CSPP 53017: Data Warehousing

Winter 2013

Lecture 6

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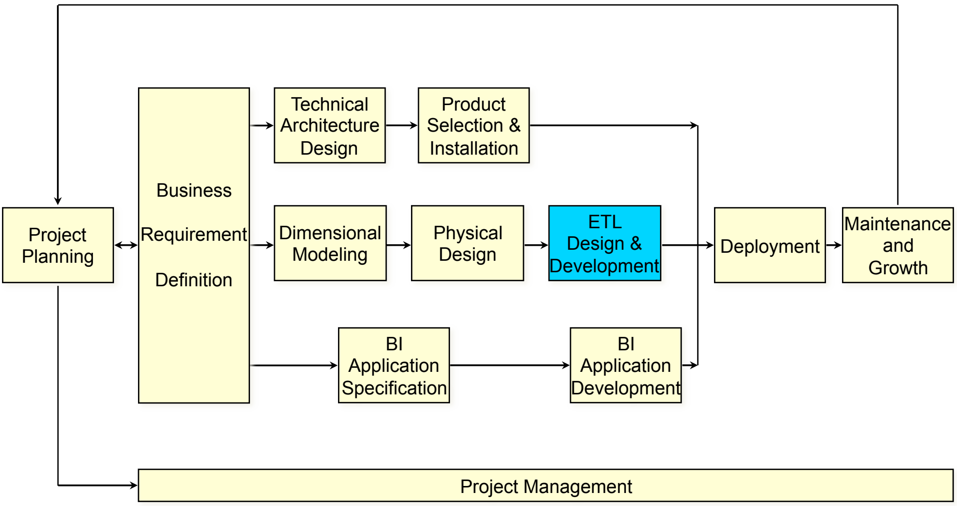
Class News

- Homework 4 is online
  - Due by Tuesday, Feb 26.
- Second 15 minute in-class quiz today at 6:30pm
  - Open book/notes
- Last 15 minute in-class quiz will be on Mar 5.

ETL Design and Development



Project Planning

Business Requirement Definition

Technical Architecture Design

Product Selection & Installation

Dimensional Modeling

Physical Design

ETL Design & Development

BI Application Specification

BI Application Development

Deployment

Maintenance and Growth

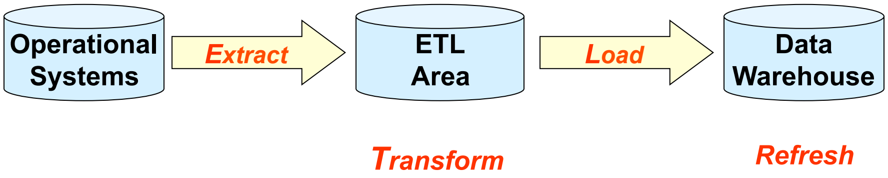
Project Management

ETL Systems

- Source Systems
  - Operational Databases, Flat Files, ODS, ERP systems (divided into modules that cover major functional areas of the business, such as HR, manufacturing, etc.), Reporting Instances, Archives, External Data.
- ETL Area
  - Place where mapping (from source systems to data warehouse) takes place.
  - Assembly plant, not intended to be seen by users.
- Presentation Server
  - Target platform where data warehouse data is stored.

ETL Processes

- ETL: Extraction/Transformation/Load
  - Must result in data that is relevant, useful, high-quality, accurate, and accessible



