

Authors Klaus Freyburger
 Peter Lehmann

Introduction to Business Intelligence

- What is Business Intelligence?
- What is „Data Warehouse“?
- What are the benefits and challenges?
- What does „multi-dimensional“ mean?
- What is „OLAP“?
- OLTP versus OLAP
- Business Intelligence tool box



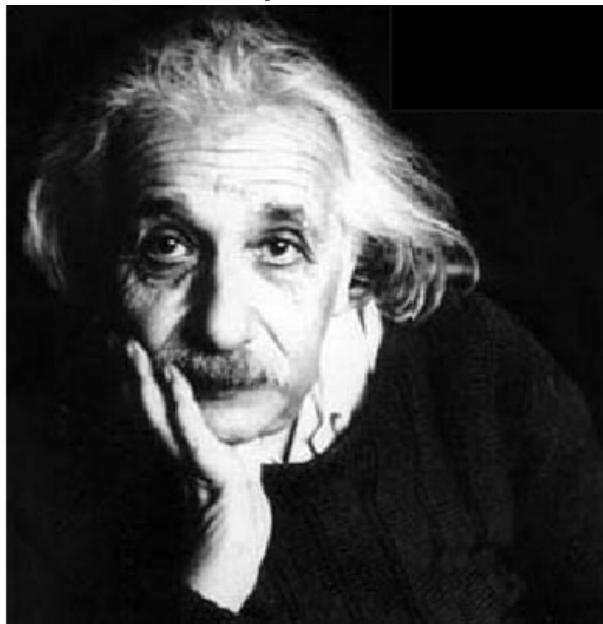
What is Business Intelligence?



- „It is our vision to be the keystone of a US intelligence community that is pre-eminent in the world, known for both the high quality of our work and the excellence of our people.“
- www.cia.org



1. Brain power, power of comprehension, intellectual power



2. Enlightenment, information, news, messages

Jan 43

If it is within FBI jurisdiction, would
not be a good idea to keep a fugitive with
Mr. Albert Einstein, who is now in Brooklyn,
NYC, hospitalized, until he is on his feet?
There are certainly individuals who
think they would benefit from his ~~1-76-77~~
weakness.

RECD BY [initials] B

Albert Einstein, 1,427 pages. An investigation was conducted by the FBI regarding the famous physicist because of his affiliation with the Communist Party. Einstein was a member, sponsor, or affiliated with thirty-four communist fronts between 1937-1954. He also served as honorary chairman for three communist organizations.

What is Intelligence?

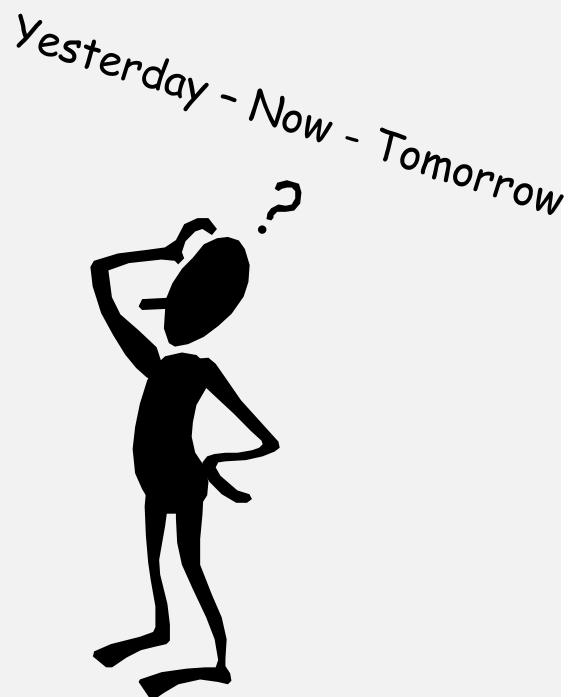
Definition:

1. The ability to learn or understand or deal with new and trying situations
2. The ability to apply knowledge to manipulate one's environment

Source: *Merriam-Webster's Online Dictionary*

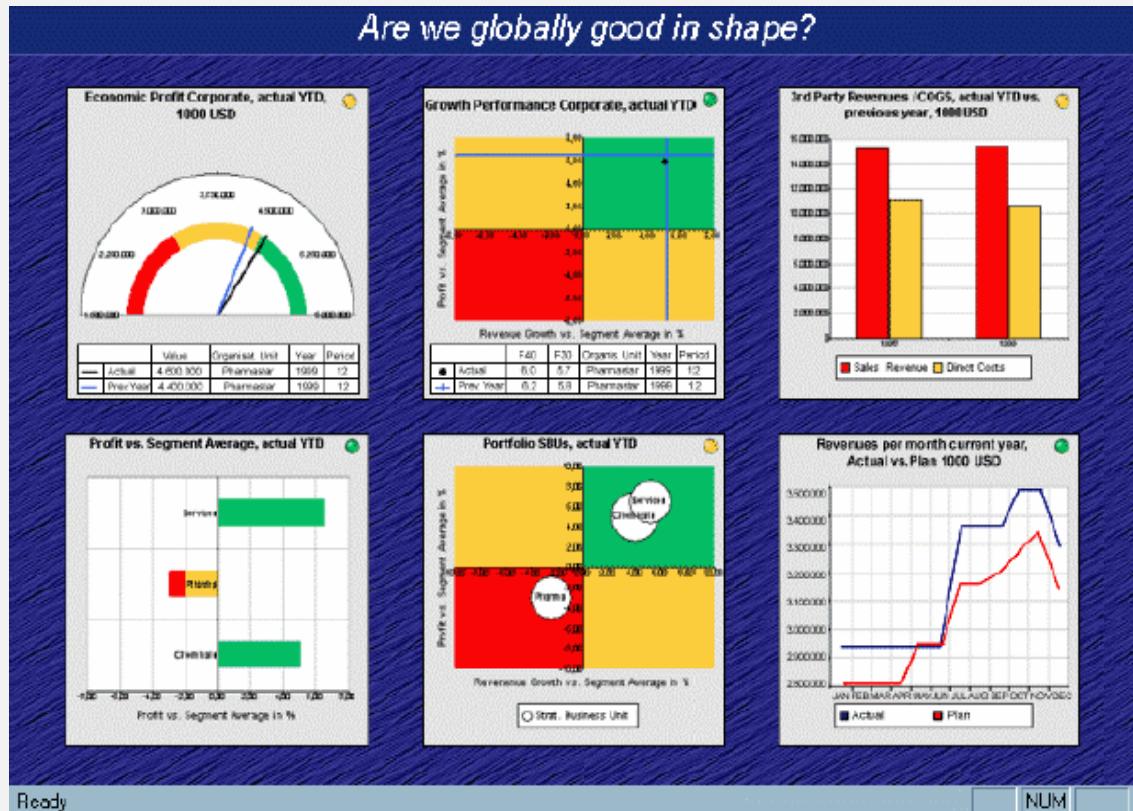


- What is the current status of the business?
 - What's going well?
 - What needs improvement?
- What are the business' strengths and weaknesses?
- Are there opportunities for innovation or competitive advantage?
- How do we improve our decision making?

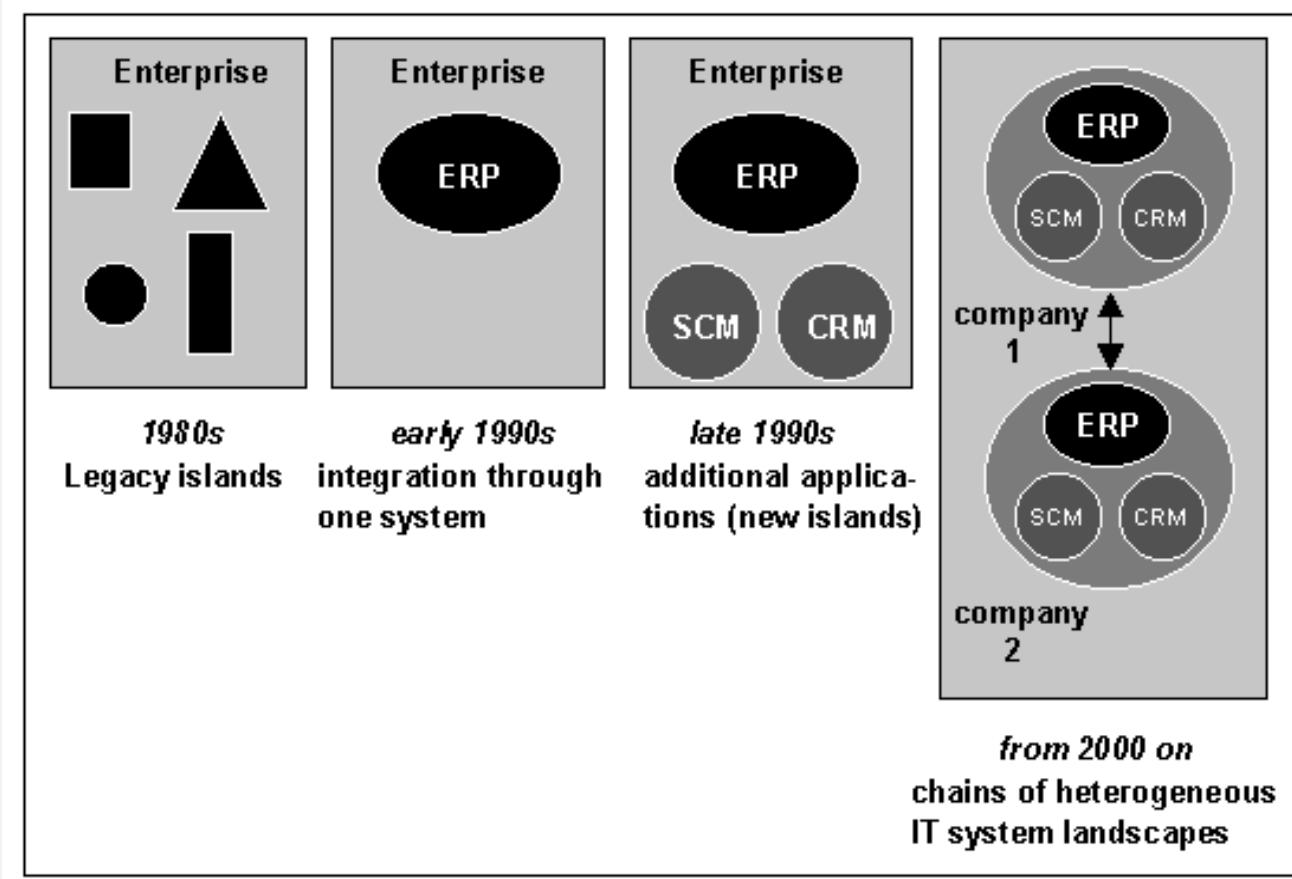


Main Objective of Business Intelligence

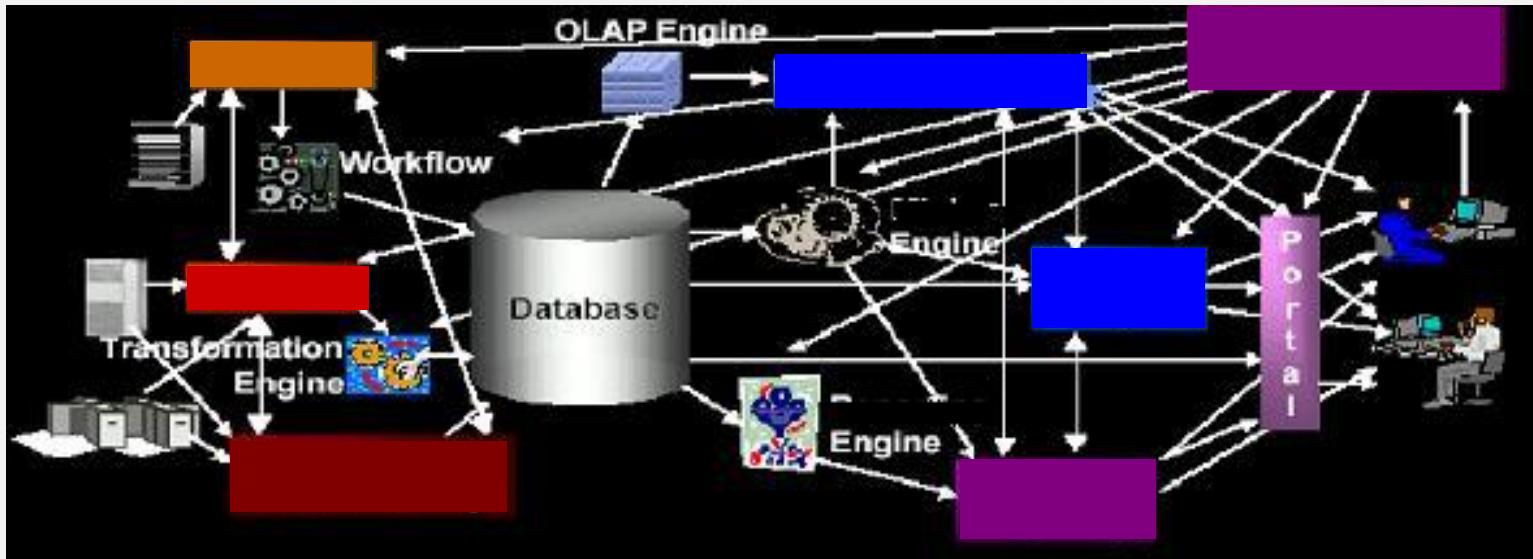
- Support intelligence (e.g., knowledge of status)



- ERP Systems

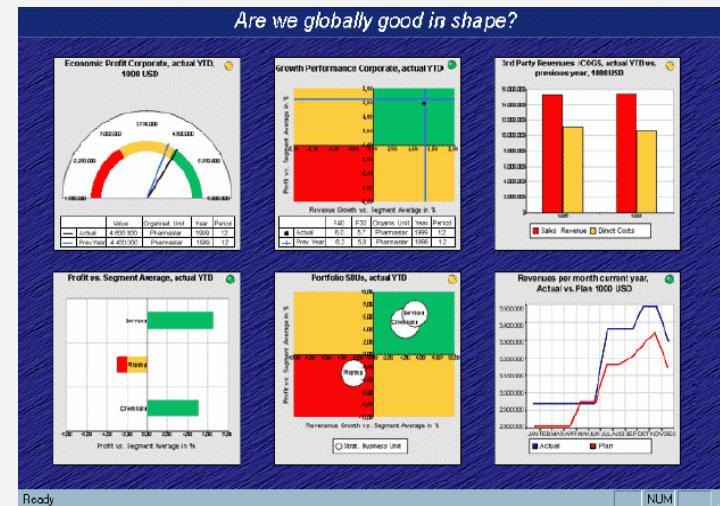
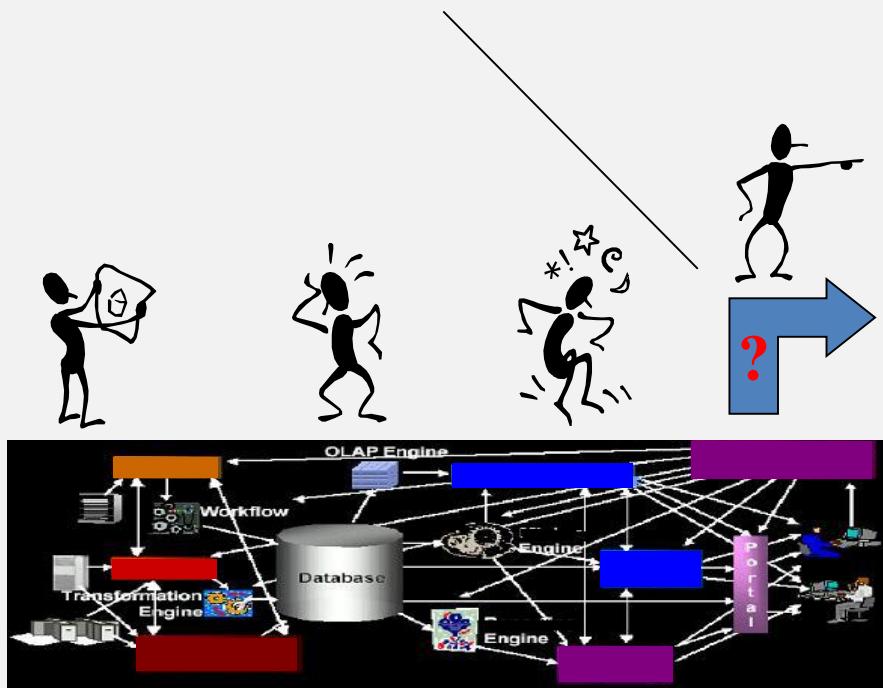


Information Systems in a Company!?



