

## INTEGRATION OF DISTRIBUTED DATABASES

### 1. INTRODUCTION

The Israel Antiquities Authority, established in 1990, is responsible for over 25,000 archeological sites in Israel. The Israel Antiquities Authority (IAA) is the only authorized government office in Israel permitted to issue licenses for the purpose of scientific excavation. The IAA is based in Jerusalem at the Rockefeller Museum. Throughout the country branches of the IAA have been established to coordinate information gathered from the various archeological sites. The information is then relayed to the main office at the Rockefeller Museum.

Prior to the establishment of the IAA all data collected from excavations was stored on simple cards and warehoused in several locations throughout the city of Jerusalem. Each card contained the specific details of a particular archeological object. With the creation of the IAA, the entire recording process was redeveloped with the establishment of a computerized system.

The computerization program began in 1991. Our expansion in only four years has been tremendous. In 1991 there were a total of five XT computers throughout the entire IAA. Today over 300 computers have been installed throughout the IAA resulting in an integrated system between the database used by archeologists in the field and the database in the central computer of the Rockefeller Museum.

### 2. ANTIQUITIES SYSTEM

The development of the computerization program was based upon two distinct but integrated databases. The central database, known as the ANTIQUITIES SYSTEM is the main storage area for all the archeological information including the particulars pertaining to archeological sites, objects, and excavations.

Terminals directly linked to the central database were placed in the warehouses which had previously stored all the information collected in the field thus allowing the transfer of information to the main system.

The ANTIQUITIES SYSTEM was originally developed on a Data General computer- Aviiion 4020 with an UNIX operation system with Oracle 6.0 database using forms 2.3. Today the system continues to run on a Data General computer, however we have transferred to an Aviiion 5000 with Oracle 7.0 using forms 3.0.

### 3. EXCAVATOR 2001

While we were in the process of building the ANTIQUITIES SYSTEM we were concurrently developing a second system to be used by archeologists in the field. This system is known as EXCAVATOR 2001. Our aims in developing EXCAVATOR 2001 included the following: creating a database which would serve the archeologists needs in storing and processing the data collected in the site and in assisting with the creation and design of his final publication.

In addition, it was essential to create a generic database for use in the field that would provide a way to record information collected from various archeological sites and periods. Finally, it was of great importance to create a database in a way that would allow all users in the field to work in the same system thus resulting in a standardized process whereby all archeologists "talk together" and pass information to each other without running the risk of losing information.

The EXCAVATOR 2001 is built on the Microsoft product database Foxpro. Throughout Israel to date there exist approximately 60 stations which utilize the EXCAVATOR 2001 database. Each EXCAVATOR 2001 station is required to be at least a 486-DX PC computer with a minimum of 4 m memory. In each station there is a kernel installed which contains the main engine of the EXCAVATOR 2001. The main engine of the kernel is as follows: navigation, menuing, user interface, and utilities. The kernel is generic thus allowing the same kernel to be used in all excavations.

EXCAVATOR 2001 can run on a single PC or on any network such as Novell, Lantastic, Windows NT, and so on. The system can be used in a single season or in a multi-season setting (a season is defined as a specified time span during which work is conducted in excavation areas).

### 4. THESAURUS OF THE SYSTEM

Both the EXCAVATOR 2001 and the ANTIQUITIES SYSTEM make use of the same unique thesaurus specially designed for the needs of archeologists. The thesaurus words are marked on the screen with an asterisk (\*). The words are written in a standardized form thus allowing all users both from the EXCAVATOR 2001 stations and users from the central system to communicate in a clear and precise manner. The thesaurus is able to recognize misspelled words and "unpreferred" words and informs the user automatically of the correct spelling or the preferred word.

### 5. INTEGRATION OF ANTIQUITIES SYSTEM AND EXCAVATOR 2001

The final phase in the design of the overall system is the integration of

the EXCAVATOR 2001 PC stations with the main ANTIQUITIES SYSTEM. The integration of these distributed databases is based upon the technology of client server. The EXCAVATOR 2001 is considered to be the client whereas the ANTIQUITIES SYSTEM is the server. The integration system, also known as the transaction system, is two sided (consisting of uploading and downloading) and multi-leveled.

The first level in the uploading of data is the registration and processing of the data into the EXCAVATOR 2001 field station. The second level in uploading consists of transferring the data by means of a computer disk into a Curator PC. The Curator PC is the bridge between the system in field (EXCAVATOR 2001) and the ANTIQUITIES SYSTEM. The data that arrives from the field is analyzed by the Curator PC. A filtering process enables the computer to examine the data from the field to prevent incorrect data from continuing onto the ANTIQUITIES SYSTEM. The final stage in uploading is the transferring of the data from the Curator PC to the ANTIQUITIES SYSTEM using an Oracle SQL NET Software through LAN typology.

