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## Completing the Conceptual and Logical Database Design

- ❖ Issues to Be Addressed
  - ◆ Entity relationship modeling and normalization
  - ◆ Data model verification
  - ◆ Logical design
  - ◆ Physical design
  - ◆ Implementation
  - ◆ Testing and evaluation
  - ◆ Operation
- ❖ Two UCL System Modules
  - ◆ Lab Management System
  - ◆ Inventory Management System

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**TABLE B.1 THE UNIVERSITY LAB SYSTEM'S DESIGN ORGANIZATION**

MODULE	ENTITIES	ATTRIBUTE PREFIX
Lab Management System	USER	USER_
	LOG	LOG_
	LAB_ASSISTANT	LA_
	WORK_SCHEDULE	SCHED_
	HOURS_WORKED	HW_
	RESERVATION	RES_
	RES_SLOT	RSLOT_
Inventory Management System	INV_TYPE	TY_
	ITEM	ITEM_
	STORAGE	STOR_
	LOCATION	LOC_
	REPAIR	REP_
	VENDOR	VEND_
	ORDER	ORD_
	ORDER_ITEM	OI_
	WITHDRAW	WD_
	WD_ITEM	WI_
	CHECK_OUT	CO_
	CHECK_OUT_ITEM	CI_
	INV_TRANS	TRANS_
TR_ITEM	TI_	

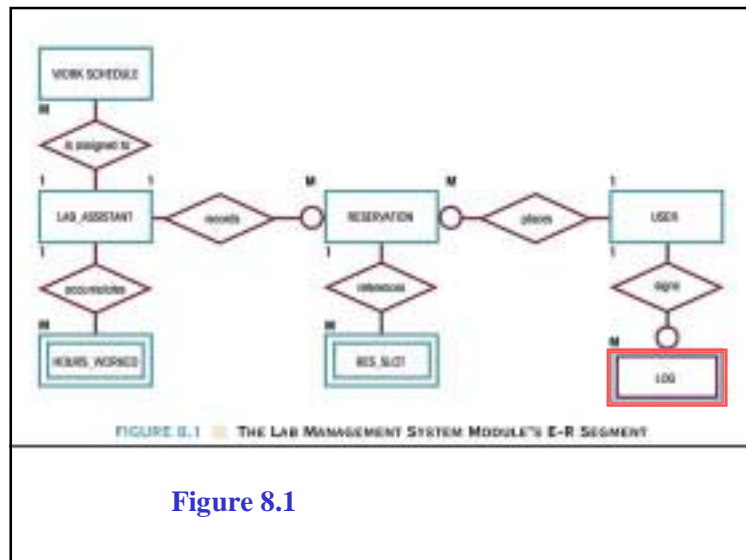


Figure 8.1

**TABLE B.3 THE LOG ENTITY**

ATTRIBUTE NAME	CONTENTS	ATTRIBUTE TYPE: COMPOSITE (C), SERVED (S), OR MULTIVALUED (M)	PRIMARY KEY (PK) AND/OR FOREIGN KEY (FK)	REFERENCES
LOG_DATE	Log-in (system) date		PK	
LOG_TIME	Log-in (system) time		PK	
LOG_READER	Magnetic card reader number		FK	
USER_ID	User identification (ID)		FK	USER

Table 8.3

# Slide Set 7: Logical Design and Implementation

Figure 8.3

LOG_DATE	LOG_TIME	LOG_READER	USER_ID
Wednesday, June 02, 1999	2:24:32 PM	1	401-85-2112
Wednesday, June 02, 1999	2:24:39 PM	2	331-62-0032
Wednesday, June 02, 1999	2:25:41 PM	2	324-52-8551
Wednesday, June 02, 1999	2:25:44 PM	1	352-14-9219
Wednesday, June 02, 1999	2:25:58 PM	2	443-56-5676
Wednesday, June 02, 1999	2:26:03 PM	1	295-07-2314
Wednesday, June 02, 1999	2:26:26 PM	2	264-77-0032
Wednesday, June 02, 1999	2:28:19 PM	1	401-67-5676
Wednesday, June 02, 1999	2:30:35 PM	1	286-39-0551
Wednesday, June 02, 1999	2:32:09 PM	1	367-11-2512
Wednesday, June 02, 1999	2:32:09 PM	2	301-12-2889
Wednesday, June 02, 1999	2:35:42 PM	2	386-12-3456
Wednesday, June 02, 1999	2:36:33 PM	1	414-36-4217
Wednesday, June 02, 1999	2:38:21 PM	1	331-62-0032
Wednesday, June 02, 1999	2:39:57 PM	1	401-85-2112
Wednesday, June 02, 1999	2:42:13 PM	1	401-67-2318
Wednesday, June 02, 1999	2:43:01 PM	2	345-76-6899
Wednesday, June 02, 1999	2:43:03 PM	1	403-11-2323
Wednesday, June 02, 1999	2:43:42 PM	1	352-14-5676
Wednesday, June 02, 1999	2:43:58 PM	2	299-87-9234
Wednesday, June 02, 1999	2:44:47 PM	1	264-77-0032

