On-Line Analytical Processing OLAP: The Interaction of Information and Decision Technologies

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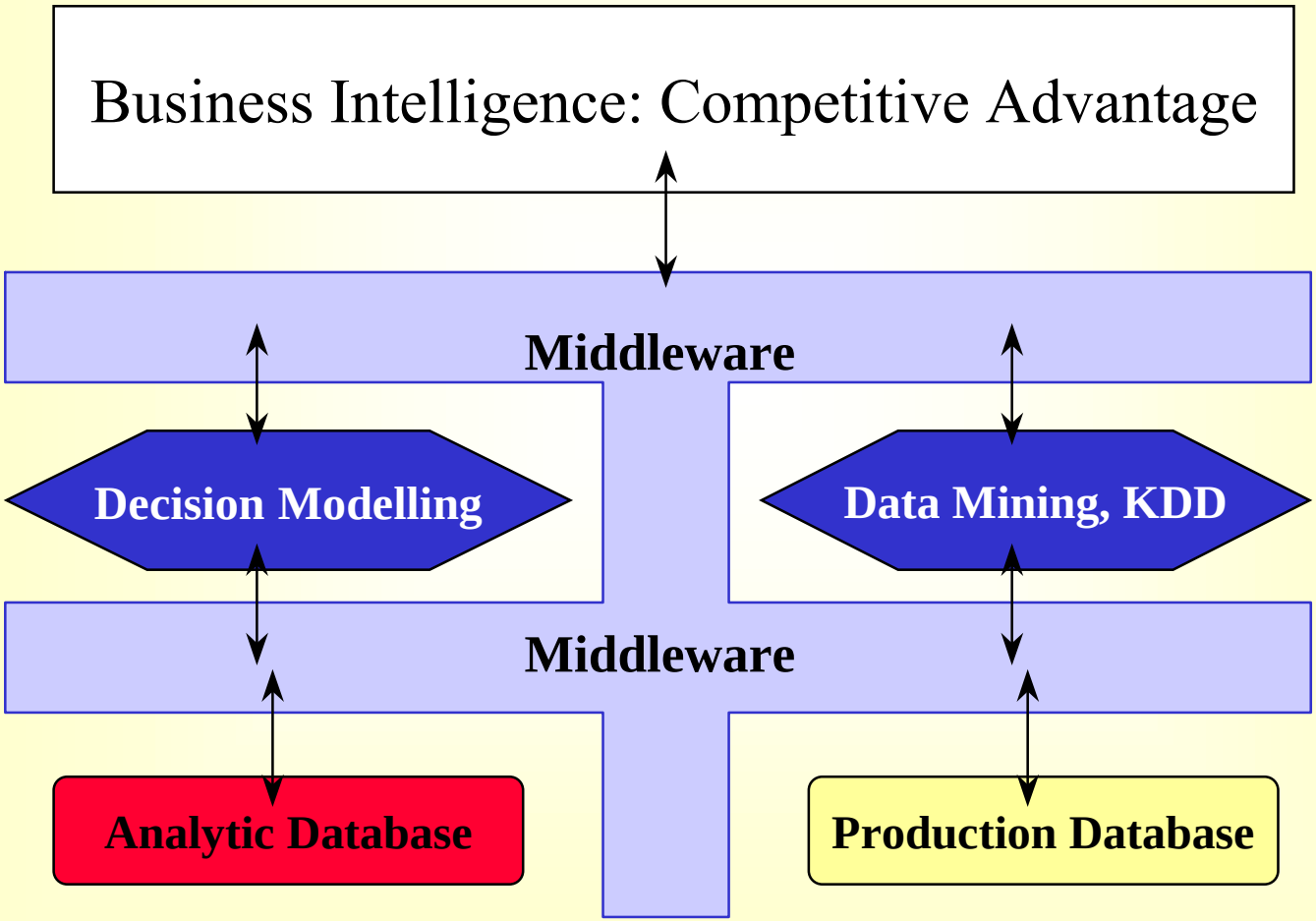
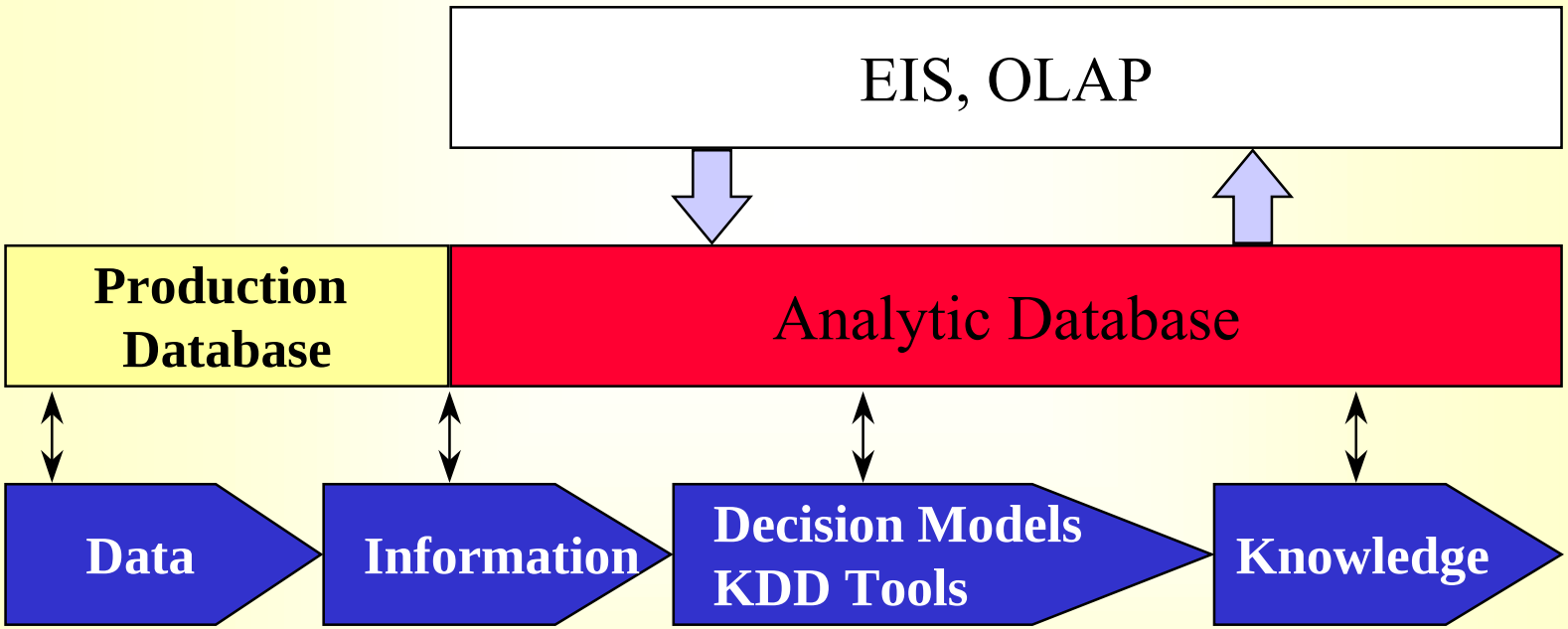
The next 15-20 minutes…

