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Developing archaeological database in Finland

Case: Lahti City Museum

LAHTI UNIVERSITY OF APPLIED SCIENCES
Degree programme in
Business Information Technology
Degree programme in Information Technology
Thesis
Spring 2014
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Degree Programme in Business Information Technology
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Bachelor's Thesis in Business Information Technology and Information Technology

54 pages, 2 pages of appendices

Spring 2014

ABSTRACT

Today, more than at any previous time, as the Internet and database tools are evolving faster than ever, no matter what the business is, the ability to collect data and manage the valued data effectively has been widely recognized as a significant factor to support or make the projects and organizations go smoothly. The field of archaeology is not an exception to this.

Unfortunately, the database management systems have not been used extensively for archaeological work in the past years of Finland. However in 2013 in Lahti, an attempt to change this was done in the form of a database developed for the Lahti Market square excavation. This study aims to figure out how to develop the archaeological database and share it for further usage in Finland. A qualitative method was used, utilizing case study, answering the construction question.

The study introduces the current archaeological databases first. Then, sort out the answers from the questionnaires and interviews of archaeologists and analyze the opinions later. As for the empirical section, this paper studies a case in Lahti City Museum and selected group of archaeologists who have used Lahti Torikaivaus Database to do the questionnaires and interviews. Besides the analysis, this thesis lists the suggestions and potential risks for Finnish future archaeological database development.

Key words: database, database design, archaeology, archaeological database

Lahden ammattikorkeakoulu
Tietojenkäsittelyn Koulutusohjelma
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Tietojenkäsittelyn ja Business Information Technologyn opinnäytetyö,
54 sivua, 2 liitesivua

Kevät 2014

TIIVISTELMÄ

Internetin ja tietokantatyökalujen kehittyessä yhä enemmän, tiedonkerääminen ja sen käsittely on laajalti tunnustettu tärkeäksi osa-alueeksi projektien ja organisaatioiden onnistumisen kannalta. Arkeologia ei ole poikkeus tästä.

Valitettavasti tietokantatyökalujen käyttö arkeologian työvälineenä ei ole ollut laajamittaista suomessa. Yritys luoda poikkeusta tähän on Lahdessa vuonna 2013, Lahden Kauppatorin arkeologisia kaivauksia varten toteutettu arkeologinen tietokanta. Tämän opinnäytteen tavoitteena on tutkia, kuinka arkeologista tietokantaa voisi kehittää suomessa, sekä kuinka se saataisiin käytettäväksi koko suomessa. Tämä tutkimus hyödyntää tässä tavoitteessa kvalitatiivista tutkimusmenetelmää.

Tämä opinnäyte esittelee ensin jo olemassaolevia arkeologisia tietokantoja ja yhdistettynä haastatteluilla ja valmiilla teorialla esittää omat johtopäätökset tutkimusongelmaan. Opinnäytteen lopuksi esitellään mahdollisia ratkaisuja, käydään läpi tuloksiin liittyviä riskejä, sekä lopuksi esitellään vaihtoehtoja tulevia tutkimuksia varten.

Asiasanat: tietokanta, tietokantasuunnittelu, arkeologia, arkeologinen tietokanta

KEYWORDS FOR RESEARCH QUESTIONS

Database: a collection of data.

Database design: the process of producing a detailed data model of a database.

Archaeology: study of human history and prehistory.

Archaeological database: database for archaeological data.

CONTENTS

1 INTRODUCTION

1.1 Background

Nowadays, in this information society, the success of an organization depends on its ability to acquire strict and real-time data about its operations, to manage this data effectively, and to use it to analyze and guide its activities. (Ramakrishnan, 1998, p. 1)Thus, effective database design is becoming a booming element of strategy to support or make the projects and organizations go smoothly, especially for the archaeological work.

As most archaeological studies are dependent on the analyses of antiques, there are always extensive data for the researchers. And unfortunately, in Finland currently, most of that data is recorded on paper format and stored in the Archives of the National Board of Antiquities (NBA) (Interviews, 04.2014). Although during the last decade, some of the reports have also become available online as pdf-files; these are just the same files as the printed version in the archives.

Thus, it is a hot issue to use the databases and database management systems to process large amount of miscellaneous archaeological data for improving the archaeologists' work efficiency in Finland.

Meanwhile, with the largest scale of archaeological excavation in Finland was hold by Lahti City Museum, the senior manager of this archaeological project noticed that this excavation cannot use the traditional way to record the archaeological constructions and layers (units) and for their stratigraphical relations, samples, photos, maps, finds and bones in this time. The senior manager planned to use a database to make the archaeologists' later researches and reports more effective. However, there was not any suitable database in Finland which could achieve the requirements. Thus, it is an urgently need for the new database that could record, search, and report for a large scale archaeological excavation. This is the initial purpose for the authors' practical training.

1.2 Purpose of the work

During the authors' practical training between 8.7.2013 -8.12.2013 they planned and developed an Access database for Lahti City Museum. The database is suitable for the storage, processing and reporting of the archaeological data collected from archaeological excavations done in Lahti city center between 20.5.2013 – 15.11.2013. The database contains records and tables for archaeological constructions and layers (units) and for their strati graphical relations, samples, photos, maps, finds and bones. The database is an essential tool for processing and analyzing this kind of massive amount of material, which consists of c. million finds, thousands of units and maps, c. 15 000 photos and c. 700 samples.

After the practical training, the archaeologists discussed with the authors about further development of the database in order to make the database even better and to make it more attractive for other users as well. Having a shared database would help archaeologists with their work. They could easily and quickly search for information from other excavations and use that information for their own work.

One of the reasons for the need to do research on archaeological database is that the usage of such systems in Finland is very limited currently. Most excavations in Finland are very small compared to Lahti Market square excavations and don't need a database system for storing gathered data. In most excavations the amount of collected data is so small that Excel and Word-files and other similar simple methods are enough to store all the needed information.

In addition to Lahti, there is another Access database in use in Turku and a shared database, Intrasis, in Sweden and parts of Denmark, Norway and Iceland. Studying the databases in Lahti and interviewing the users of the Lahti database, this study aims to find out what archaeologists in Finland want from a database and how they feel about current systems. Studying the Intrasis database, ideas for the further development of the Lahti database can be acquired. In addition, finding out how the Swedes achieved the goal of having a shared database for archaeological excavations can help in achieving the same goal in Finland.

1.3 Scope of research

This study investigates the adoption of MS Access database usage for the archaeological excavations on the Lahti market square. This study aims to figure out how to improve this database and share it for further usage. The study is based on a qualitative analysis of a case organizations adopting MS Access database application. The findings show that the improvement process is very case specific and depends on the earlier experiences and current databases of other museums.

2 RESEARCH TASK

2.1 Research problems

2.1.1 Research questions

- The construction research question is formulated as follows:
    - How should an archaeological database be developed in Finland?

By analyzing the research question in a detailed research, it is divided into several sub questions as follows:

- How should the Lahti database be further developed?
    - What are the archaeologists' wants from a database?
    - How are they feeling about current systems?
- How should a shared database for Finland be done and what would be required of it?
    - How was the database done in Sweden?
    - How did they achieve the goal of having a shared database for archaeological excavations?

This study achieves to find out a way to develop the realized database and the necessary requirements for a shared database in Finland. The study concentrates on design science. The study tries to update the database in Lahti City Museum and understand the factors adopting a shared database in Finland.

2.1.2 The relationship between keywords

The understanding of database is the basic knowledge of database design and this study. Database design is based on the concepts of database. In addition, the study is focused on a further development of archaeological database, thus the further archaeological database should depend on the requirements of archaeology work, the principles of database, and the process of database design.

2.2 Research framework

The research framework is constructed according to Hevner et al. (Hevner, March, Park, & Ram, 2004, p. 80). The framework is divided into three parts: environment, IS research and knowledge base. Environment covers the people organizations and technologies used for the research. These together provide the purpose and goals for the research (Hevner, March, Park, & Ram, 2004, p. 79). Knowledge base is divided into foundations and methodologies. These provide the information and theory to conduct the research provided by the environment. Both the environment and the knowledge base are used to create the data that leads to the goal of the research (Hevner, March, Park, & Ram, 2004, p. 80). In this case that goal is further development and sharing of the Lahti database.

