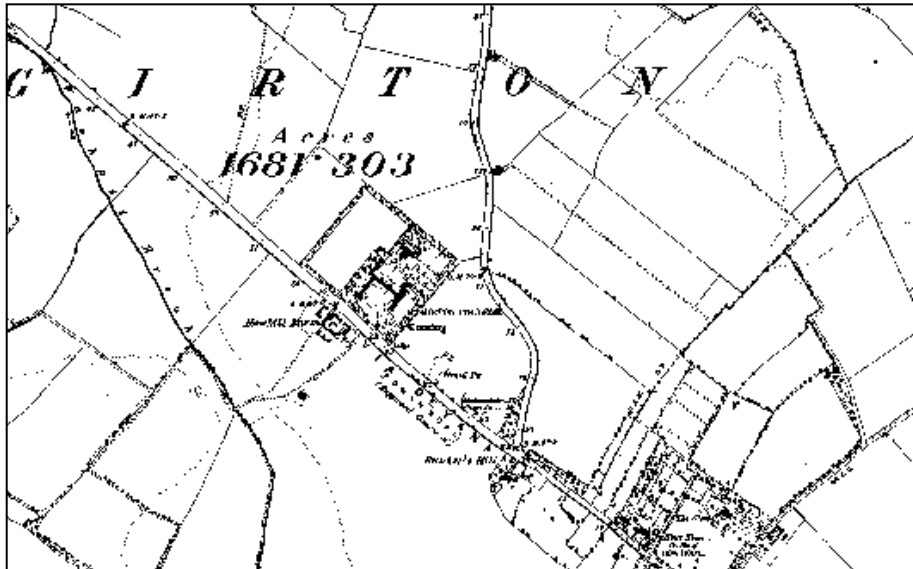

Image 6.22 Screen print of 1889 OS map the DAD links to instead of an interactive map. At British History Online, 'England - Cambridgeshire: 040/SW', *Ordnance Survey 1:10,560 - Epoch 1* (1889).URL:http://www.british-history.ac.uk/mapsheet.aspx?compid=55109&sheetid=1238&zm=4&x=147&y=168&ox=1131&oy=1292 Date accessed: 09 December 2011

> *'Well there's your map. Interesting thing about this map is that, I *assumed* we were going to get an online version of it, and I *did* manage to get an 1889 version of the map on British History online, but you *can't* actually link it into your own webpage, you have to link *to* it. So I have a clickable link where you can link to the map. So you have these clickable elements here and you can see a modern version of it as well. But as much as I thought I was going to come up with a clever online replacement for the static map it is not a reality at the moment.'*
> (Ann, meeting with Mary 30th Nov 2010)

The reason for this is that historic maps are available only for a fee, something that affects creating technologies. Having an interactive map of the area would be useful in

order to '*zoom in on the Girton College and perhaps impose on it the modern map. - - Because then when you are walking around Girton you would know more precisely where you are*' (Mary, meeting 30th Nov 2010).

After the map Ann shows the photo of Girton College (see Image 6.10), and explains that while technically it would be possible to create a gallery of photographs, there had not been a suitable online replacement for this one available, and they had had to use a digitised photocopy of the original photo. The photo is followed by a semantic application, a timeline. Ann explains:

> '*This is a semantic web application, a resource which I added into your figures. That sort of arose out of the description that you had of the excavation. Time line, you can click on the little figures - - you can get extra information, you could have links and images, extra info you didn't want to add in the narrative. What do you think of the time line format?*'
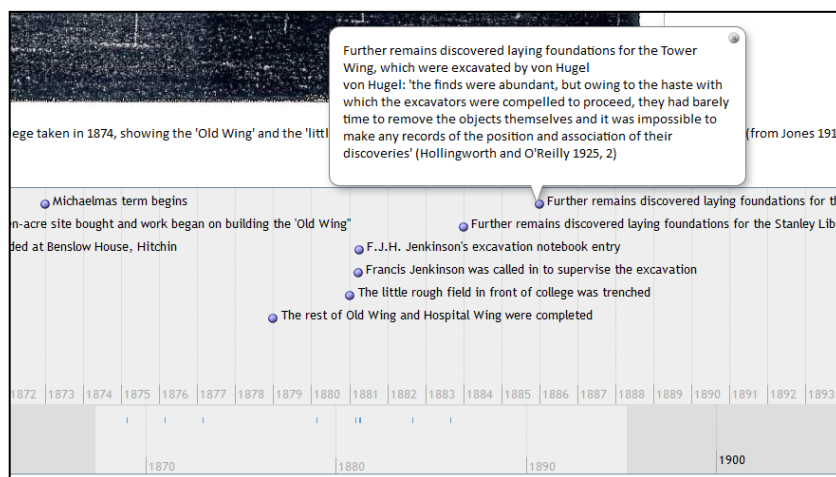> (Ann, meeting with Mary 30th Nov 2010)

Image 6.23 Screen print of the contents of the DAD version girton_brooches_5.html showing the improved timeline Exhibit, where some lenses show more information about the added events.

Mary is impressed by the time line and thinks the students would benefit from this as they would be able to '*juggle things around*' – it would help them to make connections between different events and things. She finds it amazing that you can just '*put in your information and click a button, and to be able to create *that**' (Mary, meeting 30th Nov 2010). The researchers admit they are not quite there yet: '*If someone was going to do another project like this, they would have to build the spreadsheet, first task would be to compile that and then present the time line*' (Jim, meeting with Mary, 30th Nov 2010). Compiling a timeline and preparing the spreadsheet are tasks that the students would need some support with. Finding the information relating to the Artefact-project, however, could be done largely as it is currently carried out, with the exception of perhaps utilising more online sources.