ETL Processes: Extraction

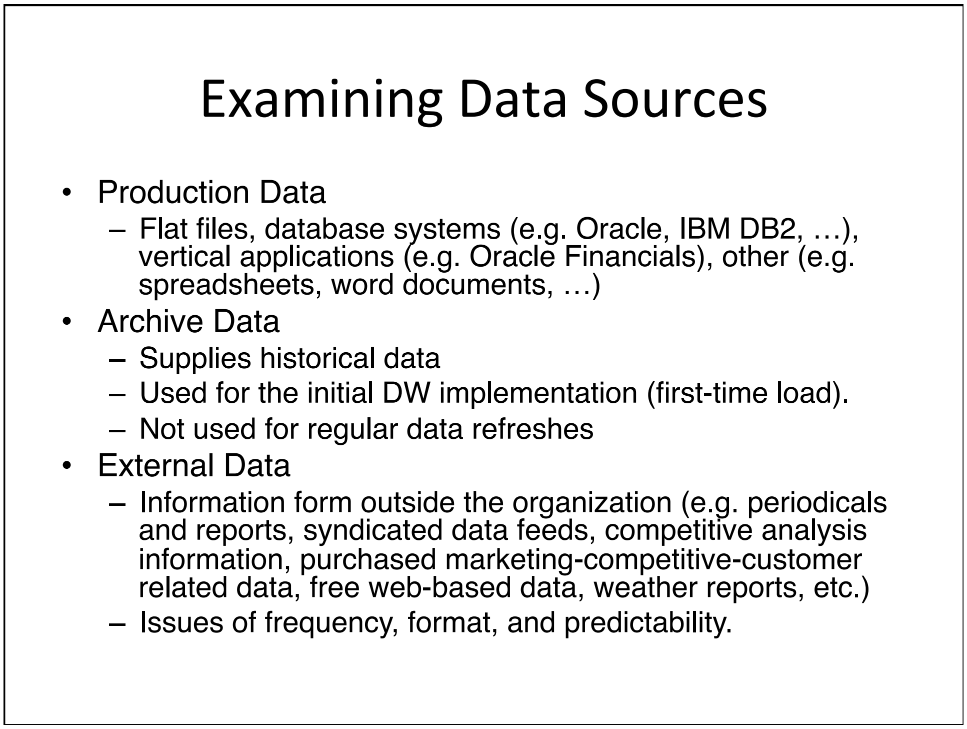
- Pulling selected data (that pertains to the subject areas of the data warehouse) from the source systems
- Often the largest single effort in the data warehouse project (rule of thumb: 60% of the data warehouse development hours are spent on the extract process), especially if the source systems are legacy, old, mainframe-based, etc.
- Challenge: determining what data to extract and what kinds of filters to apply.

ETL Processes: Transformation

- Transforming data from source systems into data suitable for end user query and analysis application.
- Transformation cleans-up, standardizes, and restructures (as subject-oriented) operational data
- Quality data is the key to a successful DW; it is better to have no data at all than bad data.

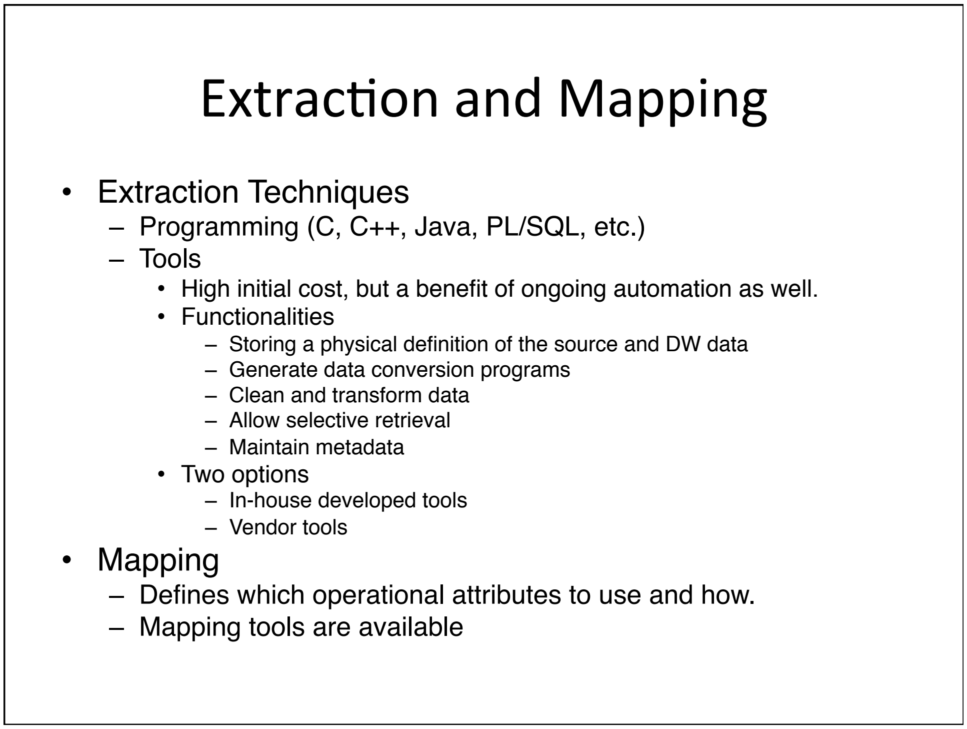
ETL Processes: Load

- Loading data into the warehouse and refreshing the warehouse with updated data
- Complications:
  - System or network failure may result in partial loads
  - Load auditing and verification
  - Data type mismatches
  - Rejected data
- Test load in a development (duplicate) environment before running in production.



