Orange Coast College  
Business Division  
CS/CIS Department  
Fall 2004  
CIS 182  
Introduction to Database Concepts  

Instructor  
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Text & Original Presentations  
The University Lab: Conceptual Design

Topics

• Develop Conceptual design
  – Develop a database initial study
  – Write a description of operations
  – Write business rules on which the database design is based
  – Translate the business rules into ERD segments
  – Put the ERD segments together to create the initial ERD
Introduction

Old Chinese proverb

“\textit{I hear it and I forget it, I see it and I remember it, I do it and I learn it}”

• Lessons:
  – If you have never stepped through a complete example of DB design, chances are that you wouldn’t be able to successfully design & implement a DB system
  – A well-functioning system is a result of a large number of small steps
  – Little details may make a difference between design success & failure
  – DB design is detail work

• Case Study:
  – Automation of large university computer lab for College of Business (COB)
Review: DB Lifecycle (DBLC)

- DB initial study
- DB design
  - Conceptual
  - Logical
  - Physical
- Implementation
- Testing & evaluation
- Operation
Review: DB Lifecycle (DBLC)

• DB initial study
  – Objectives, Organizational structure, Description of operations, Problems & constraints, Scope & boundaries

• DB design
  – Conceptual
    • Information sources & users, Information needs, Initial ER model, Define attributes & domains, Normalization, ER model verification
  – Logical
    • Tables, Indexes, views
  – Physical
    • Access methods

• Implementation
  – DB creation, DB loading & conversion, System procedures

• Testing & evaluation
  – Performance measures, Security measures, Backup & recovery procedures

• Operation
  – DB is operational, Operational procedures
Database Initial Study

• Detailed description of organization’s current and proposed superscript database system environments
• Could be hundreds of pages & interviews with key users
• Covers
  – Organizational aspects
    • Objectives
    • Structure
    • Operations
    • Problems
  – System aspects
    • Objectives
    • Scope and boundaries
    • Information sources and users
    • End-user requirements
UCL Database Initial Study

• Users (Remember the abbreviations!)
  – Assistant Dean, College of Business
  – Computer Lab Director (CLD)
    • Lab’s operational management
  – Computer Lab Assistants (LA)
    • Lab’s daily operation
  – Computer Lab Secretary (CLS)
    • Lab’s general administrative functions
  – Computer Lab Graduate Assistants
    • Technical support & training faculty & staff

• Objectives
  – Provide users with controlled access to UCL assets
    • e.g. computer printers, supplies, application SW, SW documentation
  – Guide users working with assets and provide problem-solving services
    • Format disks, copy files, install SW, basic startup procedures
Initial Study: UCL’s Organizational Structure

Figure D.1: The University Computer Lab’s Organizational Structure
Initial Study: UCL’s Organizational Structure

• Knowing the complete organizational structure is important, even if the system is designed for one component, for possible future expansions

• Organizational structure:
  – CLD manages all UCL’s operational functions
  – CLD assisted by CLS
  – Graduate assistants (GA) & undergraduate students work as lab assistants (LA)
  – CLD reports to the assistant dean of College of Business, who reports to dean of COB, who reports to academic VP, who reports to college’s president

• Our focus: Just the lab (UCL)
Initial Study:
UCL Description of Operations

- Six types of operations
  1. Inventory/storage/order management
  2. Equipment maintenance & repair management
  3. Equipment checkout / check-in management
  4. Lab assistant payroll management
  5. Lab reservations management
  6. Lab access management
Initial Study:  
1. Inventory, Storage, & Order Mgmt.

- **Classifications:**
  - Hardware
  - Software
  - Literature
  - Supplies

- Items are grouped by inventory type

- 4-part hierarchy:
  - Category
  - Class
  - Type
  - Subtype

<table>
<thead>
<tr>
<th>ITEM</th>
<th>CATEGORY</th>
<th>CLASS</th>
<th>TYPE</th>
<th>SUBTYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gateway computer, Pentium IV, 1.5 GHz</td>
<td>Hardware</td>
<td>Computer</td>
<td>Desktop</td>
<td>Pentium</td>
</tr>
<tr>
<td>Laser printer paper, 8.5 x 11</td>
<td>Supply</td>
<td>Paper</td>
<td>Laser</td>
<td>8.5 x 11</td>
</tr>
<tr>
<td>Disks, 3.5” high-density (HD)</td>
<td>Supply</td>
<td>Disks</td>
<td>3.5</td>
<td>HD</td>
</tr>
</tbody>
</table>

Table D.2 Inventory Type Hierarchy
Initial Study:  
1. Inventory, Storage, & Order Mgmt.  