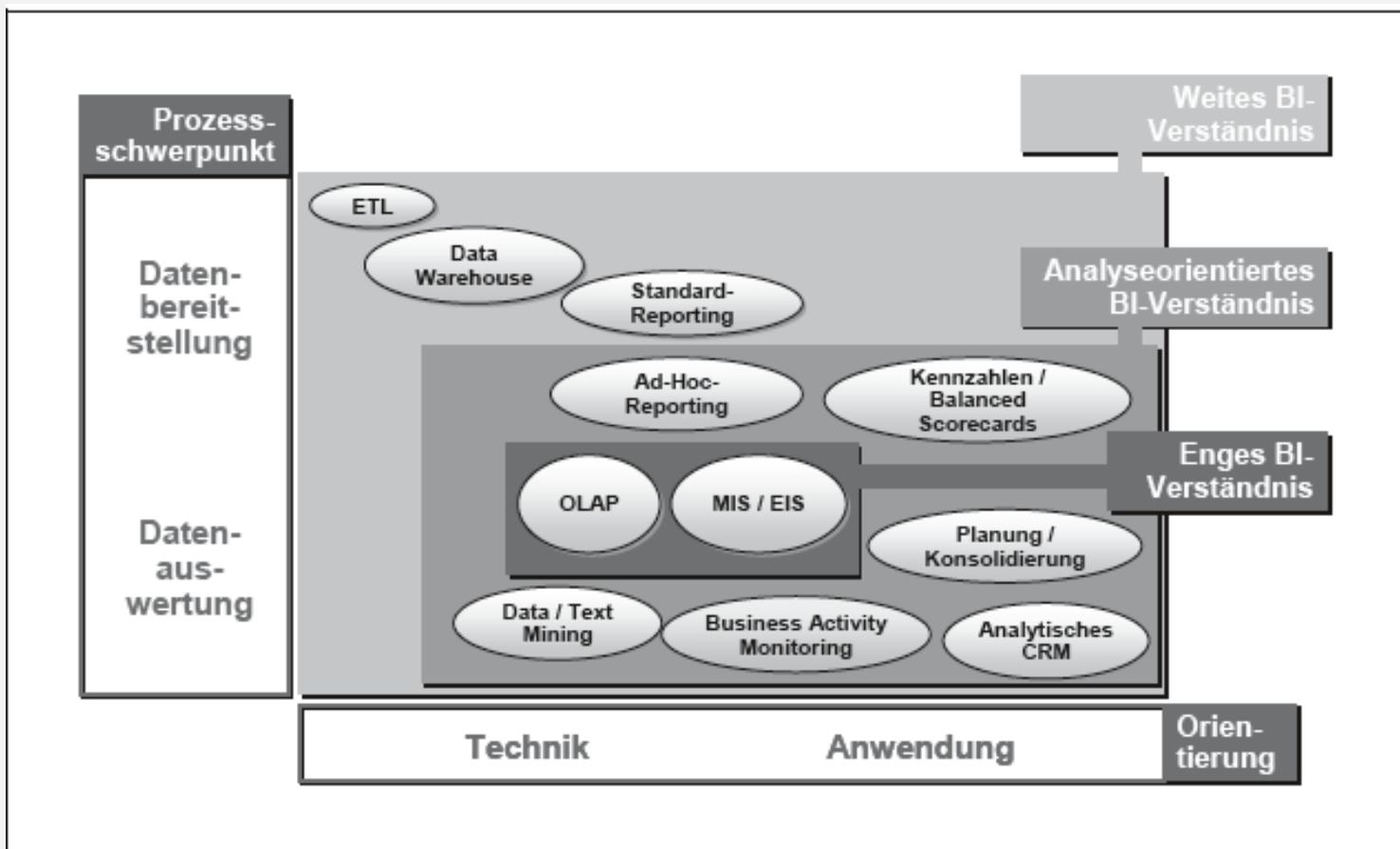
Definition: „Business Intelligence“

- „Business Intelligence“ covers **strategies, processes and technologies** in order to achieve knowledge about status, potentials and perspectives of a company out of heterogeneous and distributed data.



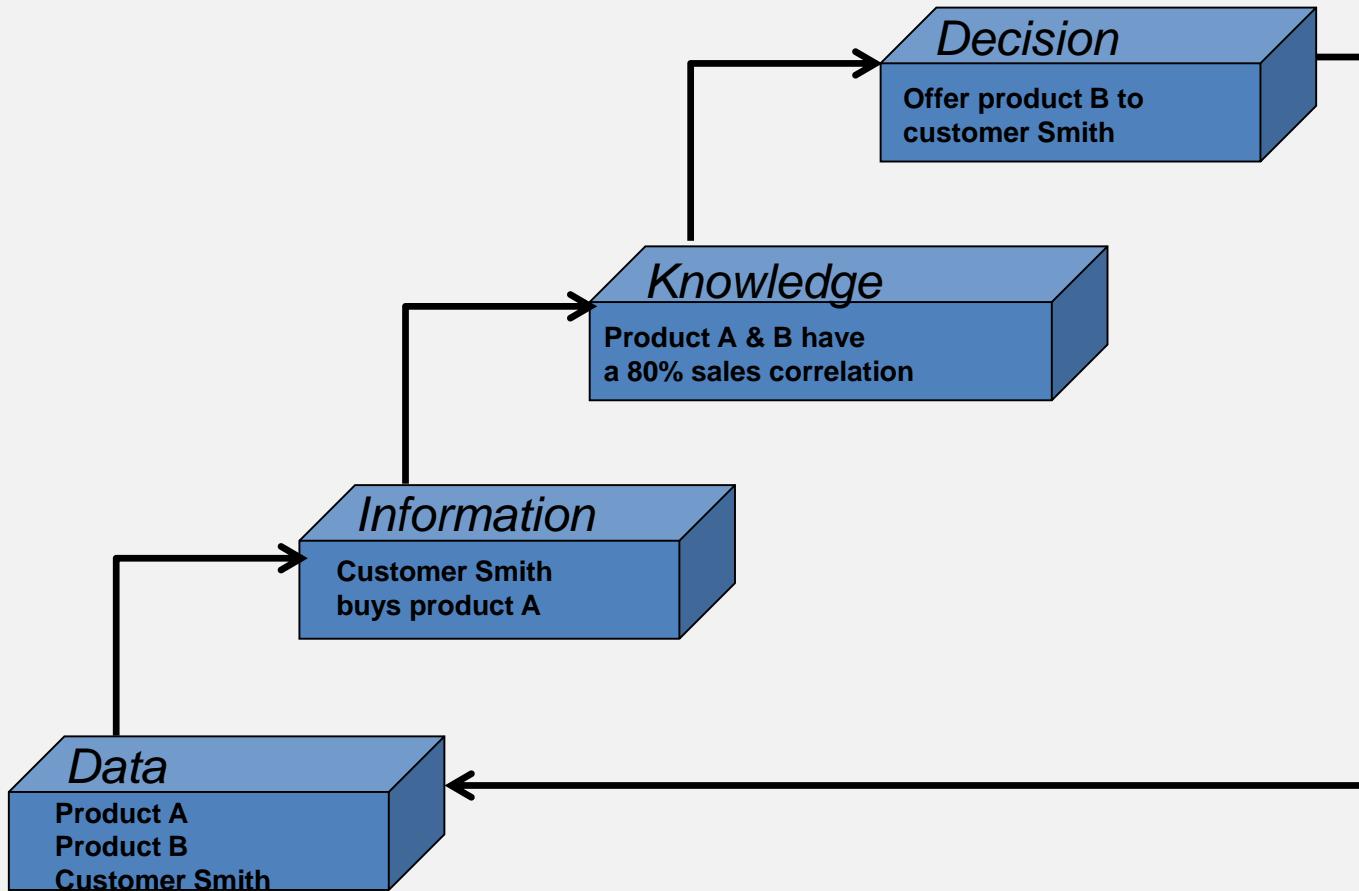
- BI als Fortsetzung der Daten- und Informationsverarbeitung: IV für die Unternehmensleitung
- BI als Filter in der Informationsflut: Informationslogistik
- BI = MIS, aber besonders schnelle/flexible Auswertungen
- BI als Frühwarnsystem („Alerting“)
- BI = Data Warehouse
- BI als Informations- und Wissensspeicherung
- BI als Prozess: Symptomerhebung → Diagnose → Therapie → Prognose → Therapiekontrolle

Quelle: Mertens, P. (2002), Business Intelligence – ein Überblick

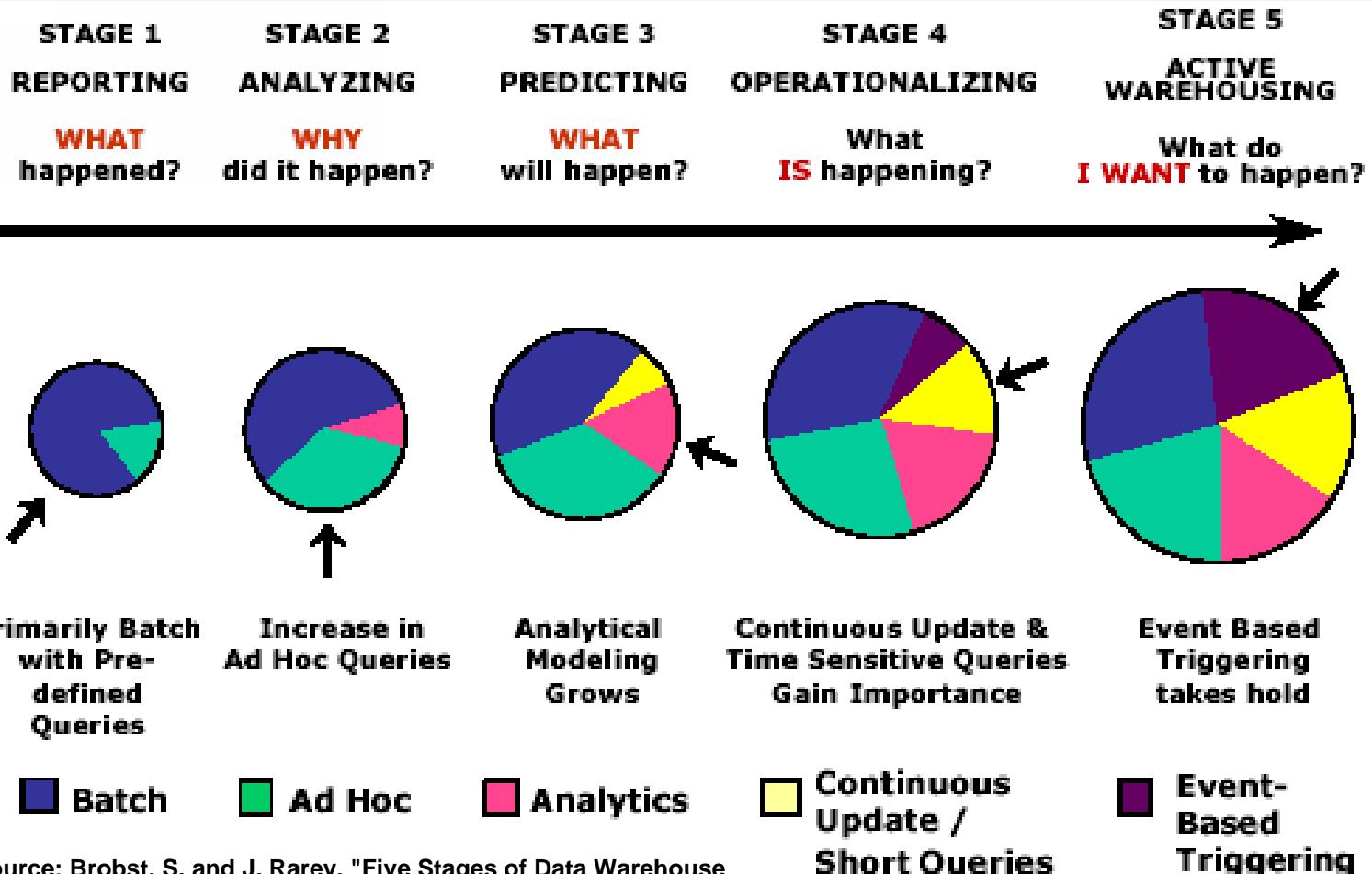


Quelle: Gluchowski, Gabriel, Dittmar (2008): Management Support Systeme und Business Intelligence

Business Intelligence Turns Data into Knowledge



Business Intelligence Stages



Source: Brobst, S. and J. Rarey, "Five Stages of Data Warehouse Decision Support Evolution", DSSResources.COM, 01/06/2003

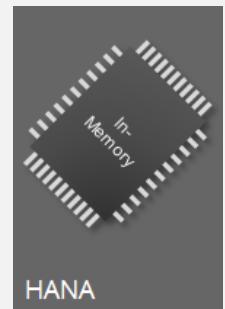
- Speed, speed, speed...

