

DATA WAREHOUSING FOR EQUIPMENT MANAGEMENT

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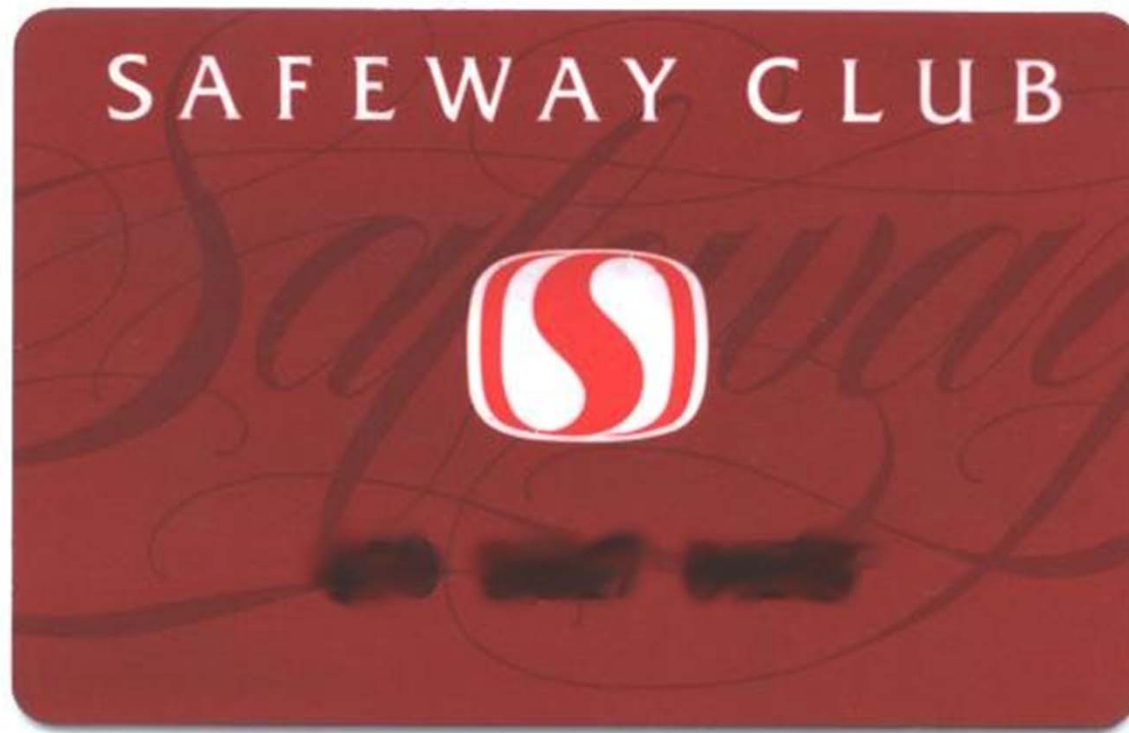
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Outline