The other Exhibit embedded in Mary's project is the distribution map of the Anglo-Saxon cemeteries:
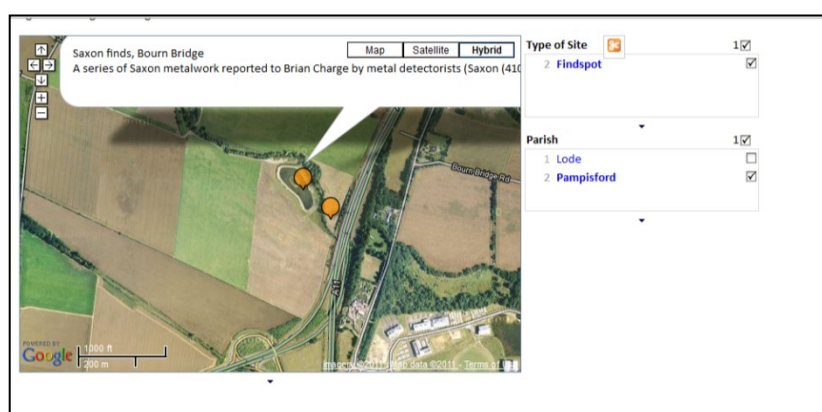

Image 6.24 Screen print of the filtered and zoomed-in section of the map showing the Anglo-Saxon cemeteries in Pampisford in Mary's Artefact-project.

Given that the map Mary had used was quite recent, from 1996, it had been possible to find more recently found cemeteries in the area, and translate these into an online Exhibit. The British History online site had returned seven hits for Anglo-Saxon cemeteries in the area. With this data Ann had been able to create a spreadsheet (by cutting and pasting in the absence of a down-load option) as full descriptions with data

labels and headings were available through that online dataset. The location data had enabled them to overlay the cemetery sites on Google maps shown in the Exhibit. The descriptions contained in the British History Online data, for instance terms like 'parish', afforded the creation of a faceted search for filtering these and other types of searches. The lenses, the little colourful blobs on the map, allow linkage of the points in the map to additional information, such as images etc. Furthermore, the map zooms in and out of the area. Jim points out that a map like this, provided it was linked to a live feed of data from the British Heritage site, could change over time. Hence, '*the danger is you write the narrative, and the map is evolving and the narrative stays the same*' (Jim, meeting with Mary, 30th Nov 2010). The map could obviously be locked down, or the data could be copy-pasted, as they had done, so it would reflect the situation at the time of the writing. However, if the map was live, the document would run away from the narrative (Ann, meeting with Mary 30th Nov 2010).

The rest of the project contains text, images, photos and sketches found in the original Artefact-project. Ann had wanted to turn the contained classification tables into timelines too, but had run out of time. The images of the brooches from different eras could have been linked to different points in the timeline. Mary finds this idea very useful, and they discuss different classifications systems for a while. Ann then takes Mary over to the end of the DAD to the Appendix section, which she has replaced with an Exhibit created by Jim using the data from the Museum Archive XML-feed. This version only displays a section of the data related to the Anglo-Saxon sites.
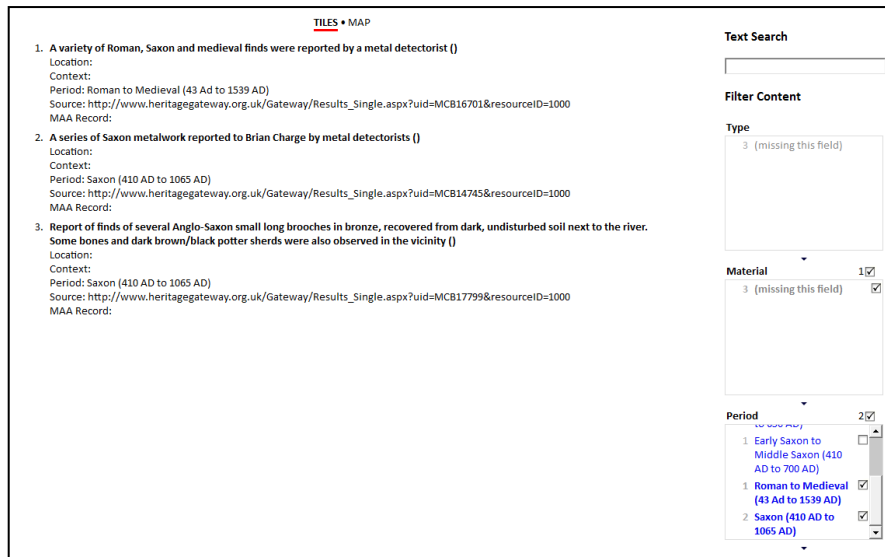
Image 6.25 screen print of the Appendix section of the Girton_brooches.html DAD displaying three filtered search finds.

With this type of visualisation it is possible to show the data in different ways, but how this can be done depends on the information that can be retrieved from the (museum) database. Issues that affect this are for instance the tiered access to data – who is allowed to see what - and the robustness of the ontology - whether the keyword set is agreed, something that affects the accuracy of faceted searching. Hence this Exhibit is here only to demonstrate what *could* be achieved. Ann asks whether this type of functionality – the possibility to visualise data in different ways - would be any good for a project like Mary's, to which she enthusiastically agrees. Having large datasets displayed visually would reveal outliers and anomalies, which Mary thinks is very useful. She is also happy for the Ensemble-project to go ahead with the development of the DAD.

The engagement with archaeology did not proceed very vigorously after this meeting, albeit the team did show the DAD to one of the lecturers and the technology developer for further feedback. Other than that the entire assemblage gathered round the archaeology setting gradually unravelled with Ann leaving the project, and Mary, their most important contact at the setting (with the view of technology development)

leaving her post at the archive. My attention now turned to dealing with the existing data rather than following the unfolding events. Those settings that were more open to innovation and collaboration with the research team had the rest of the teams' attention and interest.

So what has emerged?

Starting to follow the translations of the token I assumed that the end point for this investigation would be the moment when a finished piece of semantic educational technology for enhancing case-based learning in archaeology emerged, ready to be used by the discipline. Now, while something most definitely has emerged, and it does have a material form, what we have is anything but a complete, fully functioning and perfect piece of technology. As things stood in November 2010, with the assemblage unravelling, the Data Aggregating Document in archaeology did not solidify into a much more advanced format than what we saw here in this meeting, leaving the teaching and learning practices in archaeology largely unaffected.