FIGURE 8.3 THE LOG SAMPLE DATA

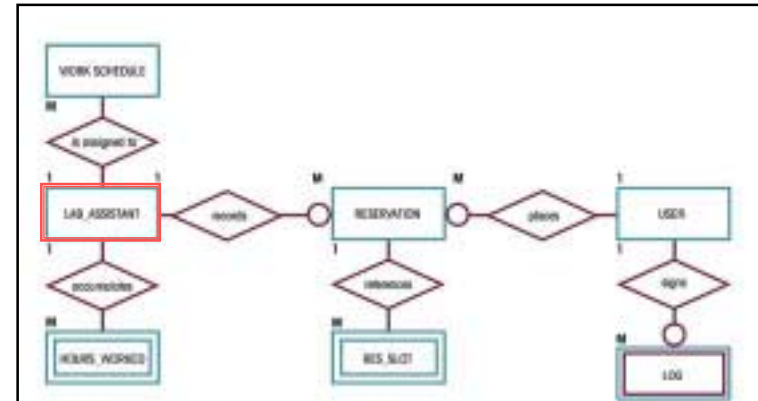


FIGURE 8.1 THE LAB MANAGEMENT SYSTEM MODULE'S E-R SEGMENT

Figure 8.1

TABLE 8.4 THE LAB\_ASSISTANT ENTITY

ATTRIBUTE NAME	CONTENTS	ATTRIBUTE TYPE: COMPOSITE (C), DERIVED (D), OR MULTIVALUED (M)	PRIMARY KEY (PK) AND/OR FOREIGN KEY (FK)	REFERENCES
LA_ID	Lab assistant identification		PK	
LA_NAME	Lab assistant name	C		
LA_PHONE	Lab assistant campus phone	C		
LA_SEMESTER	Most recent working semester	C		
LA_TYPE	Lab assistant classification: GA = graduate assistant SW = student worker WS = work study student			
LA_HIREDATE	Date hired			

Table 8.4

LA_ID	LA_NAME	LA_PHONE	LA_INITIAL	LA_PHONE	LA_SEMESTER	LA_TYPE	LA_HIREDATE
307-89-0905	Herandez	Maria	M	4123245	SPR99099	GA	Thursday, June 11, 1999
393-52-5456	Juan	Miguel	J	4123234	SPR99099	WS	Friday, January 26, 1999
402-42-8543	Jensen	George	G	9126789	SPR99099	SW	Tuesday, July 14, 1999
411-23-4568	Falstrom	Herman	H	417890	SPR99099	GA	Friday, January 26, 1999
413-21-2233	Toombs	Jack	J	4121121	FALL99	SW	Monday, January 25, 1999
431-25-6877	Evans	Peter	P	4123234	SPR99099	GA	Friday, January 26, 1999
453-11-0984	Vann	Svetlana	S	4121121	SPR99099	SW	Friday, January 26, 1999
452-23-1323	Carey	Robert	R	4145345	SPR99099	GA	Saturday, June 25, 1999
459-52-3456	Kates	Nancy	N	343989	SPR99099	GA	Friday, January 26, 1999
485-23-4567	Devrost	James	J	2431234	SPR99099	SW	Friday, January 26, 1999
493-34-5678	Smith	Jeffrey	J	4122228	SPR99099	GA	Monday, March 22, 1999
495-45-6789	Ferns	Katelyn	K	4123456	SPR99099	WS	Friday, January 26, 1999
498-52-3456	Korfin	Terrell	T	4145345	SPR99099	WS	Friday, January 26, 1999
498-23-4567	Porter	Suzanna	S	343989	SPR99099	WS	Friday, January 26, 1999
498-34-5678	Mims	William	W	9123312	SPR99099	SW	Friday, January 26, 1999
498-45-6789	Miller	Matthew	M	414567	FALL99	GA	Friday, Mar 23, 1999
457-52-3456	Thompson	Bruce	B	4126789	SPR99099	SW	Friday, January 26, 1999
457-23-4567	Woods	Jessie	J	376990	SPR99099	SW	Friday, January 26, 1999
457-34-5678	Osler	Jason	T	224533	SPR99099	GA	Monday, August 16, 1999
457-45-6789	Talbot	Mary	M	276990	SPR99099	GA	Friday, January 26, 1999