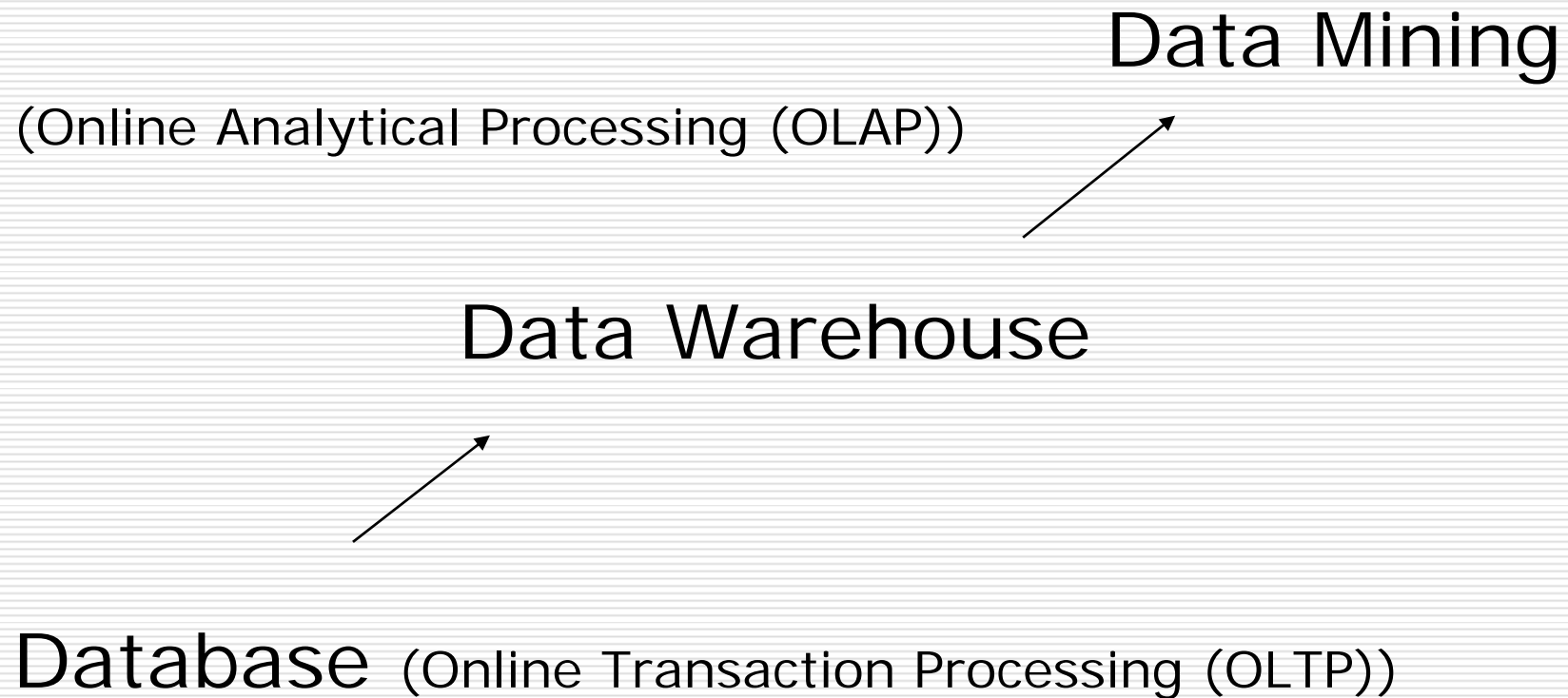
- Introduction
 - Problem Statement
 - Multi-dimensional Modeling
 - Mtrack Data Warehouse
 - Conclusions
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1. Introduction

□ SAFEWAY CLUB



1. Introduction



1. Introduction

OLTP vs. OLAP

	OLTP	OLAP
1	Transaction-oriented	Analysis-oriented
2	Detailed data	Summary data
3	Targets data-entry people	Targets decision making people
4	Reflects current situation	Reflects values over time (History)

1. Introduction

Trend of Development in DSS:

- ❑ Separation of transactional system and analytical system
 - ❑ Needs for domain specific DSS
 - ❑ Merging of data warehousing and data mining
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2. Problem Statement

- Standard General Inc. - a major equipment rental and construction contractor in Alberta.
 - Mtrack (Equipment Maintenance Management System)
 - NSERC/Alberta Construction Research Chair
 - Simplified the tedious routine management jobs
 - Record parts, fluids, fuel, etc.
-

2. Problem Statement

- Mtrack (Cont'd)

- Effective Transactional System

- But

- Lack of user control

- Data can only be viewed from pre-defined facets.