Examining Data Sources

- Production Data
  - Flat files, database systems (e.g. Oracle, IBM DB2, …), vertical applications (e.g. Oracle Financials), other (e.g. spreadsheets, word documents, …)
- Archive Data
  - Supplies historical data
  - Used for the initial DW implementation (first-time load).
  - Not used for regular data refreshes
- External Data
  - Information form outside the organization (e.g. periodicals and reports, syndicated data feeds, competitive analysis information, purchased marketing-competitive-customer related data, free web-based data, weather reports, etc.)
  - Issues of frequency, format, and predictability.



Extraction and Mapping

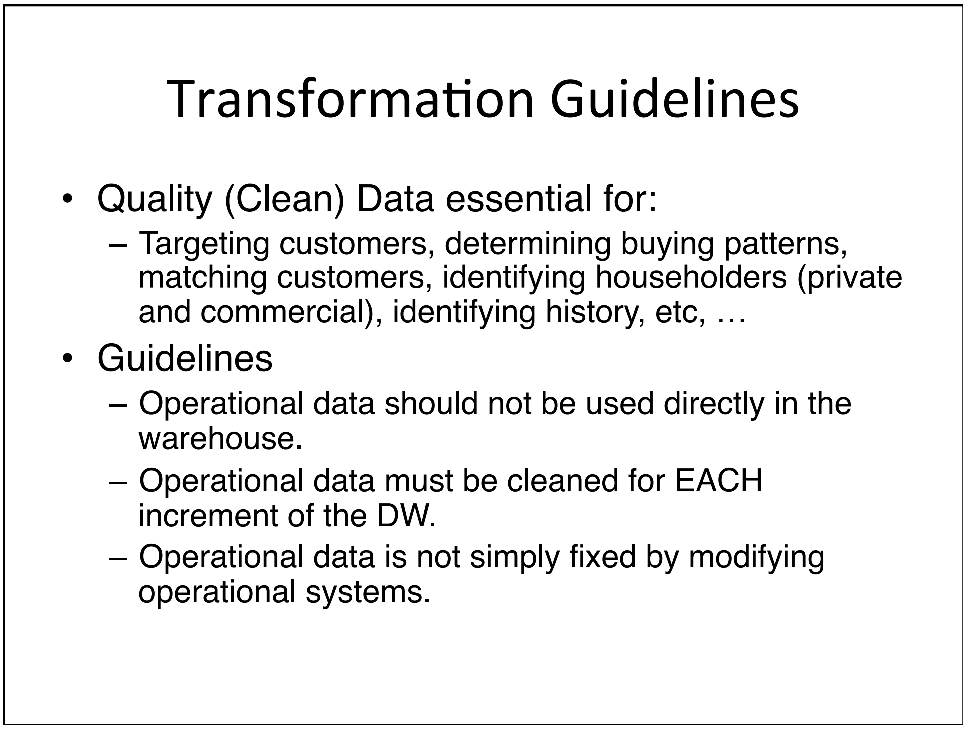
- Extraction Techniques
  - Programming (C, C++, Java, PL/SQL, etc.)
  - Tools
    - High initial cost, but a benefit of ongoing automation as well.
    - Functionalities
      - Storing a physical definition of the source and DW data
      - Generate data conversion programs
      - Clean and transform data
      - Allow selective retrieval
      - Maintain metadata
    - Two options
      - In-house developed tools
      - Vendor tools
- Mapping
  - Defines which operational attributes to use and how.
  - Mapping tools are available

Source-to-Target Mapping

- Source-to-target data map is the foundation for the development of the data staging process
- Source-to-target data map contains
  - Target Table Name
  - Target Column Name
  - Target Column Data Type
  - Target Column Length
  - Source System
  - Source Table/File
  - Soucre Table/File Column/Field
  - Data Transform Notes
  - Dimension/Data Mart
  - Attribute/Fact

