# The Impact of Columnar In-Memory Databases on Enterprise Systems

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Chair of Prof. Dr. Hasso Plattner

# Hardware Development
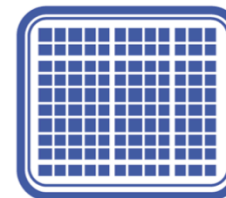## Enabler for a New Era of Business Processing



**20 YEARS AGO**

MEMORY
**1** GB ——— x 6000 ——— 

CPU
**4 x 50** MHz ——— x 1800 ——— 

MEMORY
**6** TB

CPU
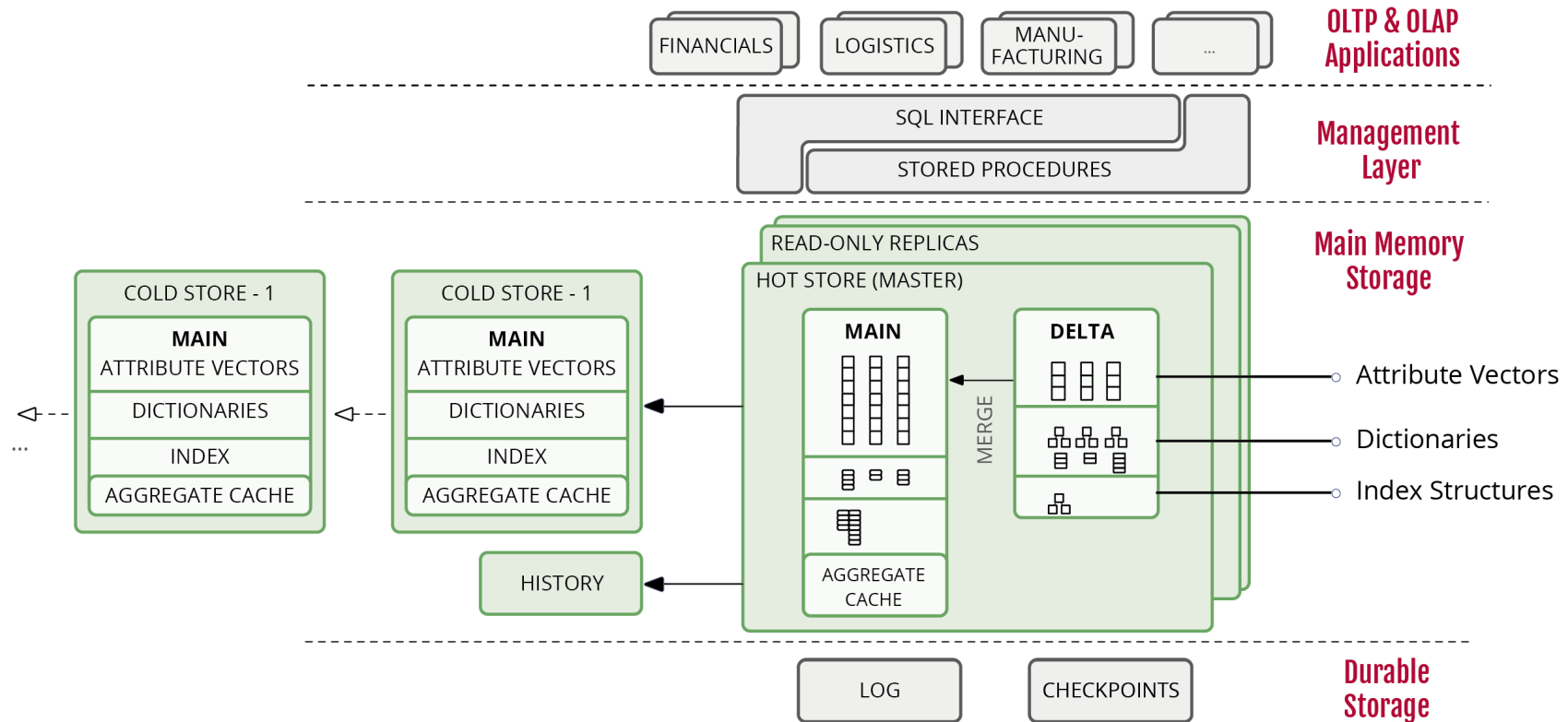**120 x 3.0** GHz

**TODAY**

**NEAR FUTURE**

MEMORY
**48** TB

CORES
**480 (8x4x15)**

# A Common Database Approach
## For OLTP and OLAP

# What's in it for the enterprise?

## Speed!

The performance of the database increases dramatically!