- Insufficient analysis functions

- Solution -> Data Warehousing

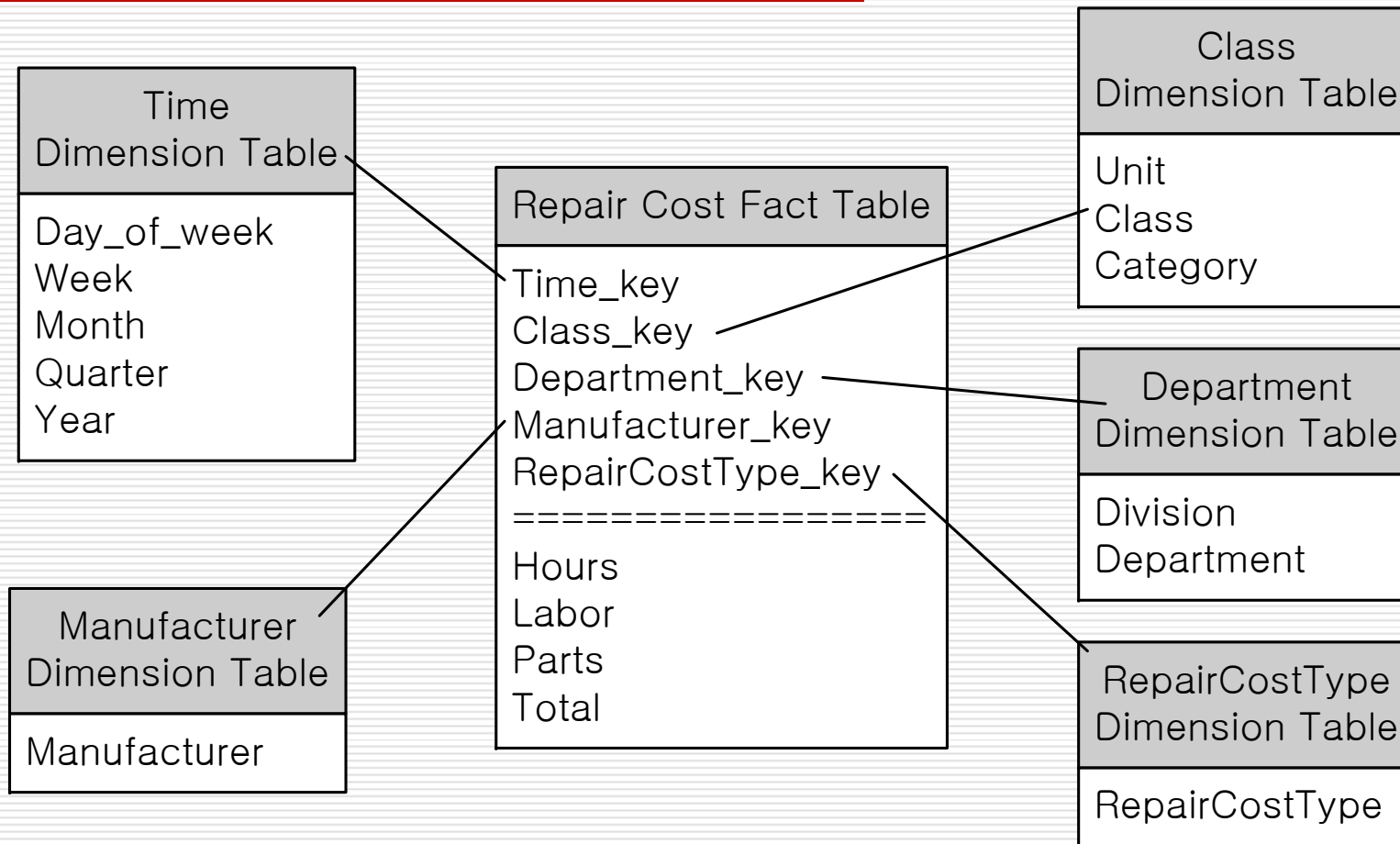
3. Multi-Dimensional Modeling

Common dimensions

Business processes	<i>the_Time</i>	<i>the_Class</i>	<i>the_Department</i>	<i>the_Account</i>	<i>the_Supplier</i>	<i>the_FuelType</i>	<i>the_FluidType</i>	<i>the_Parts</i>	<i>the_Employee</i>	<i>the_Manufacturer</i>	<i>the_Component</i>	<i>the_CostItem</i>	<i>the_RepairCostType</i>
Fuel Consumption	X	X	X	X	X	X				X			
Fuel Inventory	X		X	X	X	X							
Fluid Consumption	X	X	X	X	X		X			X			
Fluid Inventory	X		X	X	X		X						
Parts Consumption	X	X	X	X	X			X		X			
Parts Inventory	X		X	X	X			X					
Purchase Order	X	X	X	X	X			X	X		X		
Work Order	X	X	X							X	X	X	
Repair Cost	X	X	X							X			X
Human Resource	X		X	X					X				