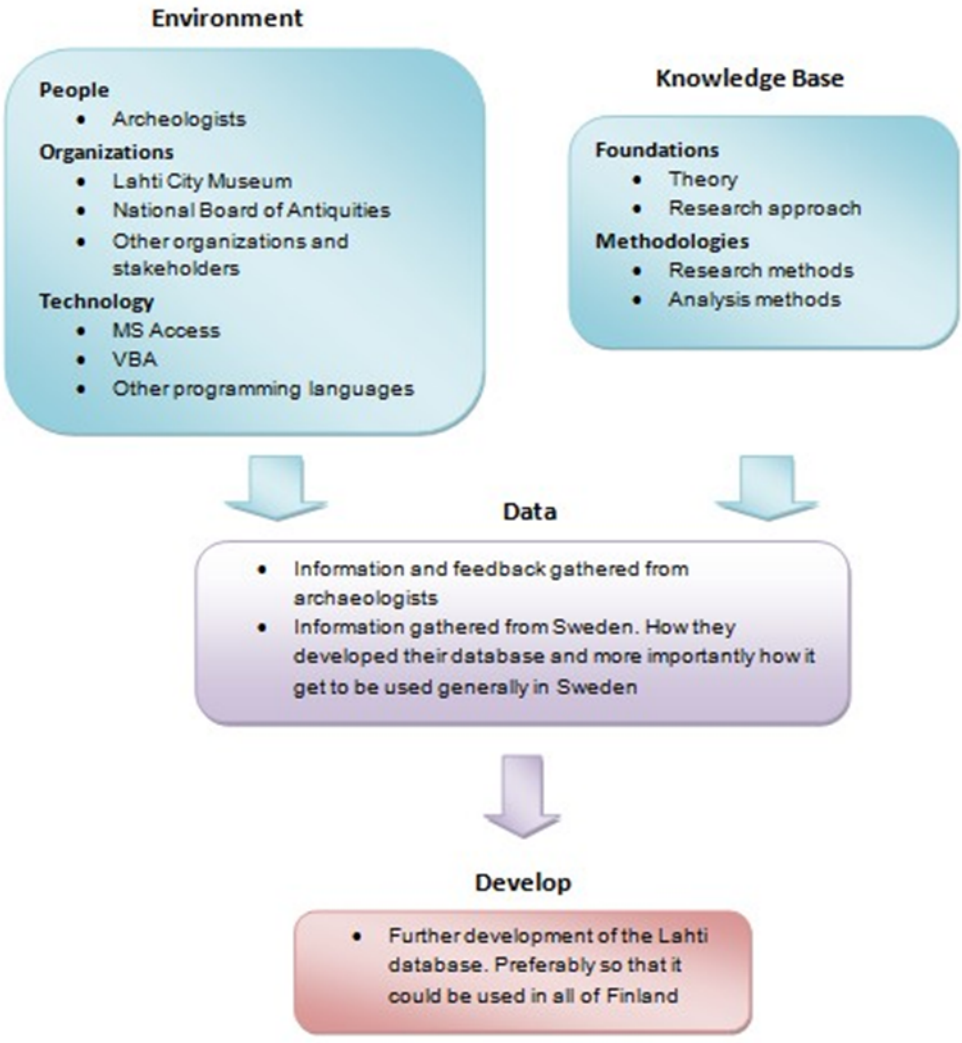

Figure 1: The research framework

According to the Figure1 of research framework, there are some explanations for the details. First of all, the “People” in the research environment are the archaeologists who are using the database and providing valuable information for the research. Then, “Organizations” involved in the environment are Lahti City Museum, National Board of Antiquities and other organizations and stakeholders. Among those organizations, Lahti City Museum initiates the research and provides help with the research and most of the requirements; National Board of Antiquities provides boundaries and rules for archaeological work in Finland; other organizations and stakeholders are universities, museums and other similar parties, which do archaeological projects in Finland and provide additional information as well as help formulate requirements. Thirdly, “Technology” used for the research includes MS Access (current database platform), VBA (visual basic for applications, current language for any programming needs of the Lahti database), other programming languages and SQL languages (PHP, C#, Java, Python, MySQL, SQL Server, Oracle and other possible languages for further development of the Lahti database beyond Access).

Besides the environment part, the knowledge base part also needs the further information. Such as the “Foundations” of the knowledge base are divided into theory and research approach. The theory is theoretical information about databases, programming and archaeology. And the research approach is how the research is approached. In this case the purpose is to move from specific to general, i.e. to create new ideas based on the study of existing phenomena; therefore the approach should be inductive. Moreover, there are two “Methodologies” used by knowledge base part: research methods (methods with which the research is done) and analysis methods (methods with which to gather and analyze data). In the study, the research method is chosen as qualitative research and analysis method is done using thematic analysis.

3 LITERATURE REVIEW

3.1 Archaeology

3.1.1 The definition

Oxford English dictionary defines the word archaeology as follows:

> *"The study of human history and prehistory through the excavation of sites and the analysis of artefacts and other physical remains."*

The word archaeology originates from early 17th century from the Greek word arkhaiologia. The term archaeology has been used in its modern meaning since middle of the 19th century. (Oxford dictionaries, 2014)

3.1.2 Archaeology as a science

As a science, defining what archaeology exactly is and what it does is not an easy task to do. In people's minds archaeology has something to do with people interested in history, the archaeologists, digging old items from the ground. These items can be anything from junk to fabulous treasures of ancient Egyptian pharaohs. While this is all somewhat true, it is not enough to accurately define what archaeology specifically is and what archaeologists do. The field of archaeology is very wide. (Halinen, et al., 2008, p. 13)

Archaeology can be placed inside even larger field of anthropology. Anthropology as a field studies humanity as a whole and is divided into three parts, one of which is archaeology. The other two parts are physical anthropology, or biological anthropology and cultural anthropology, or social anthropology. Physical anthropology studies humans as physical beings and cultural anthropology studies the cultures and societies of humans. Archaeology could be defined in this context as a cultural anthropology of the past, what humans used to do, how and why. (Renfrew & Bahn, 1991, p. 9)

Like mentioned previously, archaeology is quite wide field of science and can be divided into many smaller parts. A rough divide could be made into prehistory

and history. Prehistory focuses on humans before written records. The information it gathers, is acquired indirectly. Humans leave traces of them, which can be found and examined and then conclusions can be drawn from those. History on the other hand has the privilege of using written records as material. Archaeologists and historians can study the writings of the past to get insight into the people's minds and cultures that produced said writings. (Renfrew & Bahn, 1991, p. 10)

Archaeology can be further divided into sub-fields such as environmental archaeology, underwater archaeology and ethno archaeology. In environmental archaeology the study is focused on the plants and animals that different cultures and societies have used. Underwater archaeology studies shipwrecks to get insight into the past. Ethno archaeology is a field that attempts to understand past by studying the present. This means that by studying how for example modern hunter-gatherers live, ethno archaeologists can understand better how the hunter-gatherers of the past lived. (Renfrew & Bahn, 1991, p. 11)

3.1.3 How archaeological data is collected

Archeological excavations can be done either as on the ground level or underwater. The purpose is to acquire knowledge about human activities by observing, interpreting and documenting the sites and findings. (National Board of Antiquities, 2013d)

Before excavations can start, certain measures have to be conducted. These include activities such as finding background information about the excavated area and preparing the area for excavations. (National Board of Antiquities, 2013d)

One method for archaeological excavations is strati graphical excavation. This is used particularly in excavations in urban areas, like Lahti for example (National Board of Antiquities, 2013d). This is reflected well in the Lahti database. While Lahti database cannot be used to create graphical representations of strati graphical relations like dedicated softwares in the vein of Harris Matrix etc., Lahti

database has the capabilities of storing extensive data about strati graphical relations. This data can theoretically be used later to create graphical models.

Archaeological excavations in practice are still using a combination of low and high tech methods. Digging can be done using tools such as shovels and in some cases with mechanical excavators. Modern equipment such as tachymeters and digital cameras are also helpful. Besides picture data, archaeological excavations produce also physical items in the form of samples and finds. (National Board of Antiquities, 2013d) Samples come in various types, such as soil, structures and materials. These can be further divided in samples such as bones and plants. (National Board of Antiquities, 2013e) Lahti database can be used to store information about various attributes of these objects.

Important aspect of the excavations is interpretation, observing and documenting of anything archaeologically significant. Without these, the scientific value of the excavations is non-existent. (National Board of Antiquities, 2013d) The Lahti database is used as tool for this vital aspect of archaeological research.

Important part of the archaeological research happens after the excavations are over. This work takes usually more time than the excavations themselves. It is here when the work produced from excavations happens. This includes the creation of the excavation report. (National Board of Antiquities, 2013f) This is where Lahti database and other similar systems are used.

3.2 Database

3.2.1 The definition

There is a broad definition of database from a book named Beginning Database Design Solutions:

> *"A database is a tool that stores data, and let you create, read, update, and delete the data in some manner."*

From this broad definition, all sorts of strange things can be considered as databases including notebooks, filing cabinets, and even your brain. But, those physical objects are not fit for modern databases (Stephens, 2009, p. 23).

Simply speaking, a database is an information container. However, in the modern society, a database is a systematized collection of data that is stored in a computer and that makes it easy to obtain (Collins Dictionaries:Database, n.d.).

3.2.2 Database design

According to Wikipedia, database design is the process of producing a detailed data model of a database which can be used to represent many different parts of the design of a whole database system. (Wikipedia, Database design, 2014)

While creating a database, all the necessary logical and physical design choices and physical storage parameters needed to transfer a design in a data definition language should be contained in a logical data model. Typically, database design can be considered as the logical design of the base data structures used to store the data. (Wikipedia, Database design, 2014)

A good database design should contain many factors; here are the general conditions for a good database design from Microsoft forum (Microsoft, Database desgin basics, 2014):

- Divides your information into subject-based tables to reduce redundant data.
- Provides Access with the information it requires to join the information in the tables together as needed.
- Helps support and ensure the accuracy and integrity of your information.
- Accommodates your data processing and reporting needs.

3.2.3 Database design process

Depending on different project or the scale of data, there are a plenty of processes for doing database design which will be carried out by the database designer. However, DR Valentina Tamma, lecturer at the Department of Computer Science, University of Liverpool, summarized six stages in the design of database. (Tamma, 2003)

1. Requirement collection and analysis
    - To document the data requirements of the users.
2. Conceptual design
    - Conceptual schema design: to produce a conceptual schema of the database for achieving understanding of database structure, semantics, interrelationships and constraints.
    - Transaction design: to produce a design of the transactions, that will run on the database.
3. Choosing a DBMS (Database Management Systems)
    - Establishing the best framework for implementing the produced schema.
4. Logical design (data model mapping)
    - To transform the generic, DBMS independent conceptual schema in the data model of the chosen DBMS.
5. Physical design
    - To choose the specific storage structures and access paths for the database files.
6. Implementation
    - To create the database, compile and execute DDL (Data Definition Language) statements.