- Setting the scene
- Data Structure ➠ Model Structure
- OLAP in DSS Modelling
- Forecasting in tandem with an LP
- Discussion of Issues

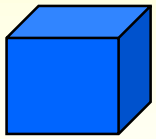
Information and Decision Technologies



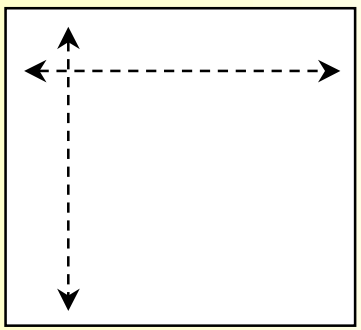
Information and Knowledge: The Value Chain



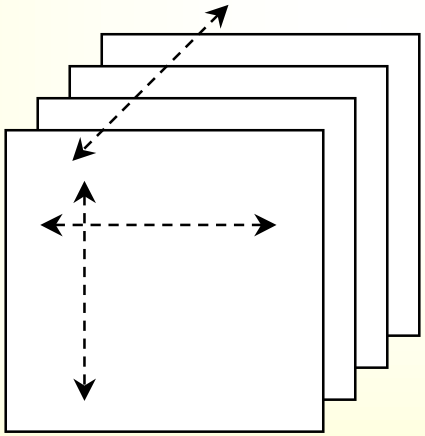
OLAP and Multidimensional Viewing: Main features