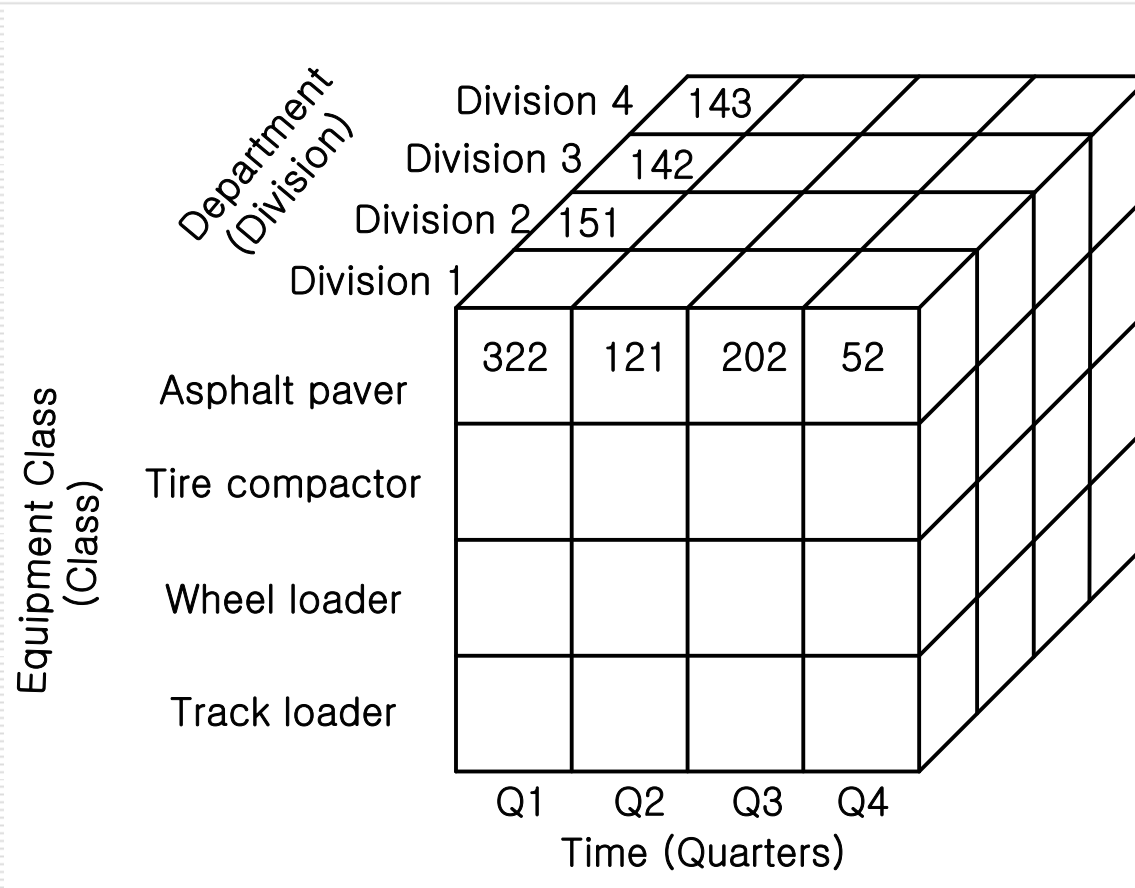
Bus Matrix for Mtrack Data Warehouse

3. Multi-Dimensional Modeling



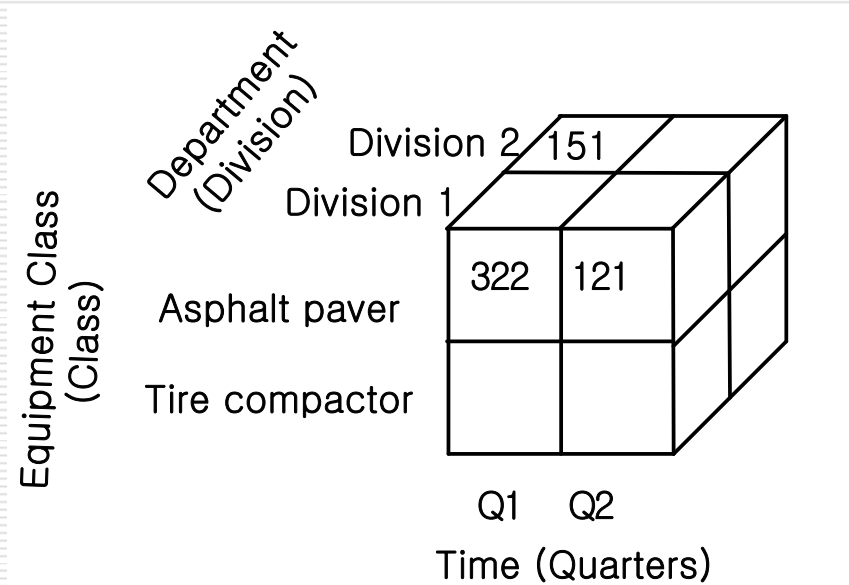