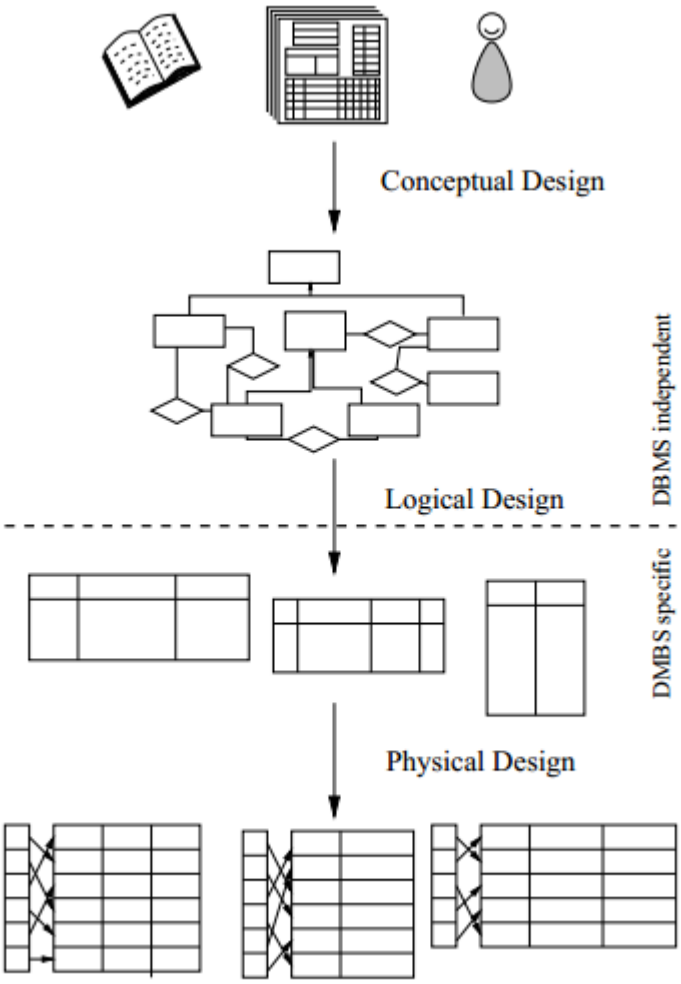

Figure 2: Database design process (Tamma, 2003)

3.2.4 Database management systems

As Raghu Ramakrishnan mentions in his book, a database management system, or DBMS, is the software designed to promote maintenance and utilization of large collections of data. And the need for this kind of systems, as well as their use, is rising rapidly. (Ramakrishnan, 1998, p. 1)

Even this subject and the techniques are used in a wide extent in computer science, such as languages, object-orientation and other programming paradigms, data structures, operating systems, algorithms, theory, parallel and distributed systems, user interface, expert systems and artificial intelligence, statistical techniques, and etc. People can consider the area of database management systems as a microcosm of computer science in general. Continuing to earn essential as more and more

data is brought online, database management made ever more comprehensible via computer networking. Indeed, not only in the computer science, DBMS also play one of the largest and most promising market segments in commerce. (Ramakrishnan, 1998, p. 2)

Compared with the normal operating system files, database management systems can make abundant tasks easier as it is a piece of software. DBMS is not just a place to store data as file systems; people can also use DBMS's features to manage the data in a gross and efficient manner. (Ramakrishnan, 1998, p. 4)

A data model, which is a collection of high-level data description constructs that hide many low-level storage details, is used to define the stored data. The users of DBMS store the defined data in data model. Moreover, most database management systems are based on the relational data model today. As DBMS is not designed to support all the constructs directly, the relational model is just one of the typically data model with few basic constructs. (Ramakrishnan, 1998, p. 5)

3.3 Access

Access is Microsoft's database management system that allows its users to create databases without having much knowledge about SQL or databases in general. Being a database management system, Access, like other database management systems, can be used to store and handle data. According to Jussi Roine (Roine, 2007, p. 74), Access is easier and more suited towards smaller businesses than Microsoft's more professional database management system SQL Server.

Access is based on Microsoft Jet (XCENT, 2014), which is Microsoft's database engine originally developed in 1992 (Wikipedia, 2014). First version of Access, Access 1.0 was launched in 1992 (InfoAge Business Development, 2014) and the latest version, Access 2013 was released in 2013 (the Inquirer, 2013).

Access databases can be divided into distinct parts: tables, forms, queries, reports, macros and modules. Tables, like in other databases, are used to store data. Information about data, such as its data type is also stored in tables. Forms are used to input data into tables in Access. Access's engine handles the conversion of the inputted data into SQL thus allowing user to use Access without having

knowledge of SQL. Queries and reports are linked together. Queries are used to gather data from tables and reports are what usually display the data. Queries can be run without making a report out of that query but reports will always need a query to show data. Queries can additionally be used to perform other tasks of SQL, for example creating new tables, deleting data or inserting data. Performing these actions however does require some knowledge of SQL syntax if done from scratch. (Microsoft, 2014c)

Macros and modules, like reports and queries, are linked together. Both are used to modify the basic Access usage. They can be used to for example automate tasks or ease the use of Access. Macros are more limited in their usage than modules. Access has a selection of ready-made macros user can select for a task. If a wanted ready-made macro does not exist, new ones can be made by creating modules using the VBA editor that comes with Access. Creating modules does require knowledge of Visual Basic or VBA or at least some form of programming language. (Microsoft, 2014c)

3.4 NBA (National Board of Antiquities)

National Board of Antiquities, Museovirasto in Finnish, is an organization operating under the Finnish Ministry of Education and Culture (Opetus- ja kulttuuriministeriö). The purpose of the National Board of Antiquities is:

> *"Protecting environments with cultural history value, archaeological culture heritage and architectural heritage, and other cultural property"* (National Board of Antiquities, 2011)

In addition to the requirements given by the archeologists and other users of the database, there are additional requirements to consider in the design of the database, derived from the role National Board of Antiquities plays in the archaeological field of Finland.

The National Board of Antiquities gives guidelines and instructions to all archeological work done in Finland. The National Board of Antiquities is itself bound by law in its actions. These laws include laws such as *Laki Museovirastosta 282/2004* and *Muinaismuistolaki 295/1963*. (National Board of Antiquities, 2013a)

These legally bound obligations for The National Board of Antiquities show in the database as additional requirements to consider. *Suomen arkeologisten kenttätöiden laatuohjeet* or *Guide to the archeological field work in Finland* gives detailed instructions on how to conduct archeological field work in Finland. This guide includes directions on the information that is to be stored from the excavations. (National Board of Antiquities, 2013c)

4 RESEARCH METHOD

4.1 Lahti database

The database for the Lahti market square excavations, referred to as Lahti database, was developed during the authors' practical training, between 8.7.2013-7.12.2013. The idea for the database came about due to the scale of the Lahti market square excavations. The excavations were the largest archeological excavations ever done in Finland with a total excavated area of around 13000 m^2 (Lahti City Museum, 2013). In comparison most of the excavations in Finland range from just a few m^2's to perhaps couple of hundred m^2's and large excavations can be around couple of thousand m^2's.

Due to this massive size, the excavations also produced larger amount of material than usual. In comparison, if an ordinary excavation in Finland produces maybe couple of finds, samples and pictures, the excavations in Lahti market square produced each of these in the thousands. This meant that some method of storing, organizing and processing this amount of data had to be devised and for such a large amount of data, a proper database seemed a good choice. According to the results of the interviews, databases are not normally used in Finnish excavations so the archaeologists faced a problem of how the database could be made. They contacted Lahti University of Applied Sciences for possible assistance and through them the authors were able to do the practical training, working on solving the database-problem.

The database itself was realized using Microsoft Access 2007. This was chosen due to its relatively low cost, in comparison to more robust database-solutions, and the Access's ease of use. The database consists of nine tables for units, finds, maps, drawings, samples, pictures, areas, groups and bones. The database is stored on the Lahti city server where the archaeologists doing their post-excavation work can simultaneously use the database for their work.

Due to the large amount of data, it was important to device methods to ease the work of the archaeologists. Access 2007 does not have all the features the archaeologists required built-in but all Office-products come with Microsoft's

VBA-editor and are compatible with macros created with it. VBA or Visual Basic for Applications is Microsoft's programming language to create macros mainly for Office-products.

VBA as a language is a combination of compiled and interpreted language. The code written in VBA is combined into what is called pseudo code, or p-code for short. This means that the code is run faster than interpreted code is normally run, but also remains the ability to run code while it is written. (Microsoft, 2007)

Lahti database is also used by the archaeologists to create excavations report required by the National Board of Antiquities.

4.1.1 Entity-Relationship diagram of the Lahti database

Entity-relationship diagram, or ER-diagram for short, is a way to represent data in a graphical form (Webopedia, 2014), in this case the Lahti database. Diagram 1 shows the entities, that is, the tables in the database and how they relate to each other. In the interests of not fully revealing how the database is structured, what kind of data there is and how they relate to each other, the ER-diagram is simplified. However it should give an approximate idea on the database.