| ID | Name | Salary |
|----|----------------|--------|
| 1 | Ludwig Langsam | 45000 |
| 2 | Frieder Flink | 56000 |
| 3 | Susi Schlau | 63000 |



1,2,3;
Ludwig Langsam, Frieder Flink, Susi Schlau;
45000, 56000; 63000;

- Performancevorteile bei analytischen Szenarien mit Aggregationen über große Datenmengen
- Reduktion der Komplexität (Aggregate, Datenmodell)
- Beispiele:



In Memory

Hardware

- Mehr Memory für weniger Geld, 64bit OS
- Parallelisierung durch Multicore CPUs / GPUs

Spaltenorientierte
DBs

- Datenkompression
- Partitionierung
- Aggregationen *on the fly*

**Gesamte DB
im Memory
„In Memory
Analytics“**

SAP: HANA

Palo: In Memory MOLAP mit GPU

Erweiterung → Planungsszenarien

Jasperserver: In Memory OLAP

“By 2014, 30% of analytic applications will use in-memory functions to add scale and computational speed”
(Gartner 01/2011)

No SQL und Big Data



Web 2.0 / Social Media generieren große Datenmengen, mit RDBMS nicht mehr verarbeitbar
→ Neue Technologien zur Speicherung und Verarbeitung mit Standard HW
→ Hadoop, Google bigtable



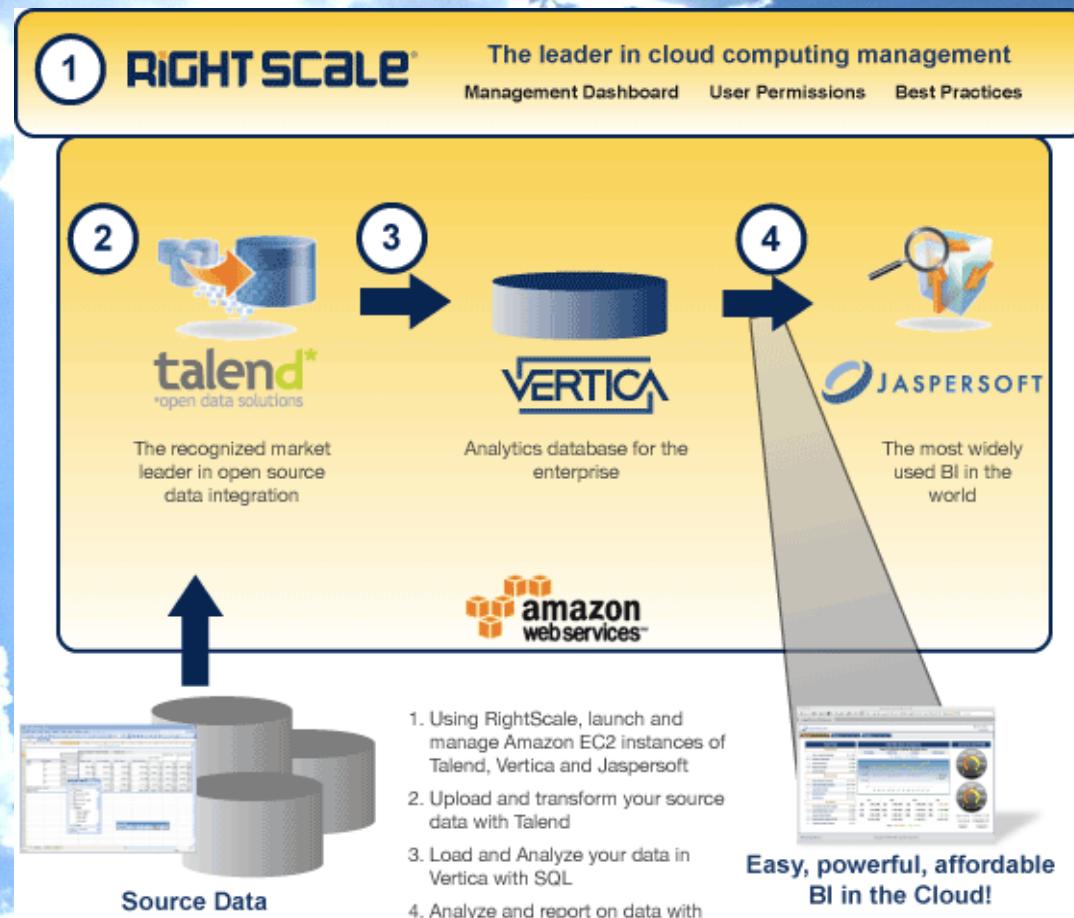
Adapter & Komponenten für No SQL- und Big Data-Quellen in ETL-Schicht (Pentaho & Jaspersoft)

- BI On-Demand = gehostete Version

- SAP
- Microsoft
- Jaspersoft
-

- ▶ Cloud OSBI = OSBI Distribution, die in der Cloud (z.B. Amazon EC2) deployed wird

- ▶ Szenarien
 - Prototyping
 - Projekte
 - Daten sind bereits im Web



“By 2013, 33% of BI functionality will be consumed via handheld devices.”
(Gartner 01/2011)

→ Jeder BI-Anbieter benötigt Mobile BI Angebot





- Von Gartner als sehr wichtiges Kriterium eingestuft
- Fachabteilung „kann nicht warten“
- Übergang zu „IT-governed“?



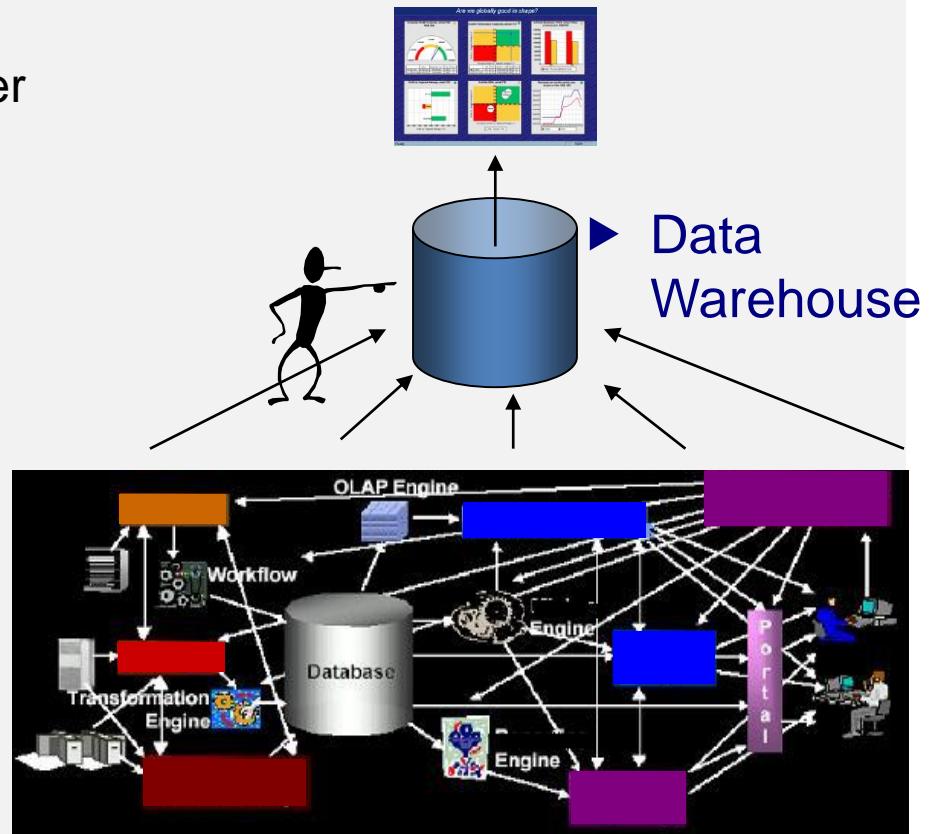
Quelle der Bilder: <https://www.jaspersoft.com/self-service-business-intelligence>, <http://www.birst.com/product>

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- What does „multi-dimensional“ mean?
- What is „OLAP“?
- OLTP versus OLAP
- Business Intelligence tool box

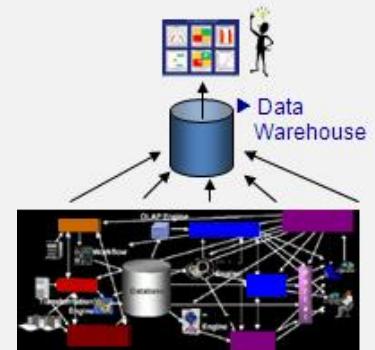


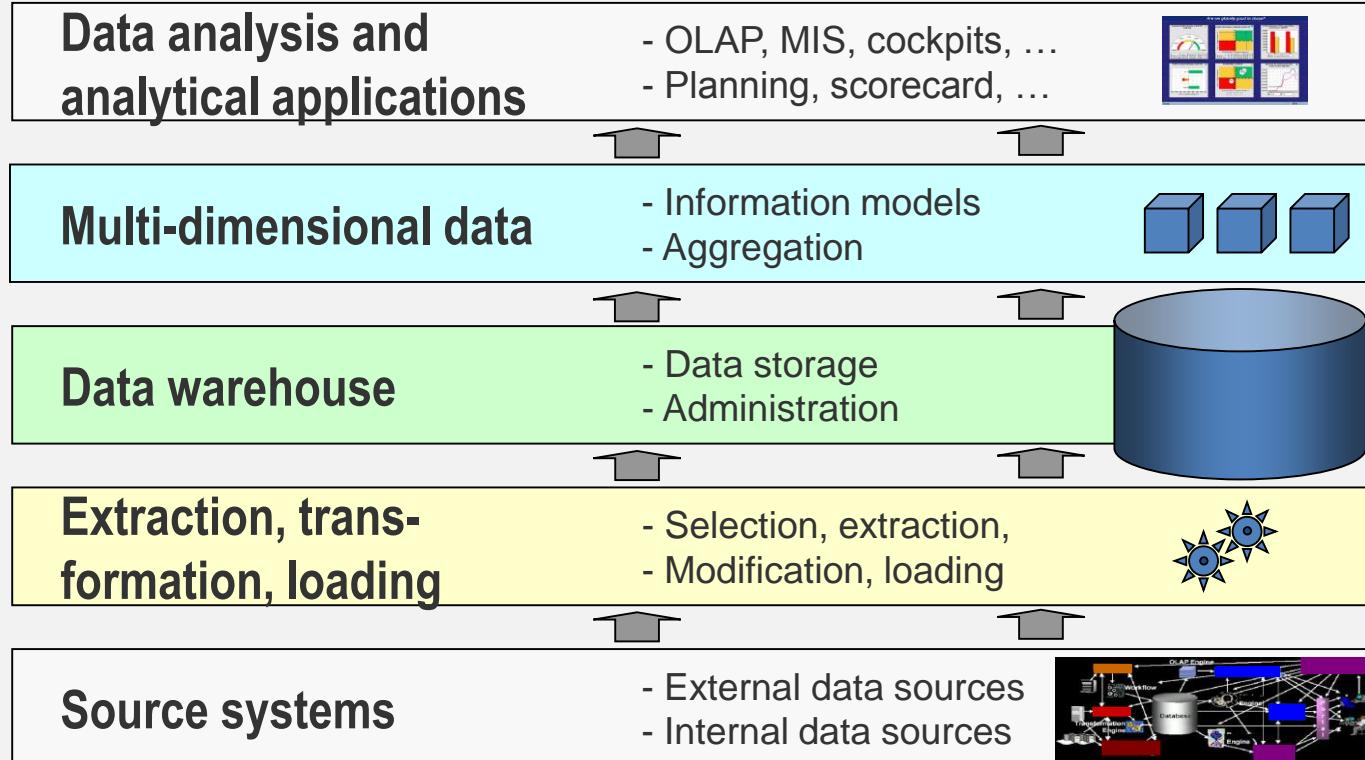
What is a Data Warehouse?

- A **data warehouse** is the most common data architecture for business intelligence.
- A data warehouse is a specific company-wide data pool in order to support decision makers.
 - Top management
 - Mid and lower management
 - Planners, controllers, ...
 - ...



- "A Data Warehouse is a subject-oriented, integrated, time-variant and nonvolatile collection of data in order to support management decisions," Bill Inmon (1996).
 - **Subject-oriented**
 - The organization of data is guided by the view of decision makers on specific areas of business.
 - **Integrated**
 - The Data Warehouse contains data from different internal and external sources. Important is the high quality of data, i.e., its correctness and consistency.
 - **Time-oriented**
 - Data in a Data Warehouse has a time dimension, i.e. all data values and their changes in time can be compared and analyzed along the time axis.
 - **Nonvolatile**
 - As opposed to operational databases, data are stored persistently in a Data Warehouse. Access is by reading the data; analysis does not change the data.