Repair Cost with Star Schema

3. Multi-Dimensional Modeling



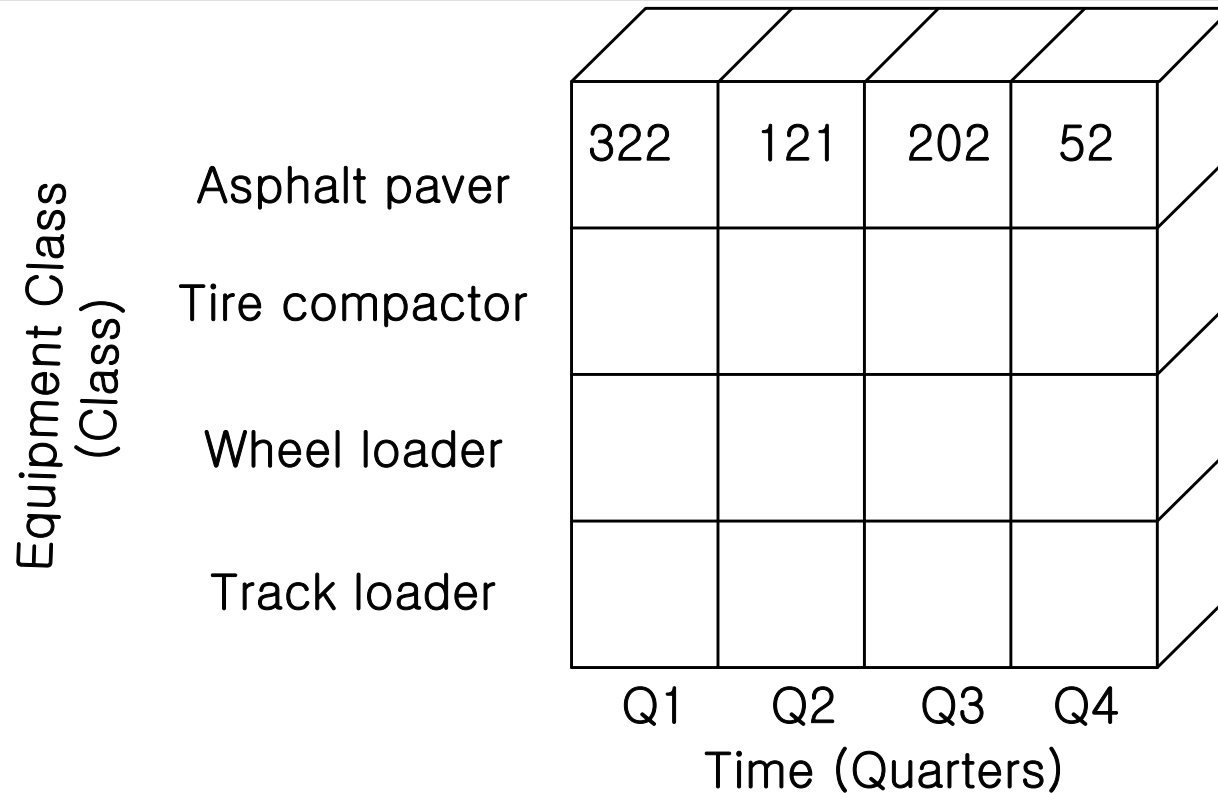
Data Cube for Repair Cost