Multidimensionality ≡ Data 

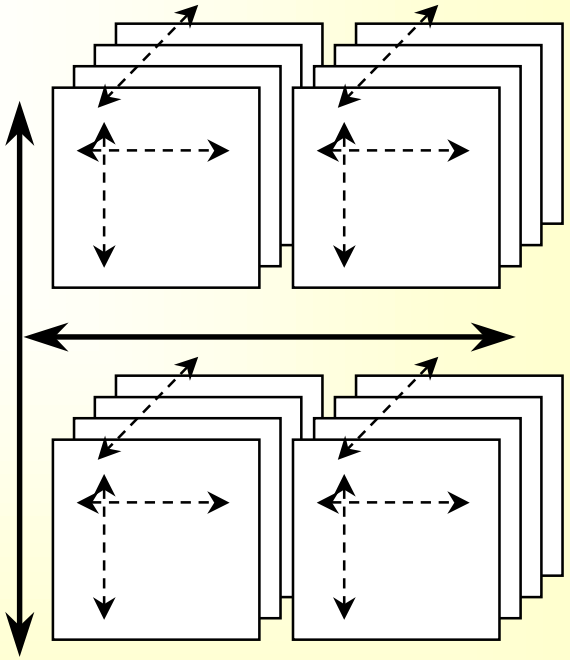
2 Dimensions



3 Dimensions



5 Dimensions



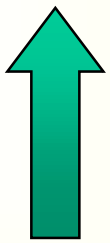
OLAP and Multidimensional Viewing: Main features

"Sales": per Year, Product, Sales Area

Slice 

Area: North	Year 1	Year 2
Product A	2000	2800
Product B	2500	3000
Product C	2800	3000