Business Intelligence Platforms – 2008



Source: Gartner 2008

As of January 2008

Business Intelligence Platforms – 2015



Source: Gartner 2015

Business Intelligence Platforms – 2016

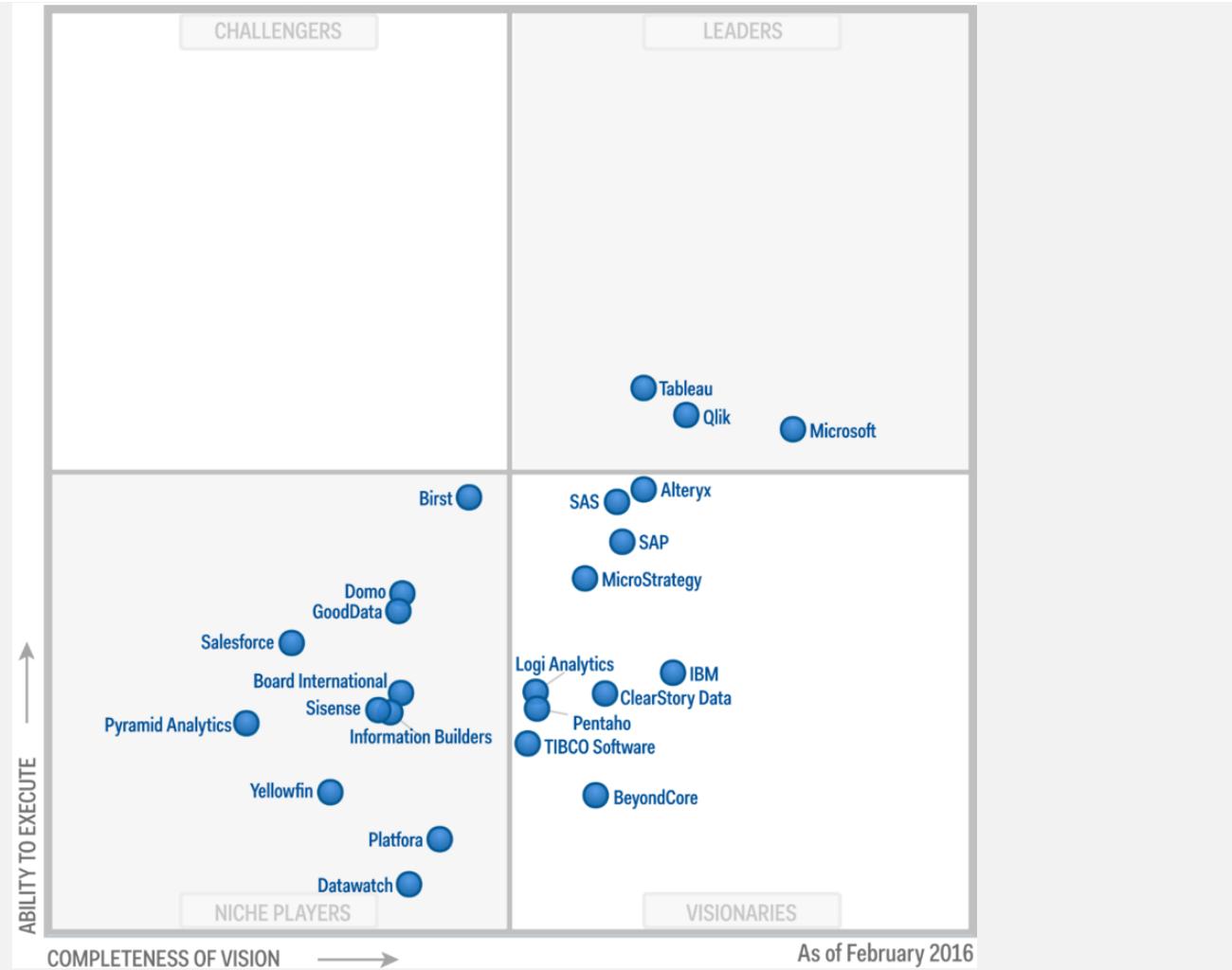
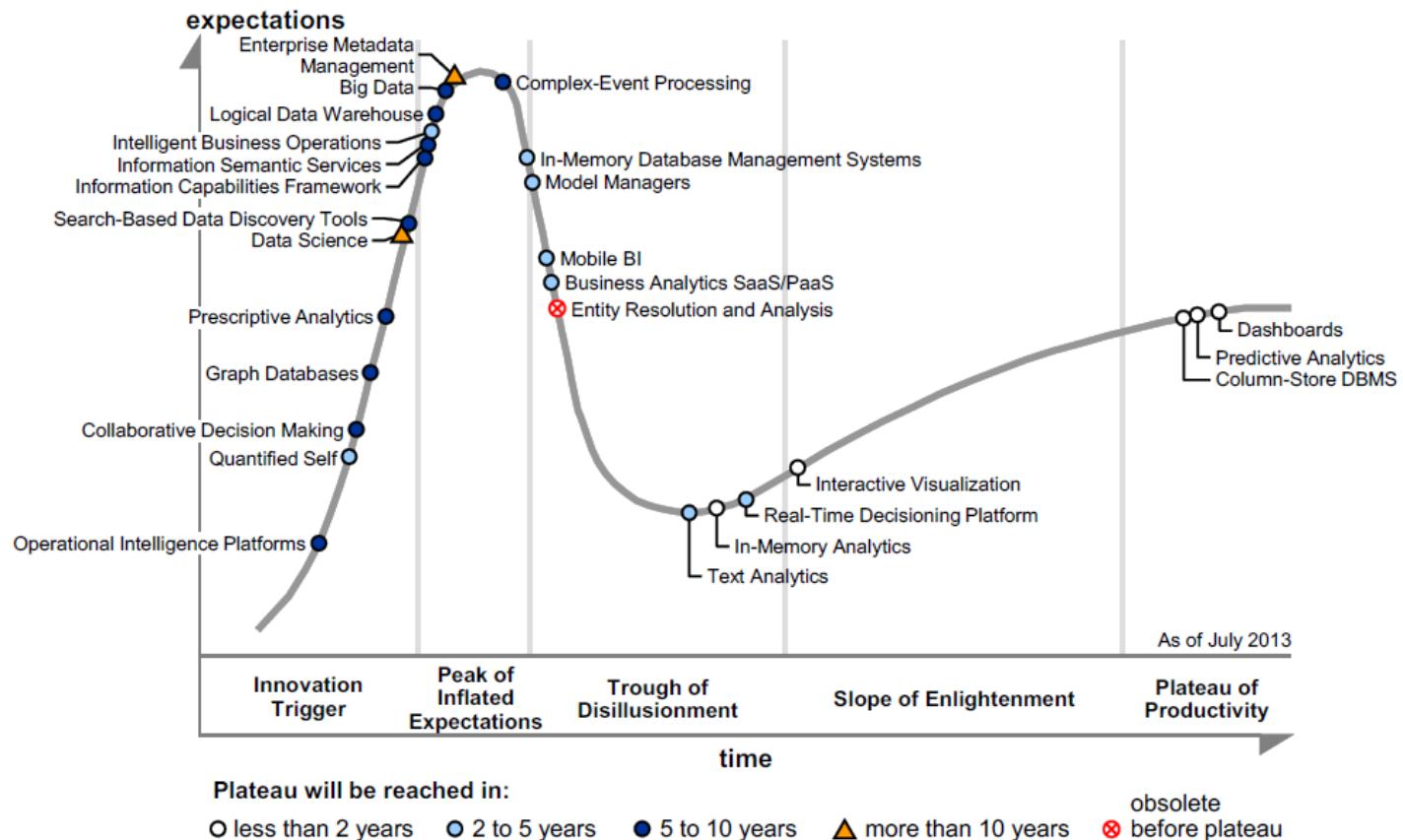
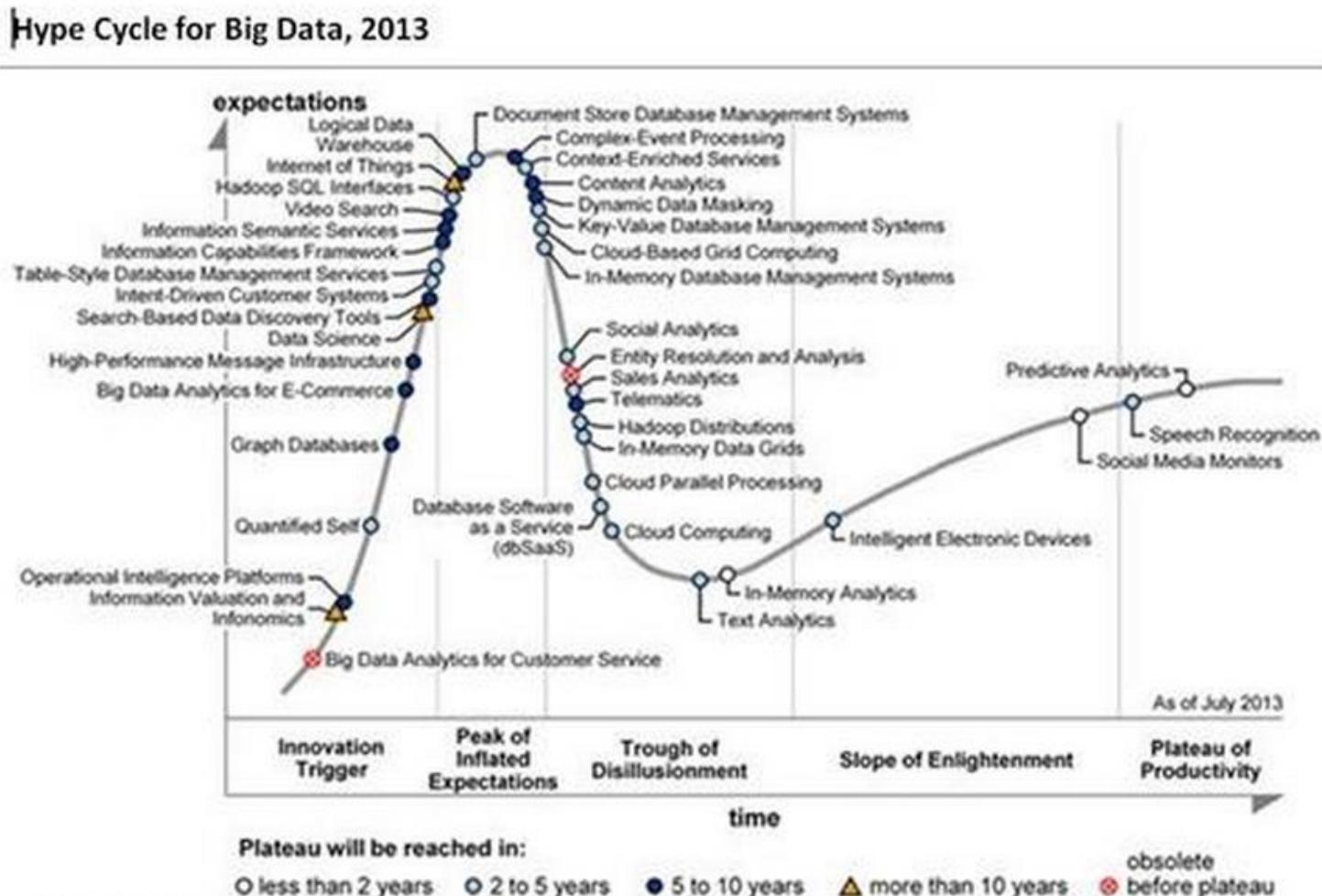


Figure 1. Hype Cycle for Business Intelligence and Analytics, 2013



BI = business intelligence; DBMS = database management system; SaaS = software as a service; PaaS = platform as a service



Source: Gartner

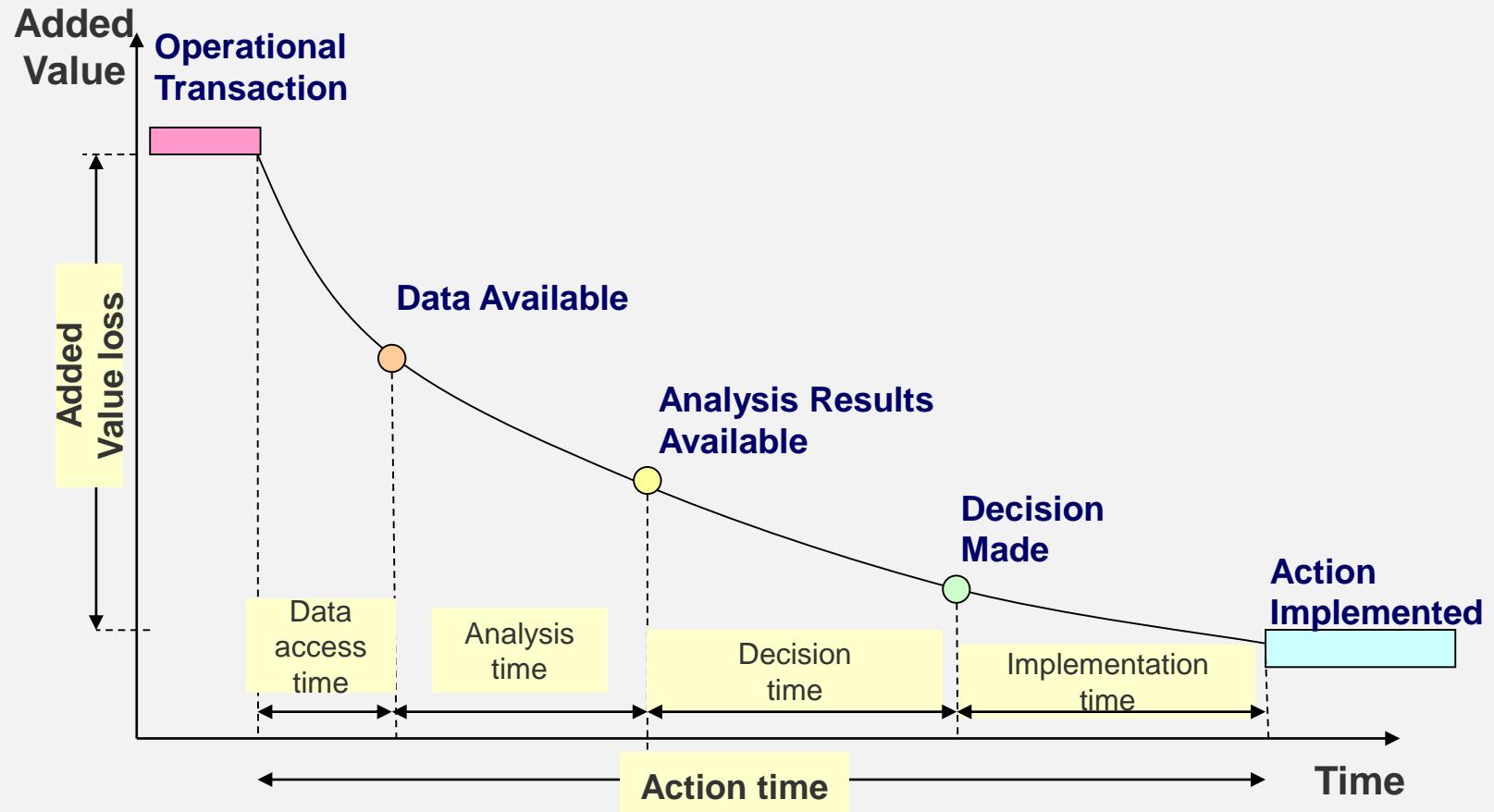
| Rang | Firma | Software-Umsatz 2011 (in Mio. Euro) | Veränderung zu 2010 | Marktanteil in Prozent |
|------|----------------------------|--|------------------------|---------------------------|
| 1 | SAP | 171 | 8% | 16,0% |
| 2 | Oracle | 140 | 6% | 13,0% |
| 3 | IBM | 135 | 14% | 13,0% |
| 4 | SAS | 115 | 8% | 11,0% |
| 5 | Microsoft | 83 | 14% | 7,8% |
| 6 | Informatica | 43 | 5% | 4,0% |
| 7 | QlikTech | 36 | 40% | 3,3% |
| 8 | MicroStrategy | 33 | 25% | 3,1% |
| 9 | Teradata | 29 | -8% | 2,7% |
| 10 | Software AG/ IDS Scheer | 17 | 6% | 1,6% |