FIGURE 8.4 SELECTED LAB\_ASSISTANT RECORDS

Figure 8.4

## Slide Set 7: Logical Design and Implementation

**TABLE B.7 THE HOURS\_WORKED ENTITY**

ATTRIBUTE NAME	CONTENTS	ATTRIBUTE TYPE: COMPOSITE (C), DERIVED (D), OR MULTIVALUED (M)	PRIMARY KEY (PK) AND/OR FOREIGN KEY (FK)	REFERENCES
LA_ID	Lab assistant ID		PK, FK	LAB_ASSISTANT
HW_SEMESTER	Semester designation	C	FK	
HW_DATE	Work period ending date		FK	
HW_HOURS_WORKED	Total hours worked			

LA_ID	HW_SEMESTER	HW_DATE	HW_HOURS_WORKED
35-77-8498	SPRING99	Tuesday, June 15, 1999	40
387-99-9665	SPRING99	Tuesday, June 15, 1999	40
402-12-8543	SPRING99	Tuesday, June 15, 1999	8
412-31-2255	SPRING99	Tuesday, June 15, 1999	20
452-11-0094	SPRING99	Tuesday, June 15, 1999	20
456-34-5678	SPRING99	Tuesday, June 15, 1999	20
456-45-6789	SPRING99	Tuesday, June 15, 1999	40

**FIGURE 8.6 SAMPLE DATA IN THE HOURS\_WORKED TABLE**

**TABLE B.1 THE UNIVERSITY LAB SYSTEM'S DESIGN ORGANIZATION**

MODULE	ENTITIES	ATTRIBUTE PREFIX
<b>Lab Management System</b>	USER LOG LAB_ASSISTANT WORK_SCHEDULE HOURS_WORKED RESERVATION RES_SLOT	USER_ LOG_ LA_ SCHED_ HW_ RES_ RSLOT_
<b>Inventory Management System</b>	INV_TYPE ITEM STORAGE LOCATION REPAIR VENDOR ORDER ORDER_ITEM WITHDRAW WD_ITEM CHECK_OUT CHECK_OUT_ITEM INV_TRANS TR_ITEM	TY_ ITEM_ STOR_ LOC_ REP_ VEND_ ORD_ OI_ WD_ WI_ CO_ CI_ TRANS_ TI_

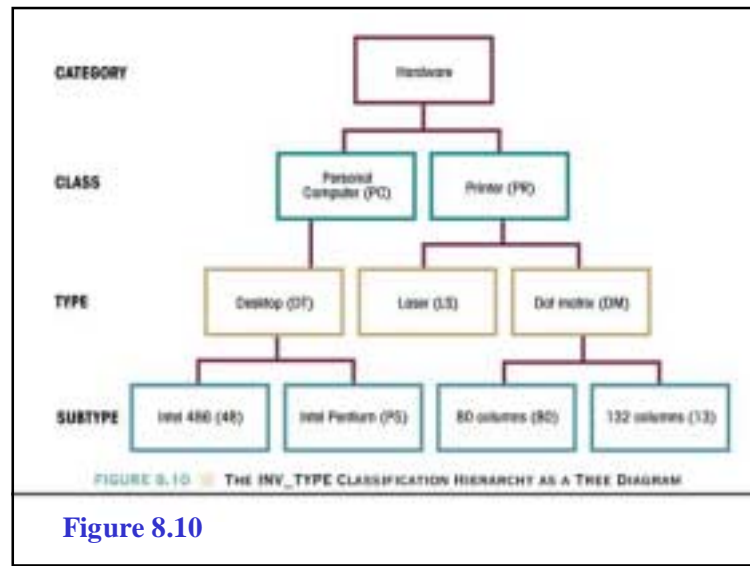


Figure 8.10

**TABLE B.12 THE INV\_TYPE ENTITY**

ATTRIBUTE NAME	CONTENTS	ATTRIBUTE TYPE: COMPOSITE (C), DERIVED (D), OR MULTIVALUED (M)	PRIMARY KEY (PK) AND/OR FOREIGN KEY (FK)	REFERENCES
TY_GROUP	Inventory group code	C	PK	
TY_CATEGORY	Inventory category			
TY_CLASS	Inventory class			
TY_TYPE	Inventory type			
TY_SUBTYPE	Inventory subtype			
TY_DESCRIPTION	Group description			
TY_UNIT	Unit of measurement (box, rack, etc.)			