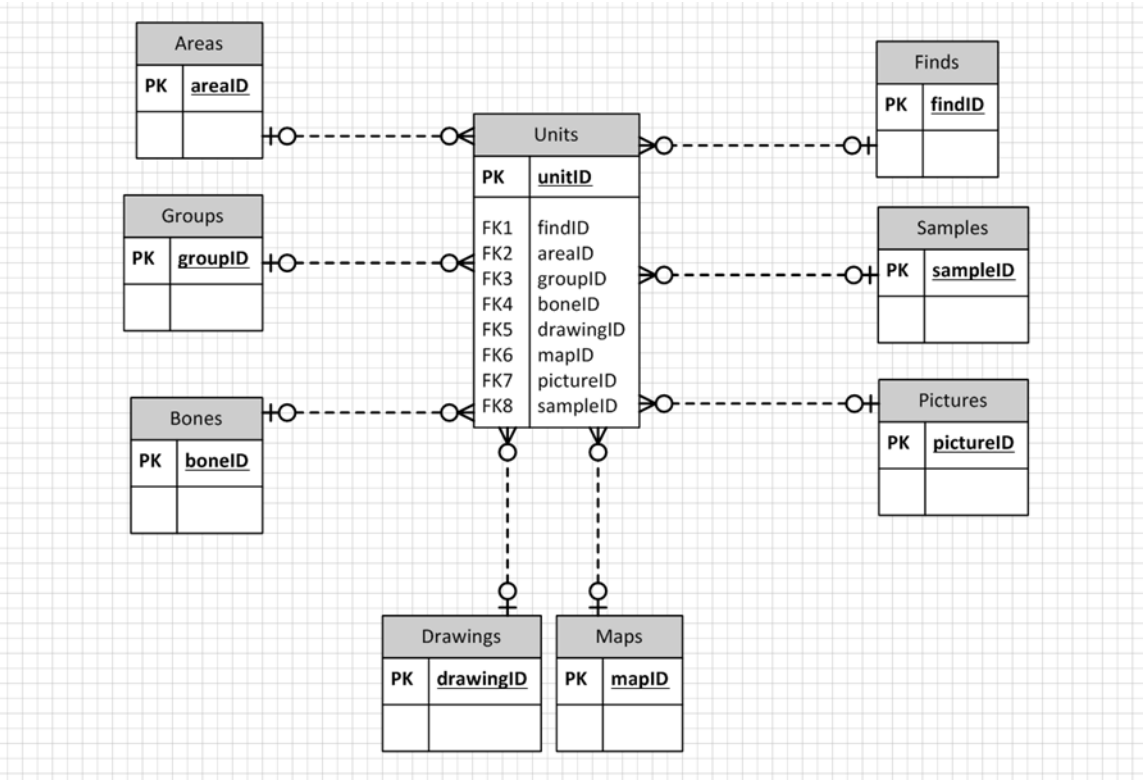

Figure 3: Simple ER-diagram of the Lahti database

4.1.2 Use case diagram of the Lahti database

Use case diagram is a visual representation on use cases. Use cases themselves are a textual description of how system interacts with its users, or actors (Cockburn, 2004, p. 1). The way information is represented in use case diagrams follows the conventions of UML, which means Universal Modeling Language. Actors of the system are displayed as stick figures and the use cases as ellipses containing brief description of a use case. (Cockburn, 2004, p. 233)

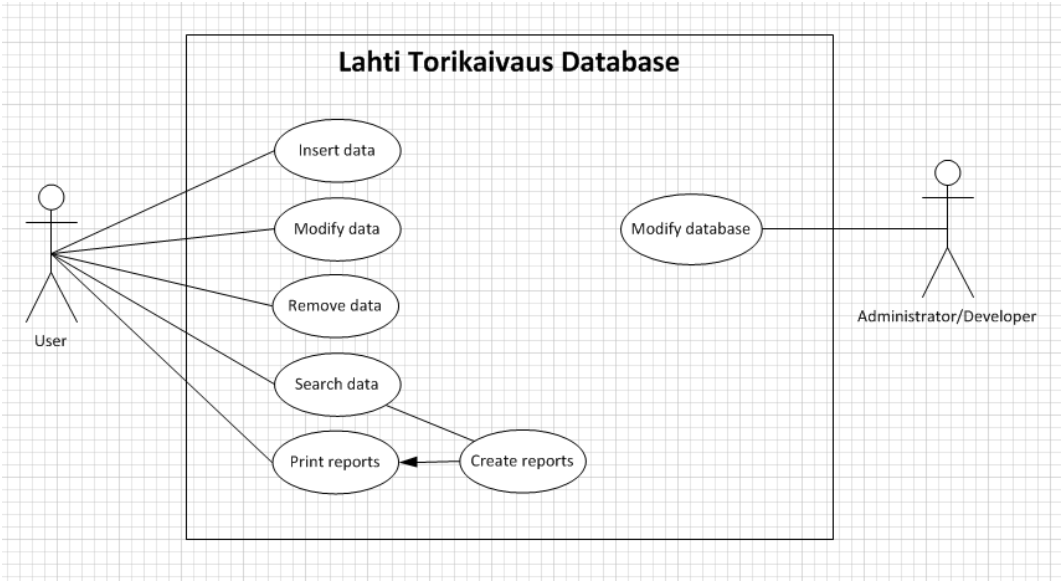

Figure 4: Use Case Diagram of the Lahti database

Cockburn (2004, p. 233) argues that use case diagrams are insufficient in conveying information about the system. Use case diagrams are merely visual aid to proper use cases in textual form. For the purposes of the thesis however, it is enough to only show simple visualization of the system. It is more important to understand what the Lahti database does and who are the actors involved, than how it works.

Use case diagram of the Lahti database can be seen in diagram 2. Actors in the Lahti database are split in two groups. The primary actor, in this case the archaeologists is placed on the left, labelled as *"User"*. Supporting actor, those in

charge of making the system function and making changes into it is labelled as *"Administrator/Developer"* and placed on the right.

Lahti database contains six use cases for the User and one use case for the Administrator/ developer. Users, or archaeologists, can use the Lahti database for inserting, modifying and searching data, as well as removing it. They can also create and print reports. Administrator/ developer is responsible for all the changes and updates required for the system.

4.1.3 Relation to theory

The Lahti database mostly follows the ideals of good database design, mainly in that it the data is divided and structured and it provides access to said data in a way that is useful for the archaeological work. This also helps makes the database a suitable tool for following proper steps for conducting archaeological research.

However, there are some issues with the design of the Lahti database and how it relates to proper database design process. Largest of these issues is the data accuracy and integrity. This is largely result of the database design process.

The design process of the Lahti database did not follow some of the steps of database design in sufficient detail. Most affected steps were requirement gathering and conceptual design. Design and development processes were mostly done in conjunction and as a result the structure of the database was constantly changing. Following this, the database has problems with data accuracy and integrity like previously mentioned.

4.2 Qualitative Research Method

Qualitative research is a method of inquiry employed in many different academic disciplines, traditionally in the social sciences, but also in market research and further contexts. (Norman K. & Yvonna S., 2005)Qualitative researchers aim to gather an in-depth understanding of human behavior and the reasons that govern such behavior. The qualitative method investigates the why and how of decision

making, not just what, where, when. Hence, smaller but focused samples are more often needed than large samples. (Wikipedia, Qualitative research, 2014)

This research approach is more intrusive and less structured than quantitative research techniques. It has been suggested that qualitative methods are appropriate when the research is exploratory in nature. The fact that the aim of this study is analyzing and comparing the current archaeological databases, and based on the requirements of interviews' results then gives the suggestions to the further development of archaeological database in Finland. Hence, a qualitative study focusing on a real case study – Lahti Torikaivaus Database – will be made.

Since qualitative research methods always consider about complex social research, need for understanding of human behaviour, exploratory and descriptive studies, practice-oriented research, and developing theory. Case study is used in this paper with the aim that it involves investigation of a particular contemporary phenomenon which contact with the real life situation, and this is also what common features of qualitative researches are. More than one case study analysis, there are some other artefacts were also discussed in this paper. And background literature that was collected from books, Internet, documents, interviews and etc. A qualitative data collection method is used within the interviews of this study.

4.3 Research Approach

Inductive approach is the analysis of data and examination of practice problems within their own context rather than from a predetermined theoretical basis. This kind of approach moves from the specific to the general. (Mosby's Medical Dictionary, 2009)

According to this study, following by the inductive approach, it introduces the necessity of the database usage for archaeological work in today's Finland. This introduction will describe some phenomena within the real-life context. Then, listing several popular databases used in archaeological research from Finland and Sweden. Since the Lahti Torikaivaus Database is the case study in this paper, the study will interview 6 archaeologists who have used Lahti database. This paper interprets the phenomenon from subjectivist point of view. According the case

study, especially, the researchers want to know the comments from the current users of Lahti database (both the positive and negative aspects), what are the potential problems which may have occurred in the future development, and the attitude of archaeologists about acquiring new computer skills, such as using database management systems. And consequently, summarizing several useful suggestions for the further archaeological database developed in Finland, also contingent risks.

4.4 Description of Research Method

Firstly, the researchers sent questionnaire to the archaeologists who have used the Lahti Torikaivaus Database. After the feedback was collected, the researchers picked up some interested answers to do the further discussion with the intervieweers. Then, several face-to-face interviews ware held between the researchers and archaeologists. In the end, the researchers did the analysis of the organized answers from the questionnaires and interviews. The study compared the observations and interviews with the theoretical concepts of archaeological database to summarize the common suggestion.

5 DATA ANALYSIS

5.1 Current databases

5.1.1 Intrasis

5.1.2 Intrasis in general

Intrasis or Intra-site Information System is an archeological database developed by Sweco. It is owned by Contract Archaeology Service (Arkeologiska Uppdragsverksamheten, UV), which is part of the Swedish National Heritage Board (Contract Archeology Service, 2014a), equivalent to the Finnish National Board of Archives (Museovirasto).

At its core Intrasis is a Geographic Information System or GIS, meaning it is a system designed to handle geographical data (Esri, 2014). This is reflected by the fact that it uses PostgreSQL as its database language. PostgreSQL has an extender also used in Intrasis called PostGIS that is specially designed for spatial and geographic objects (PostGIS, 2014). In addition to geographical data, Intrasis can be used to handle all the necessary data gathered from an excavation. This data includes, for example finds or samples.

PostgreSQL was also chosen for a spatial database built for the archaeological sites in Romania. Like in the case of Intrasis PostgreSQL being an open source tool was one of the deciding factors. The already mentioned PostGIS extender was also one of the key features. (Mocanu & Velicanu, 2011)The Lahti database is not currently needed to handle geographical data beyond of just storing it but for further development. PostgreSQL could be an option. Popular database management system MySQL can also be used to handle geographical information but its abilities are limited compared to PostgreSQL/PostGIS (BostonGIS, 2014). MySQL could still be an option over PostgreSQL if the database is to be transformed into web application.

Comparing to the Lahti database, Intrasis can be used to handle everything that the Lahti database is used for. Intrasis can be used by any party that has need for this type of data recording but archaeologists are its main focus.

Intrasis was launched in April 2000 and is widely used in Sweden. It also has some use outside of Sweden, mainly in other Nordic countries excluding Finland. Usage of Intrasis is mandatory if the excavation is done by the Swedish Heritage Board, otherwise it is optional (Lund, 2014).

The usage of Intrasis is not free. To use Intrasis a license must be bought from the Contract Archeology Service. License for Intrasis costs SEK 20000 and there is also an additional annual support fee of SEK 4000. (Lund, 2014) This fee includes upgrades to the system. Additionally to use Intrasis a copy of the newest version, Intrasis 3.0, must be downloaded. It is therefore not available straight from the internet (Contract Archeology Service, 2014b).