The original Plan, which formed after the case and a niche for technology development for archaeology had emerged, was to find a way of linking the Artefact-projects to the museum's database utilising the capacities of the semantic technologies. The idea was that this would make the Artefact-projects more available to students, supporting their case-based pedagogy, while also adding to the museum's database. This was also planned to be contributing by way of technological insight into the large museums' database project. Scientific practice is goal oriented, but as Pickering states 'no one knows in advance the shape of future machines and what they will do[113]' (1995, 14).

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[113] The 'machine' in the quote can be replaced by 'software' in this instance.

This depends on 'the practical, goal-oriented and goal-revising dialectic of resistance and accommodation' (Pickering 1995, 22-23) of the socio-material agencies.

As Ann set out to translate the Plan into practices of research and development, she first had to enrol a number of allies in order to gain access to information and examples of the Artefact-projects in order to study these. This was quite a straightforward process once an important gatekeeper, Mark, was onboard the Plan. Through him the project gained access to further resources, information and examples of the Artefact-project. However, just as the team were ready to engage the setting in participatory design activities, the prospective workshop participants were not available anymore. This situation forced the team to put their activities on hold and wait to see if they could re-engage and re-enrol these participants later on in the autumn. Unfortunately important momentum was lost, and the assemblage started unravelling at this point.

The Artefact-project itself resisted attempts at being translated into an Exhibit, a single semantic application. Not only were the resources used in writing these largely not available in a digital format, a prerequisite for a semantic technology to work, but also the range of types of artefacts being written about was vast, e.g. from a building to a piece of flint. The purpose of creating the Artefact-projects - to introduce students to aspects of archaeological professional practice - resisted the translations as well. Several suggested designs would have meant that the learning objective – learning about the professional practice – would have been lost in the process, or the process of creating the Artefact-projects on-line would have required more support than currently was available. Realising the importance of retaining the narrative structure of the Artefact-project was vital in its translation into a semantic tool, as was the 'injection' of technological insight into the team's thinking by the visiting consultant from MIT.

Keeping the narrative structure meant the learning objective would be met, and that also the use of off-line sources was possible.

It would be unrealistic to expect the students to be able to turn their Artefact-projects into a Data Aggregating Documents. The prototype shown to Mary can simply demonstrate the concept of what *could* be done using this type of technology. Rather than offering a solution to the a problem of how to link the student Artefact-projects to the museum database, DAD became a means of raising and discussing issues to do with the nature of online data, access to that data and how the restrictions around downloading it affect how information can be represented. It also highlighted issues to do with the nature of working practices in archaeology.

The museum database and the semantic technologies did not manage to fully enrol each other, for the museum archive lacks a standardised key wording system, a robust ontology, without which the semantic technology does not work as expected. Similarly, the varied standards in scales of measurement in data have implications for the development of semantic technologies. These are critical issues for the development of semantic technologies more generally, something that should urgently be addressed if semantic technologies are to expand to this domain in the near future. Other considerations highlighted by the DAD are questions about data accessibility: while there is a growing trend for data to be made openly accessible, in practice this is still only an aspiration. The data either are not downloadable, or these do not exist in the necessary (XML) format.

Our original token, Research Question 1, a materialisation of a vision of what-might-be has become translated into a *concept* for a Data Aggregating Document, which materialised as a prototype shown to Mary. DAD shows *what might be possible to*

achieve should the circumstances be right. The tangible materialities and practices of archaeology mean that semantic applications remain a vision for future in this setting. The research and development process has had to accommodate the way the heterogeneous actors and their agencies have resisted and assisted its progress. At present, in November 2011, I do not know if the token has been translated further or if it has travelled someplace else, but given that the translation is not an outcome but a process, it is possible that we may find it at some point in some new location, doing new things.

7. The precarious nature of research and development

Ethnographic research methods have been used in studies that seek to understand the everyday way of life and practices of a given group of peoples. In the past few decades the ethnographers' attention has turned to 'tribes' closer to home, to scientists working in laboratories or in the field (e.g. Latour and Woolgar 1979, Latour 1999), forming a new domain called Science and Technology Studies (STS). This ethnographic case study has focussed even closer to home, to the work of fellow educational researchers and social scientists working with technology developers in a joint project studying case-based learning in a number of disciplines in Higher Education with a view to developing semantic technologies for supporting that pedagogy. The current study also aligns with a new field of Studies in Social Science and Humanities (Meyer et al., 2008) which is emerging alongside and from within the STS. Interdisciplinary endeavours between domains pertaining largely to the natural and the social sciences respectively have not been studied very commonly within either area.

The current study has had three points of interest. The first one has been to open up to scrutiny the interdisciplinary research and development processes taking place in the Ensemble-project and to seek to understand how a shared research question becomes answered in practice when divergent research approaches are brought to bear upon it. While the practices of scientists have been studied for a few decades now, those of social scientists and educational researchers working with technology developers have not been the focus of a similar study to date. The second point of interest has been to study how the envisaged piece of semantic technology came to be – or not, as also might be the case - through the research and development practices engaged by the team. As we saw, what emerged was a *concept* of what-might-be rather than a fully

functional, ready-to-use application. The third aim in the study has been to assess the capacity of Actor-Network Theory, the approach I have been working with, for studying the unfolding, open-ended processes of research and development in real time. I have argued that conceptualising ANT as *theoretical practice* best describes the all-encompassing way that ANT has enabled me to approach the research topic both methodologically and analytically. While the data either accumulated or was generated through multiple ethnographic research methods and through *critical ethnographic participation*, ANT has worked as a more general *sensibility* to the topic, as a way of thinking of the processes and making sense of what has been happening. While the study has incorporated concepts originating from the classic ANT studies, such as the 'token' and 'translations', the current study can be located within the post-ANT (cf. Law 2009) which aligns with the performative and practice turns in social theory. Hence the focus has been on the doing, on the practices engaged in the project between the heterogeneous participants.