But, does a faster system change the game?
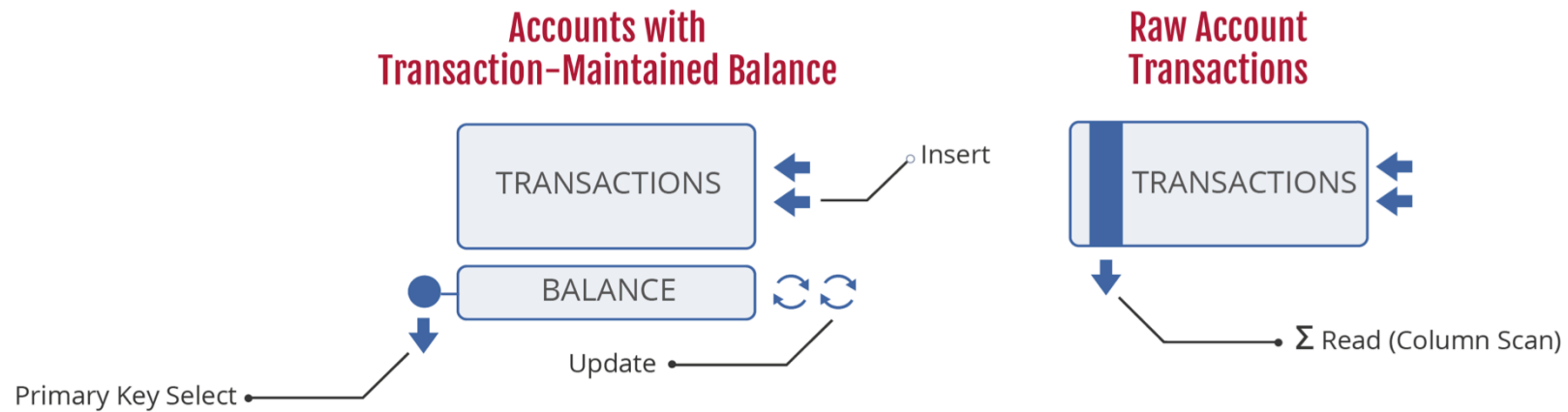
It might for some, but there is more.