The process of downloading involves the sending of information from the ANTIQUITIES SYSTEM to the EXCAVATOR 2001 field PC computer. The information that is sent to the field PC is an updated and corrected version of the data that was received from the uploading process. The process of downloading involves the same three levels as was described for the process of uploading, only in reverse order beginning with the data being transferred from the ANTIQUITIES SYSTEM to the Curator Module and from the Curator Module to the EXCAVATOR 2001 field PC.

## 6. THE COINS MODULE TRANSACTION SYSTEM

The Coins Module Transaction System (CMTS) is an example of the integration process between the EXCAVATOR 2001 and the ANTIQUITIES SYSTEM. In the field, when coins are found at an archeological site, an identification of the coin needs to be made. When an expert in the identification of coins is present, then the data on the coin is collected and recorded in the EXCAVATOR 2001. In this case scenario the identification of the coin is full and complete from the side of the field.

In a case where an expert on identification of coins is not present, then the data recorded onto the EXCAVATOR 2001 is listed as the following:

1. The locus referring to the area in which the coin was found.
2. The basket referring to the physical unit into which the coin is placed.
3. The quantity referring to number of coins in the basket.

Afterwards, the disk containing the data from the coins along with the actual coins are sent to the Curator PC. In the case where an expert on coin identification was present in the field, the uploading process will continue by

sending the data to the Curator PC in any existing index such as period, locus id, basket id and so on. In the case where an expert on coin identification was not present in the field, then the uploading will continue by sending the data to the Curator PC only in an index of the locus id and basket id.

Once the disk is sent to the Curator PC, the local EXCAVATOR 2001 PC automatically locks all the data that was included on the disk thereby allowing the user only to view the data and preventing the user from attempting to update the data.

The Curator initiates the upload process and the data is recorded onto the Curator PC. Verification of the permit/license number from the excavation site is checked through use of the Oracle SQL Net Server. If the number is valid the data is relayed to the Oracle ANTIQUITIES SYSTEM and a new registration certificate is opened in the main central system. All inaccurate data found by the Curator PC is transferred to a log file. The log file is sent back to the EXCAVATOR 2001 station to be viewed and corrected by the user.

Along with the data which is transferred to the main ANTIQUITIES SYSTEM, the actual physical coins are also sent to the IAA at the Rockefeller Museum. All coins are sent to a special department in the IAA which is responsible for the identification of coins. Coins which were not identified in the field (due to the lack of an expert present on the site) are further examined at the IAA. The process of documenting the specifics of the coins is continued in the main ANTIQUITIES SYSTEM using the original locus and basket id numbers. The coins which were identified in the field are also sent to the same department of the IAA at which point they are stored for further use.

In downloading there are two types of data: one type of data is that pertaining to the coins that were not identified by an expert in the field, and the other type of data relates to the coins which were identified by an expert in the field. Both types of data are sent from the ANTIQUITIES SYSTEM through the Curator PC to the EXCAVATOR 2001 station. Data from the coins which were not identified by an expert in the field is automatically loaded into the EXCAVATOR 2001 and is integrated into the database. Data from the coins that were identified by an expert in the field and in turn corrected by the IAA persons working in the central system is not automatically integrated in the database of the EXCAVATOR 2001 station; the data is viewed by the user and the user decides whether or not to correct the records.

In developing CMTS many obstacles had to be overcome. The system had to be built in such a way that the user has an overall picture of the data being transferred from one level to the next. This is achieved through the creation of log files supplied by the CMTS. The CMTS must also be designed in such a way that it can identify, verify, and transfer accurate data to the appropriate destination. The data structure of the table upon which the CMTS

is built must flexible in order to maintain the integrity and suability of the ANTIQUITIES SYSTEM and the EXCAVATOR 2001.

## 7. CONCLUSION /FUTURE DIRECTIONS

In attempting to connect the databases of many users working in various excavation sites throughout the country with a main database terminal located in an office one is presented with many challenges. Our aim was to create a national database consisting of the vast material and objects obtained by hundreds of archeologists working in the field. The ultimate goal is to create a system in which the data can be absorbed in a precise manner thus resulting in a reliable and secure technological system.

In the future we envision a further expansion of the national database; through the use of the INTERNET system we hope to create an international database.

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## ABSTRACT

The Israel Antiquities Authority, established in 1990, is responsible for over 25,000 archaeological sites in Israel. Rockefeller Museum in Jerusalem is the headquarters of the Israel Antiquities Authority (IAA). The IAA began its computerization program in 1991. In 1991 there were a total of five XT computers throughout the IAA allowing it to facilitate an integrated system between the database used by archaeologists in the field and the database in the central computer of the Rockefeller Museum. Excavator 2001, the database used by archaeologists in the field, is built on a FoxPro database. The database of the central computer is known as the Antiquity System and is built on a Oracle database.

In the final analysis our aim is to create a national database consisting of the vast material and objects obtained by hundreds of archaeologists working in the field. In addition to the artifacts and data which are currently being processed and integrated into the new system, we are also in the process of cataloguing hundreds of thousands of artifacts which are discovered and stored prior to the development of the national database system.