To start answering the research questions I had set for myself, conceptualising the first research question of the Ensemble-project as a 'token' (Latour 1987, Gaskell and Hepburn 1998) suggested itself as a way into the mass of data. The study proceeded by following the trails of translations of the token through research and development practices. The focus was on these in relation to one of the six research settings, the discipline of archaeology at the University of Cambridge. Foregrounding practices (cf. Mol 2003), the doing of research and development, made it possible to examine how the token became reconfigured as part of these. For instance, we saw the token multiplying in the process of research through enactments of divergent research hinterlands, and materialising into conflicting interpretations of data. These unified again into a single token, where the divergent interpretations became translated into a

tension under the pressure to follow the shared goal in a joint project. This gave space for both interpretations to exist for a while. Being manipulated as part of research practices the token has thus not only multiplied but gone through series of translations. This element of transformation of the object-being-manipulated-in-practices differs from that in Mol's study, where the disease, while multiplying in the different practices engaged in the Dutch hospital, is still seen as remaining as the 'same disease' (Mol 2003). Here however while the token starts out as a research question, it finally emerges as a *concept* for a Data Aggregating Document, materialised as a prototype for a piece of semantic software in a process where each step is traceable back to the original token.

Approaching the token from their respective hinterlands the researchers produced divergent 'realities' (cf. Law 2004). For instance, we saw the emergence of two conflicting 'realities' early on in the research process when the team arrived at two contradictory sets of findings based on the same data: either cases in archaeology were multiple, or they did not exist. Only one of these realities could 'live on' because of the collaborative and shared nature of the exercise: the prerequisite for the collaborative research and development process to progress was that the team could settle on a single 'reality'. This happened after the controversy was settled (cf. Latour and Woolgar 1979), which in this case happened due to the majority 'opinion' being behind one interpretation rather than the other. This highlights the point John Law (2004) makes about the political nature of methods: the choice of methods determines the types of realities produced through that piece of research. These realities can be made singular and out-there, or unknowable, contested and multiple, for instance. This is a particularly pertinent point to take into account in educational research, where the variety of methods used range from experimental controlled studies to unstructured

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ethnographic ones and anything in between. Yet at the same time 'educational research' with its diverse methods and findings is often taken for granted, blackboxed (Latour 1987) even if it is clear that the field of educational research is not unified (cf. Pollard 2005, Biesta 2011). The reports do not elaborate on what type of research or by which methods the findings have been discovered, nor necessarily what the data have been. Yet, at the same time, each method or set of methods create 'different realities' of education and learning, 'realities' which are being used as a basis for decision making. The question to ask is whose reality are these decisions being based on?

During the first 6-9 months of the project the educational and technology strands of the project worked in relative isolation from one another, getting to know their respective new fields Hence the first part of the thesis has focussed on following the work of educational researchers working with the token, trying to identify 'the case' in archaeology. This period is characterised by the involvement of several researchers working together, and the exploration of a variety of teaching and learning settings. The difficulty in pinpointing 'the case' was associated with the institutional diversity and internal fragmentation into specialist areas of the discipline, and the tension between the deductive theory-led versus the inductive ethnographic research approaches in understanding the nature of cases. The research process into cases in archaeology was more exploratory than at any other setting, leading the team to engage with a far greater number of research participants than at other settings.

In the spring of 2009 the pressure to move onto technology development in the project increased. Both at the behest of the leaders of the project and with the help of the Semantic Spider diagram as the *practice negotiating artefact* the two strands of the project started growing closer together. Identifying a suitable niche for technology development became intertwined with the search for the elusive case in archaeology.

Usually technology development sets out to solve an existing problem (e.g. Nusebeih and Easterbrook 2000, Vinck 2003) but for Ensemble the starting point was different. In this case, it was a vision of the *potential* that marrying semantic technologies with case-based learning pedagogy could offer in relation to technology enhanced learning (Original bid 2008). Thus, the team needed to pin point suitable case-based learning technological 'problems' at the settings, or help the research participants to envisage these for the as-not-yet-existing technology to solve. From the various 'case' options the team explored, the one that stuck to Ann's mind as potentially viable for technology development was the creation of Artefact-projects as a means of introducing the archaeology students to professional practice of the field. The niche for starting to design the technology was: 'how to link the Artefact-projects to the museum database?' This was envisaged also to support the teaching of Artefact-projects by making previous project work available for students on the database.

It was only after the case and the niche were identified that the project could move onto the technology design phase. The cases were still understood to be multiple in archaeology. Yet in order for technology development to proceed sensibly, it needed a single space in which to develop. Given the team's commitment to a participatory ethos both in research and design (while it has been acknowledged this was not universally the case in the project team) meant that Participatory Design methods were planned in order to involve research participants in the development process. The traditional PD methods were, however, deemed too structured and prescriptive. They assumed a known and existing problem and a set practice that the team would be designing for, from these it would be possible to identify user requirements for the future tool. The use of Participatory Research meant that data was more fluid, changeable and less structured. Imposing structured PD methods on this type of data would mean missing

the moving, evolving target. A more iterative design process was needed, which is why the team decided to mix methods and ideas from PD and PR, ending up with a way of doing 'participatory research into technology development'. As part of this practice the team planned to arrange cycles of PD workshops with their research participants at all settings, including archaeology.

In order to start the design, however, the team needed to identify a suitable practice. Since 'the case' in archaeology was not known, identifying a case-based learning practice took a long time. The co-emergence of 'the case' with the niche for technology development enabled identifying a practice and those engaged in it: the teaching of Artefact-projects. Pin-pointing the case and niche marks a turning point in the research and design process in archaeology. The research process became more focussed, concentrating on the Artefact-project, its related practices and the heterogeneous participants engaged in it. Developments that led to the expansion of a number of new research settings in the project meant that it was no longer sustainable to have several researchers engaged on a single setting. The implication of this in terms of interdisciplinary collaboration was that the immediate tensions created by the divergent research approaches disappeared as one researcher, in this case Ann, enacting a single approach took the lead for the setting. At the same time the importance of the Virtual Research Environment as participant in the project assemblage increased, enabling collaboration despite the more varied and distributed nature of the work.

The first task that Ann needed to do was to gain access to those engaged in the practice of teaching the Artefact-project. This was a process of gathering and enrolling allies and of extending the project assemblage into archaeology teaching. The entry point into the setting had happened through the contact person at the museum as well as the archivist at the museum archive, which is also where the niche emerged. During winter

and spring 2009-2010 Ann managed to gain access to teachers and students involved in teaching or creating the Artefact-projects, as well as to several examples of the project work. This allowed her to study the related practices and materialities with technology development in mind. However, being involved in a number of other settings, Ann had to divide her time between several, geographically dispersed research locations, some of which demanded a lot of her time and attention, leaving the archaeology setting with less. By the time the project team had learned enough about Artefact-projects and were ready to move onto the PD phase, some important momentum was lost and their prospective research and design participants were no longer available. The only faithful participants left were the photocopies of the Artefact-projects.