5.1.3 Comparison to Lahti database

On a cursory glance of Intrasis it would seem that it or something like it would be a good system for Finland as well. Intrasis does everything that the Lahti database was designed to do and what is more important, it has a party behind it to developed and provide continued support. An issue with the Lahti database is that who is going to support it after the work for the excavation is done. If the database is merely forgotten it has not really served its purpose.

There are however, few issues with Intrasis in regard to the research questions. These are the shareability of Intrasis and that it is not strictly mandatory. Intrasis is not meant to be a web application but instead to be used from a local drive or a server that is not associated with Intrasis (Lund, 2014). One of the key issues in the research is the sharing of the database. It would be important to have all the data always available. Another issue is the optional usage if Intrasis. The research done among archaeologists using the Lahti database revealed that to be usable in Finland, the database usage should be mandatory and controlled by the National Board of Antiquities. This is naturally smaller issue than Intrasis not being a web

application. If a database like Intrasis were to be adopted in Finland, the National Board of Antiquities could merely make its usage mandatory.

5.1.4 Musketti

Musketti is a database originally built for storing information about different ethnographical objects (Interview, 2014). Nowadays it is also used to store information about objects in museums as well as pictures. Musketti is owned and designed by the National Board of Antiquities. (National Board of Antiquities, Musketti-sovellus, 2013b)

5.2 Research data

Interviews were done in two phases. In first phase a questionnaire was made for the archaeologists who used the current Lahti database. After they answered this questionnaire, face-to-face interviews were conducted for each of them. These interviews were recorded between 19th of March, 2014 to 21st of March, 2014.

5.3 Data analysis

5.3.1 Interview table

Table1: Fragments from questionnaires and interviews at the beginning of the adoption

Question	I1	I2	I3	I4	I5	I6	Summary
1. What kind of, if any, problems have you had regarding storing data in previous excavations?	Missed question on the form.	Most excavation data is saved in paper form because the NBA doesn't accept digital data. Some people use their own databases to create the field report in Word format.	Hasn't had any problems.	The NBA only used paper for storing information, because there are always just some excavations. The main problem is that people can only get the data in paper copies for researches; this may doubles or even triples the amount of work.	Has not had any problems.	Turku database has had problems with upkeeping it. It was developed by an archeologist and there is no one who would have the upkeep as their duty. Development is done when there is need and time. Should be noted that the database is also outside of the museum budget so any development has to reflect that.	Not too great issues but access to data can be problematic, due to it being in paper form in an archive.
2. Have you used databases before for archeological work?	Has not used databases before. If the data has been digitalised, the information has been stored on	Used Musketti for cataloging photographs (heavy to use, inquiries is not good) and the NBA (easy to	Diaries, notes, maps, photos on hard disks, paper lists. Data and backups on	Used separated Access databases for photos, contexts and finds before.	Has not used databases before, other than Musketti. Data was stored as	Has used the database in Turku.It has been in gradual development for about 14 years. Turku database is about to be converted to be	Nearly everyone has some experiences with databases, though usually in small scale

	cd's and memory sticks. This has lead to poor availability of the information and also the possibility of lost data.	use).	hard disks as well. This works well enough on small scale excavations.	Some projects use individual Word and Excel files for different types for data.	prints, maps, photographs, and different files like word and pdf. Musketti was used for storing data about pictures.	compatible with the building heritage database.	
3. Have you used Access before or other databases	Only very little.	Used Access for the master thesis in archaeology.	Has used Access in university. History department has a compulsory computer course. Access use was not focused on archeology though, but was more general use.	Has used Access for several projects and the Master's thesis. She thinks Access is easy to use and would like to have some short Access-course.	Haven't used Access, only Musketti. She feels that Musketti is large, complex and not very useful.	Has used Access before (in Turku). Thinks basic Access use is easy for non professionals (in IT). Easy to comprehend as well.	Only one does not have previous experience with Access
4. For which purposes do you use a database software to store information?	Digitalising hand-written information.	Uses the Lahti database for photographs. (inserting photographical information, searches etc.)	Gathering material from different people, collecting it together in one entity.	Used Access in Masters' thesis and in different associations for lists of members and their addresses, paid fee etc. She also used database software designed for accounting and bookkeeping.	Stores data about samples, units, groups and black and white pictures. The goal of all this is to produce an excavation report for the NBA.	Organizing and utilizing large amounts of information. One of his duties is to make maps using autoCAD. For this he utilizes the database by looking up stratigraphical information. Later on he will also input map information into the database.	Interviewees use the Lahti database for various tasks
5. How is the data and results from other excavations currently accessed?	Physically visiting the archive the information is stored in. Reports have been made available on the internet though, but only reports and basic site information, not all the data.	Some excavations reports are available in the Internet as PDF formats. Several information of finds also available in the Internet, but cannot use in research. Find catalogues are only in paper format.	Reports from excavations are collected and archived in a single place. If someone wants to look at a report they would need to travel to the archive physically. Some of the material is being digitalized, which is a current topic in Estonia. Right now this is mostly done on older material. Feels that newer material will also be digitized.	All data is on paper and stored in the Archives of NBA. Just some of the reports are available online as PDF format.	Does not feel that accessibility is very good. Printed reports are stored in physical archive and only a few are available on the internet as pdf's.	The database in Turku can be accessed for excavation reports etc. but is only available for the museum personnel. The database was going to open for wider audience. This was to be done with assigning guest privileges to the database, which probably means that the database was going to have different types of user accounts. The development has been frozen now due to funding.	Mostly results are available by going to archive for a paper copy. Some are available online as pdf's
6. Are you familiar or do you know any other database software that have been used for archaeological work?	Is not aware of any.	Musketti and the Register of Ancient Monuments.	Is not aware of any. Feels that if there are any databases then those are for personal use only.	Believes that Turku Museum has used some software for its data, but it has been created by archeologist in the 90's and hasn not been updated since.	Knows about the Turku database or that it exists.	Is not familiar with other databases but knows about Musketti.	Answers range from not being familiar to mentions about three different databases (Musketti, Register of Ancient Monuments and

				She did not get to use the database.			Turku database) In conclusion, they don't seem to be aware of many archaeological databases
7. What is your opinion about the database built for Lahti market square excavations	Database for such a large amount of data as in Lahti, is essential. The database enables cross referencing data so it doesn't need to be done manually, which is time-consuming task.	Access is simple and easy to use.	Convenient to search for data as well as "forcing" people to store data in a similar way. No problems really, other than some initial bugs.	It has enabled to work with their massive amount of data in a quite quick way. The only problem is the time on making, using and doing the required corrections after some of the data is already in the database. The corrections of the database always made their work slower and took much time to check and update everything again. It will be better if all the team members, especially archaeologists, could join the designing of the database in the beginning.	Feels that the Lahti database is ok but at the same time it is not finished yet. Additionally development began before all the requirements were available. Searches could also be more detailed. Lahti database helps in a way that the information they need is available faster.	Doing searches in the Turku database has not been as useful as he hoped. Without the Lahti database he would create a simpler version of it himself with Access. He feels that report processing would be harder.	Mostly the thoughts are positive (easy to use, helpful etc.) Some mention minor issues but no one thinks there are large problems
8. How would you describe the essentiality or non essentiality of databases in doing archaeological research?	Thinks that they are the future of archeology and would be good to have one large shared database instead of several disconnected ones.	Every researcher usually builds his/her own database for specific study. It is really essential to have one database for finds in this moment.	Feels very positively about a database like Lahti on a large excavation.	It depends the size of the excavations. With small excavations, it can easily be done by single word page, but if there are over hundred photos, contexts and finds, it is easier to use database. However, as a researcher, she feels it would be essential to have one national database.	Useful for large scale excavations. More than 100-200 units. Using a database would be also useful in a smaller excavation unless it would need to be developed first. Problem is the lack of permanent database, the kind of we aim to develop. Large scale excavations are more common in Turku and Helsinki. Normal excavations are around 20-40m2, Lahti is 13000m2.	There is a lot data produced by archeological excavations and there needs to be something that enables to work with that data. He feels that a database would be essential to do this work.	Generally interviewees think it is a good idea but that type of database is dependant on the scale of the excavations
9. What is	Such a	That would be	Likes the	It would be too	Good idea	Seems open to the	Interviewees

your opinion on a shared database in Finland for archeological data? Similar to Lahti database but available from anywhere and at all times to all archeologists in Finland.	database would make research easier and more convenient. It could also make archeological work more transparent and accessible to general public.	great but does not ever happen because the National Board of Antiquities will not accept of this idea while considering about the time, money and effort.	idea but doesn't feel that it could work. Feels that a lot material would not be inputted into the database because it would be public. Feels that some form of protection on inserted data before it gets public would help with making archeologists feel more secure about putting information in public place. Would have to be made mandatory by state or some other official party with power to make such obligations.	heavy and slow to use if one national database for all the information is in the public, just similar as Musketti. Now, it is necessary to have one unite database about finds in open access or controlled by NBA As to the other information on excavations she thinks that everyone should use the same type of database, but it could be saved as one excavation per one database-file. And those databases per excavation should be accessed, not totally open in web, at least by asking a read-only file from the NBA or others.	but doubts it would happen. NBA might be against it. There is too much work for them and they are set in their ways. Museums and universities on the other hand could be interested. Thinks that having a database for finds at least would be great.	idea. Suggests that Musketti and Muinasjäännörekisteri (a database for archeological sites in Finland, managed by the National Board of Antiquities) should be taken into consideration in the development.	like the idea but feel cautious about if it can be implemented. NBA might be a problem in development
10. Would such a database be helpful in your work? If yes, how might it help?	It would make archeological work faster and easier. It would remove the need to travel to the data location and also reduces risk of lost data.	It is helpful, especially for cataloging the finds. Information would be recorded coherently and researchers would have easier access to go through the information by using a database.	Would help as it would remove the need to travel to get information.	At least the find catalogue would help the research a lot.	Would help as it would remove the need to travel to get information.	Would be helpful. There would not be need for travelling or physically ordering materials anymore.	Everyone thinks it would be helpful
11. How do you personally feel about learning and using new software or computer systems for storing excavation findings?	Is interested.	Learning to use new software is a good thing if it is necessary to make the job easier.	Positively	Does not have any objections on that.	Interested but worried about how long the stored data lasts. It would need to be available even in 100 years time and that might not happen.	Feels that different systems are necessary.	Everyone feels positive about this

5.3.2 Interview analysis

1. What kind of, if any, problems have you had regarding storing data in previous excavations?

Opinions towards difficulties in previous excavations were rather divided. Two of the interviewees did not feel that they have had any problems and two of them felt that the main issues were in the storage of data.