3. Multi-Dimensional Modeling



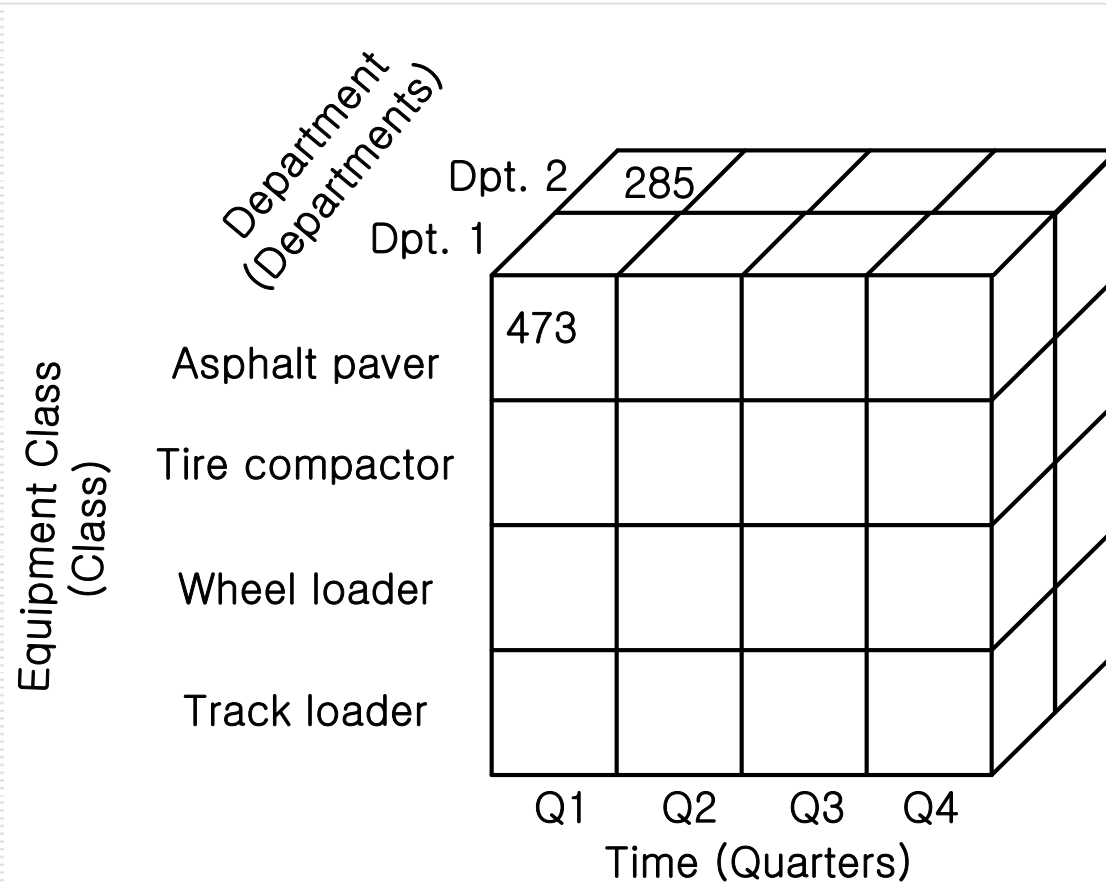
Dice for D1 ,2, and Q1, Q2, and Asphalt paver, Tire Compactor