Research and design are goal-oriented activities, as Pickering (1995) stated, but the goals can be changed or revised. For instance, planning to engage a setting in participatory design is good as long as you have willing participants. Now that participants were no longer available, the design process focussed on what could be done withthe Artefact-projects[114]. At other settings the starting point for design activities had been the Exhibit-tool. However, as transpired from the July 2010 brainstorming session between Ann and Jim, the Artefact-projects refused to be translated into a functioning Exhibit. Apart from having to cope with largely non-digital resources, the other major resistance to translating the Artefact-projects into an Exhibit was the learning objective to offer the students an experience of the professional practice of doing research in Archaeology. This was associated with the resources used: part of the exercise was to guide students towards a realisation of the ways in which information is searched for in archives and libraries. If this resource was made available

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[114] The nature of Artefact-projects as participants in design is debatable; their spokespersons had consented for them to be part of the process, yet their participation is necessarily different from those of human participants.

online for the purposes of the Artefact-projects, that would defeat the pedagogical point of making Artefact-projects. What made the design process difficult was also the uncertain purpose of the tool: what was it going to be primarily for - the museum, the archive or teaching and learning?

A break-through in the design process happened suddenly in the autumn, with Ann returning to the task after it had seemed that the engagement with setting might have to be abandoned as unfruitful. There was a concurrence of ideas that helped push the design forward: Ann's realisation of the importance of keeping the narrative structure, the suggestion of semantically rich texts by a visiting scholar, and a brain storming session bringing these into fruition as a Data Aggregating Document. This turned the concept of Exhibit inside out: rather than extracting data from a narrative and turning that into an Exhibit tool, the team decided to keep the narrative and insert small semantic Exhibitlets within the narrative. The concept of DAD was materialised as a live prototype for archaeology. At the same time it became clear that 'the case' relating to the Artefact-project was the collection of resources gathered by students about the object, rather than the object itself.

In developing the semantic technology the team were in effect gathering a new fold into the space between the project, the discipline of archaeology, the archive, museum and the semantic technologies. Ann was doing this by trying to enmesh several networks, and by aligning the interests and needs of the project with those of archaeology teaching and the museum archive, and with the affordances of the semantic technology, the museum database and the Artefact-projects. This meant extending the translation network to all of these areas. While it was possible to align the prospective interests of the participating networks, the project was not able to hold the assemblage together long enough for the development process to enable the affordances of the semantic

technologies, the museum archive and archaeology teaching to accommodate each other. In other words, the networks of the semantic technologies and that of the archaeology discipline and museum database failed to successfully link with each other.

The TEL programme funding the project had demanded 'authentic interdisciplinarity' from its projects, assuming that the researchers would come to change the way they conceptualised their own disciplines by being exposed to new and different ideas and practices, and by integrating these into their ways of working. Ann became a shining example of this development, learning about and embracing semantic technologies as part of her everyday work. Through this she was able to become a spokesperson for semantic technologies in archaeology, for pedagogy in technology development, and for participatory research methods in participatory design. Without the expansion of her networks, this would not have happened. This also enabled her to participate in and take forward the development of semantic technologies with Jim in the archaeology setting. We saw very little involvement of the other two technology developers of the team, while we know that they worked with the research participants at other settings. The two multidisciplinary areas of Ensemble, education and computer sciences, ended up extending their respective practices into each' others' areas weaving together the pedagogical and the technological both in research and in the development of educational technologies. Further, interdisciplinarity reached beyond simply engaging education and computer sciences with one another, involving also the varied research participants in the processes of research and design through participatory methods. The project became as much about learning about the research settings and educating their research participants in these about semantic technologies, as it was about research into pedagogies and development of technologies for them.

ANT in and as practice of research

The third aim of this thesis was to see how Actor-Network Theory works as part of a longitudinal, live study. ANT combined with ethnographic methods has been used before for studying the work of scientists (Latour and Woolgar 1979, Latour 1999). The initial hurdle was to detangle the messy and dispersed ways the Actor-Network Theory has been used. Being able to place the variety of ANT studies either within the Classic ANT (or ANT 1990) or Post-ANT movements was a crucial step (cf. Law 2009) in understanding how ANT is *not* a singular approach that has remained static over time even if many studies enact and treat it as such. Comprehending the emerging sensibilities of ANT, and being able to start conceptualising the world according to these was essential in order to be able to formulate the research question and start thinking about how to answer them in practice. The approach makes the assumption that the world consists of heterogeneous networks or assemblages where division in the social and natural worlds are the results of our engagement with the world rather than originally existing states of affairs. ANT also assumes that these heterogeneous networks emerge as the effects of actions by human and nonhuman actors and that all of these actors are to be approached symmetrically, or by abstaining from making a priori assumptions about their status in these relations.

In terms of method, I found ANT to be notoriously hazy. There were four main influences that helped in finding the practical means by which I came to approach the expansive data set through ANT. The analysis has progressed by following the different uptakes and translations of the token into the practice of research and development. Asking who and what participate in these translations has brought forward a plethora of heterogeneous actors that have been enrolled in *and* out of this dynamic assemblage

moving through space and time. Studying the work of an interdisciplinary research and development team by following the token and its multiple translations has led me to classrooms, museums, archives, into places in cyber space, to different universities, meeting rooms, conferences etc. The token has been 'translated' in discussions, negotiations, interview situations, smaller and larger meetings, in introspective diary entries, sketches and diagrams, email correspondence, informal discussions, on computer screens. Great numbers of heterogeneous participants have been involved in the processes: pieces of software, skills, knowledges, researchers, staff and students of archaeology, staff at museums, technology developers and museum archivists, and me. The advantage of this approach has been to be able to account for not only the human interactions but also to take into account how things, concepts and knowledge become entangled in or emerge out of these assemblages. It has also enabled following a moving target across time and space, without fixing it in place in advance.