Source: BARC 2012

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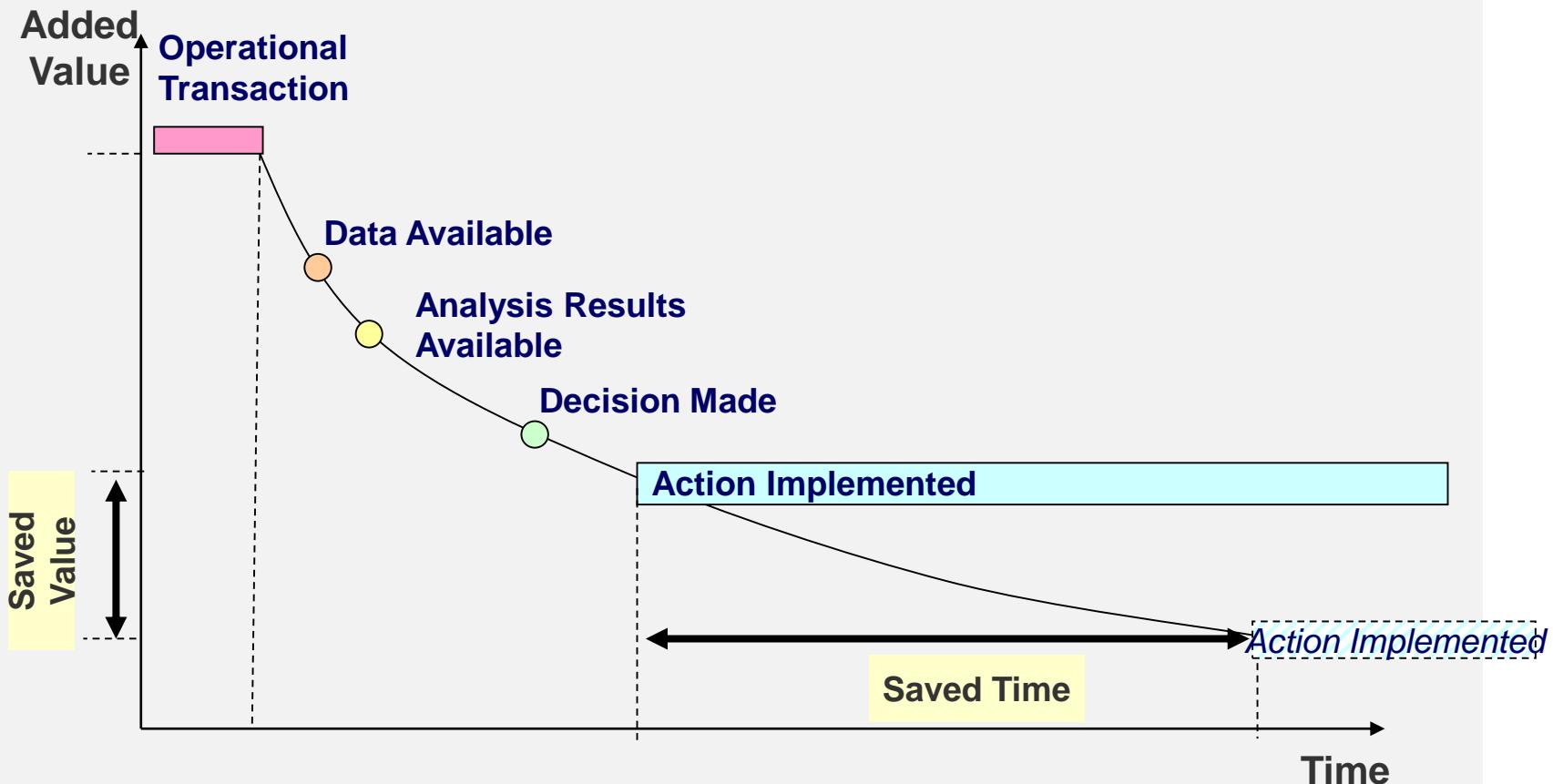


Benefit: Reduce Action Time



Source: Hackathorn, R.: Minimizing Action Distance (2003), <http://www.tdan.com/view-articles/5132/>

Benefit: Reduce Action Time to Nearly Real Time



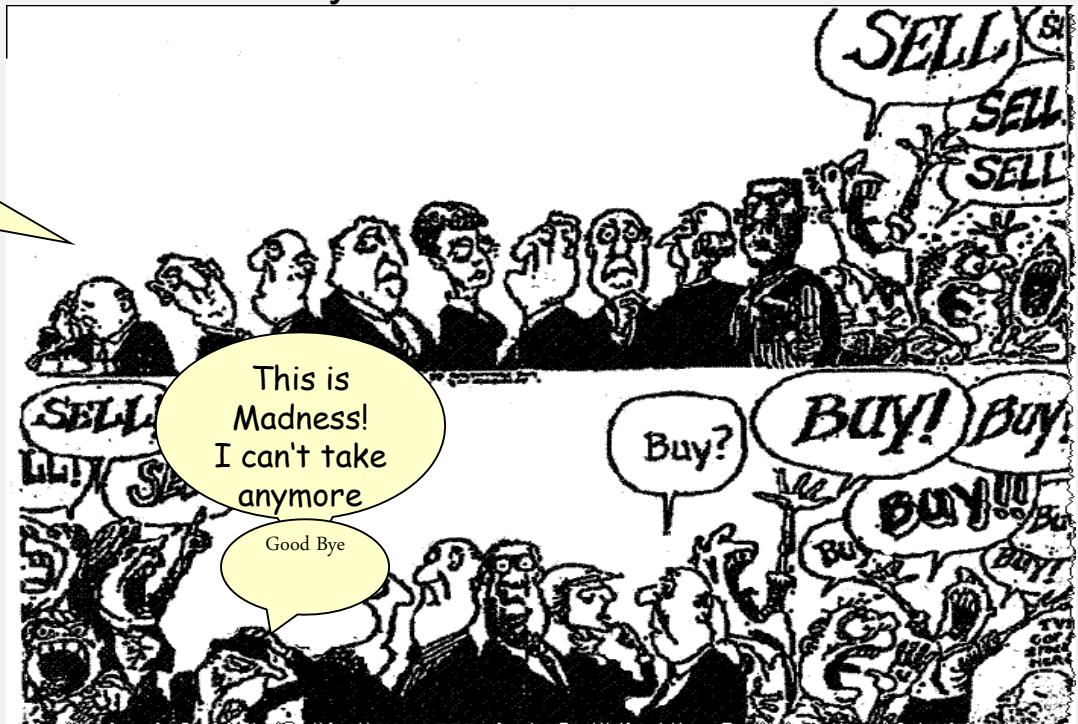
- Increased
 - Information quality by a „single version of the truth“
 - Competitive ability
 - Customer satisfaction
 - Inter-company and inter-department collaboration
 - Alignment with business strategy
- Compliance with financial reporting regulations
 - Risk management
 - Financial consolidation
 - Corporate planning and forecasting
 - SOX (US), BASEL II (European Community), etc.
 - ...

- Data Quality
 - Precise
 - Subject-oriented
 - Complete
 - Accessable
 - Flexibility
 - Security and authorisation
 - Time dependencies

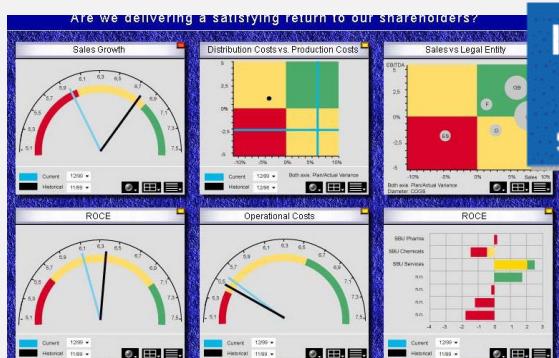
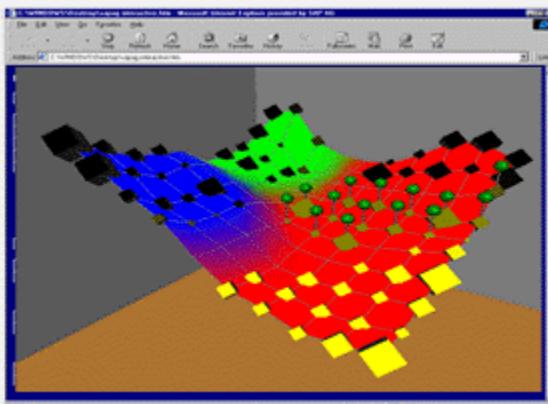
- Business Terms – What do you mean?
 - „What is our revenue“?
 - „95% of our trains arrive just in time!“
 - “How many students will certainly finish?”

- ...

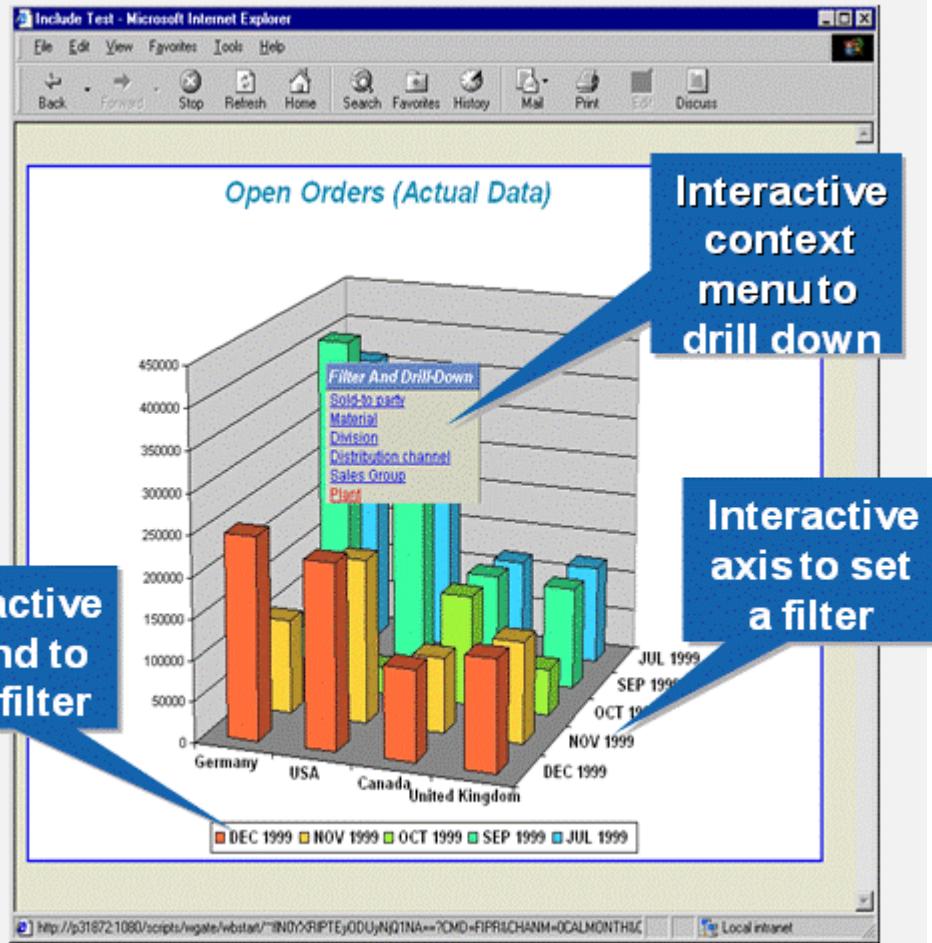
I have a
stock here
that could
really
excel !



- Tools – easy to use?



Interactive
legend to
set a filter



- Others
 - No clear project scope
 - No management project support
 - No appropriated IT infrastructure
 - Inadequate staff qualification
 - Lack of end user acceptance
 - ...

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A material number?

A telephone number?

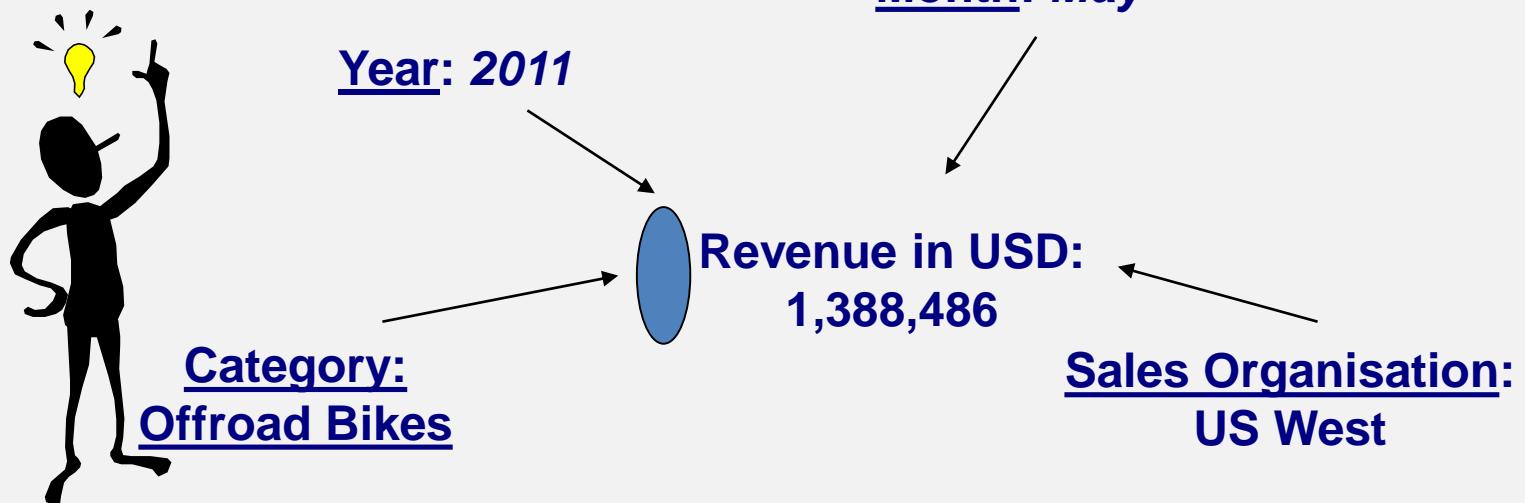
Revenue in September 2007?

My boss' salary?



- A key figure without a relationship to any **object** makes no sense!

- US West had 1,388,486 USD revenue in May 2011 by selling Offroad Bikes



Multi-dimensional means a key figure always relates to one or more objects.

- **Key figure:** Revenue

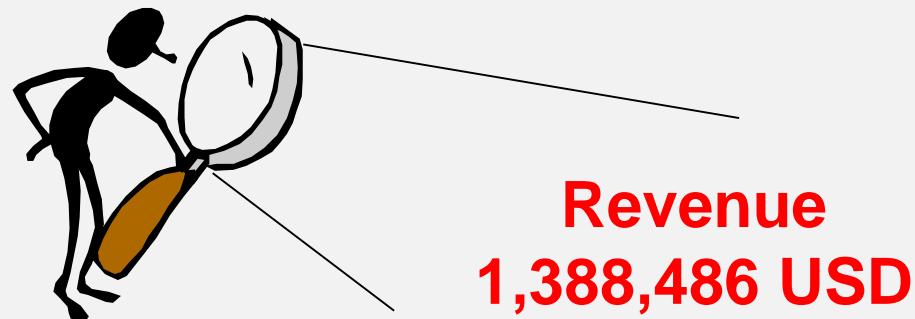
- **Object:**

| | | Values |
|----------------------|---|---------------|
| - Month | → | May |
| - Year | → | 2011 |
| - Sales Organisation | → | US West |
| - Product Category | → | Offroad Bike |

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On-line Analytical Processing is a software technology which allows end-user driven, fast and interactive data analysis.