3. Multi-Dimensional Modeling



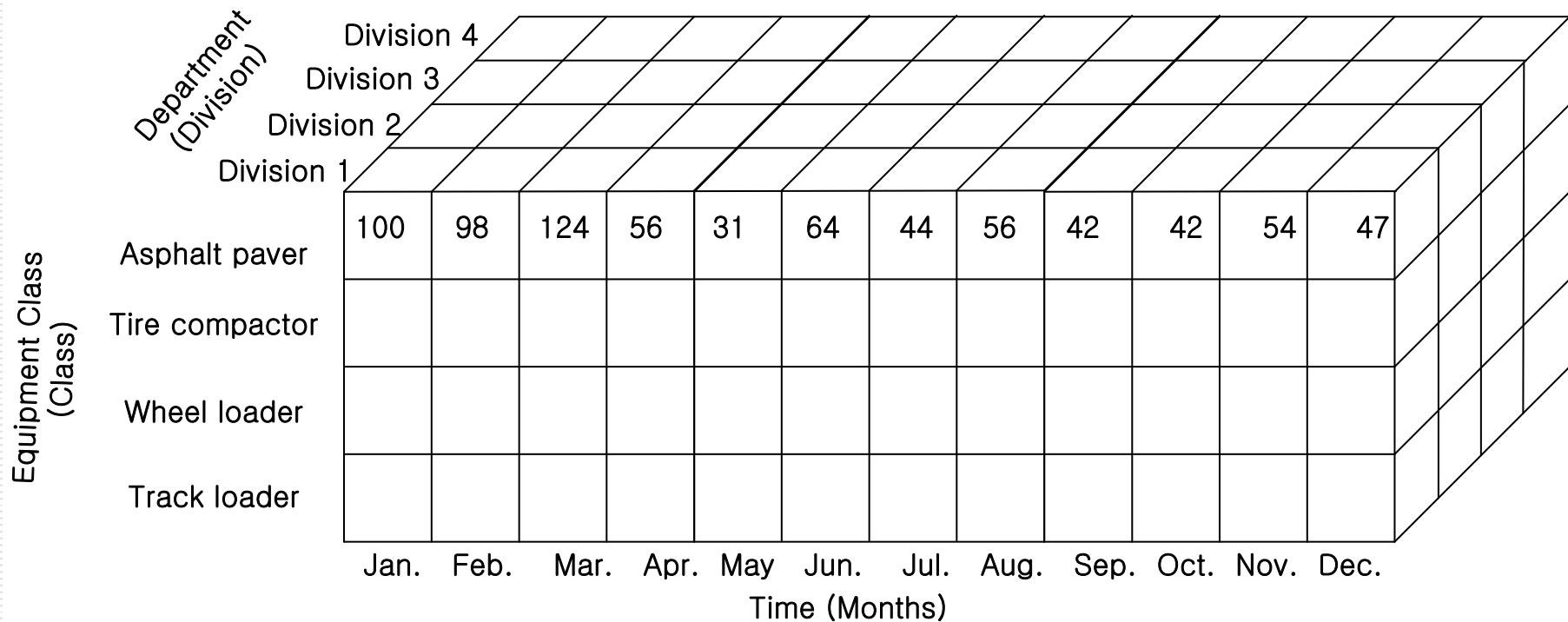
Slice for Division 1

3. Multi-Dimensional Modeling



Roll-up on Department (from Divisions to Departments)

3. Multi-Dimensional Modeling

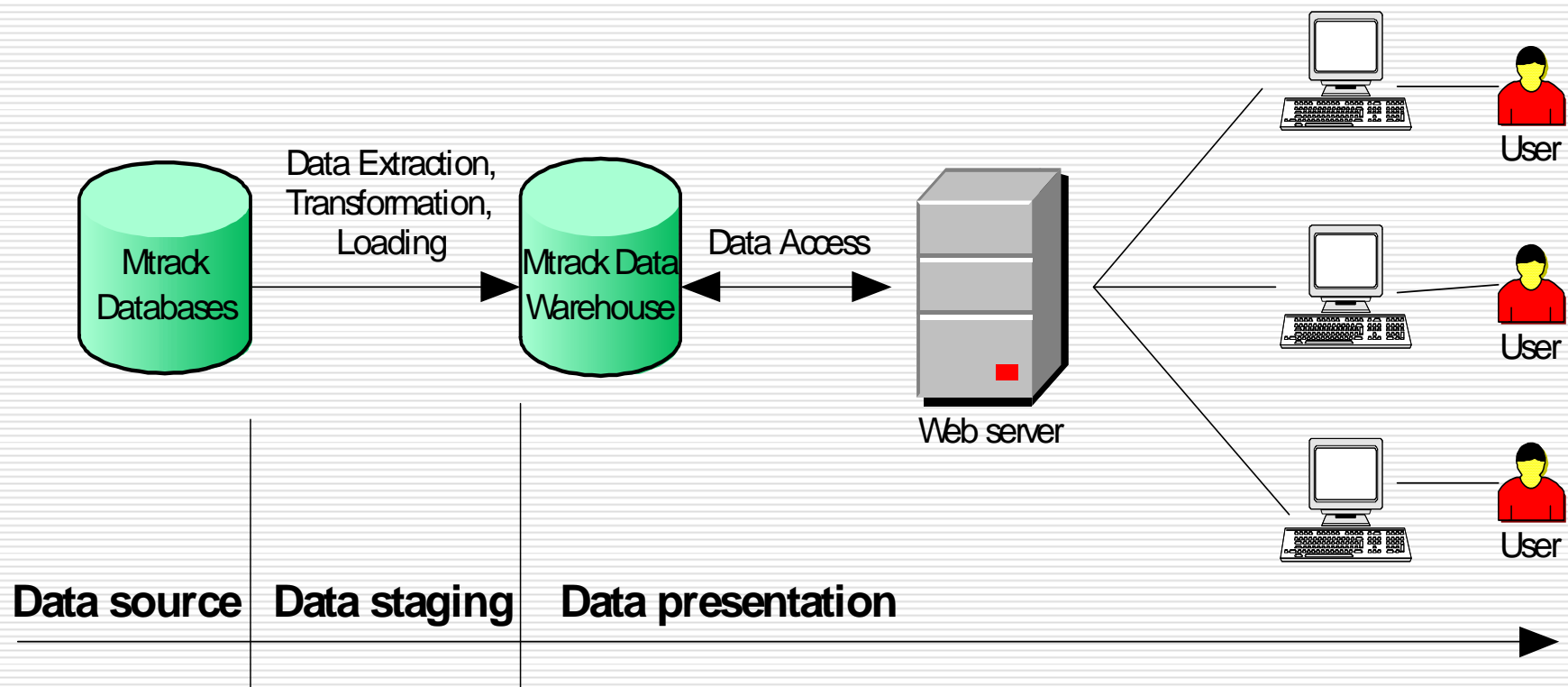


Drill-down on Time (from Quarters to Months)