# What is the impact of In-Memory Technology?

**Speed** is just an enabler for **Simplification**.

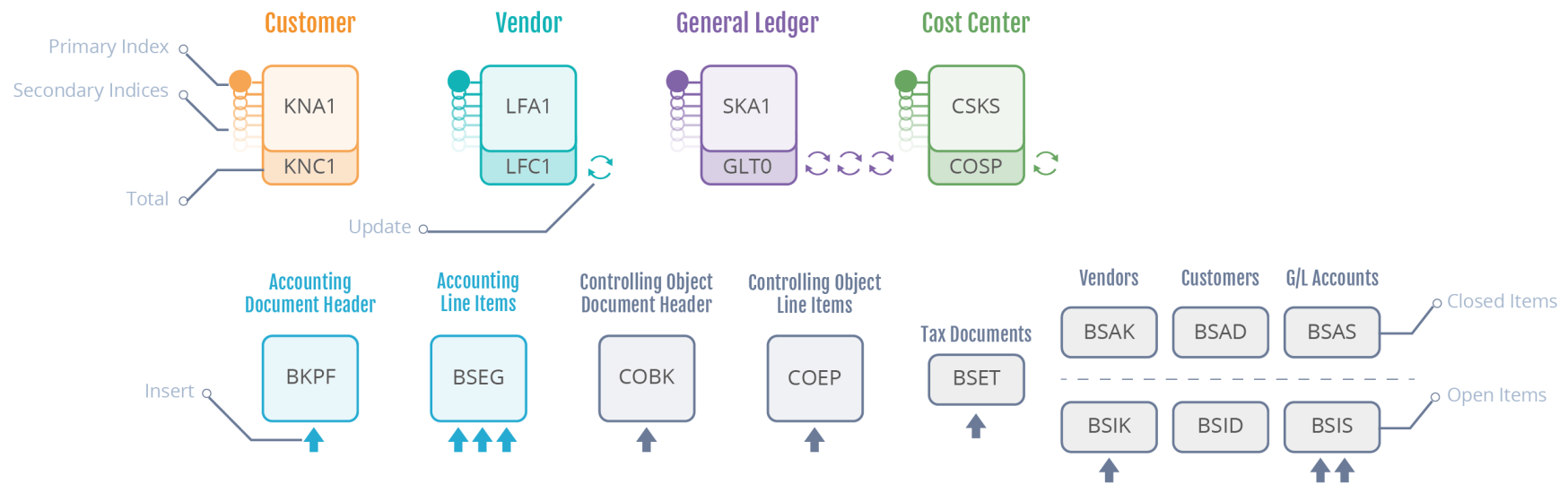**Simplification** allows to increase **Flexibility** and decrease **TCO**.

**Flexibility** enables companies to **re-think** their existing, or approach **new, Business Models**.

# A Textbook Example:
## Wire Money from Account A to Account B



**Accounts with Transaction-Maintained Balance**

TRANSACTIONS ← Insert

BALANCE

Primary Key Select

Update

**Raw Account Transactions**

TRANSACTIONS ←

Σ Read (Column Scan)

# SAP Financials – Invoice Posting
## Before Simplification

# SAP Financials – Invoice Posting
## Simplification



| Customer | Vendor | General Ledger | Cost Center |