> *”No problems at all”*

> *”... hasn't been any specific problems. There is just the bigger problem of general ruling... that only valid storing method at this moment is to print everything on paper.”*

> *”National Board of Antiquities doesn't accept digital data.”*

Currently the National Board of Antiquities wants everything printed on a paper and does not accept digital data. This was thought to be a problem due to the need to go to the archive for a report and also any additional methods used on an excavation may be lost to archaeologists other than those who worked on the said excavation.

One of the interviewees has worked with the Access database in Turku Museum Centre and felt that the database in question is not being updated consistently. The database in Turku is outside of the museum's budget and therefore any work done on it must be done whenever there is time, money and someone who can do any development work on it.

> *”There is no actual person in museum who... permanently takes care of that database”*

Based on the answers a digital archive for archaeological data would help archaeologists in their work. For this purpose a general, shared database for information about archaeological excavations would be ideal. As the National Board of Antiquities is an important party in archaeological work, it would be good if the database could be developed with the needs of the National Board of Antiquities, as well as the archaeologists, in mind. Ideally the database could even be owned and operated by the National Board of Antiquities. This would both serve their needs for archival of excavation reports as well as the needs of archaeologists to have excavation data easily available. In regards to the database in Turku, having a central party such as the National Board of Antiquities in charge of the database would remove or at least help with the issue of no one having the database as responsibility. This is especially important considering that there is a possibility of the fate of the Turku database happening to the Lahti database as well. To compare both existing databases to Intrasis in Sweden, a clear difference is that Intrasis has a powerful backer behind it, the Swedish National Heritage Board. If the National Board of Antiquities could take the role that the National Heritage Board in Sweden has in regards to Intrasis, it would assure the archaeologists that the database is in capable hands and that it is being taken seriously.

2. Have you used databases before for archaeological work?

Four of the interviewees have had previous experience with databases and two of them have not. Out of those four who have had previous experience with databases, one has only had experience with small scale databases, one has had experience with database comparable to Lahti in Turku and two have used Musketti. Musketti is a database developed originally for ethnographical objects but now contains pictures as well. It is governed by the National Board of Antiquities and is fairly large database.

”The data about pictures was stored in WebMusketti database.”

”In archaeology Musketti is used for cataloguing photographs.”

The answers point towards the idea that knowledge about databases among Finnish archaeologists is rather limited usually centred on the usage of smaller databases. This corresponds to research conducted by Isto Huvila among Finnish and Swedish archaeologists. According to his study, smaller databases are used often by archaeologists. His finds also confirm that larger, shared databases do not really exist in archaeology. (Huvila, 2006, ss. 193-194).

In the further development of the Lahti database this is something to take into consideration. The database has to be simple to use and it needs to be introduced so that the resistance towards it will be eliminated. Resistance to change is a real problem in working life (Trader-Leigh, 2002, p. 138) and the database is supposed to be used by many different people whose common feature is the field of archaeology. If little experience with databases is a common feature among archaeologists it should be taken into consideration during development.

Another point is regarding the Musketti. Those interviewed felt that it was not very user-friendly.

”It's large, it's very complex and it's not very useful”

”It's quite a heavy to use... Also this database's possibility to make inquiries is not good.”

Combined with the need to take resistance towards the database into consideration, it is important that the database is as user friendly as possible. Features such as very simple data entry forms and simple search functions should be considered. In general the front-end should be as simple as possible so that the archaeologists would feel positive about the database.

3. Have you used Access before or other databases?

Only one of the interviewees has not had any previous experience with Access. Three interviewees have made their own databases on Access, one for a computer course in university and two for a master's thesis.

> *”Only very little”*

> *”I have used Access before in the computer course in the university.”*

> *”While doing my master thesis in archaeology I used an Access database which I and my friend made.”*

All of the interviewees with previous Access experience felt that it is easy to use. A possibility in further development of the Lahti database is to keep it Access-based. Positive experiences of the interviewees would suggest that Access-database could be something that the archaeologists in general could feel positive about. The problem with this solution though is that the sharing can become problematic. Access in general is not really geared towards large scale use, which has showed during the use of the Lahti database. A possible solution to this issue could be moving the Lahti database to SharePoint. SharePoint has the option of having Access databases online (Microsoft, 2014a). This could be an option that combines the archaeologists' positive feelings towards Access with the need to have it shared.

4. For which purposes do you use a database software (in Lahti) to store information?

The tasks and duties interviewees have on the Lahti database are varied. Lahti database can be used to store several different types of data about the Lahti Market square excavations. This is something to consider in further development. The database should be able to handle large amounts of various data. From a developer point of view this is something that the Lahti database has problems with. The database feels somewhat bloated with all the different requirements it should be able to handle as well as having multiple people using it at the same time.

5. How is the data and results from other excavations currently accessed?

The general sentiment among the interviewees is that currently the information is a bit hard to access. Excavation reports are stored in a physical archive that needs to be visited to read them. There are however pdf-files available online of some reports but like one of the interviewees mentioned the pdf-files are merely digital copies of paper reports.

> *”Poorly, printed reports are in archives and few of them are as pdf-files on internet.”*

> *”Data from excavations is normally accessed only by visiting the archive where the original forms are held.”*

One interviewee mentioned that while there is some information about finds online, proper find catalogues are only available as paper versions, which they felt to be a problem for research.

> *”Find catalogues are only in paper form, which is a great*

problem while doing research."

Two interesting exceptions about data access were to be found from the interviews. One interviewee who has experience with the Access database in Turku Museum Centre talked about how data is accessed there. The data in the database is used to produce the reports, the same reports which most felt were difficult to reach, but the data that produces the reports is available. This data however is only available to the museum personnel. Original, now halted, idea was to have the database available to people outside the museum as well.

"Information of databases is currently in a permanent databank of which Turku Museum Center utilizes."

"Its original idea was to be open for wider audience... development phase of the database has frozen this idea until further notice."

Other deviation from the norm is how the data is accessed in Estonia. Mostly the methods are similar in that reports are stored as physical copies while some is available online. However, it seems that there is more of a focus in Estonia to digitalize the archived information. Current digitalization process is more focused on the older material but the interviewee thought that the focus will eventually move to newer material.

"Digitalizing different historical archives has been hot topic in Estonia in last years."

"I do think that when they have been uploaded those older material, they will get to the newer material also."

Based on the answers having a shared database would help with the information retrieval. Additionally it is important to avoid the issue of the Turku database. There should be a party to supervise the database.

6. Are you familiar or do you know any other database software that have been used for archaeological work?

In general the interviewees are not aware of archaeological databases apart from the database built for Turku Museum Center, Musketti and the register of ancient monuments. Two of these databases, Musketti and the register of ancient monuments are rather specialized databases. These results correspond again with Huvila in that larger, shared databases do not really exist in archaeology (Huvila, 2006, ss. 193-194).

This can be both a challenge and opportunity for the further development of the Lahti database. Without references to existing and working solutions it could be a problem to find a party willing to invest in the database. Based on the results of the research, this party would need to be the National Board of Antiquities. On the other hand, convincing the National Board of Antiquities of the need for a shared database could be good for the development. Without already existing systems, the database in Lahti could be marketed as an option for a basis of a shared database.

7. What is your opinion about the database built for Lahti market square excavation?

Most interviewees regard the database built for Lahti market square excavation as a helpful tool which brings conveniences to their daily work in some ways. As all of the interviewees are responsible for different posts, they are satisfied to use the Lahti market square excavation database for storing personal research data and searching data.

> *"The most important thing about the database is that it makes cross references between the different items that has been inserted in it…"*

> *"I make cross-checking of relations in various aspects of information."*

Since Lahti market square excavation is a large-scale excavation, by using the database built for Lahti market square excavation, two of the interviewees pointed out that a database could make the research easier.

> *"A database is essential for storing such a vast quantities of information as the Lahti excavation has."*

> *"…it has enabled to work with our massive amount of data in a quite quick way"*

> *"…it makes much more sense to use a unified system such as the current database."*

This question was further divided into a sub question: "without the database how the data storing and handling would be done?" Only two interviewees answered that they would use Musketti or Access for personal database and the rest of other interviewees said they would try to create their own databases. According to those positive opinions about the database built for Lahti market square excavation, it is clear that a combined database is necessary for the large-scale excavations in nowadays. This database should appropriate for both common and personal use.

However, the database built for Lahti market square is not perfect currently; there are several problems that have been noted while the interviewees work on it.

> *"Database does not correspond with separate parts so flexibly as I wished…"*

> *"…it`s not finished and part of it is made before we even knew what kind of data we would have"*

> *"The only problem has been the timing on making it ad using it and then doing the required corrections after some of the data is already in."*

Basically, there are no notable issues on storing data in Access database built for Lahti market square excavation. Problems come out while the interviewees cross reference data and the developers make corrections. Especially when the developers are making corrections, the archaeologists have to stop their current work in Access and after the corrections; archaeologists may have to redo the previous work. This might be the worst disadvantage to Access that it is not really intended to support many users accessing the database simultaneously (Stephens, 2009, p. 287).