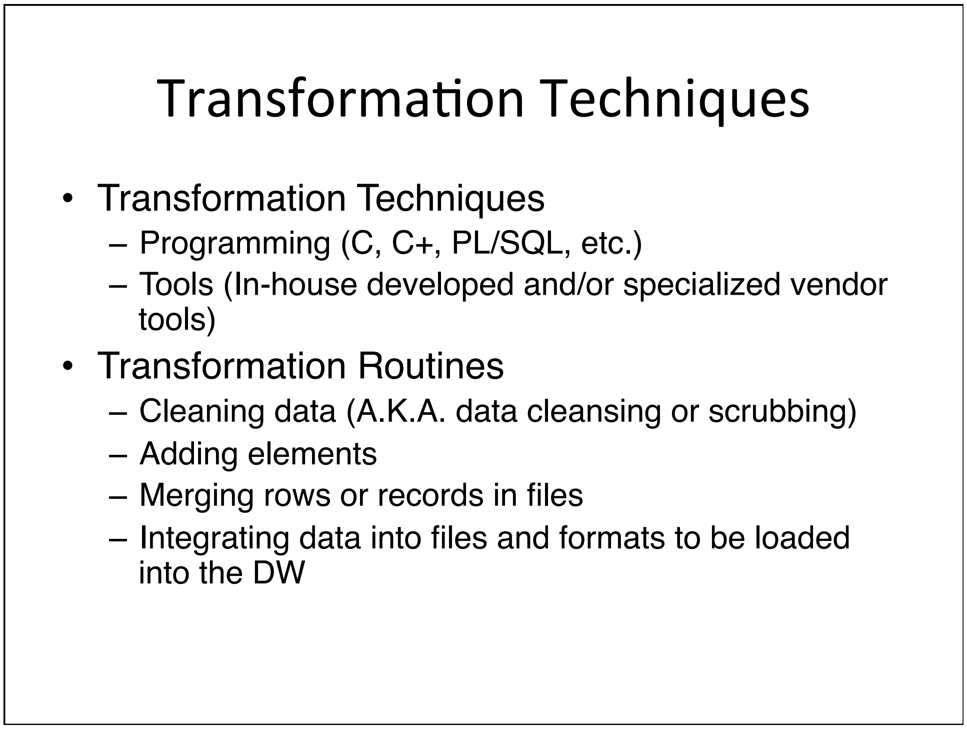
Source-to-Target Data Map

Target Table	Target Column	Data Type	Len	Target Column Description	Src Systm	Src Table / File	Src Col / Field	Data Txform Notes
Customer Dimension	CUST_ KEY	Num	8	P.K. for Cust. Dimension	New	New	New	Create
Customer Dimension	CUST_ ID	Char	11	Operational Key for Cust.	OPS10	CUST_ MAST	Cid	Direct
Customer Dimension	CUST_ FNAME	Char	15	Customer First Name	OPS10	CUST_ MAST	CFull Name	ParseOut Before 1st Space
Customer Dimension	CUST_ LNAME	Char	25	Customer Last Name	OPS10	CUST_ MAST	CFull Name	ParseOut After Last Space
…	…	…	…	…	…	…	…	…