|----------|--------|----------------|-------------|
| KNA1 | LFA1 | SKA1 | CSKS |
| KNC1 | LFC1 | GLT0 | COSP |

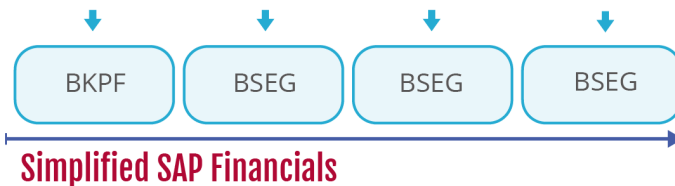| Accounting Document Header | Accounting Line Items | Controlling Object Document Header | Controlling Object Line Items | Tax Documents | Vendors | Customers | G/L Accounts |
|---|---|---|---|---|---|---|---|
| BKPF | BSEG | COBK | COEP | BSET | BSAK | BSAD | BSAS |
| | | | | | BSIK | BSID | BSIS |
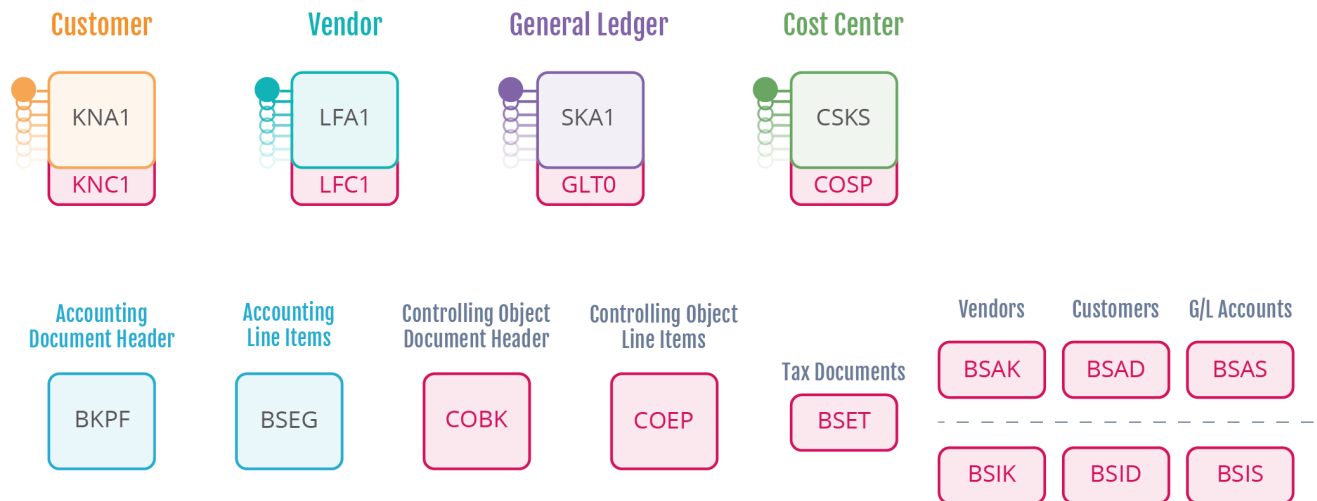
# SAP Financials – Invoice Posting
## After Simplification with Database Views