To solve those problems, one of the interviewee put forward a feasible suggestion. She recommends that all the team members, especially the archaeologists, should join in the designing and creating the database after the field season. From this side, the database could be more perfect from the beginning and achieve what archaeologists exactly need. Thus, there should be more communication between the developers and the archaeologists while doing further development for the database. In addition, one possible solution to avoid the pause between corrections could be using web application instead of coding in Access.

8. How would you describe the essentiality or non-essentiality of database in doing archaeological research?

Generally interviewees agree that it is the future to having a database in archaeological researches. But the type of database is dependent on the scale of

the excavations. For the small size of excavations, all the information could be saved just in several Word pages, and then there is no necessity to have a comprehensive database. Nevertheless, if there is a large-scale excavation with immense scale of artefacts and information as Lahti market square excavation, it is essential to have a database or a system to sort all the materials.

Interviews revealed that large scale excavations do not happen often in Finland. This might be one reason for why there is not a national database in use for archaeological researches in Finland. In a word, the essentiality of a database in archaeological work is depended on the size of excavations.

9. What is your opinion on a shared database in Finland for archaeological data? Similar to Lahti database but available from anywhere and at all times to all archaeologists in Finland.

What is interesting is that all of the interviewees like the idea about a shared database in Finland for archaeological data, but feel cautious about if it can be implemented. No one considers this national database is achievable; the NBA might be a problem in development.

> *"I suppose it would be a good idea; however I don't think it's doable…"*

> *"This would be great but I don't think that this will ever happen."*

> *"It`s very good idea and I strongly support it, but I doubt it would never happen."*

> *"I am not sure if one national database for all the information (similar to our database with photos, finds, context, samples etc.) is required to be public…"*

Some of the interviewees mentioned that the digital archive for national archaeological data would be too heavy and slow to use, because this happened with Musketti. Musketti has the similar idea about storing all the data on museum objects and photos in one database. Another consideration of the feasibility for this shared database in Finland is the National Board of Antiquities. With the desired supports for the abundant finance, resource, and manpower to sustain the progress of a national database, the achievement might depend on the attitude of the National Board of Antiquities, which is the important party in archaeological work. The acceptation of the National Board of Antiquities would be the main support for enforcing this database. One of the interviewees also indicates that the personal intentions about the sharing database would be one influence factor to realize the shared database in Finland.

Thus, firstly, considering the urgent need about an integrated database, the developers could separately design the national database into different parts with photos, finds, context, samples and etc. in the beginning and combine those databases as a unified database while the single databases are working perfectly.

Secondly, the designers should negotiate with the National Board of Antiquities to gain the most possible sponsor from different sides, which means that the national database could be controlled by the National Board Antiquities and the public researchers can get the read-only file of the unified database by asking the access from the National Board of Antiquities in normal days. But, if there is an excavation needs to modify the database, the National Board Antiquities could backup the old database firstly and then, give the limited rights to the staff of modifying the database during the excavation period. After the excavation, the National Board of Antiquities would update the current data into the unified database for the public.

10. Would such a database be helpful in your work? If "Yes", how might it help?

There is no doubt that everyone thinks a database would be helpful, two of the interviewees emphasize the finds catalogue in particular.

> *"It would help if I would need to get information about the certain excavations immediately."*

> *"Yes it would be, especially when thinking of cataloguing the finds."*

> *"It would be helpful as one can at that situation do studying of a site without travelling or ordering materials to see."*

> *"At least the find catalogue would help the research a lot."*

Those answers reply that the current database in Lahti market square excavation is achievable to be the basis of a united database in Finland after the future development.

11. How do you personally feel about learning and using new software or computer systems for storing excavation findings?

All of the interviewees feel positive about this answer. They believe that the new software or computer systems for storing excavation findings will make the researches faster and easier. There could be a short training about manipulative systems for information to each archaeologist in the beginning of the excavation. This is a necessity for the archaeologists that might not have enough knowledge about the computer skills working smoothly in the storing excavation findings while using new software or computer systems.

6 CONCLUSION

Based on the literature review, a well research report for the result of an archaeological excavation is needed while publishing the discovery. And the published result should rely on the analysis of a massive data; in consequence, an appropriate archaeological database management system which is followed by the database design process will improve the efficiency of research.

However, as the archaeological work proceeds in Finland, NBA plays a significant role to realize a national archaeological database. As the achievement of authors' practical training, Access is a simple choice for building the archaeological database even it has several limitations of personal customization.

In addition, from the data analysis, Intrasis is a successful and popular archaeological database developed by Sweco. However, Intrasis is not free to use, and the sharing of database is not enough either. And most interviewees have the experience of using Musketti which is owned and designed by the NBA.

According the analysis of interviews, Access has a broad-based usage in archaeologists' daily work. Interviews are satisfied with the current Lahti database, and a digital archive for archaeological data helps their work. But, although all the interviewees agreed that an archaeological database is necessary, the realibility is a problem and the NBA is a barrier also. Furthermore, the scale of archaeological excavation should be considered while creating a database. At last, the current Lahti database could be the basis of a united database in Finland after the future development.

6.1 Role of the National Board of antiquities

This research has shown that archaeologists like the idea of a shared database but do not feel that it would happen. They feel that the NBA will not support the idea. In addition they are apprehensive towards it due to fears of it becoming another Musketti, slow and inefficient.

National Board of Antiquities gives guidelines for archaeologists to follow. To make the usage of the database more convenient it would be best if it was

developed with the guidelines of the NBA in mind. In general, it has become apparent during the research that the National Board of Antiquities is the key factor in developing a shared database for archaeologists. Same applies in the further development of the Lahti database. Certain data is even legally needed to be included in excavation reports etc. so it is doubly important to accommodate the NBA requirements.

6.2 What to keep in mind during development

Archaeologists are not used to large databases. Exception to this being Musketti but for only some people, as it is used for storing picture data. Development needs to be done with this in mind. The database needs to be simple to use. Additional issue is that Musketti is not very user-friendly.

There are many functions needed for the database to perform. Current Lahti database has a bit of a problem with this so it would probably be best if the system was moved to a more robust platform capable of handling everything required from it.

Requirements' gathering is very important part of the development of any system, perhaps even the most important. Finding and fixing errors in the system during the requirements phase compared to implementation can be as much as 100 times less expensive (Avison & Fitzgerald, 2006, p. 98). This is something that happened in the development of the Lahti database. One of the developers had to be hired so that the database could be finished. This was done while the database was being used, which caused problems with using the database. Taking archaeologists in the design process could be useful. This is something that needs to be done when archaeologists do not have excavations to do as became apparent during the interviews.

Again, data is currently hard to get and even then it is pretty much only in the form of excavation reports. Some of these are available as pdf's but they are merely electronic versions of paper reports and do not add any new information.

Usefulness of the database seems to be connected to the size of the excavation. Most excavations are small and therefore using a database to store information

may not seem needed. This could be one of the reasons for a common database not existing. To be able to start development of the database, archaeologists and the NBA should be convinced that it would be useful even for small excavations.

7 DISCUSSION

7.1 Suggestions

Based on the results presented in previous chapters there are some conclusions to draw on as to what to do to answer the research questions.

7.1.1 Using Access

Access is familiar to archaeologists and could be an option for development. Access does not seem to be really suited for the type of work that the research is aiming for though. Keeping this in mind, getting the National Board of Antiquities to support Lahti database seems unlikely or at best difficult. Even if they would be interested, the issue of the Lahti database not being suitable for such a large scale use that is needed, would come up again.

7.1.2 Moving Lahti database to SharePoint

Another simple solution would be moving the Lahti database to SharePoint. SharePoint is a good platform in its own right but would it be suitable for a database that could become very large is an issue. The Lahti database alone is quite large and while the Lahti Market square excavations was largest ever done in Finland, it still was only one excavation. With this option the role of the National Board of Antiquities comes in question again. Would they be willing to support a third party option, or would they want to keep everything in their control.

7.1.3 Intrasis as a solution

Intrasis seems useful. It can do everything that the Lahti database was designed to do. It is however not free to use which could be a problem. If archaeologists would have to pay for a license to use the system they might not be interested in it. Intrasis is also not shared which is an issue, considering the research problem. This also raises the same issue than with SharePoint. The National Board of

Antiquities is in constant competition with other archaeological instances and as such, is likely to want to adopt a system governed by its competitor.

Another option could be to combine the way Intrasis can be shared with the suggestion of using Lahti database. The National Board of Antiquities could be responsible for administering copies of blank versions of the Lahti database or database based on it, which could be used on excavations to create databases for that excavation. While this would be a relatively cheap solution, which would still let archaeologists use a system they are familiar with, it ultimately fails on answering the second research question i.e. how the database could be shared.

Using this method would lead to a situation similar to Intrasis. There would be several different copies of the database with information from many different excavations but accessing that information could be difficult. Sharing this way would require that either archaeologist send their copies to other archaeologists or that they send a copy to the National Board of Antiquities, which in turn makes the copies available for all archaeologists.

7.1.4 Using Lahti database as a basis for a new system

Perhaps a user-experience similar to Access could be a solution. Lahti database could be taken as a basis for development for a more robust system. As it is an already existing, functioning system built on a platform familiar to archaeologists, starting development process by examining it could save time and money.

With this method, the National Board of Antiquities could develop a system that they feel is best for their needs and take ideas from the Lahti database. Additionally it is likely that this system would be developed by a professional software development company, meaning that the issues with the Lahti database can be avoided. Developing this system as a web application would also solve the problem with sharing the database. This would also mean that the database would be used if it was required by the National Board of Antiquities.

To develop the database like this, it would be needed to move from Access to another database such as MySQL or Oracle. Figure5 shows that MySQL is the most popular open source database management system, making it a good

candidate for the database. This is because using MySQL would be both free to use and be have large, already existing user base with plenty of support. Oracle and SQL Server are more popular but both are commercial database management systems. Additionally for the development it should be kept in mind that SQL Server is for Windows systems only (Microsoft, Hardware and Software Requirements for Installing SQL Server 2014, 2014b). This is important to keep in mind in case the server running the database uses some other operating systems. Both MySQL and Oracle work on multiple operating systems.