- **Items could be:**  
  - **Non-Serialized:**  
    - For non-durable supplies; paper, toner, …  
    - Don’t require an assigned serial number or tracking code  
  - **Serialized:**  
    - For durable supplies; printers, computers, …  
    - Require an assigned serial number or tracking code  

- **Inventory updated when:**  
  - Order items received  
  - Items checked-out or checked-in  
  - Consumable item withdrawn for use  

- **CLD must adjust inventory**
Initial Study:

2. Equipment Maintenance/Repair Mgmt.

- Defective equipment usually repaired by CLD
- Information kept in “Bad Equipment Log”
- If problem can’t be solved in house, equipment are sent to vendor
- Information kept in “Hardware Returned for Service Log”
Initial Study:
3. Equipment Check-out/Check-in Mgmt.

1. Inventory/storage/order management
2. Equipment maintenance & repair management
3. Equipment checkout / check-in management
4. Lab assistant payroll management
5. Lab reservations management
6. Lab access management

- Only professors may borrow equipment from the lab
- Borrowed equipment must be checked out and a form must be filled out
  - The form should include checkout date & estimated return date
- Notice sent for late equipment
- Manuals & data disks are for lab use only and may not be borrowed
Initial Study:
4. Lab Assistant Payroll Mgmt.

- LA work on hourly basis
- Time sheets is used to track LA’s hours Hourly basis for a fourteen day period
- CLD checks actual hours worked and sends time sheet to the payroll dept. for further processing
- GA are paid monthly stipend and work fixed number of hours, & they aren’t included in payroll calculations
Initial Study:
5. Lab Reservation Mgmt.

• UCL can be reserved by faculty for teaching purposes at least **one week ahead** of time
• Faculty member completes **reservation form** with date, time, department, and course number
• Students not enrolled in the class may use remaining **unoccupied computers** at teacher’s discretion
• Right now there is **no limits** on the numbers of reserved hours
• **End user proposes** limiting reserved hours to one hour in the morning and one hour in the afternoon, specially when projects are due
Initial Study:

- Lab users sign users’ log and leave a valid University ID card
- LA makes sure that all checked out items are returned by the user
  - Examples: Manuals, data disks, …
- There are no time restrictions except when the UCL is reserved for class
Initial Study: Information Log

- As you start to understand the operations taking place, you may begin to create a **Volume of Information Log** that estimates the amount of data that the system will manage. The log should show the type of information and how many entries you expect in designated periods of time.
- **Example:** See Table D.3, pp. 10-11
  - Lab assistant: 14 per semester
  - Work schedule: 8 hours per workday per lab assistant
  - Hours worked: 1 entry per pay period per lab assistant
  - Users: Faculty: 300, Students: 15,000, Staff: 650
  - Reservations: 4 per week
- **Daily lab uses:** 570 per day
  - Orders: 20 per month
  - Items ordered: 3 per order
  - Inventory types: 15
  - Locations 5
  - Repairs: 20 per month
  - Vendors: 40
Initial Study:
Problems/Constraints in Current System

- Problems are classified as either “general” or “specific” to the type of operation
- General problems
  - Manual system
  - Never up to date and error-ridden
  - Too much data duplication and inconsistency
  - Does not generate useful information for reports
  - Does not allow ad hoc queries
  - CLD spends too much time processing data manually
  - Lack of computerization makes inventory management difficult
Initial Study: Problems/Constraints in Current System

- Specific problems related to each of the six types of operations
  1. Inventory/Storage/Order Management
  2. Equipment maintenance and repair management
  3. Equipment check-out/check-in management
  4. Lab assistant payroll management
  5. Lab reservations management
  6. Computer lab access management
Initial Study: Specific Problems for Inventory/Storage/Order Management

1. Inventory/storage/order management
2. Equipment maintenance & repair management
3. Equipment checkout / check-in management
4. Lab assistant payroll management
5. Lab reservations management
6. Lab access management

• No access to crucial inventory management data for CLD
  – Which items have been ordered, which are ordered but not received, …

• UCL needs available stock figures & average use of supplies
  – Which quantity to order, ..