**Revenue
1,388,486 USD**

Excel PivotTable

| YEAR | MONTH | DAY | CUSTOMER | CUSTOMERDESCR | CITY | Country | Product | ProductDescr | SalesUnit | Revenue | Currency | Discount |
|------|-------|-----|----------|----------------|--------|---------|----------|-------------------|-----------|---------|----------|----------|
| 2011 | 6 | 30 | 5000 | Beantown Bikes | Boston | US | CAGE1000 | Water Bottle Cage | 5 ST | 95,5 | USD | 4,78 |
| 2011 | 6 | 30 | 5000 | Beantown Bikes | Boston | US | RKIT1000 | Repair Kit | 1 ST | 33,96 | USD | 1,7 |
| 2011 | 6 | 30 | 5000 | Beantown Bikes | Boston | US | PUMP1000 | Air Pump | 8 ST | 237,76 | USD | 11,89 |
| 2011 | 6 | 30 | 5000 | Beantown Bikes | Boston | US | BOTL1000 | Water Bottle | 1 ST | 21,23 | USD | 1,06 |
| | | | | | | | | | 1 ST | 3184,09 | USD | 95,52 |
| | | | | | | | | | 1 ST | 3396,36 | USD | 101,89 |
| | | | | | | | | | 1 ST | 2547,27 | USD | 76,42 |

- „What is the revenue in each country in 2011?“

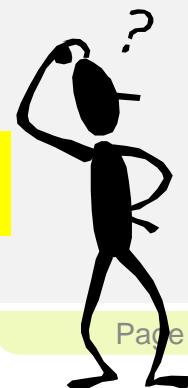


| | | | | | | | | | | | | |
|------|---|----|-------|---------------|------------|----|----------|---------------------|------|---------|-----|--------|
| 2011 | 6 | 30 | 9000 | SoCal Bikes | Irvine | US | ORWN1100 | Women's Off Road | 1 ST | 2653,41 | USD | 79,6 |
| 2011 | 6 | 30 | 9000 | SoCal Bikes | Irvine | US | ORHT1120 | Men's Off Road Bike | 2 ST | 3608,64 | USD | 108,26 |
| 2011 | 6 | 30 | 9000 | SoCal Bikes | Irvine | US | RAAL1120 | Road Bike Alu SRAM | 1 ST | 1751,25 | USD | 52,54 |
| 2011 | 6 | 30 | 9000 | SoCal Bikes | Irvine | US | RACA1110 | Road Bike Carbon S | 1 ST | 4245,45 | USD | 127,36 |
| 2011 | 6 | 30 | 9000 | SoCal Bikes | Irvine | US | SHRT1000 | T-shirt | 1 ST | 31,84 | USD | 0,96 |
| 2011 | 6 | 30 | 9000 | SoCal Bikes | Irvine | US | CAGE1000 | Water Bottle Cage | 2 ST | 38,2 | USD | 1,15 |
| 2011 | 6 | 30 | 9000 | SoCal Bikes | Irvine | US | PUMP1000 | Air Pump | 2 ST | 59,44 | USD | 1,78 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | DXTR1100 | Deluxe Touring Bike | 1 ST | 2601,19 | EUR | 78,04 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | DXTR2100 | Deluxe Touring Bike | 2 ST | 5202,38 | EUR | 156,07 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | PRTR2100 | Professional Tourin | 1 ST | 2774,6 | EUR | 83,24 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | PRTR3100 | Professional Tourin | 1 ST | 2774,6 | EUR | 83,24 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | ORMN1100 | Men's Off Road Bike | 2 ST | 4161,9 | EUR | 124,86 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | ORWN1100 | Women's Off Road | 1 ST | 2167,66 | EUR | 65,03 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | ORHT1110 | Men's Off Road Bike | 2 ST | 2774,6 | EUR | 83,24 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | RAAL1110 | Road Bike Alu Shim | 2 ST | 2948,02 | EUR | 88,44 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | RAAL1120 | Road Bike Alu SRAM | 1 ST | 1430,65 | EUR | 42,92 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | RACA1110 | Road Bike Carbon S | 2 ST | 6936,5 | EUR | 208,1 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | OHMT1000 | Off Road Helmet | 1 ST | 43,35 | EUR | 1,3 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | CAGE1000 | Water Bottle Cage | 1 ST | 15,61 | EUR | 0,47 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | PUMP1000 | Air Pump | 4 ST | 97,12 | EUR | 2,91 |
| 2011 | 6 | 30 | 17000 | Cruiser Bikes | Hannover | DE | FAID1000 | First Aid Kit | 1 ST | 34,68 | EUR | 1,04 |
| 2011 | 6 | 30 | 20000 | Neckarrad | Heidelberg | DE | DXTR1100 | Deluxe Touring Bike | 1 ST | 2601,19 | EUR | 78,04 |
| 2011 | 6 | 30 | 20000 | Neckarrad | Heidelberg | DE | DXTR2100 | Deluxe Touring Bike | 1 ST | 2601,19 | EUR | 78,04 |
| 2011 | 6 | 30 | 20000 | Neckarrad | Heidelberg | DE | PRTR3100 | Professional Tourin | 1 ST | 2774,6 | EUR | 83,24 |
| 2011 | 6 | 30 | 20000 | Neckarrad | Heidelberg | DE | ORMN1100 | Men's Off Road Bike | 4 ST | 8323,8 | EUR | 249,71 |



| YEAR | 2011 | |
|-----------------------|------------------------|-------------------------|
| Summe Revenue | Spaltenbeschriftungen | |
| Zeilenbeschriftungen | DE | US |
| E-Bikes | 1.484.411,00 € | |
| Offroad Bikes | 7.529.578,22 € | \$ 6.227.974,32 |
| Road Bikes | 7.355.858,41 € | \$ 6.720.395,00 |
| Touring Bikes | 9.468.673,58 € | \$ 8.314.080,09 |
| Trend Bikes | 59.567,11 € | \$ 40.438,07 |
| Gesamtergebnis | 25.898.088,32 € | \$ 21.302.887,48 |

- ▶ „What is the revenue in each country per month?“



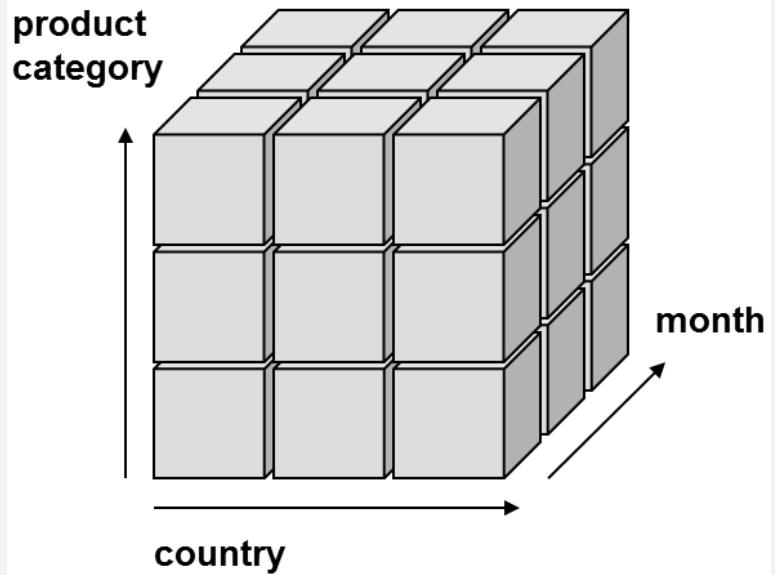
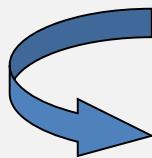
Pivot Table (2)

| | | |
|----------------------|-----------------------|---------------|
| YEAR | 2011 | |
| Month | March | |
| Summe Revenue | Spaltenbeschriftungen | |
| Zeilenbeschriftungen | DE | US |
| E-Bikes | 72.833,25 € | |
| Offroad Bikes | 400.323,18 € | \$ 296.332,65 |
| YEAR | 2011 | |
| Month | February | |
| Summe Revenue | Spaltenbeschriftungen | |
| Zeilenbeschriftungen | DE | US |
| E-Bikes | 48.555,50 € | |
| Offroad Bikes | 279.801,38 € | \$ 173.426,79 |
| YEAR | 2011 | |
| Month | January | |
| Summe Revenue | Spaltenbeschriftungen | |
| Zeilenbeschriftungen | DE | US |
| E-Bikes | 31.214,25 € | |
| Offroad Bikes | 162.834,51 € | \$ 111.549,30 |
| Road Bikes | 120.174,96 € | \$ 98.123,06 |
| Touring Bikes | 194.222,08 € | \$ 128.000,37 |
| Gesamtergebnis | 508.445,80 € | \$ 337.672,73 |



From Table View to a 3-Dimensional Cube

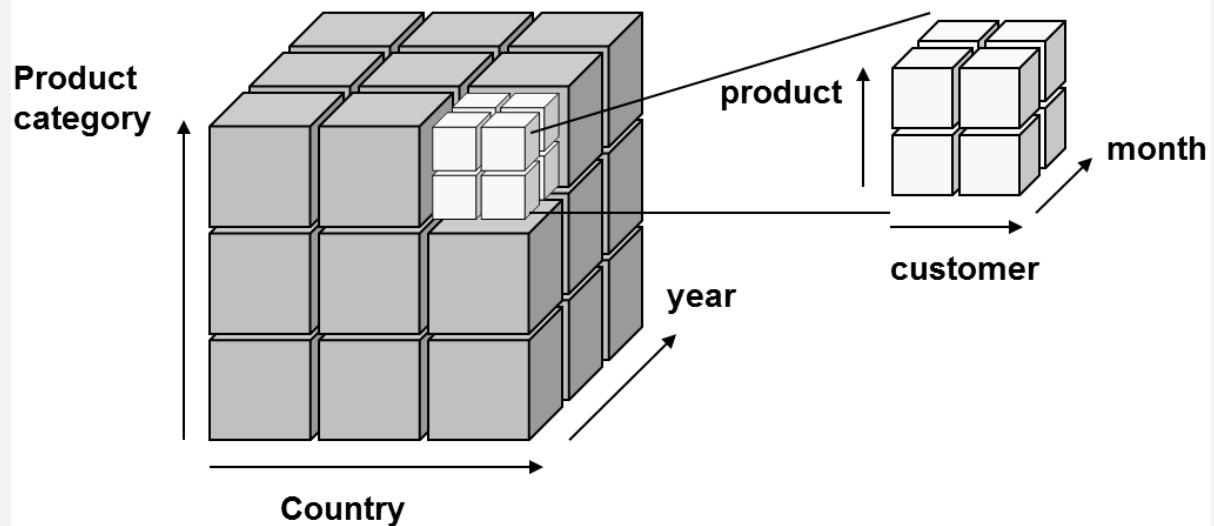
| YEAR | 2011 | |
|----------------------|-----------------------|-----------------------|
| Month | March | |
| Summe Revenue | | Spaltenbeschriftungen |
| Zeilenbeschriftungen | DE | US |
| E-Bikes | 72.833,25 € | |
| Offroad Bikes | 400.323,18 € | \$ 296.332,65 |
| | 369.152,09 € | \$ 241.247,96 |
| | 467.867,14 € | \$ 406.502,01 |
| | 1.310.175,66 € | |
| YEAR | 2011 | |
| Month | February | |
| Summe Revenue | | Spaltenbeschriftungen |
| Zeilenbeschriftungen | DE | US |
| E-Bikes | 48.555,50 € | |
| Offroad Bikes | 279.801,38 € | \$ 173.426,79 |
| | € 160.531,25 | |
| | € 246.660,74 | |
| | € 580.618,78 | |
| YEAR | 2011 | |
| Month | January | |
| Summe Revenue | | Spaltenbeschriftungen |
| Zeilenbeschriftungen | DE | US |
| E-Bikes | 31.214,25 € | |
| Offroad Bikes | 162.834,51 € | \$ 111.549,30 |
| Road Bikes | 120.174,96 € | \$ 98.123,06 |
| Touring Bikes | 194.222,08 € | \$ 128.000,37 |
| Gesamtergebnis | 508.445,80 € | \$ 337.672,73 |



Hierarchies Allow Subcubes in a Cube

- Division → product category → products
- Year → months → day
- Country → sales organisation → customer

Example



From Cube to Report: MS Excel

YEAR 2011

Month March

Summe Revenue Spaltenbeschriftungen

Zeilenbeschriftungen DE US Gesamtergebnis

| | | DE | US | Gesamtergebnis |
|-----------------------|--|-----------------------|----------------------|-------------------|
| E-Bikes | | 72.833,25 € | | 72833,25 |
| Offroad Bikes | | 400.323,18 € | \$ 296.332,65 | 696655,83 |
| Road Bikes | | 369.152,09 € | \$ 241.247,96 | 610400,05 |
| Touring Bikes | | 467.867,14 € | \$ 406.502,01 | 874369,15 |
| Gesamtergebnis | | 1.310.175,66 € | \$ 944.082,62 | 2254258,28 |

Felder auswählen, die dem Bericht

Suchen

Salesdata

YEAR

MONTH

DAY

Customer

CustomerDescr

City

Salesorg

Country

OrderNumber

OrderItem

Product

ProductDescr

Product Category

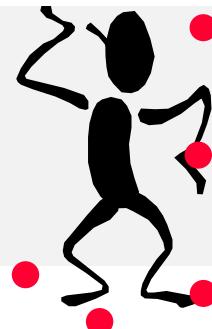
Division

SalesQuantity

UnitOfMeasure

Revenue

Cube





BEx Query Designer - Query: GBI Sales Data for Analysis

Query Edit View Tools Help

InfoProvider: GBI Reporting Master

Key Figures: Cost of Goods M USD, Discount, Net Sales, Revenue, Sales Quantity

Dimensions: Product, Division, Material, Product Category, Customer, Country, Customer, Sales Organization, Data Package, Time, Unit

Free Characteristics: Calendar month, Division, Calendar year

Columns: Country

Area for Dimensions

Rows: Product Category

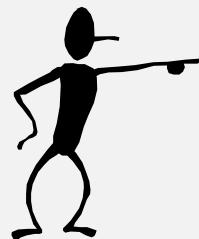
Area for Dimensions

Preview:

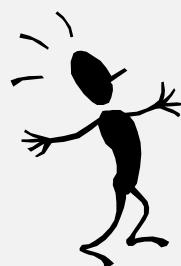
| | a-Country | b-Country |
|-----------|-----------|-----------|
| a-Product | | |
| b-Product | | |