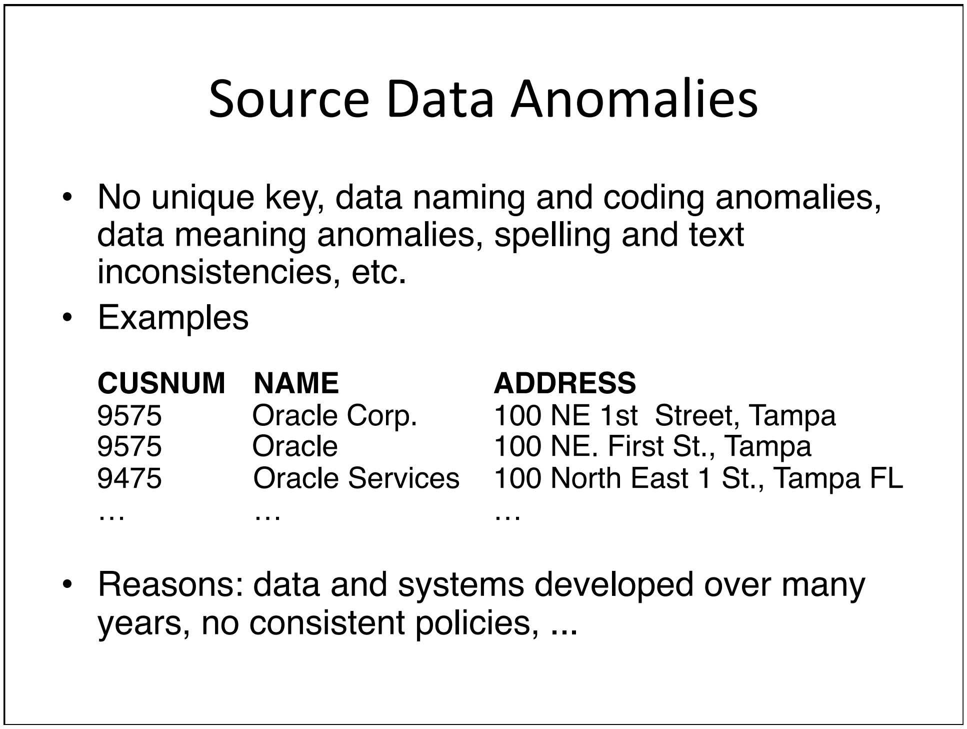
Transformation Guidelines

- Quality (Clean) Data essential for:
  - Targeting customers, determining buying patterns, matching customers, identifying householders (private and commercial), identifying history, etc, …
- Guidelines
  - Operational data should not be used directly in the warehouse.
  - Operational data must be cleaned for EACH increment of the DW.
  - Operational data is not simply fixed by modifying operational systems.



Transformation Techniques

- Transformation Techniques
  - Programming (C, C+, PL/SQL, etc.)
  - Tools (In-house developed and/or specialized vendor tools)
- Transformation Routines
  - Cleaning data (A.K.A. data cleansing or scrubbing)
  - Adding elements
  - Merging rows or records in files
  - Integrating data into files and formats to be loaded into the DW

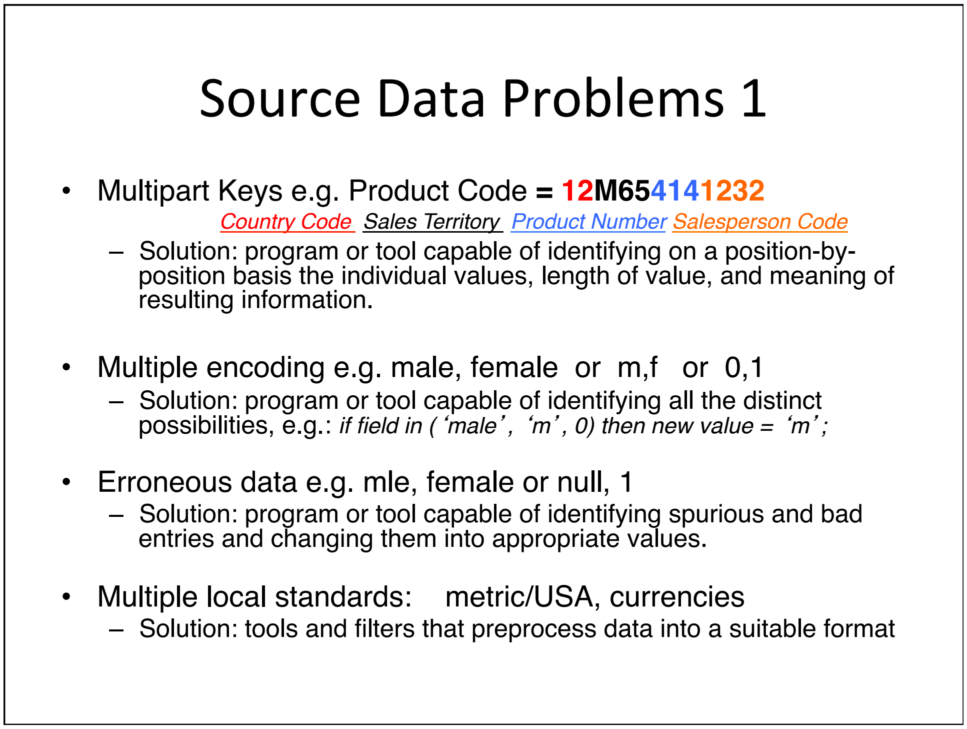


Source Data Anomalies

- No unique key, data naming and coding anomalies, data meaning anomalies, spelling and text inconsistencies, etc.
- Examples

CUSNUM	NAME	ADDRESS
9575	Oracle Corp.	100 NE 1st Street, Tampa
9575	Oracle	100 NE. First St., Tampa
9475	Oracle Services	100 North East 1 St., Tampa FL
…	…	…

- Reasons: data and systems developed over many years, no consistent policies, ...