• CLD does not know item location
  – Impossible to track inventory by category or manufacturer
Initial Study: Specific Problems for Equipment Maintenance & Repair Management

1. Inventory/storage/order management
2. Equipment maintenance & repair management
3. Equipment checkout / check-in management
4. Lab assistant payroll management
5. Lab reservations management
6. Lab access management

• CLD cannot generate **history** for equipment
• CLD cannot determine the **status** of items subject to maintenance procedures
Initial Study: Specific Problems for Equipment Check-out/-in Management

• CLD lacks information about lab \textit{assets}
  – Which equipment is checked out, to whom, when, …

• Activity \textit{summaries} not available
Initial Study: Specific Problems for Lab Assistant Payroll Management

• CLD spends too much time summarizing hours worked LA’s

• CLD cannot estimate work loads
Initial Study: Specific Problems for Lab Reservations Management

1. Inventory/storage/order management
2. Equipment maintenance & repair management
3. Equipment checkout / check-in management
4. Lab assistant payroll management
5. Lab reservations management
6. Lab access management

• Manual reservation system inadequate
• No statistical information for scheduling lab reservations
Initial Study: Specific Problems for Lab Access Mgmt.

1. Inventory/storage/order management
2. Equipment maintenance & repair management
3. Equipment checkout / check-in management
4. Lab assistant payroll management
5. Lab reservations management
6. Lab access management

- User log not properly maintained
- Certain items not returned
- Security problems
  - Unauthorized network access,
  - Unauthorized SW installation/deletion
  - HW & manuals disappear
Initial Study: Conclusion

• Problems:
  – Current manual system is inadequate
  – Overwhelming paper work
  – Data not readily available
  – Transforming data to information is too time-consuming & impractical

• Problems solved within constraints:
  – Operational constraint
  – Economic constraint
Initial Study: Constraints for UCL

• Time Frame
  – Operational within 3 months

• Hardware and Software
  – Use existing UCL hardware and software

• Distributed Aspects and Expandability
  – Operate in multiuser environment
  – Independent of existing administrative systems

• Cost
  – Development costs must be minimal
  – Use no more than two additional terminals
  – Operate without additional personnel
  – $9,500 is available
Initial Study:
System Objectives for UCL

• General System Objectives
  – Improve operational efficiency
  – Provide useful information for planning, control, and security

• Specific Objectives
  – Separate objective for each system component
    • Inventory/ storage/order
    • Equipment maintenance & repair
    • Equipment check-out / check-in
    • Lab assistant payroll
    • Lab reservation
    • Computer lab access
Initial Study: Objectives for UCL
Inventory/Storage/Order Management

1. Inventory/storage/order management
2. Equipment maintenance & repair management
3. Equipment checkout / check-in management
4. Lab assistant payroll management
5. Lab reservations management
6. Lab access management

• Better **purchase order control**
• Monitor **supply item stock**
• Control **inventory** by type and item
• Quick information about **item location**
• Timely information about use of **supplies** and generate **statistics** to aid in future purchases
Initial Study: Objectives for UCL for Equipment Maintenance & Repair Mgmt.

- Monitor maintenance histories
- Track items returned to vendor

1. Inventory/storage/order management
2. Equipment maintenance & repair management
3. Equipment checkout / check-in management
4. Lab assistant payroll management
5. Lab reservations management
6. Lab access management
Initial Study: Objectives for UCL Equipment Check-out/-in Mgmt.

1. Inventory/storage/order management
2. Equipment maintenance & repair management
3. Equipment checkout / check-in management
4. Lab assistant payroll management
5. Lab reservations management
6. Lab access management

- Track items checked out
- Monitor item check-out time
- Generate usage statistics
Initial Study: Objectives for UCL
Lab Assistant Payroll Management

- Scheduling and work loads information
- Work summaries

1. Inventory/storage/order management
2. Equipment maintenance & repair management
3. Equipment checkout / check-in management
4. Lab assistant payroll management
5. Lab reservations management
6. Lab access management
Initial Study: Objectives for UCL Lab Reservations Management

- Decrease reservation processing time
- Produce reservation schedules
- Generate statistical summaries

1. Inventory/storage/order management
2. Equipment maintenance & repair management
3. Equipment checkout / check-in management
4. Lab assistant payroll management
5. Lab reservations management
6. Lab access management
Initial Study: Objectives for UCL Computer Lab Access Management