**Table 8.12**

TV_GROUP	TV_CATEGORY	TV_CLASS	TV_TYPE	TV_QUANTITY	TV_DESCRIPTION	TV_PRICE
HMP0248	HW	PC	DT	48	Desktop PC, Intel 486	181
HMP0275	HW	PC	DT	75	Desktop PC, Intel Pentium (P5)	181
HMP0140	HW	PC	LT	40	Laptop PC, Intel 486	181
HMP0175	HW	PC	LT	75	Laptop PC, Intel Pentium	181
HMP0345	HW	PC	TV	45	Tower PC, Intel Pentium (P5)	181
HMP0300	HW	PJ	PA	30	LCD Flat Panel Projector	181
HMP0413	HW	PR	DR	13	Dot Matrix printer, 132 col	181
HMP0460	HW	PR	DR	60	Dot Matrix printer, 60 col	181
HMP0100	HW	PR	M	00	Heat Printer, color	181
HMP0150	HW	PR	LP	50	Line printer, Monochrome	181
HMP0100	HW	PR	LS	00	Laser printer, Standard	181
HMP0100	HW	PR	PL	00	Plotter	181
SJCA001	SU	CA	M	01	Heat Black Cartridge	181
SJCA002	SU	CA	M	02	Heat Color Cartridge	181
SJCA003	SU	CA	LP	03	Laser Printer Cartridge	181
SJDR0500	SU	DR	SE	00	3.5" diskette, HDDS	181
SJPP0011	SU	PP	CO	11	Cont. feed paper, 11"	181
SJPP0014	SU	PP	CO	14	Cont. feed paper, 14"	181
SJPP0011	SU	PP	DS	11	Single sheet paper, 11"	181
SJPP0014	SU	PP	DS	14	Single sheet paper, 14"	181

FIGURE 8.11 THE INV\_TYPE SAMPLE DATA

Figure 8.11

## E-R Model Verification

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- ❖ Review of the Conceptual Design Process
  - ◆ Entity sets, attributes, and domains
  - ◆ Composite attributes
  - ◆ Multivalued attributes
  - ◆ Primary keys
  - ◆ Foreign keys
  - ◆ Derived attributes
  - ◆ Composite entities

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## E-R Model Verification

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- ❖ The verification process is used to established that:
  - ◆ The design properly reflects the end user or application views of the database.
  - ◆ All database transactions are defined and modeled to ensure that the implementation of the design will support all transaction-processing requirements.
  - ◆ The database design is capable of meeting all output requirements.
  - ◆ All required input screens and data entry forms are supported.
  - ◆ The design is sufficiently flexible to support expected enhancements and modifications.

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## E-R Model Verification

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- ❖ Tasks of E-R Model Verification
  - ◆ Identifying the central entity
    - Item
  - ◆ Identifying each module and its components
  - ◆ Identifying each module transaction requirement
    - Focus on INVENTORY module reporting requirements

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## Logical Design

- ❖ The **logical design** translates the conceptual model to match the format expected of the DBMS that is used to implement the system.
- ❖ It sets the stage for creating the relational table structures, indexes, and views.

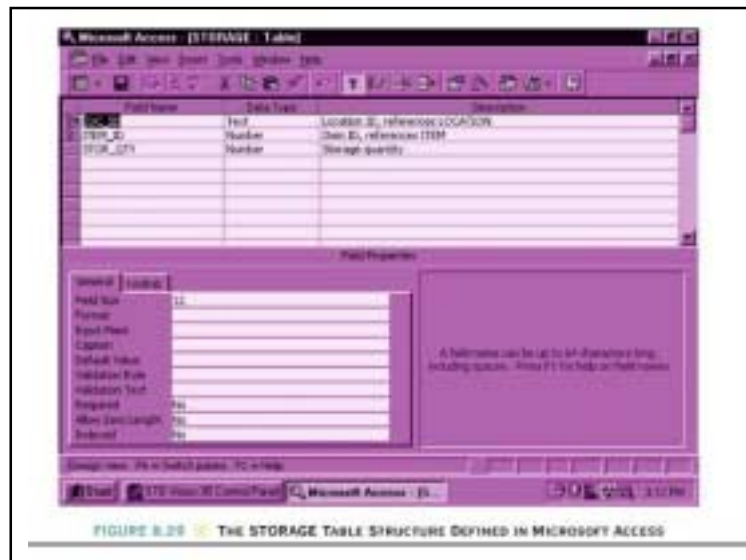
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## Tables