Source Data Problems 1

- Multipart Keys e.g. Product Code **= 12M654141232**
  Country Code Sales Territory Product Number Salesperson Code
  - Solution: program or tool capable of identifying on a position-by-position basis the individual values, length of value, and meaning of resulting information.
- Multiple encoding e.g. male, female or m,f or 0,1
  - Solution: program or tool capable of identifying all the distinct possibilities, e.g.: *if field in ('male', 'm', 0) then new value = 'm';*
- Erroneous data e.g. mle, female or null, 1
  - Solution: program or tool capable of identifying spurious and bad entries and changing them into appropriate values.
- Multiple local standards: metric/USA, currencies
  - Solution: tools and filters that preprocess data into a suitable format

Source Data Problems 2

- **Missing Values**
  Solutions: ignore the missing data, wait until entered, …
- **Duplicate Values**
  Solution: duplicate values must be eliminated by e.g. using standard SQL UNION operator.
- **Element Names Problems**
  Solution: agree on standardization and re-name.
- **Element Meaning Problem**:
  Solution: Document the meaning in metadata.
- **Referential Integrity Problem**:
  Solution: Clean data and enforce referential integrity constraints.

Example: Name and Address

- No unique key
- Missing values
- Personal and commercial names mixed
- Different address for same customer
- Different names and spelling for same customer
- One name on multiple lines
- Many names on one line, e.g.

Name	**Location_id**
Joe Smith	N100
Tina Lewis	F101
Andy and Ann Jones	M300
…	…

- Single vs. Multiple Field format
  e.g. Name, Location Vs. Name, Street, City, Zipcode, County

Solutions

- Create atomic values
- Standardize formats
- Verify data accuracy
- Match with other records
- Identify private and commercial addresses and inhabitants
- Document in metadata
- May require sophisticated tools and techniques

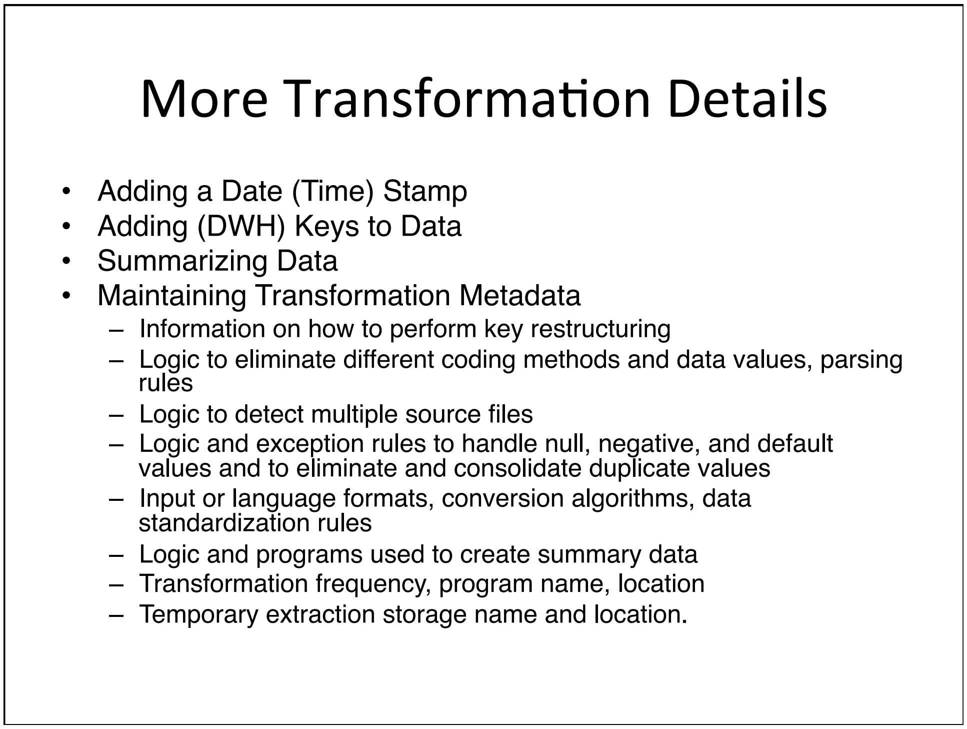
Merging Data

- Operational transactions usually do not map one-to-one with warehouse data
- Data for the warehouse is merged to provide information for analysis