1. Inventory/storage/order management
2. Equipment maintenance & repair management
3. Equipment checkout / check-in management
4. Lab assistant payroll management
5. Lab reservations management
6. Lab access management

- Control users and lab resources
- Reduce sign-in time
- Provide peak use information for scheduling
Initial Study: Scope and Boundaries

- Very important for the designer and the system
- Without defining boundaries and scope, the designer may be legally required to expand the system indefinitely and the system environment will not contain built-in constraints
Initial Study: Scope and Boundaries

• What should be included:
  – What will be system’s extent?
    • UCL portion of organizational chart
    • Independent of other systems
  – What operational areas are covered by system?
    • Limited to six areas addressed earlier
    • Implemented as autonomous units that can be tested & implemented in stages
  – What design/implementation strategy to use?
    • Organization into system modules
  – What modules must be included in system?
    • Lab management
    • Inventory management
  – How do modules interface?
    • INVENTORY is the system’s key component and will interface with all other processes
    • Through CHECK_OUT module
Initial Study: Modules

Table D.4 Required UCL System Module

<table>
<thead>
<tr>
<th>MODULE</th>
<th>OPERATIONAL AREA</th>
<th>PROCESS NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Management System</td>
<td>Computer Lab Access Reservations Lab assistants’ payroll</td>
<td>ACCESS RESERVATION PERSONNEL</td>
</tr>
<tr>
<td>Inventory Management System</td>
<td>Inventory Order Storage Equipment maintenance and repair Equipment check-out and check-in</td>
<td>INVENTORY ORDER STORAGE MAINTENANCE CHECK_OUT</td>
</tr>
</tbody>
</table>
Initial Study: Interfaces

Figure D.2: The University Computer Lab Management System
End of Initial Study & Begin of Design Phase
Design Phase

• DB design
  – Conceptual
    • Information sources & users
    • Information needs
    • Initial ER model
    • Define attributes & domains
    • Normalization
    • ER model verification
  – Logical
    • Tables, Indexes, views
  – Physical
    • Access methods
Conceptual Design Phase:

- Good data sources should cover
  - Current system sources
  - Prospective system sources
- The following groups are considered good data sources for both current & prospective systems
  - Assistant dean, CLD, CLS, LA, GA, Students, Faculty, & all documentations & manuals

<table>
<thead>
<tr>
<th>MODULE</th>
<th>PROCESS</th>
<th>SOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory Management System</td>
<td>INVENTORY</td>
<td>Inventory forms, CLD</td>
</tr>
<tr>
<td></td>
<td>Item data</td>
<td>Inventory forms</td>
</tr>
<tr>
<td></td>
<td>Withdrawal</td>
<td>Inventory forms</td>
</tr>
<tr>
<td></td>
<td>Repairs</td>
<td>Inventory forms</td>
</tr>
<tr>
<td></td>
<td>Check-out</td>
<td>Bad Equipment Log</td>
</tr>
<tr>
<td></td>
<td>Location</td>
<td>Check-out forms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inventory forms</td>
</tr>
<tr>
<td>ORDER</td>
<td></td>
<td>Order forms</td>
</tr>
<tr>
<td></td>
<td>Order data</td>
<td>Order forms</td>
</tr>
<tr>
<td></td>
<td>Items ordered</td>
<td>Order forms</td>
</tr>
<tr>
<td></td>
<td>Items received</td>
<td>Order forms, Inventory forms, CLD</td>
</tr>
<tr>
<td></td>
<td>Inventory type</td>
<td>Order forms</td>
</tr>
<tr>
<td></td>
<td>Vendors</td>
<td>Order forms</td>
</tr>
</tbody>
</table>

From Table D.5: Data Sources and Users
Conceptual Design:
General Systems Requirements

- Easy to use
- Provide security measures
- Fully integrated
- Able to access system concurrently from several workstations
- Perform various functions
  - Personnel
  - Inventory
  - Order
  - Maintenance
  - Reservation
  - Check_out
  - Access
- Input driven by output
  - See table D.7, p. 19 for required reports
## Conceptual Design: Uses & Users

<table>
<thead>
<tr>
<th>USER</th>
<th>PROCESSESAccessor</th>
<th>USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCL director (CLD)</td>
<td>All</td>
<td>System administration</td>
</tr>
<tr>
<td>UCL secretary (CLS)</td>
<td>INVENTORY ORDER</td>
<td>Updates and queries</td>
</tr>
<tr>
<td></td>
<td>STORAGE MAINTENANCE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHECK_OUT RESERVATION</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PERSONNEL</td>
<td></td>
</tr>
</tbody>
</table>

From Table D.6: Workstation Assignments: Uses and Users
Conceptual Design: Setup Summary View

Figure D.3: University Computer Lab Management System: A Setup Summary View
Conceptual Design: Initial Entities

- Represent the most important objects as viewed by designer & end user.