4. Mtrack Data Warehouse

- Data warehousing indicates the building and maintaining of a data warehouse
 - Data Extraction, Transformation and Loading
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4. Mtrack Data Warehouse



Data Warehousing and Data Access

4. Mtrack Data Warehouse

□ System Architecture

- Three-layer application: data layer, business layer and user interface.
 - Three modes for user query: Visual Browsing of OLAP cubes, pre-formulated queries, and user-defined queries
-

4. Mtrack Data Warehouse

The screenshot displays the Mtrack Data Warehouse web application interface within a Microsoft Internet Explorer browser window. The browser title is "WebForm1 - Microsoft Internet Explorer" and the address bar shows "http://localhost/mtrack/WebForm8001.aspx".

The application header includes the "MTRACK DECISION SUPPORT" logo and navigation links: Home, Fuel Consumption, Fuel Inventory, Fluid Consumption, Fluid Inventory, Parts Consumption, Parts Inventory, Purchase Order, Work Order, Repair Cost, Human Resource, Documentation, and Contact. There are also "Log off" and "Help" links.

The main content area is titled "Work Order OLAP Cube Visual Browsing". It features a "Browse the data cube" link and sections for "Pre-defined MDX Queries" and "User-defined MDX Queries".

The central part of the interface shows a "Microsoft Office PivotTable 11.0" with the following data:

the_Time	Cost Item	Est Cost	Act Cost	pctVar
2001				
	Labor	147999	180243	-0.402179755
	Parts	301881	195402	0.502622715
	Grand Total	449880	375645	0.068477947

Below the pivot table is a bar chart titled "pctVar" for the year 2001. The y-axis ranges from 0.2 to 0.6. A single blue bar represents the "Grand Total" value of approximately 0.068.

On the right side, there is a "PivotTable Field List" pane showing the data source "Work Order" and fields: Totals, Act Cost, Cost Var, Est Cost, and pctVar. The fields are organized into a hierarchy: the_Class, the_costItem, the_Departm, the_Manufac, and the_Time.

Below the field list is a "Work Order OLAP Cube Pre-defined Query" section. It contains a text area with an MDX query:

```
with member [measures].[pct variation] as [measures].[pctvar]',format='#00.0%' select {[Measures].[Act Cost],[Measures].[pct variation]} on 0, [Earthmoving Equipment].children,[Measures].[Work Order] where [the_Time].[All the
```

A "Submit" button is located below the query text.

At the bottom right, there is a "Description" section with a red header and the text: "Tire compactor, 100+ hp".

4. Mtrack Data Warehouse

Effective Data Analysis

- Large data sets
 - Various questions can be answered
 - on each subject
 - along any dimensions
 - at any level
 - High query efficiency
-

4. Mtrack Data Warehouse

Example question 1 :

Compare the Estimated Labor Cost and Actual Labor Cost for different manufacturers in the Year 2001

Cost Item	Man Desc	Data	Year 2001
Labor	Caterpillar	Estimated Cost	100000
		Actual Cost	90000
		Pct Variation	-10.0%
	Ford	Estimated Cost	10000
		Actual Cost	11000
		Pct Variation	10.0%
	GMC	Estimated Cost	1000
		Actual Cost	950
		Pct Variation	-5.0%

Note that the data in the table have been distorted for confidential reason

4. Mtrack Data Warehouse

Example question 2 :

Show the itemized fuel costs for all the manufactures in Quarter 3, 2001

Cost	Fuel Desc				
Man Desc	Clear Diesel	Propane	Purple Diesel	Regular Unleaded	Grand Total
ABG	300		2000		2300
Advance				1100	1100
Aztec			3000		3000
Barber Greene	2200		300		2500

Note that the data in the table have been distorted for confidential reason

4. Mtrack Data Warehouse

Example question 3 :

Show the itemized fuel Consumption (liters) for Auto Equipment in 2001

Volume	Cat Desc
Fuel Desc	Automotive Equipment
Clear Diesel	15000
Propane	1200
Purple Diesel	90000
Regular Unleaded	342343
Grand Total	448543

Note that the data in the table have been distorted for confidential reason

5. Conclusions

- ❑ Data Warehousing is a powerful tool for creating an effective Decision Support System for construction equipment management.
 - ❑ Data Warehousing is also applicable to other construction areas such as project analysis, infrastructure management, etc.
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6. Acknowledgements

We would like to thank:

- Standard General Inc.
 - NSERC/Alberta Construction Research Chair
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