Deciding to follow the translations of the token was a useful way into the massive dataset, and it has helped in picking up strands of activity for examination. However, doggedly following the travels of the token has also cut the network (Strathern 1996) in my path, zooming in on certain things, simultaneously creating absences, othering, and leaving things, people, events, actions etc. out of the picture. This study has primarily dealt with what has been enrolled into focus by the travels of the token. This has meant that for instance Ann has played a far more prominent role in this study than what would have been the case had I been concentrating on some other setting. At the same time some other team members have become marginalised, if not completely left out of the picture, even if they might have been stars of the show in connection with some other setting. Similarly, at the beginning of the project I expected to be dealing much more with semantic technologies and technology development, but given how things

have unfolded in archaeology, these have not played as central a role in the study as anticipated. The Ensemble-project has produced some innovative pieces of technology, but these have not become enrolled into the archaeology setting, and are hence left unattended here. The same issue concerns the work of the two technology developers Amy and Sam whose impact on the progress of the Ensemble work has been highly significant, while it does not show in the archaeology setting. This is partially due to Ann's proficiency with the semantic technologies, and the fact that she and Jim (who obviously is a technologist as well as a researcher) managed that work on their own.

Another challenge in this study has been the sheer amount of data in relation to the available time and the parameters of a PhD-thesis. With an ANT approach, as Latour (2005) points out, anything and everything becomes data when you start following actors. Anything that happens, anything anyone says, does or produces has to be potentially taken into account and this can at times be overwhelming. The researcher ends up living in data and it is unfortunately only with the blessing of retrospect that it becomes possible to say what was important and what was not.

A vital actor in researching the work of the Ensemble-team was the Virtual Research Environment and the way the team chose to use it for supporting their work. Storing and sharing all data, information and diary entries reporting the progress of work at the settings not only allowed the geographically distributed team to work collaboratively and be informed about all the latest developments, but it also gave me unique access to the researchers' work practices and thought processes otherwise unattainable, regardless of physical proximity to the team. Furthermore, the practice of self-documenting the progress of their work, which most team members embraced, meant that meetings, negotiations and discussions, including sketches and plans drawn on

white boards or scribbles on pieces of paper, were preserved for later use. These were digitally recorded, photographed or scanned, and stored in the VRE, meaning that the moment was not completely lost, but could be returned to at a later date. The VRE also provided access to different drafts of posters and papers, and the accompanying correspondence or discussions, allowing examination of their development. These were practices without which this piece of work would not be as detailed and rich as it now is, especially given the oscillation between being physically and absently present with the team as a researcher. Further, the use of multiple ethnographic methods is recommended in addition to 'simply' observing research settings. Engaging as much as possible with those whose work you study is the best way of gaining an understanding of how they work.

The performative post-ANT method has allowed me to approach the realities and other outcomes generated by the Ensemble-project as issues related to ontology (rather than epistemology) and as enactments of the researchers' respective hinterlands (Law 2004) in creating different realities. Studying the practices, the doing of research, enabled examination of how these (the findings, the realities) were arrived at and what they did or what happened to them. In doing so, this study is naturally another layer of reality I have produced through engaging with Ensemble-as-a-research-domain. The enacted reality could be slightly different, if it was produced by someone else, or if it was produced through different methods. This does not mean that my enactment of Ensemble-as- a-research-domain is less, nor more, valid than anyone else's (provided the internal validity of methods are met), this is simply one of the possible realities that could have been produced. I expect the team members to recognise their project from this narrative while they might not agree with every single sentence of it. In writing this piece of research, I have tried to allow for space for as much heterogeneity and

multiplicity as possible to exist and come through. At the same time, the reality produced is very selective with obvious blind spots. But then, that would be the case with any research method: that is the beauty of objects manipulated in practices – these become more than one, less than many, as Mol (2003, 55) points out. This is one enactment of Ensemble as a research team, a construction, yet based on real experiences of engaging with it.

This study has demonstrated empirically the point made by John Law (2004) and Annemarie Mol (2003) about the political nature of research methods, and how the methods we choose already signpost the types of 'realities' we come to construct through them. Particular methods enable us to generate particular types of data: statistical methods will produce statistical data, semi-structured interview methods data on pre-set themes, for instance. These will allow us to construct the world as singular, and knowledge as generalisable, or as something where there is space for re-interpretation and multiplicity. The criteria for good research emphasise the validity and reliability of methods, leading to questions of truthfulness of knowledge and reality. When we understand research methods performatively, these questions become about *whose* knowledge, *whose* reality and *whose* truth is in question, as well as about which ones are allowed to flourish and why. This highlights the importance of carefully assessing motivations for choosing particular methods to be used, for instance, when commissioning research in education, or any other domain. Further, research should not be taken as a 'black box' when findings are reported, but methods used in the production of these should always be laid open to scrutiny. Studying the implications of realities produced through particular methods, for instance in terms of educational policies, would be worth undertaking. Would the use of different types of methods on studying X-issue have led to the different types of policies, and what would the effects

of that be on education? Understanding research methods performatively offers a way for more critical evaluation of purposes and motivations of research.

Post-script

When we left the research team in December 2010, the concept for the Data Aggregating Document had emerged with one prototype materialising. As the assemblage surrounding the archaeology setting started unravelling immediately after that it seemed at the time that the DAD did not develop very rigorously or go very far. In terms of traditional technology development literature it might be deemed that the development work had failed to meet its objectives. However, I have since learned, having dug my head out of the existing data set and taken a new look at the project that the token has in fact travelled on and developed further from where we left it. The network the Ensemble-project has provided has enabled the DAD to enrol and become enrolled in other settings where databases have been more 'semantically ready', and where the surrounding network has been more prepared to engage the application in their practices. Without going further into the matter, I have listed below a number of examples where the Data Aggregating Document has been picked up and materialised.

- Environmental Education has taken DAD and turned it into a resource to be used in an assessment task, involving the same data made available as a database/collection and as a structured narrative: http://www.ensemble.ac.uk/projects/settings/outdoor/HEP/ (Accessed 24th Jan 2012).
- A research project, where examples of narratives have resources linked to them from a database for educational research methods, utilise DAD:

http://www.ensemble.ac.uk/projects/edeval/edeval_applications.html (Accessed 24th Jan 2012).