<table>
<thead>
<tr>
<th>ENTITY NAME</th>
<th>ENTITY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>USER</td>
<td>User data: includes administration, faculty, and students</td>
</tr>
<tr>
<td>LAB_ASSISTANT</td>
<td>Lab assistant data: includes graduate assistants</td>
</tr>
<tr>
<td>WORK_SCHEDULE</td>
<td>Lab assistant work schedule data: hours each lab assistant is assigned to work</td>
</tr>
<tr>
<td>HOURS_WORKED</td>
<td>Lab assistant hours worked data: actual hours worked per each pay period for each lab assistant</td>
</tr>
<tr>
<td>LOG</td>
<td>Daily users of the UCL: one entry for each visitor</td>
</tr>
<tr>
<td>RESERVATION</td>
<td>Lab reservation details</td>
</tr>
<tr>
<td>INV_TYPE</td>
<td>Inventory types</td>
</tr>
<tr>
<td>ITEM</td>
<td>Item details</td>
</tr>
<tr>
<td>LOCATION</td>
<td>Storage locations</td>
</tr>
<tr>
<td>REPAIR</td>
<td>Repair data by item</td>
</tr>
<tr>
<td>VENDOR</td>
<td>Vendor details</td>
</tr>
<tr>
<td>ORDER</td>
<td>Order details</td>
</tr>
</tbody>
</table>

Table D.8: Initial UCL Entities Based on the Initial Study
Business Rules

1. Each item belongs to only one inventory type, & each inventory type may have zero, or more items.
2. An item may be placed for use upon its arrival, or it may be stored. Some items may be stored in more than one location (e.g. printer cartridge).
3. An order references only one vendor, and each vendor may have zero or more orders.
4. Each order contains one or many order items and each order item line belongs to only one order.
5. Each ordered item line corresponds to one inventory type, and each inventory type can be referenced by one or many order item lines.
6. Each item may require zero or more repairs, and each repair refers to only one item.
7. Each item to be repaired may or may not be returned to the vendor.
8. Each user may check out zero or more items, and each item may be checked out by zero or more users during the semester.
9. Each faculty/staff user may withdraw zero or many items, and each item may be withdrawn by zero or many users during the semester.
10. Each student user may sign into the user log many times during the semester, and each user log entry is made by only one student user.
11. Each faculty user may place zero or more reservations during the semester, and each reservation is placed by one faculty member.
12. Each reservation is recorded by an LA, and each LA may record zero or more reservations during the semester.
13. Each LA is assigned at least one day in each week’s work schedule, and each work schedule assignment is made for one LA.
14. Each LA accumulates hours worked during each 2-week period, and each “hour worked” entry is associated with one LA.
15. Each item is supplied by a specific vendor, and each vendor may supply several different items.
Conceptual Design: Initial ERD
Business Rule 1

- Each item belongs to only one inventory type, & each inventory type may have zero, or more items (Table D.9, p.21)

![ER Model Segment for Business Rule 1](image)

Figure D.4: the ER Model Segment for Business Rule 1
Conceptual Design: Initial ERD  
Business Rule 2

• An item may be placed for use upon its arrival, or it may be stored.
• Some items may be stored in more than one location (e.g. printer cartridge)

![ER Model Segment for Business Rule 2]

**Figure D.5: The ER Model Segment for Business Rule 2**
Conceptual Design: Initial ERD
Business Rule 3

- An order references only one vendor, and each vendor may have zero or more orders

Figure D.6: The ER Model Segment for Business Rule 3
Conceptual Design: Initial ERD
Business Rule 4

- Each order contains one or many order items
- Each order item line belongs to only one order

Figure D.7: The ER Model Segment for Business Rule 4
Conceptual Design: Initial ERD
Business Rule 5

- Each ordered item line corresponds to one inventory type, and each inventory type can be referenced by one or many order item lines.
- Note: The relationship between INV_TYPE and ORDER_ITEM is weak => TY_GROUP should not be part of the key in ORDER_ITEMS.