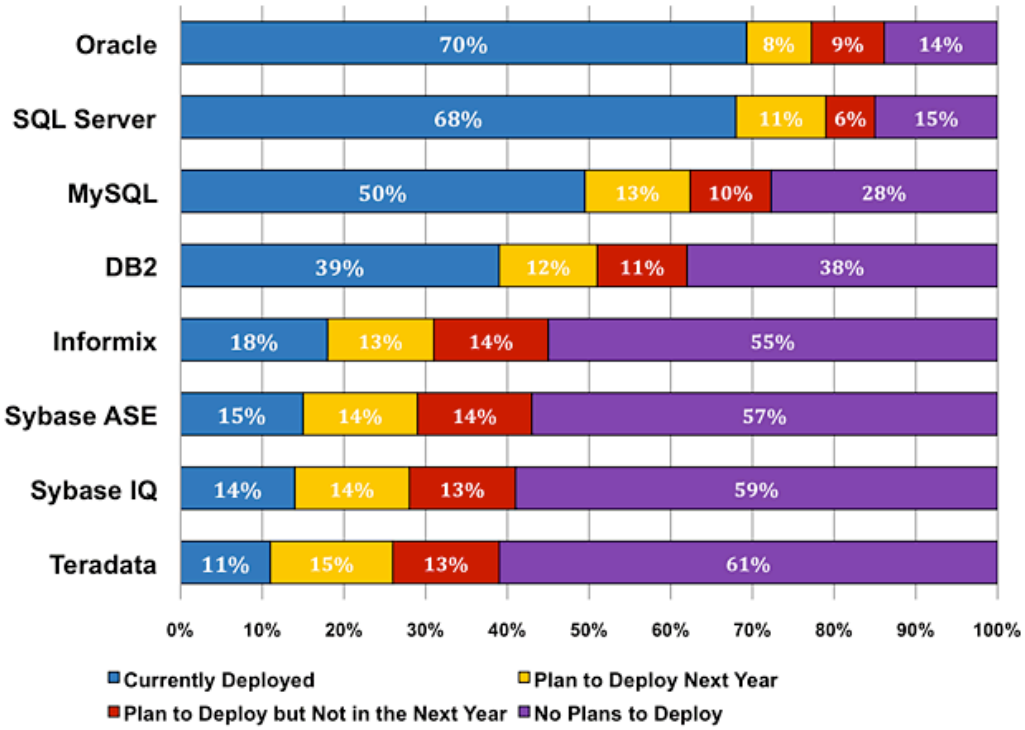

Figure 5: Database Management System Market Shares – 2008 (Mysql.com: Market share

7.2 Previous research

Research regarding archaeological databases in Finland seems rather limited. In general the usage of archaeological databases in Finland is not very wide spread but still there are some databases in use, like the Register of Ancient Monuments or Musketti for picture data. Keeping this in mind it is rather strange that studies on these databases are so limited. Perhaps the owners and stakeholders of these databases have not felt the need to do any research regarding these databases; after all, databases are not really at the core of archaeological interests. Other

possibility is that there is previous research done on archaeological databases but the studies and results have remained unpublished.

7.3 Risks

There are some risks involved in the application of the suggestions of the research. These risks should be covered in order to knowledge their existence and plan actions to counter the risks.

Firstly, the applicability of any of the thesis' suggestions relies on the National Board of Antiquities. It has been mentioned often how important the role of the National Board of Antiquities is in the archaeological field in Finland. Therefore all the suggestions of this thesis will eventually have to be reviewed by the National Board of Antiquities if they are to have any real life effect.

Currently there is a lack of already existing large databases in Finland, apart from Musketti. Musketti in itself is useful only for some archaeologists as its main function for them is to store pictures and picture data. This lack of databases could be problematic in proving NBA that a database is needed. If there are not any databases in use, then beginning to develop a large database might be something they are not interested in. One solution is that development could be started from smaller than a complete database with everything in it, for example a database for finds at first. The design could be made with the possible additions in mind.

The role of the National Board of Antiquities is additionally important when considering that it is a real risk that what happened with Turku database could also happen in Lahti. Turku database has no official party to supervise it. To prevent the same thing happening to Lahti database, it would be important to have some larger backer to support it. For this the National Board of Antiquities would be ideal.

Secondly, this research hasn't covered the aspect of funding the database. It seems apparent that a database of the scale that would be needed will need funding to happen. While an obvious candidate to provide necessary funding would be the National Board of Antiquities, it is not certain they would be interested in such a task. In addition of development cost, the finished system would also need

continued up keeping, which will also need money. Examining possible sources of funding could be a good topic for additional research.

Third risk centres on the Lahti database and specifically its developers. Because the database was built as a practical training task, it is not certain if the development was documented in sufficient detail. In addition the developers themselves are not likely to be involved in further development so any development has to be done based on the Lahti database as is and its documentation. Additionally, the database was originally planned as a reporting tool but transformed into a research tool as well while it was being developed. This means that it may not work as well as it would had it been developed as a research tool from the beginning.

Like mentioned in the chapter 4.1.3 the design of the Lahti database did not follow the proper design process sufficiently enough to be completely reliable. While most of the problems have been acknowledged and fixed, it is not certain that the Lahti database could produce reliable enough information for further uses.

7.4 Reliability and validity

The validity and reliability of this research is not certain. Like mentioned in the chapter 7.2, research done on this subject is rather limited and therefore it is not easy to validate. Suggestions provided by this thesis can however be considered reliable in a general sense. The suggestions are based on general theory of databases and database design, but their applicability on this specific context may need further research.

7.5 Further research

There is definitely use for further research regarding archaeological databases, considering how limited the research is currently. This research alone is not enough to give any concrete results on the future of archaeological databases, merely suggestions on how to proceed. In addition, more research could be done to either validate the findings of this research or debunk them.

One, more general topic for further research could be the adoption of archaeological databases on a more global scale. How are countries that have large scale archaeological excavations, like Italy, or otherwise are heavily involved in the field, handling their archaeological data? Perhaps they have already existing, well-tested databases like Intrasis, which could also be adopted in Finland.

Regarding the research questions of this thesis, a possible topic could be further research into development of archaeological database in Finland. This study gives a starting point and preliminary ideas but as the study is basically conducted from scratch; more research is required to give any solid advice. As mentioned previously, a research into funding of a project of this type could be another research topic. If an archaeological database would be developed in Finland, the funding of it would be needed anyway so usefulness of such research is almost certain.

8 SUMMARY

To sum up, the aim of this study is to figure out the possible solutions of improving a more effective archaeological database in Finland. The qualitative research method is used in this paper, and since the paper is based on a case study, inductive approach is the applied to moves the results from the specific to general. The authors make questionnaire and interview to collect the data for analysis.

The paper can be divided into eight chapters, starting from the introduction chapter. The introduction chapter described the background information of this study, including the recently status of database used in archaeological work, the necessity of building a wide used archaeological database, and the purpose of the study is according to the requirements from Lahti Market square excavation project. Then, in the end of Chapter 1, the scope of this study is explained.

After introducing brief information from Chapter 1, Chapter 2 presents the basic part before conducting research a research methodology including research problem and research framework. “How an Archaeological Database Could Be Developed in Finland” is the main construction research question for the study. The research framework is based on a design science framework from Hevner et al.

Theoretical knowledge for audience better understanding is explained as literature review in Chapter 3. This chapter answers the listed theoretical research sub-questions for a deeper knowledge, the basic concepts of archaeology and database design are the focusing theory parts. Besides two main concepts, Access and NBA (National Board of Antiquities) are also mentioned as appended knowledge for the following research analysis.

While the paper comprehends the theory part, it is easier to explain the research method in Chapter 4. This chapter presents Lahti database as a foundation of the research method at first. After the understanding of Lahti database, the details of the qualitative method and inductive research approach used for this study are expounded as sub chapters.

Based on the structure of this study and the theory information in previous chapters, data collection and analysis is presented in Chapter 5. The data collects from the comparison with Intrasis Information System which typically used in Swedish archaeological researches and Musketti which used in Finland domestically. But the main data and data analysis comes from the answers of questionnaires and interviews.

According to all chapters above, Chapter 6 aims at making conclusion of all the findings for the research questions. Following the conclusion, the recommendations are provided for the developing archaeological database in Finland. Based on the research analysis all the suggestions revolve around the participation of the National Board of Antiquities

However, while doing the data analysis and conclusion chapters, the authors recognize some risks and other topics for the further study. Chapter 7 is the discussion chapter for this study. This chapter attempted to recognize some of the risks as well as explore possibilities for further research and discuss about the lack of already existing research.

At last, the summary chapter, Chapter 8 summarizes the whole study. And references, questionnaire are added as appendix in the end of the study.

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APPENDICES

Questionnaire

General Information
Name (all names will be changed into aliases in thesis):

Age:
Education:
Excavations/ Project Experience:

Previous experience with databases

1. What kind of, if any, problems have you had regarding storing data in previous excavations?

2. Have you used databases before for archeological work?
   If yes: What kind of database(s) and what is your opinion about it/those?
   If no: How did you store the data gathered from archeological work?

3. Have you used Access before or other databases (If yes, what do you think about Access? e.g. easy to use or not, the aim of using Access etc.)?

Current experience with databases

4. For which purposes do you use a database software to store information?

5. How is the data and results from other excavations currently accessed?

6. Are you familiar or do you know any other database software that have been used for archaeological work?

7. What is your opinion about the database built for Lahti market square excavations (e.g. positive comments, negative comments etc.)
   - How does the database help in your work?
   - Without the database how would the data storing and handling be done?

8. How would you describe the essentiality or non essentiality of databases in doing archaeological research?

Databases in the future

9. What is your opinion on a shared database in Finland for archeological data? Similar to Lahti database but available from anywhere and at all times to all archeologists in Finland.

10. Would such a database be helpful in your work? If yes, how might it help?

11. How do you personally feel about learning and using new software or computer systems for storing excavation findings?