- The archaeology DAD has been further developed and is available at: http://www.ensemble.ac.uk/projects/archaeology/girton/ (Accessed 24th Jan 2012).

- The final stabilisation of research findings from the archaeology setting can be viewed here, on the project website : http://www.ensemble.ac.uk/wp/projects/archaeology (Accessed 24th Jan 2012).

Technology development often assumes a premise of well defined user requirements as well as fully understood conditions by which technologies become adopted or not. However, this study has exemplified the precarious and unpredictable nature of that process. It has shown the importance of access to the relevant networks both in research and in technology development, and how unpredictable events may divert the intended course of action. The archaeology setting and semantic technologies might not have been ready for each other, but through the networks the Ensemble-project had created and brought together, the concept of Data Aggregating Document found more 'fertile' planting grounds at other settings and continued to develop and translate.

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Unpublished sources

Primary data:

Sanna's interviews with team members (those in italics directly quoted):

- with Amy, 17th Feb 2009
- *with Ann, 17th Feb 2009*
- *with Tom, 18th Feb 2009*
- with Admin, 18th Feb 2009
- *with Jim, 19th Feb 2009*
- *with Will, 19th Feb 2009*
- with Jim, 24th Aug 2009
- with Jim, 26th Aug 2009
- *with Ann 21st Sep 2009*
- with Tom, 20th Oct 2009
- with Ann, 21st Oct 2009
- with Ann, 22nd Oct 2009
- with Tom, 22nd Oct 2009
- with Ann, 8th Dec 2009
- with Amy, 10th Dec 2009
- with Admin, 11th Dec 2009
- *with Lea, 23rd Feb 2010*
- *with Ann, 27th April 2010*
- *with Jim, 8th Jun 2010*
- *with Lea, 11th June 2010*
- *with Ann, 16th June 2010*
- with Ann 18th June 2010
- *with Tom, 11th June 2010*
- *with Amy, 11th June 2010*
- *with Ann, 17th June 2010*
- *with Ann, 27th July 2010*
- with Sam 22nd Oct 2010
- *with Sam, Jim and Amy, 22nd Oct 2010*
- *with Sam, Jim and Amy, 22nd Oct 2010*
- with Jim, 26th Oct 2010
- with Will, 25th Nov 2010
- *with Ann, 26th Nov 2010*
- with Jim, 3rd Dec 2010
- with Ann, 6th Dec 2010
- with Jim, 8th Dec 2010
- *personal communication with Lea, 5th Nov 2010*
- *personal communication with Jim, 25th Oct 2010*

Ensemble small meetings:

- 3rd April 2009 - meeting with Ann, Tom, Will and Mia discussing the observation notes
- 14th May 2009 - meeting with Ann, Tom and Will discussing the interview with Matt and Phil, a Lecturer
- 9th Nov 2009 – Post-interview meeting with Ann, Tom and Will discussing the interview with Matt on the same day
- 22nd Nov 2010 - meeting with Ann and Jim brainstorming to develop a semantic application for Archaeology,

Ensemble has held monthly 2-day residential team-meetings; out of these, the following all-day recordings quoted directly in the study:

- November 2009
- January 2010
- February 2010
- March 2010
- April 2010
- May 2010
- July 2010
- September 2010
- October 2010
- November 2010

Email correspondence (quoted emails):

- 1st May 2009, from Sanna to Ann and Tom
- 8th May 2009, from Will to the team
- 12th May 2009, from Will to the team
- 29th May 2009, email correspondence between Ann, Will, Tom and Sanna
- 17th Nov 2009, email from Ann to Mary the Archivist
- 18th Nov 2009, email from Gary, the programmer, to Ann
- 20th Nov 2009, email correspondence between Sanna, Ann, Will and Tom
- 18th Dec 2009, email from Will to Jim, Ann, Tom and Sanna
- 18th Dec 2009, email from Ann to Mark, an Archaeology lecturer
- 18th Jan 2010, email from Ann to the members of the Teaching Committee
- 25th Jan 2010, email from Ann to Will, Tom and Sanna
- 24th Feb 2010, email from Ann to Will, Tom and Sanna
- 7th May 2010, email from Ann to Mary, the Archivist
- 10th May 2010, email correspondence between Ann and Gary
- 26th May 2010, emails from Ann to the three students
- 14th June 2010, email from Ann to the Classical museum
- 14th June 2010, email from Ann to Matt
- 2nd Aug 2010, email correspondence between Will, Jim and Ann
- 10th Sept 2010, email from Ann to Gary
- 4th Oct 2010, email from Gary to Ann
- 6th Oct 2010, email from Ann to Gary

- 1st Nov 2010, emails from Ann to Gary
- 2nd Nov 2010, email from Ann to Mary
- 2nd Nov 2010, Ann to three Archaeology lecturers, Mark, Kate and Jack
- 22nd and 23rd Nov 2010, email correspondence between Jim and the core team
- 24th Nov 2010, email correspondence between Ann and Gary
- 28th Nov 2010, email from Jim to the core team
- 7th Dec 2010, email Jim to Sanna
- 29th Nov 2010, email from Ann to Jim and the core team
- 23rd April 2011, email from Tom to Sanna
- 21st April 2011, email from Will to Sanna
- 21st April 2011, email from Ann to Sanna
- 3rd Oct 2011, email Ann to Sanna

Posters:

- Ensemble, June-event Poster draft version 1, 6th May 2009
- Ensemble, June-event Poster draft version 2, 8th May 2009
- Ensemble, June-event Poster draft version 3, 12th May 2009
- Ensemble, June-event Poster draft version 4, 13th May 2009
- Ensemble Archaeology and Anthropology-poster, version 3, June 2009
- Ensemble Archaeology and Anthropology-poster, version 2, May 2009

Power point presentations:

- Power point presentation entitled '*Studying CBL in practice. Settings report. What are cases?*' prepared by Tom and Ann for the team meeting held in 30 April – 1 May 2009

Conference papers:

- Ensemble- paper 1 (2009) *Case Methods, Pedagogical Innovation and Semantic Technologies.* SemHE conference
- Ensemble- paper 2 (2009) *Semantic Technologies to Support Teaching and Learning with Cases: Challenges and Opportunities.* SemHE conference
- Ensemble- paper 3 (2009) IJRME

Diary entries (ca 100 000 words in total):

- Diary entries by Ann from October 2008 to December 2010
- Diary entries by Ann from January 2010 to December 2010
- Diary entries by Tom from October 2008-April 2009

Versions of the Data Aggregating document (Nov 2010):

- MOAM Deep Water Data Aggregating Document deepwater_aggdoc_all.html; Source: VRE TechDev Resources.
- Girton_brooches.html. Source: VRE TechDev Resources.
- Girton_brooches1.html

- Girton_brooches2.html
- Girton_brooches3.html
- Girton_brooches4.html
- Girton_brooches5.html
- Maa.xml

Secondary data

Observation notes:

Ceramics classes:

- *Tom, 22nd Jan 2009*
- *Will, 22nd Jan 2009*
- Tom, 29th Jan 2009
- Will, 29th Jan 2009
- Ann, 5th Feb 2009
- Mia, 12th Feb 2009
- Sanna, 19th Feb 2009
- Sanna, 5th Mar 2009
- Ann, 12th Mar 2009

World of Goods lectures:

- Ann, 6th Feb 2009
- Ann, 13th Feb 2009

Flag Fenn field trip observation notes:

- Ann, 8th Oct 2009
- Tom, 8th Oct 2009

Aerial Photo workshop:

- Ann, 15th Oct 2009

Museum re-development Seminar:

- Ann and Will, 11th Jan 2010

Interviews/meetings by the team with research participants:

- 28th Oct 2009 – team with Matt, a scoping interview
- *8th May 2009 - Ann and Will's meeting with Matt and Phil,*
- *28th May 2009 - Ann, Will and Tom's interview with Mary, the Archivist*

- *28th May 2009 - Ann, Will and Tom's interview with Jack, an Archaeology lecturer*
- *9th Nov 2009 - Ann's interview with Matt*
- *17th Nov 2009 - Ann's interview with Gary*
- *12th Dec 2009 – Ann and Will's interview with Clare, an Archaeology lecturer*
- *22nd Jan 2010 - Ann's interview with Mark, an Archaeology lecturer*
- *5th May 2010 - Ann's interview with Gary, the computer programmer*
- *19th May 2010 - Ann's interview with Mary, the Archivist*
- *5th May 2010 - Ann's interview with Gary, the computer programmer*
- *7th May 2010 - Ann's interview with Katy, an Archaeology lecturer*
- *19th May 2010 – Ann's interview with Mary, the Archivist*
- *30th Nov 2010 - Ann and Jim's meeting with Mary*

Ann's interviews with students:

- *Interview with student A, 8th Mar 2010*
- *Interview with student B & C, 9th Mar 2010*

Spreadsheets:

- Excel-Spreadsheet OP_SemWebApps_tbl_22Apr2010 emailed to SR on the 27th April 2010
- Settings spreadsheet, document 2, Steering Committee meeting 14th and 15th Jan 2010
- Excel sheet with location data for graves. Source: The VRE, TechDev site resources, no date.

Artefact-projects used:

- A Cruciform Brooch and two Small-Long brooches (2000)
- Candy Duft (year?)
- Tuddenham coins (year?)

Screen prints:

- *Archaeology and Anthropology Projects exhibit, linked to Ann's research diary 5th Mar 2010.*
- Map of resources used for an Artefact-project on hoard of coins found in Norfolk, created by Ann. Source: The Ensemble VRE Resources area, accessed 20th Aug 2011
- The first Data Aggregating Document for MOAM Deep Water case. Source: VRE resources
- Screen print of the first girton_brooches.html exhibit version.
- Section of the Map of the Girton Parish -reproduced from 1947 OS map (from Bashford and Bolgar 1977). In: Artefact-project on Anglosaxon brooches (2000).

- Photograph of Girton College taken in 1874, showing the 'Old Wing' and the 'little rough field' which proved to be the site of the Anglosaxon cemetery (from Jones 1913, 23). In: Artefact-project on Anglosaxon brooches (2000).
- Section of the map showing some of the early Anglosaxon graves. (from: Malim 1996, In: Artefact-project on Anglosaxon brooches (2000).)
- Screen Print of the Museum Archive Exhibit, tile view. Note the faceted search.
- Screen print of Map Exhibit showing the faceted search for 'Find spot' and the results on the map. One of the spots lens has been clicked on to show more information.
- Screen print of the Museum Archive Exhibit, map view. Displaying the same search result as a map. The Lenses open up for more information and link to the live Museum collection.
- Screen print of the contents section of the DAD version girton_brooches_5.html. Arrow pointing to first Exhibit link to the Excavation Timeline.
- Screen print of 1889 OS map the DAD links to instead of creating an interactive map. At British History Online, http://www.british-history.ac.uk/
- Screen print of the contents of the DAD version girton_brooches_5.html showing the improved timeline Exhibit, where some lenses show more information about the added events.
- screen print of the Appendix section of the Girton_brooches.html DAD displaying three filtered search finds.

Miscalleneous:

- Will's analysis of Mark's interview, 29th Feb 2010.
- Instructions for writing the Artefact-project (Option paper for Prehistory of Europe), no date.
- **ARCHAEOLOGY STUDENT ARTEFACT PROJECT INITIAL INTERVIEW PLAN, 5TH MARCH 2010.**
- Ann and Lea, meeting document 10th Mar 2010
- European Prehistory Course Structure 2010 –document, no date.
- Ann's entry in the Tech Dev Wiki, 4th May 2010
- Ann in TechDev Wiki, 5th May 2010
- Ann's entry on the [Museum] Semantic Web App wiki page, no date, May 2010
- Ann's hand written notes on the 11th Nov 2010 (Linked to Ann's research diary 11th Nov 2010
- White board drawing by Jim 22nd Nov 2010.
- Various degrees of translation: photocopy of the Artefact-project with the OCR version on the big screen, and the VRE up on the laptop. Photo taken 26th Nov 2010 by SR.
- The Ensemble-team VRE, Resources folder, accessed 29th Aug 2011