Figure D.8: The ER Model Segment for Business Rule 5
Conceptual Design: Initial ERD

Business Rule 6

- Each item may require zero or more repairs, and each repair refers to only one item

![Diagram of ER Model Segment for Business Rule 6]

Figure D.9: The ER Model Segment for Business Rule 6
• Each item to be repaired may or may not be returned to the vendor

Figure D.10 The ER Model Segment for Business Rule 7
Conceptual Design: Initial ERD
Business Rule 8

- Each user may check out zero or more items, and each item may be checked out by zero or more users during the semester.

![ER Model Segment for Business Rule 8](image)

**Figure D.11 The ER Model Segment for Business Rule 8**
Each faculty/staff user may withdraw zero or many items, and each item may be withdrawn by zero or many users during the semester.
Conceptual Design: Initial ERD
Business Rule 10

- Each student user may sign into the user log many times during the semester, and each user log entry is made by only one student user.

![ER Model Segment for Business Rule 10](image)

**Figure D.13 The ER Model Segment for Business Rule 10**
Conceptual Design: Initial ERD
Business Rule 11

- Each faculty user may place zero or more reservations during the semester, and each reservation is placed by one faculty member.

![ER Model Segment for Business Rule 11](image-url)

Figure D.14: The ER Model Segment for Business Rule 11
Each reservation is recorded by an LA, and each LA may record zero or more reservations during the semester.
Conceptual Design: Initial ERD

Business Rule 13

- Each LA is assigned at least one day in each week’s work schedule, and each work schedule assignment is made for one LA
- Note: LA_ID should not be part of the key in WORK_SCHEDULE table, since the relationship is weak

![ER Model Segment for Business Rule 13](image)

Figure D.16: The ER Model Segment for Business Rule 13
Conceptual Design: Initial ERD
Business Rule 14

- Each LA accumulates hours worked during each 2-week period, and each “hour worked” entry is associated with one LA.

Figure D.17: The ER Model Segment for Business Rule 14
Conceptual Design: Initial ERD

Business Rule 15

- Each item is supplied by a specific vendor, and each vendor may supply several different items

Figure D.18: The ER Model Segment for Business Rule 15
### Table D.10: UCL Entities Based on the Business Rules

<table>
<thead>
<tr>
<th>ENTITY NAME</th>
<th>ENTITY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>USER</td>
<td>User data</td>
</tr>
<tr>
<td>LAB_ASSISTANT</td>
<td>Lab assistant data</td>
</tr>
<tr>
<td>WORK_SCHEDULE</td>
<td>Lab assistant work schedule data</td>
</tr>
<tr>
<td>HOURS_WORKED</td>
<td>Lab assistant hours worked data</td>
</tr>
<tr>
<td>LOG</td>
<td>Daily users of the UCL</td>
</tr>
<tr>
<td>RESERVATION</td>
<td>Lab reservations data</td>
</tr>
<tr>
<td>INV_TYPE</td>
<td>Inventory type data</td>
</tr>
<tr>
<td>ITEM</td>
<td>Items data</td>
</tr>
<tr>
<td>CHECK_OUT</td>
<td>Check-out data</td>
</tr>
<tr>
<td>WITHDRAW</td>
<td>Withdrawal data</td>
</tr>
<tr>
<td>LOCATION</td>
<td>Locations where items are stored</td>
</tr>
<tr>
<td>STORAGE</td>
<td>Items stored by location</td>
</tr>
<tr>
<td>REPAIR</td>
<td>Repair data</td>
</tr>
<tr>
<td>VENDOR</td>
<td>Vendor data</td>
</tr>
<tr>
<td>ORDER</td>
<td>Order data</td>
</tr>
<tr>
<td>ORDER_ITEM</td>
<td>Items ordered data</td>
</tr>
</tbody>
</table>
Conceptual Design: Combined Initial ERD for UCL

- Note: Check the Figure in App. D for differences in the ERD’s
Summary

• Initial study defines
  – Current system’s objectives, organizational structure, description of operation, problems, constraints
  – Objectives, scope and boundaries of proposed system
• Initial DB conceptual design follows the initial study and is based on the results of initial study
• Conceptual design defines organization’s sources, users, and end user requirements for ad hoc queries and reports
• Careful description of operations help define business rules, that in turn help establish entities & relationships
• ER diagram contains information about connectivity, entity characteristics, & type of relationship (optional, weak, ..)