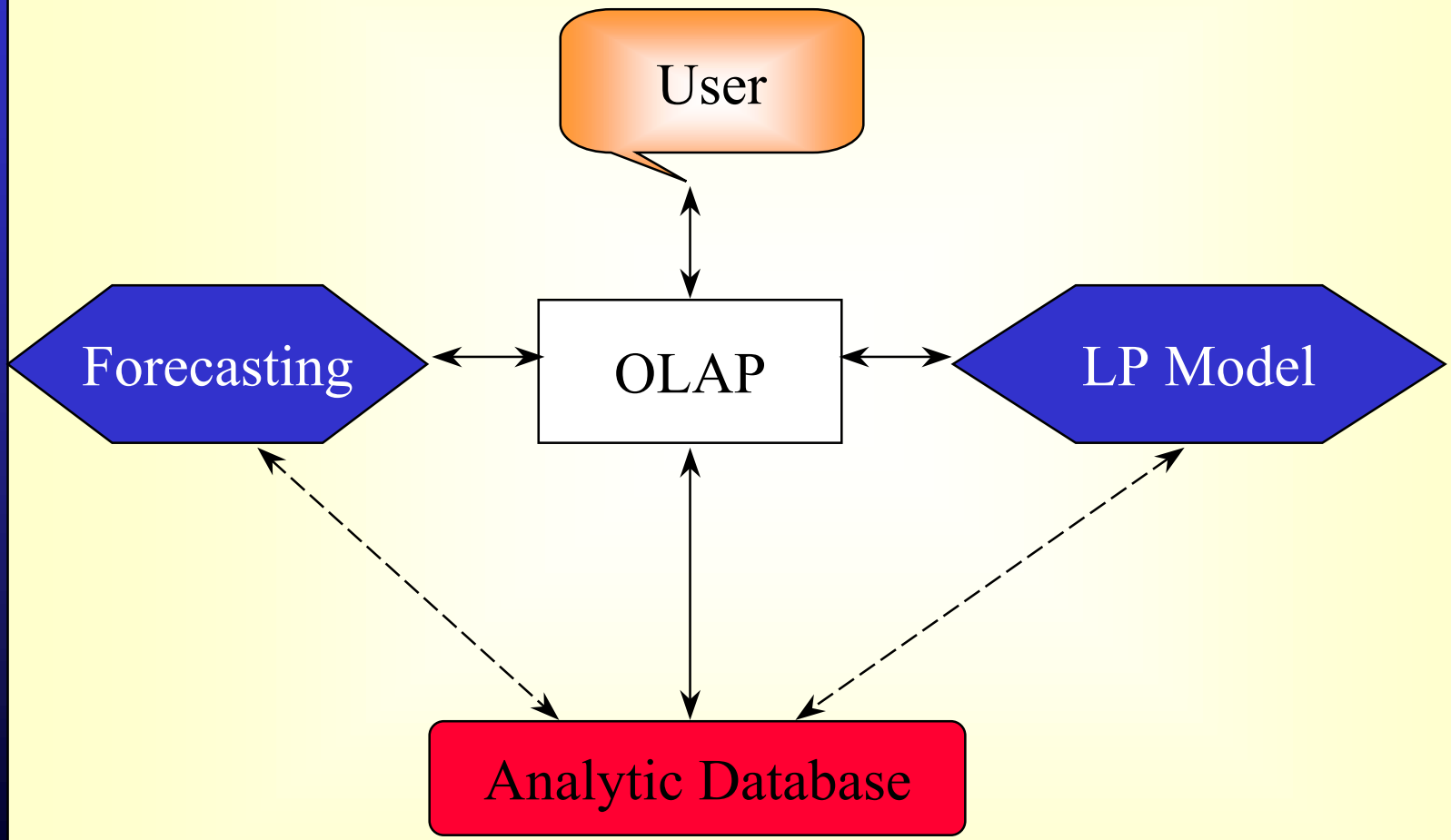

Drill Down


Roll Up

"Sales": per Quarter, Product, Sales Area

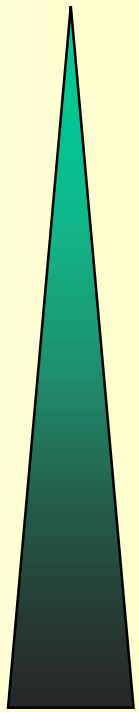
Area:	Year 1				Year 2			
North	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Prod A	500	500	500	500	700	700	700	700
Prod B	650	650	600	600	700	700	800	800
Prod C	700	700	700	700	700	700	800	800

An architecture for DSS



Hierarchy of Tools and their Interaction

Function(s)	DSS Interaction	Software Tool	User Interaction
Model Solving	Solver	FortMP (LP Solution) Personal Express	
LP-Optimisation Forecast	Symbolic (Decision) Modelling	MPL (LP Model) Personal Express	
Roll-Up Drill-Down Slice What if GUI Graphs	Analytic DB - Data Modelling	Personal Express	
	Interface for the Analysis of data, Decision Models, Solutions	Data and Optimisation Modelling Environment - DOME (LP)	



Next...

- Data Structure ➠ Model Structure
- OLAP in DSS Modelling
- Forecasting in tandem with an LP
- Discussion of Issues

Data Structure ➠ Model Structure

NutBolt Co. ltd

- 3 Products, 2 Plants, 4 Regions,...
  - Past Sales to Forecast future Demand
  - Production & Distribution Optimisation
- 2 Decision Models:
  - Forecast
  - LP-based Optimisation
- 1 Database ...

Data Structure ➠ Model Structure

- We consider DSS.
- For illustration two frequently used models. Forecast + LP
- We investigate how they interact

•Forecasting Model: Winter's Method:

$d_{i+T}=(a_i+b_iT)F*$

Where … d_{i+T} is the forecast at time period i, for T time periods into the future, a is… b is … F is ...*

In the LP model d_i is represented by $\mathbf{d_{iko}}$

Data Structure ➠ Model Structure

- The LP-Optimisation Model:

Indices:
____i time periods
k products
o sales areas
e production sites
…

Data Tables:
d_{iko} demand
…

Decision Variables:
z_{ikeo} product shipment
w_{iko} shortfall
…

Objective: Maximize Profit
Σ(revenue) - Σ(transportation costs) - Σ(production costs) - Σ(storage costs)

Constraints:

Machine Availability: Σ(production rate*units produced)≤ time available

Inventory balance …

Demand: $\Sigma_e z_{ikeo} + w_{iko} \geq d_{iko} \; \forall i,k,o$

Bounds ...