**Customer**
KNA1

**Vendor**
LFA1

**General Ledger**
SKA1

**Cost Center**
CSKS

KNC1
LFC1
GLT0
COSP

**Views with On-The-Fly Aggregations**

**Accounting Document Header**
BKPF

**Accounting Line Items**
BSEG

BSAK  BSAD  BSAS
BSIK  BSID  BSIS
COBK  COEP  BSET

**Views with Projection and Selection**
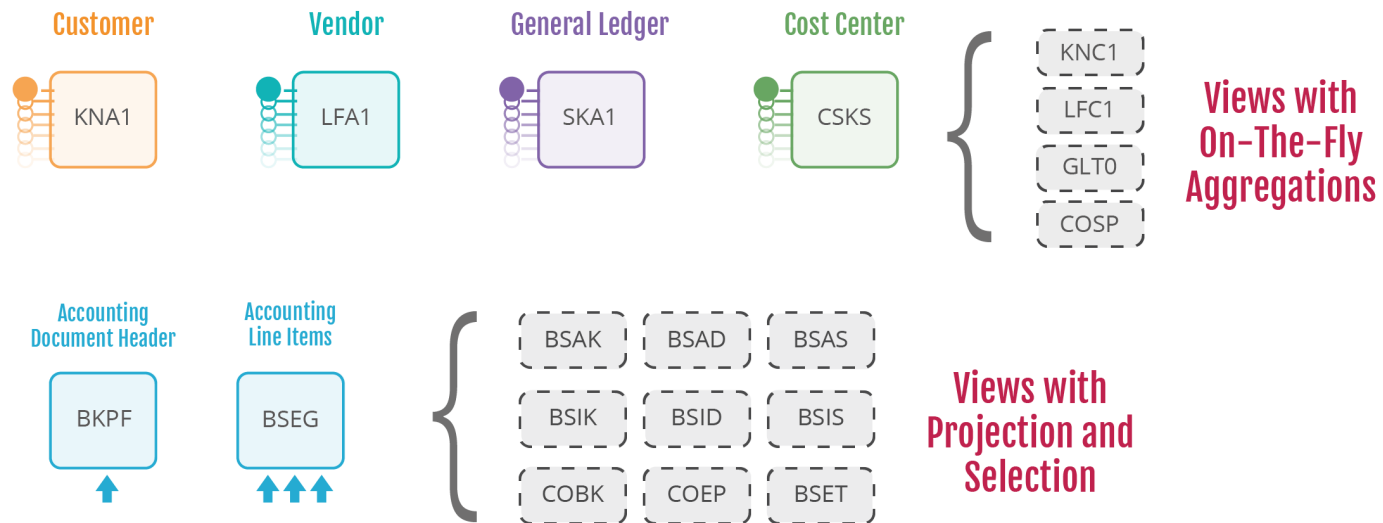
# Why Column Stores are better than Row Stores for Transactional Processing