Sale	10/2/2001	12:00:01	Ham Pizza	$12.00
Sale	10/2/2001	12:00:02	Cheese Pizza	$10.00
Sale	10/2/2001	12:00:03	Veggie Pizza	$120.00
Cancel	10/2/2001	12:00:04	Veggie Pizza	- $120.00
Sale	10/2/2001	12:00:05	Veggie Pizza	$12.00
Sale	10/2/2001	12:00:06	Cheese Pizza	$10.00

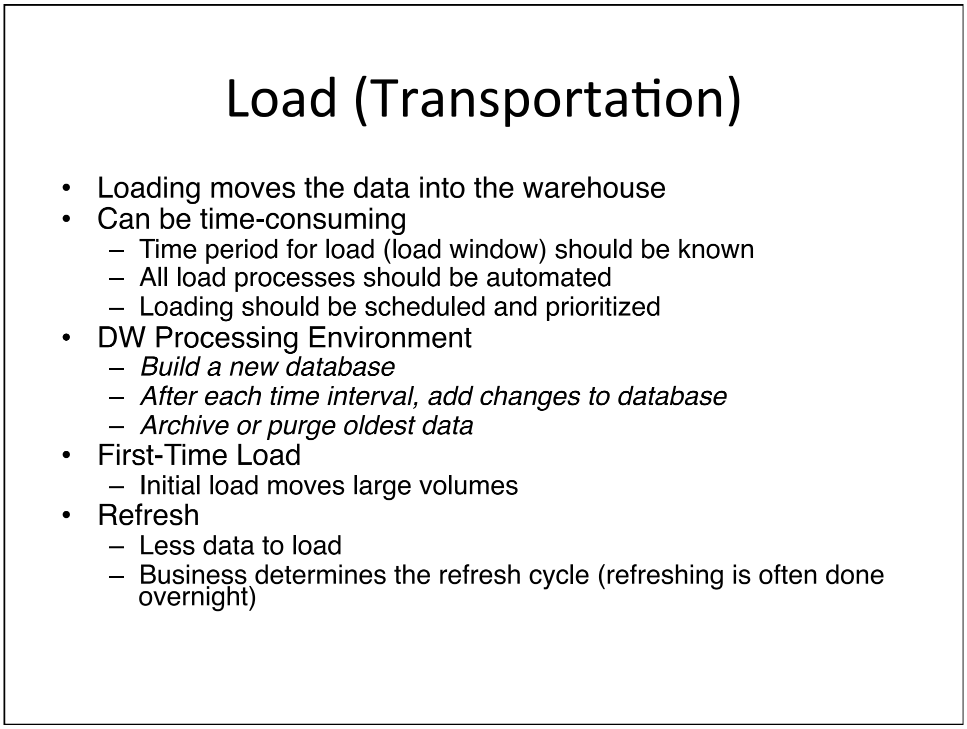
↓

Sale	10/2/2001	12:00:01	Ham Pizza	$12.00
Sale	10/2/2001	12:00:02	Cheese Pizza	$10.00
Sale	10/2/2001	12:00:05	Veggie Pizza	$12.00
Sale	10/2/2001	12:00:06	Cheese Pizza	$10.00



More Transformation Details

- Adding a Date (Time) Stamp
- Adding (DWH) Keys to Data
- Summarizing Data
- Maintaining Transformation Metadata
  - Information on how to perform key restructuring
  - Logic to eliminate different coding methods and data values, parsing rules
  - Logic to detect multiple source files
  - Logic and exception rules to handle null, negative, and default values and to eliminate and consolidate duplicate values
  - Input or language formats, conversion algorithms, data standardization rules
  - Logic and programs used to create summary data
  - Transformation frequency, program name, location
  - Temporary extraction storage name and location.



Load (Transportation)

- Loading moves the data into the warehouse
- Can be time-consuming
  - Time period for load (load window) should be known
  - All load processes should be automated
  - Loading should be scheduled and prioritized
- DW Processing Environment
  - *Build a new database*
  - *After each time interval, add changes to database*
  - *Archive or purge oldest data*
- First-Time Load
  - Initial load moves large volumes
- Refresh
  - Less data to load
  - Business determines the refresh cycle (refreshing is often done overnight)