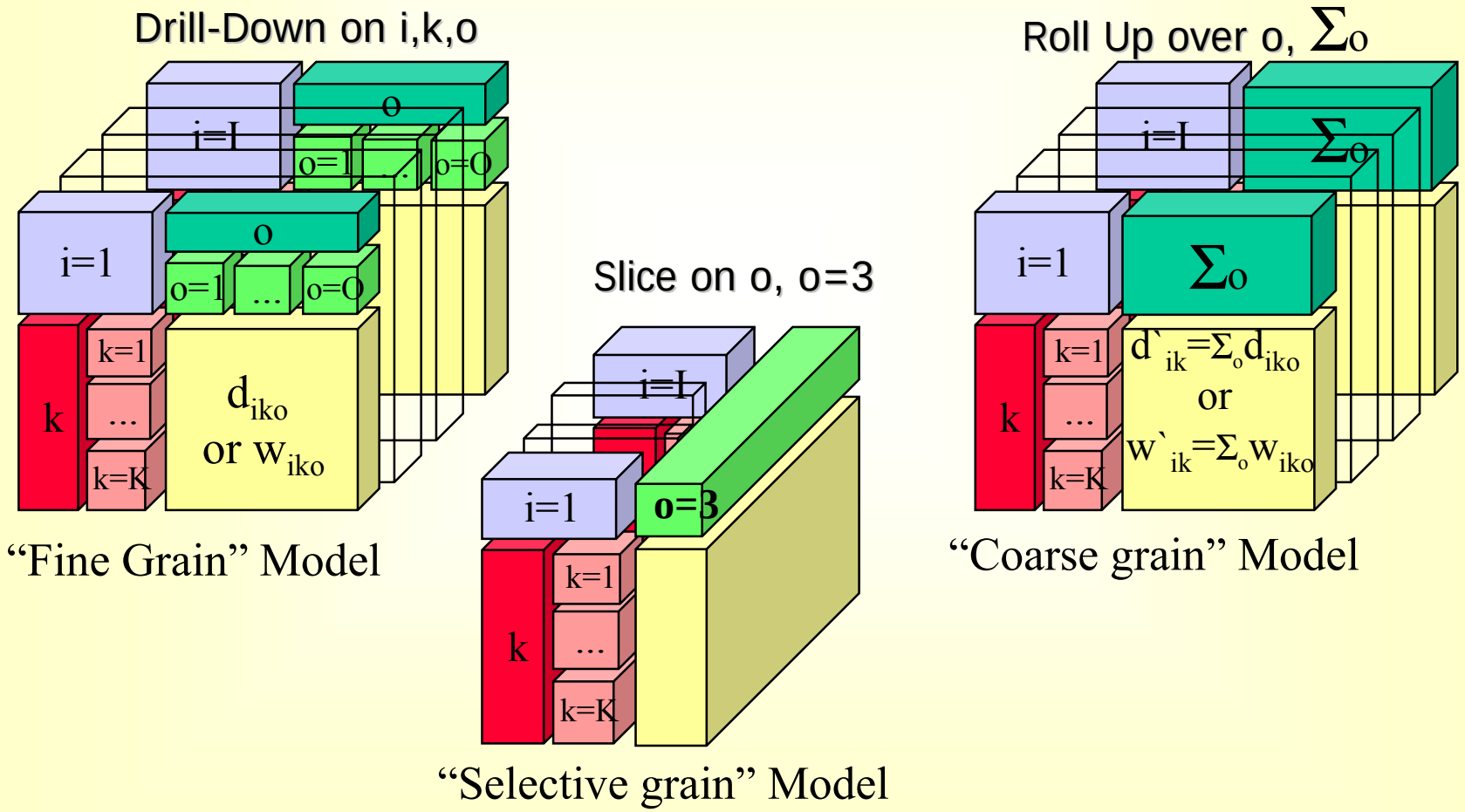
Non-negativity ...

OLAP features in DSS Modelling

- Roll Up in Data Model ➔ Aggregation in Decision Model ("Coarse Grain"):
  - Useful for very large applications in validating data, and gaining insight into model behaviour
  - Faster for assessing feasibility of new ideas
- Drill Down in Data Model ➔ Detailed Decision Model ("Fine Grain"):
  - This is the model of real interest.
  - More time to solve due to the level of detail in the model
- Data Slice ➔ Creation of a typical Sub-Model ("Selective Grain"):
  - Useful in validation and investigation

OLAP features in DSS Modelling

Suppose i=1,…,I k=1,…K, o=1,…O, and I, K, O>1



Forecasting in Tandem with an LP

Detail Model (Drill Down)

Data Drill Down

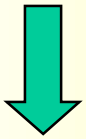
Solution: Forecast

Solution: Optimisation

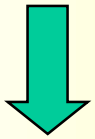
Fine Grain Model:
Profit 2,079.68

Summary Model (Roll Up)

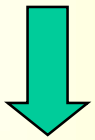
Data Roll Up



Solution: Forecast



Solution: Optimisation



Coarse Grain Model:
Profit 2,210.80

Discussion of Issues...

- OLAP MDDB and Model Structure closely (dynamically) coupled
- New Dimensions: Time, Case, Easily introduced.
- Difficulties - New Directions
  - Tools in a variety of platforms:
  - Modelling-PCs, Solvers-other
  - Need for a distributed environment
  - and closely coupled tools

Thank you for your attention.