**Classic SAP Financials with Transaction-Maintained Aggregates**

BKPF | BSEG | BSEG | BSEG | BSIS | BSIS | BSIK | BSET | LFC1 | GLT0 | GLT0 | GLT0 | COBK | COEP | COSP

**Simplified SAP Financials**

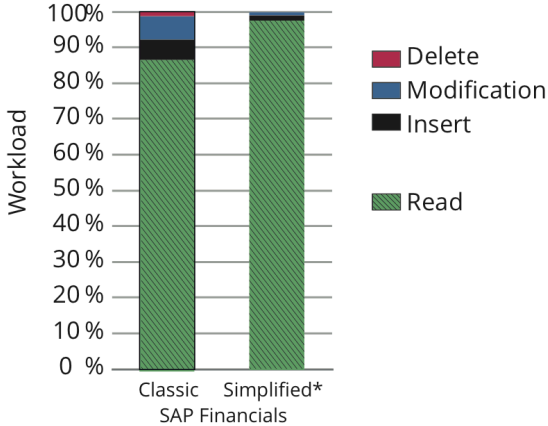BKPF | BSEG | BSEG | BSEG
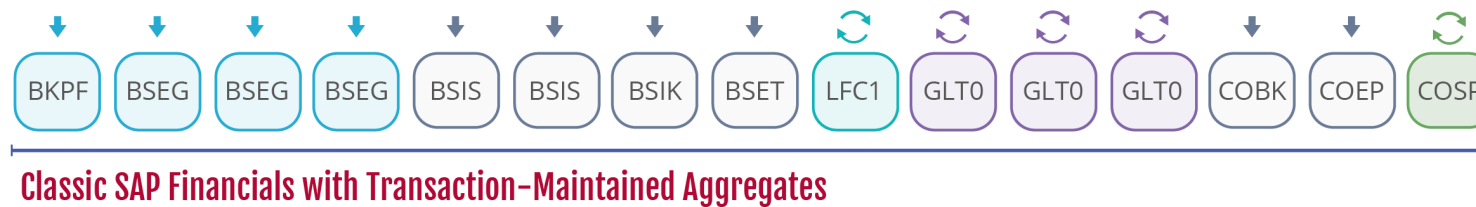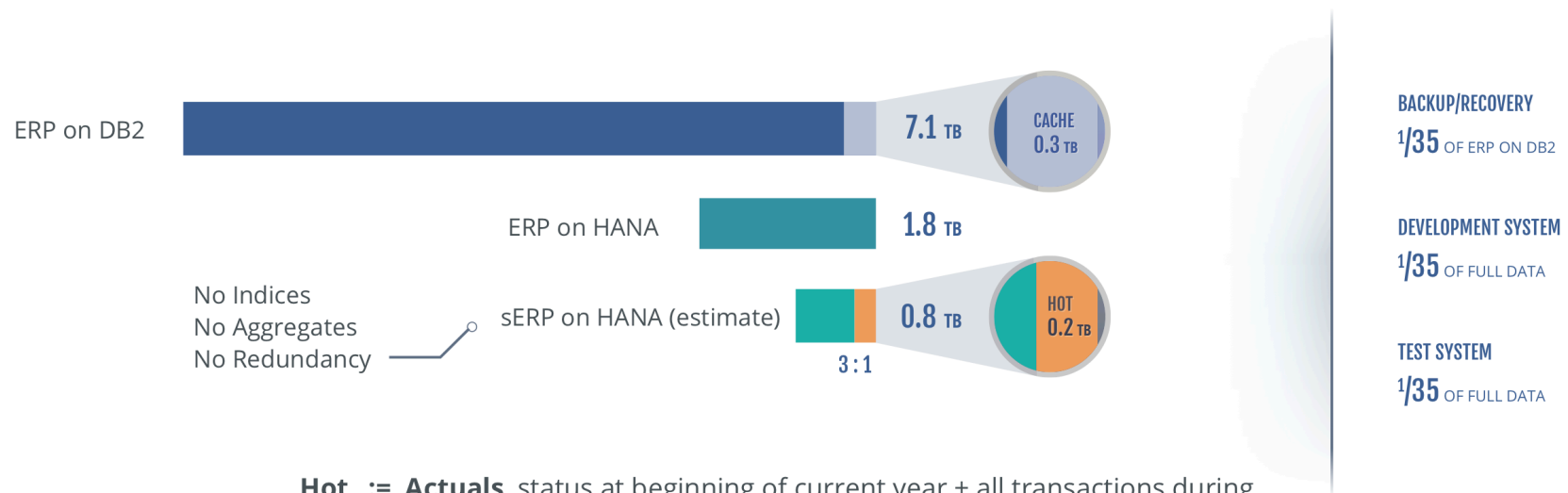
# Enterprise Workload Analysis
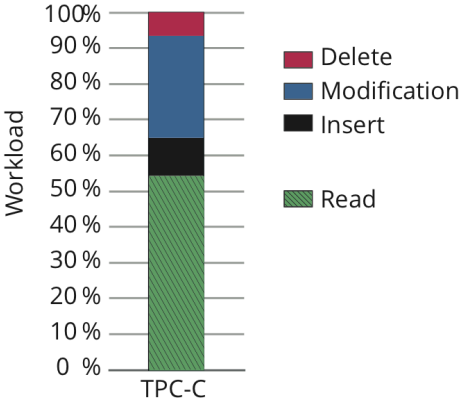