The screenshot shows the SAP BEx Query Designer interface. On the left, the 'InfoProvider' pane displays 'GBI Reporting Master' with sections for 'Key Figures' and 'Dimensions'. The 'Dimensions' section is expanded to show 'Customer', which is highlighted with a red box and labeled 'Cube'. A large red 'X' is drawn over the 'Customer' dimension. In the center, the 'Rows/Columns' pane shows 'Free Characteristics' like 'Calendar month', 'Division', and 'Calendar year', and 'Columns' like 'Country'. A red arrow points from the 'Customer' dimension in the 'InfoProvider' to the 'Rows' section in the 'Rows/Columns' pane. Another red arrow points from the 'Country' characteristic in the 'Free Characteristics' section to the 'Columns' section. On the right, the 'Preview' pane shows a table with columns 'a-Country' and 'b-Country' and rows for 'a-Product' and 'b-Product'. The background of the slide features a light gray gradient.

click

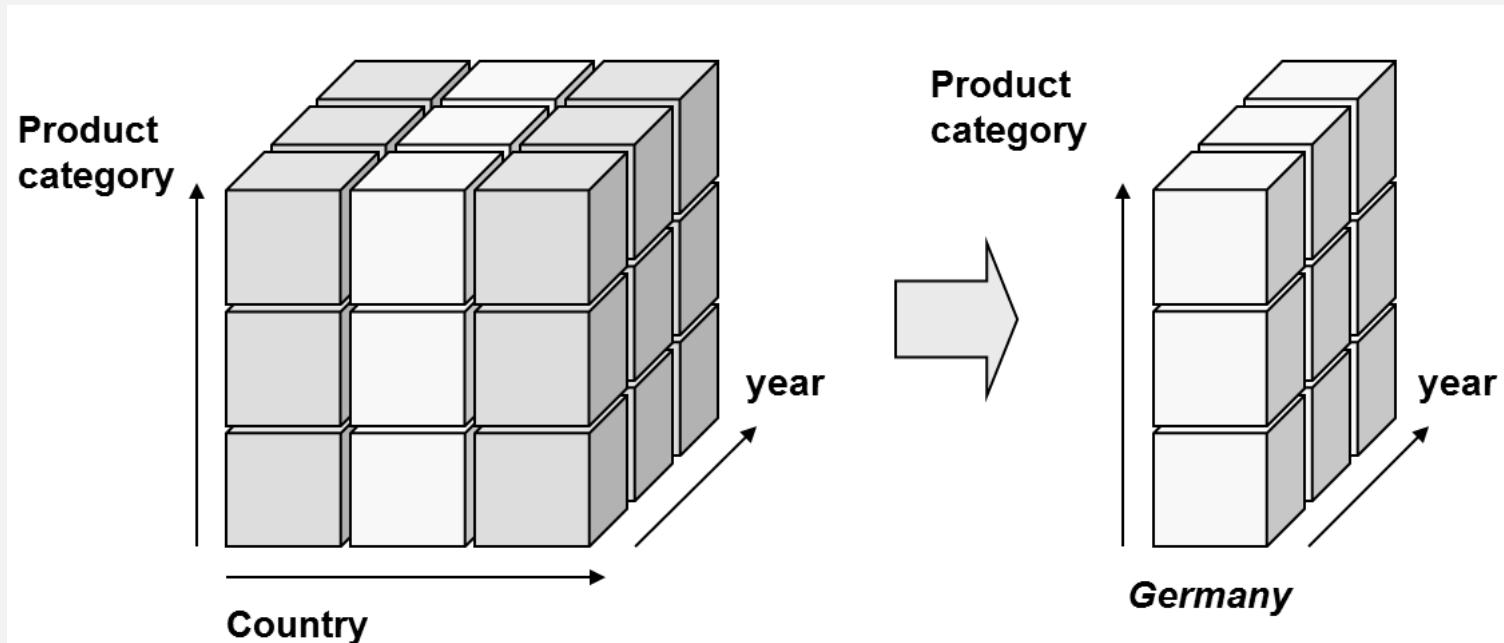


| Country | DE | US |
|-------------------|-----------|-----------|
| Product Category | EUR | \$ |
| [+] E-Bikes | 1.484.411 | |
| [+] Offroad Bikes | 7.529.578 | 6.227.974 |
| [+] Road Bikes | 7.355.858 | 6.720.395 |
| [+] Touring Bikes | 9.468.674 | 8.314.080 |
| [+] Trend Bikes | 59.567 | 40.438 |

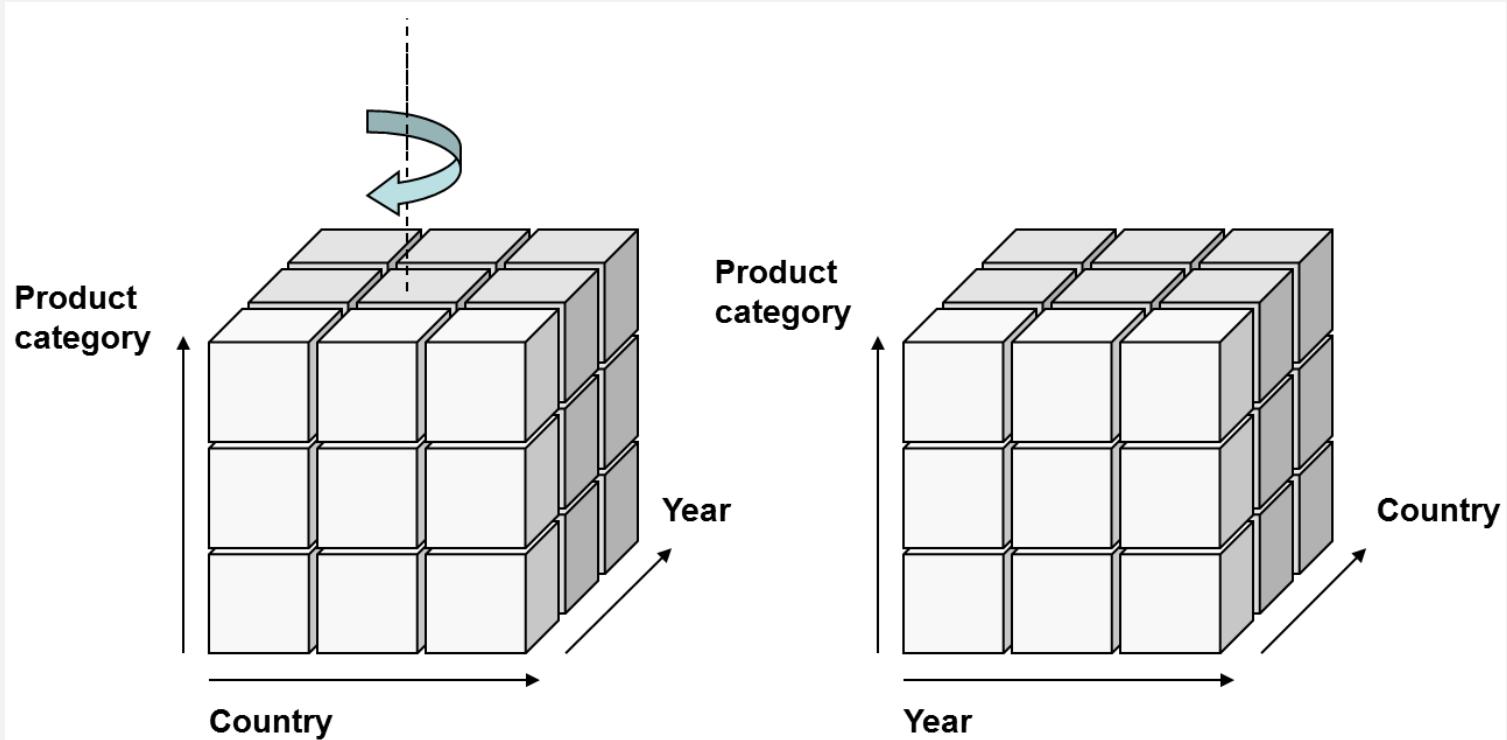


| Country | DE | US |
|---------------------------------------|-----------|-----------|
| Product Category | EUR | \$ |
| [+] E-Bikes | 1.484.411 | |
| [+] Offroad Bikes | 7.529.578 | 6.227.974 |
| Men's Off Road Bike Fully | 2.971.597 | 2.132.065 |
| Men's Off Road Bike Hard Tail Shimano | 1.213.888 | 1.220.991 |
| Men's Off Road Bike Hard Tail SRAM | 2.069.510 | 1.869.276 |
| Women's Off Road Bike Fully | 1.274.584 | 1.005.642 |
| [+] Road Bikes | 7.355.858 | 6.720.395 |
| [+] Touring Bikes | 9.468.674 | 8.314.080 |
| [+] Trend Bikes | 59.567 | 40.438 |

- Slice



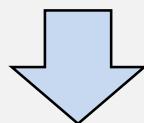
- Rotation



Cube Navigation (3)

- Rotation, Example

| Country | DE | US |
|------------------|-----------|-----------|
| Product Category | EUR | \$ |
| E-Bikes | 1.484.411 | |
| Offroad Bikes | 7.529.578 | 6.227.974 |
| Road Bikes | 7.355.858 | 6.720.395 |
| Touring Bikes | 9.468.674 | 8.314.080 |
| Trend Bikes | 59.567 | 40.438 |



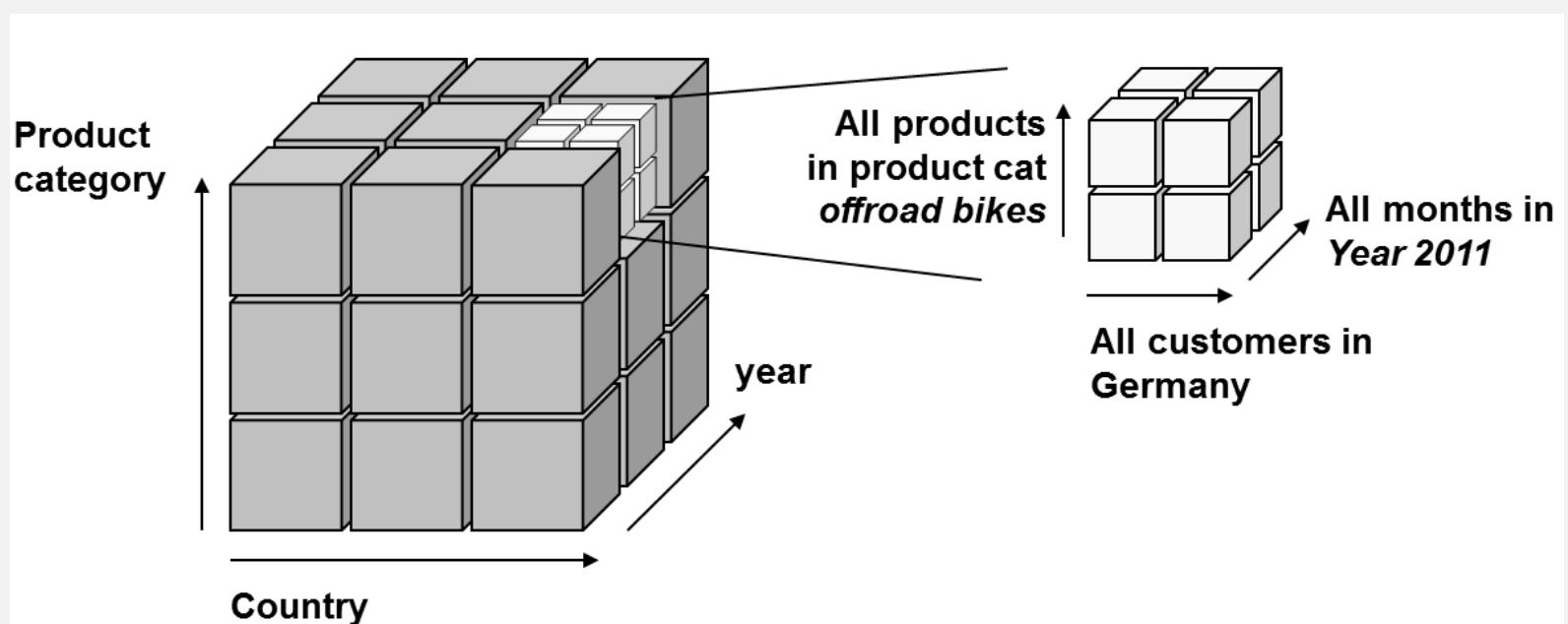
| Calendar year | 2007 | 2008 | 2009 | 2010 | 2011 |
|------------------|------------|------------|------------|------------|------------|
| Product Category | \$ | \$ | \$ | \$ | \$ |
| E-Bikes | | | | 2.024.436 | 1.998.759 |
| Offroad Bikes | 17.656.066 | 17.432.272 | 15.828.093 | 16.635.249 | 16.366.551 |
| Road Bikes | 18.386.899 | 17.458.734 | 15.590.421 | 15.701.905 | 16.625.058 |
| Touring Bikes | 23.986.492 | 23.903.397 | 20.644.309 | 20.926.826 | 21.063.649 |
| Trend Bikes | 177.150 | 152.098 | 120.104 | 111.647 | 120.645 |

Product Category
and Country
visible, Year
restricted to 2011

Product Category
and Year visible,
all Countries
aggregated



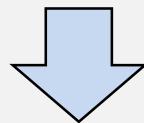
- Dice



- Drill-Down / Roll-Up

| | | |
|------------------|------------|------------|
| Country | DE | US |
| Product Category | EUR | \$ |
| Offroad Bikes | 36.796.979 | 34.371.099 |