- ❖ MS Access does NOT support SQL CREATE TABLE
- ❖ Oracle and most other DBMS use SQL
- ❖ Example of SQL to create the STORAGE table:

```


CREATE TABLE STORAGE (
  LOC_ID   CHAR(12) NOT NULL,
  ITEM_ID  CHAR(10) NOT NULL,
  STOR_QTY NUMBER,
  PRIMARY KEY (LOC_ID, ITEM_ID),
  FOREIGN KEY (LOC_ID) REFERENCES LOCATION
    ON DELETE RESTRICT
    ON UPDATE RESTRICT,
  FOREIGN KEY (ITEM_ID) REFERENCES ITEM
    ON DELETE CASCADE
    ON UPDATE CASCADE);
        
```



## Logical Design

- ❖ **Indexes**
  - ❖ Indexes are created to enhance operational speed and to enable us to produce logically ordered output sequences.
- ❖ **Views**
  - ❖ Views are often used for security purposes. However, views are also used to streamline the system's processing requirements.

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## Physical Design

- ❖ **Physical design** requires the definition of specific storage or access methods that will be used by the database.
- ❖ It must include an estimate of the space required to store the database.
- ❖ Physical storage characteristics are a function of the DBMS and the operating systems being used.

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**TABLE B.27** FIXED SPACE CLAIMED BY OS/2 DBM V1.2 PER DATABASE

	DISK SPACE IN KB
Fixed space per table created within the database	535
17 tables × 4 KB per table	68
Total fixed overhead used by database	603

**TABLE B.28** PHYSICAL STORAGE REQUIREMENTS: THE USER TABLE


ATTRIBUTE NAME	DATA TYPE	STORAGE REQUIREMENT (BYTES)
USER_ID	CHAR(11)	11
DEPT_CODE	CHAR(7)	7
USER_TYPE	CHAR(5)	5
USER_CLASS	CHAR(5)	5
USER_SEX	CHAR(1)	1
	Row length	29
	Number of rows	15,950
	Total space required	462,550



## Implementation Phase

- ❖ **Database administrator (DBA)**, who controls the database management function, must define the standards and procedures required to interact with the database.
- ❖ The implementation plan includes:
  - ◆ Formal definitions of the processes and standards.
  - ◆ Chronology of the required activities.
  - ◆ Development of adequate documentation standards.
  - ◆ Identification of responsibilities for continued development and maintenance.


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## Implementation Phase

- ❖ **Database Creation**
  - ◆ Tables, indexes, and views are created.
  - ◆ Storage space and access methods are implemented.
- ❖ **Database Loading and Conversion**
  - ◆ Data are entered one table at a time or by copying the data from existing databases or files.
  - ◆ Processes may require data to be loaded in a specific order.


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## Implementation Phase

- ❖ **System Procedures**
  - ◆ **System procedures** describe the steps required to manage, access, and maintain the database system.
  - ◆ Procedures must be established to
    - Test and evaluate the database.
    - Fine-tune the database.
    - Ensure database security and integrity.
    - Back up and recover the database.
    - Access and use the database system.

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## Testing and Evaluation Phase

- ❖ The purpose of testing and evaluation is to determine how well the database meets its goals.
- ❖ Testing and evaluation should be an ongoing process.
- ❖ Testing and evaluation should consider:
  - ◆ Performance measures.
  - ◆ Security measures.
  - ◆ Backup and recovery procedures.

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## Operation

- ❖ **Database operation** is an ongoing venture that includes all the DBA's administrative and technical functions designed to ensure the database's continuity.
  - ◆ **Operational Database**  
An operational database provides all necessary support for the system's daily operations and maintains all appropriate operational procedures.
  - ◆ **Operational Procedures**  
Database operational procedures are written documents in which the activities of the daily database operations are described.
  - ◆ **Managing the Database: Maintenance and Evolution**  
The DBA is responsible for coordinating all operational and managerial aspects of the new DBMS environment.



## Operation

- ❖ **DBA's Responsibilities**
  - ◆ Monitoring and fine-tuning the database
  - ◆ Planning for and allocating resources for changes and enhancements
  - ◆ Planning for and allocating resources for periodic system upgrades
  - ◆ Providing preventive and corrective maintenance
  - ◆ Providing end user management services
  - ◆ Performing periodic security audits
  - ◆ Performing necessary training
  - ◆ Establishing and enforcing database standards
  - ◆ Marketing the database to the organization's users
  - ◆ Obtaining funding for database operations, upgrades, and enhancements
  - ◆ Ensuring completion of database projects within time and budget constraints

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