TPC–C Benchmark
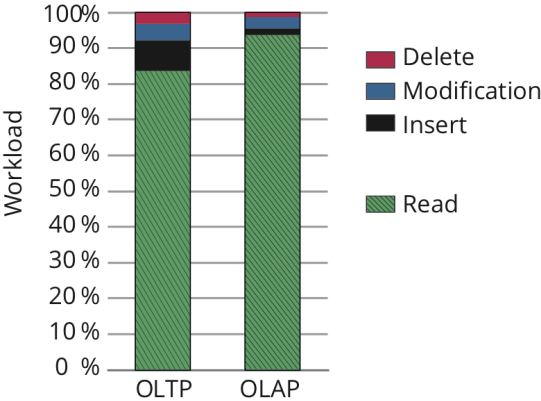
Workload Analysis
Krueger et al. VLDB'11

SAP Financials
Workload Analysis

*Without Transaction-Maintained Aggregates

# Simplification reduces Data Footprint



ERP on DB2 — 7.1 TB — CACHE 0.3 TB

ERP on HANA — 1.8 TB

No Indices
No Aggregates
No Redundancy — sERP on HANA (estimate) — 0.8 TB — HOT 0.2 TB
3 : 1

**BACKUP/RECOVERY**
$1/35$ OF ERP ON DB2

**DEVELOPMENT SYSTEM**
$1/35$ OF FULL DATA

**TEST SYSTEM**
$1/35$ OF FULL DATA

**Hot := Actuals**, status at beginning of current year + all transactions during
current year to conduct business and fullfill statuary reporting
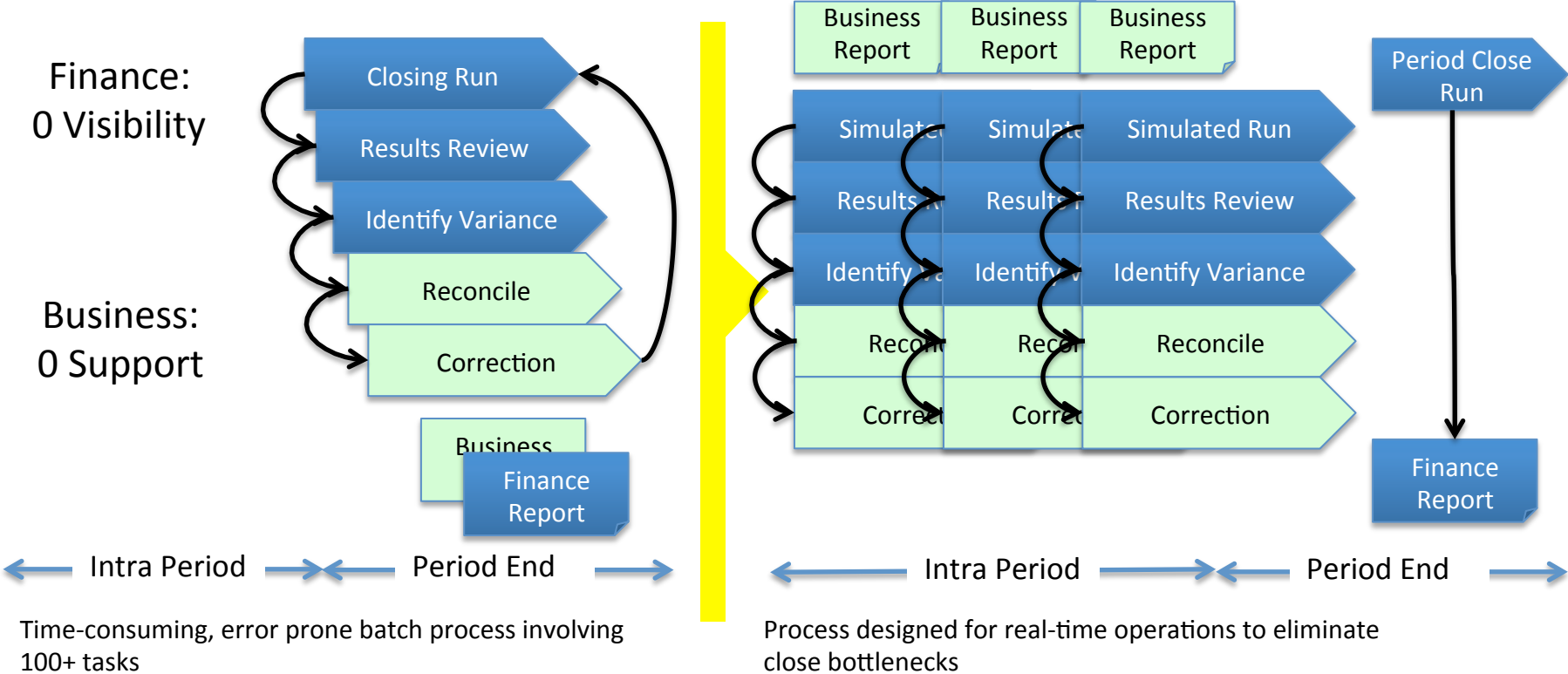
**Cold := Historical**, up to 10 years

# Examples

What is the business value generated from speed and flexibility?

1. Period End Close Simulation
2. Planning

# 1. Period End Close Simulation



Finance:
0 Visibility

Business:
0 Support

Closing Run
Results Review
Identify Variance
Reconcile
Correction

Business
Finance Report

Business Report
Business Report
Business Report

Simulated Run
Results Review
Identify Variance
Reconcile
Correction

Period Close Run

Finance Report

Intra Period → Period End →

Intra Period → Period End →

Time-consuming, error prone batch process involving 100+ tasks

Process designed for real-time operations to eliminate close bottlenecks

# 2. Planning

1. Currently, planning is a static process, which operate on aggregates.

2. Planning information
   - competitors,
   - Inflation rate
   - growth rates,
   - economy,
   - forecasted pipeline

applied on aggregates is dangerous and not very scientific. Its like holding your thumb in the air

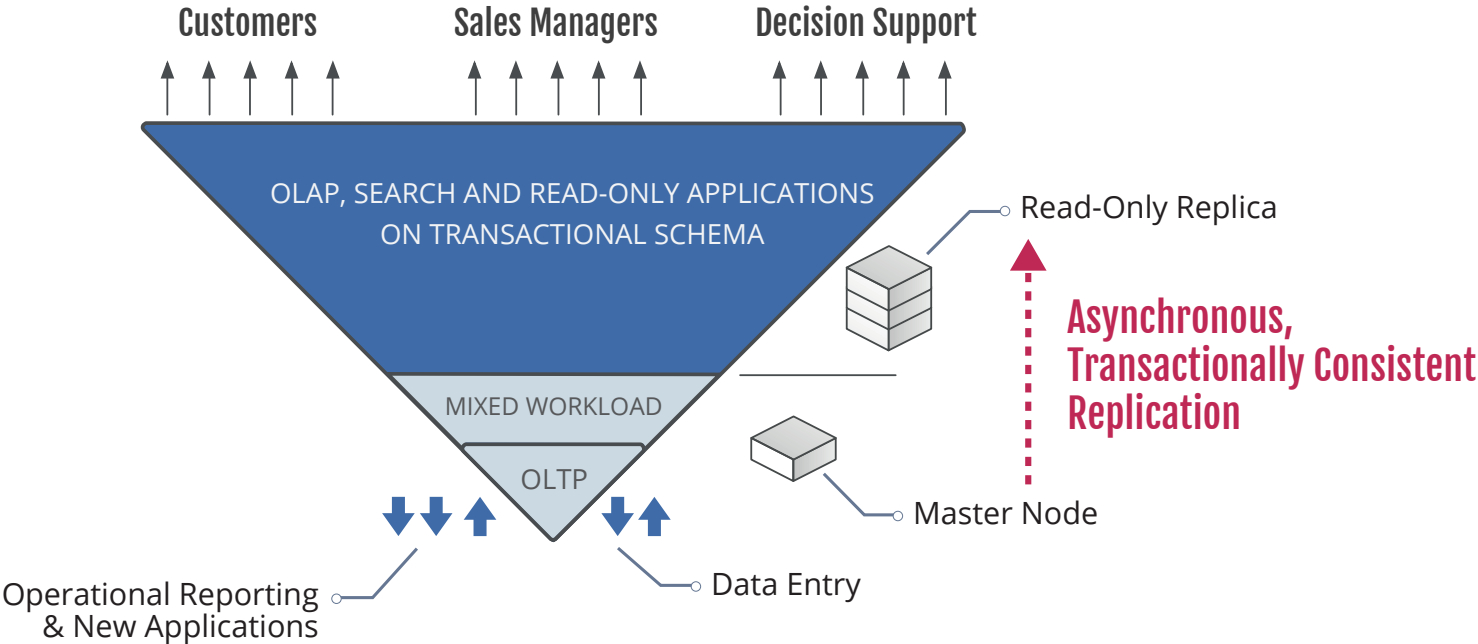|  | America | Asia | Europe |  |
|---|---|---|---|---|
| Cars | 9 | 17 | 6 | 32 |
| Bikes | 8 | 8 | 4 | 20 |
| Planes | 18 | 25 | 5 | 48 |
|  | 35 | 50 | 15 | 100% |

3. Plans are done rolling 1,3,5 years. What if your organizational structure changes? All plans are invalid!

Planning 2.0: You need to abstract your revenue structures and apply planning rules to the lowest level of granularity, the line item level!!

# Thank You!

# Read-Only Replication



**Customers**  **Sales Managers**  **Decision Support**

OLAP, SEARCH AND READ-ONLY APPLICATIONS
ON TRANSACTIONAL SCHEMA

Read-Only Replica

**Asynchronous,
Transactionally Consistent
Replication**

MIXED WORKLOAD

OLTP

Master Node

Operational Reporting
& New Applications

Data Entry

# Transparent Aggregate Cache