Drill-Down



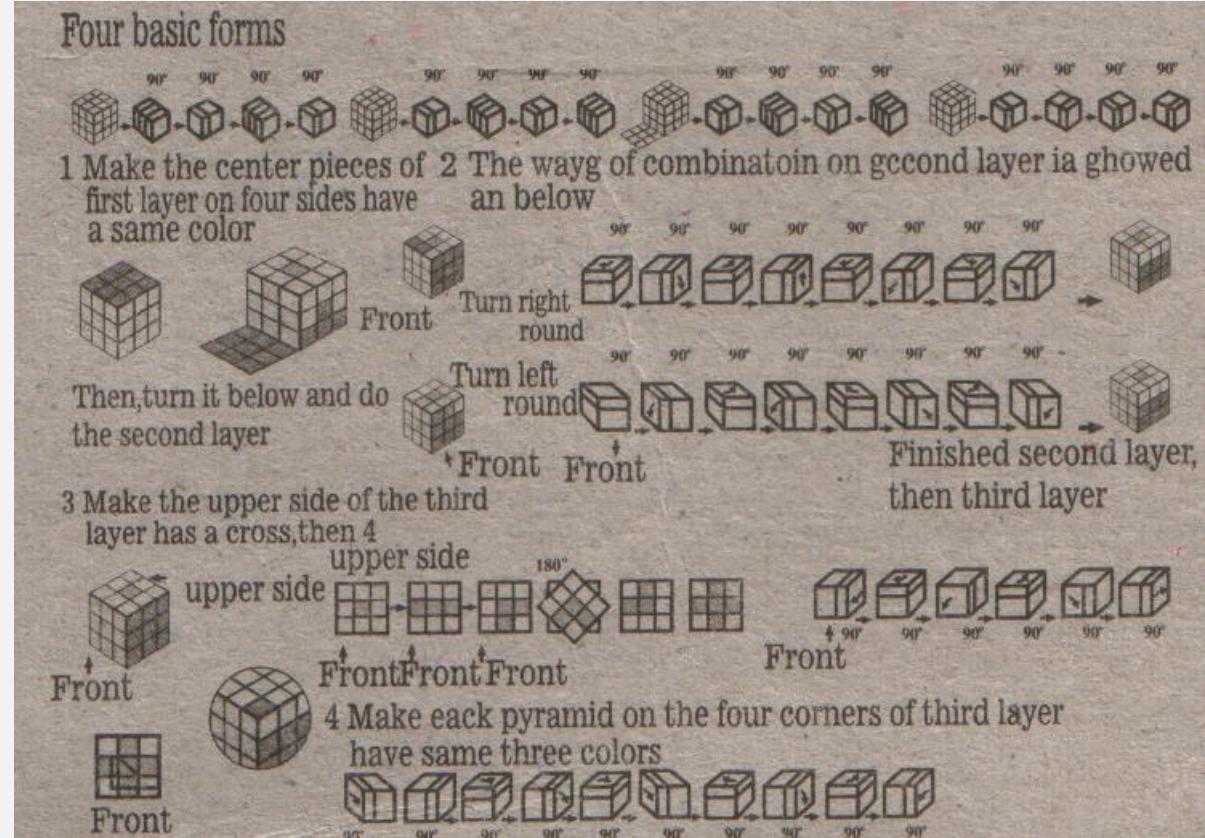
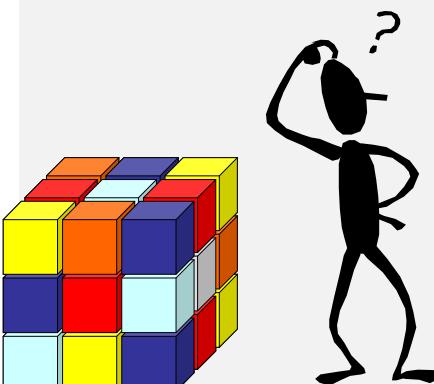
Roll-Up



| | | |
|---------------------------------------|---------------|---------------|
| Country | DE | US |
| Product Category | Offroad Bikes | Offroad Bikes |
| Material | EUR | \$ |
| Overall Result | 36.796.979 | 34.371.099 |
| Men's Off Road Bike Fully | 14.043.022 | 11.704.489 |
| Men's Off Road Bike Hard Tail Shimano | 6.091.811 | 6.616.454 |
| Men's Off Road Bike Hard Tail SRAM | 10.326.245 | 10.698.016 |
| Women's Off Road Bike Fully | 6.335.901 | 5.352.140 |

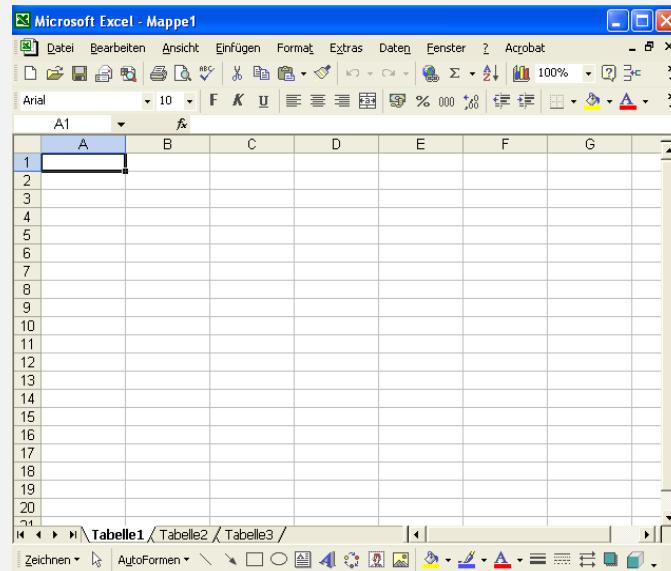
Cube Navigation (Summary)

- Rotation
- Slice
- Dice
- Drilldown



Is a Excel an OLAP Tool?

- CFOs & controllers love it
- Cheap
- MS Office component
- Easy to use
- Nice graphics



Is Excel an OLAP tool? What about...

- Concurrent users?
- Data volume?
- Processing performance?
- Aggregation behavior (fat client)?
- Authorizations?
- Metadata?
- Many data sources?
- Cell references?
- ...

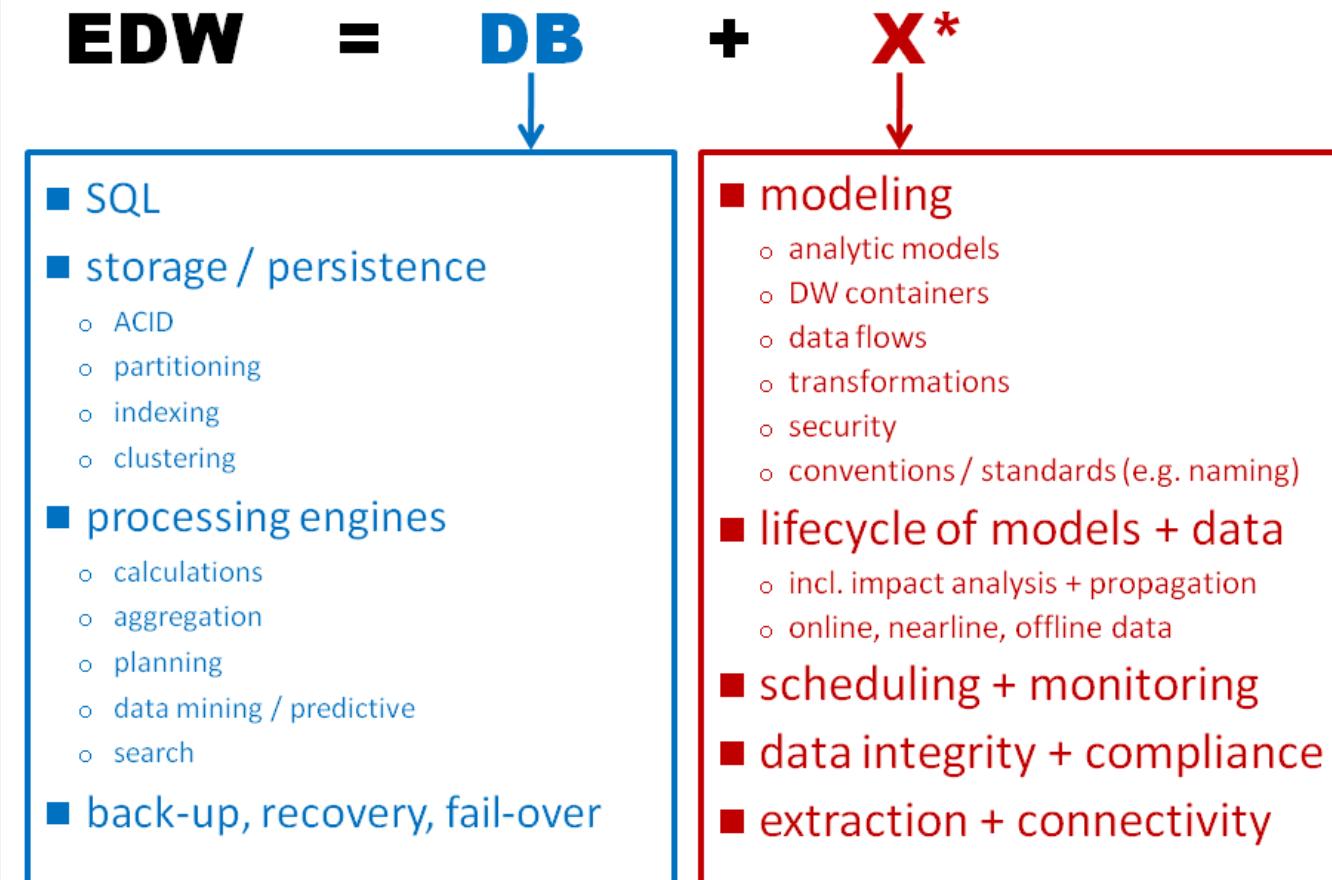


| | | Microsoft Excel - Mappe1 | | | | |
|----|--|---|---|---|---|---|
| | | Datei Bearbeiten Ansicht Einfügen Format Extras Daten Fenster ? Acrobat | | | | |
| | | Arial 10 F K U 100% 100% 100% 100% | | | | |
| A1 | | B | C | D | E | F |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |
| 16 | | | | | | |
| 17 | | | | | | |
| 18 | | | | | | |
| 19 | | | | | | |
| 20 | | | | | | |
| 21 | | | | | | |

The screenshot shows a Microsoft Excel spreadsheet titled "Microsoft Excel - Mappe1". The data is organized into three columns of operations and one column of results:

| | | Operations | Results |
|--|---|------------|---------------|
| | | | 5.000,00 KM |
| | | | 10.000,00 € |
| | + | | \$20.000,00 |
| | + | | 30.000,00 BHT |
| | = | | 65.000,00 € |

- Many concurrent users (1000+)
- Sophisticated authorizations and security
- Fast response time (< 5 sec)
- High data volumes (>100+ GB or TB)
- Multiple data sources
- Easy to use (slice, dice, drill-down, roll-up)
- Enhanced reporting functions



* X is a *DW application* running on top of the DB

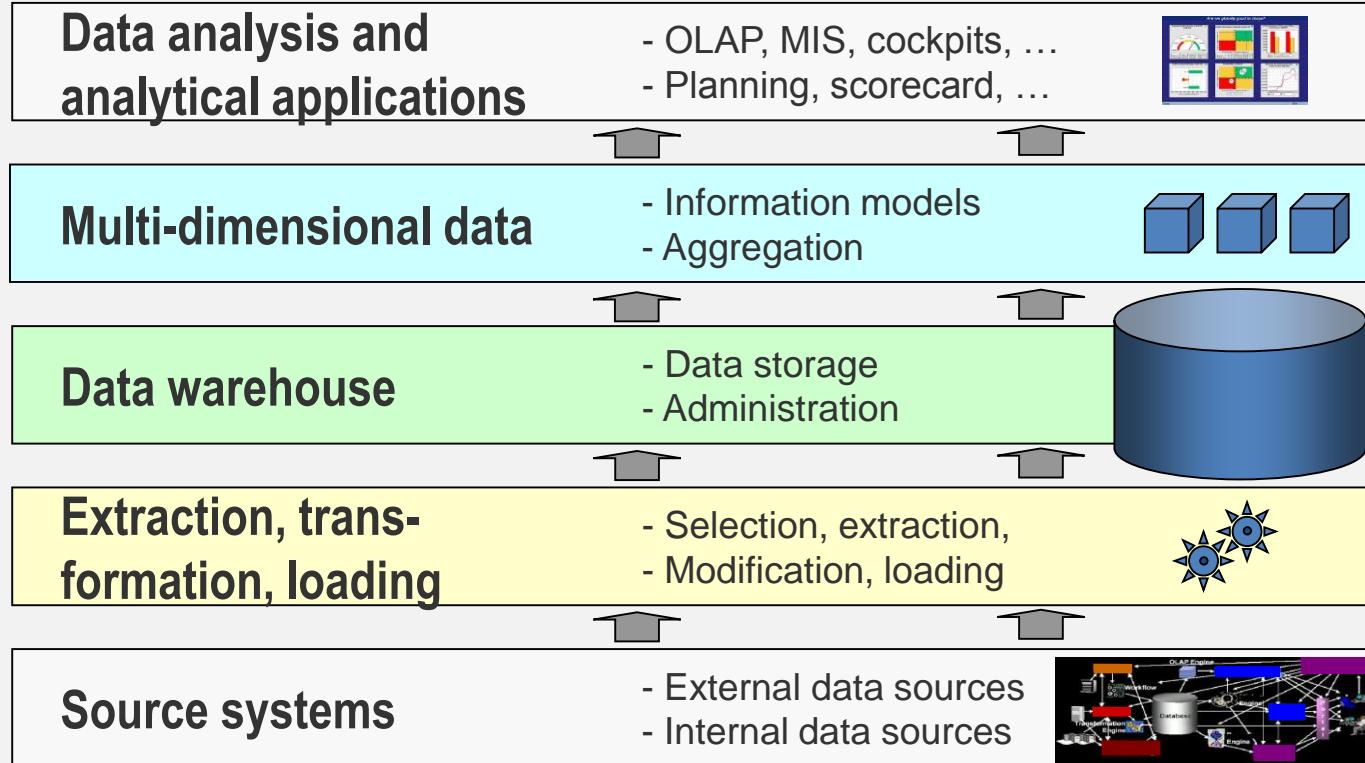
OLAP: Challenges in Calculation

| | | | | | (Standard) key figure aggregated by SUM | COUNT DISTINCT key figure | Calculated key figure, normalizing to the subtotal |
|-------------|----------|----------|--------------------|----------------------|---|---------------------------|--|
| Country | Material | Quantity | Distinct Customers | Quantity per Country | | | |
| DE | Pencil | 10 | 5 | 10/15 | | | |
| | Paper | 5 | 3 | 5/15 | | | |
| | Subtotal | 15 | 6 | 1 | | | |
| US | Pencil | 7 | 3 | 7/18 | | | |
| | Glue | 11 | 5 | 11/18 | | | |
| | Subtotal | 18 | 7 | 1 | | | |
| Grand Total | | 33 | 11 | 1 | | | |

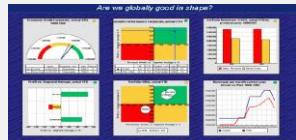
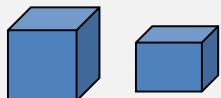
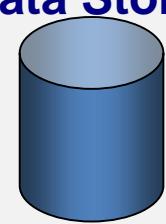
- ▶ Cannot be handled by simple SQL → „Calculation Graph“

Source: <http://tfxz.wordpress.com/2013/02/15/the-olap-compiler-in-bw-on-hana/>

- OLAP navigation using Excel PivotTables
- OLAP navigation in SAP
 - Business Explorer Analyzer (Excel)
 - Business Explorer Web (Browser)

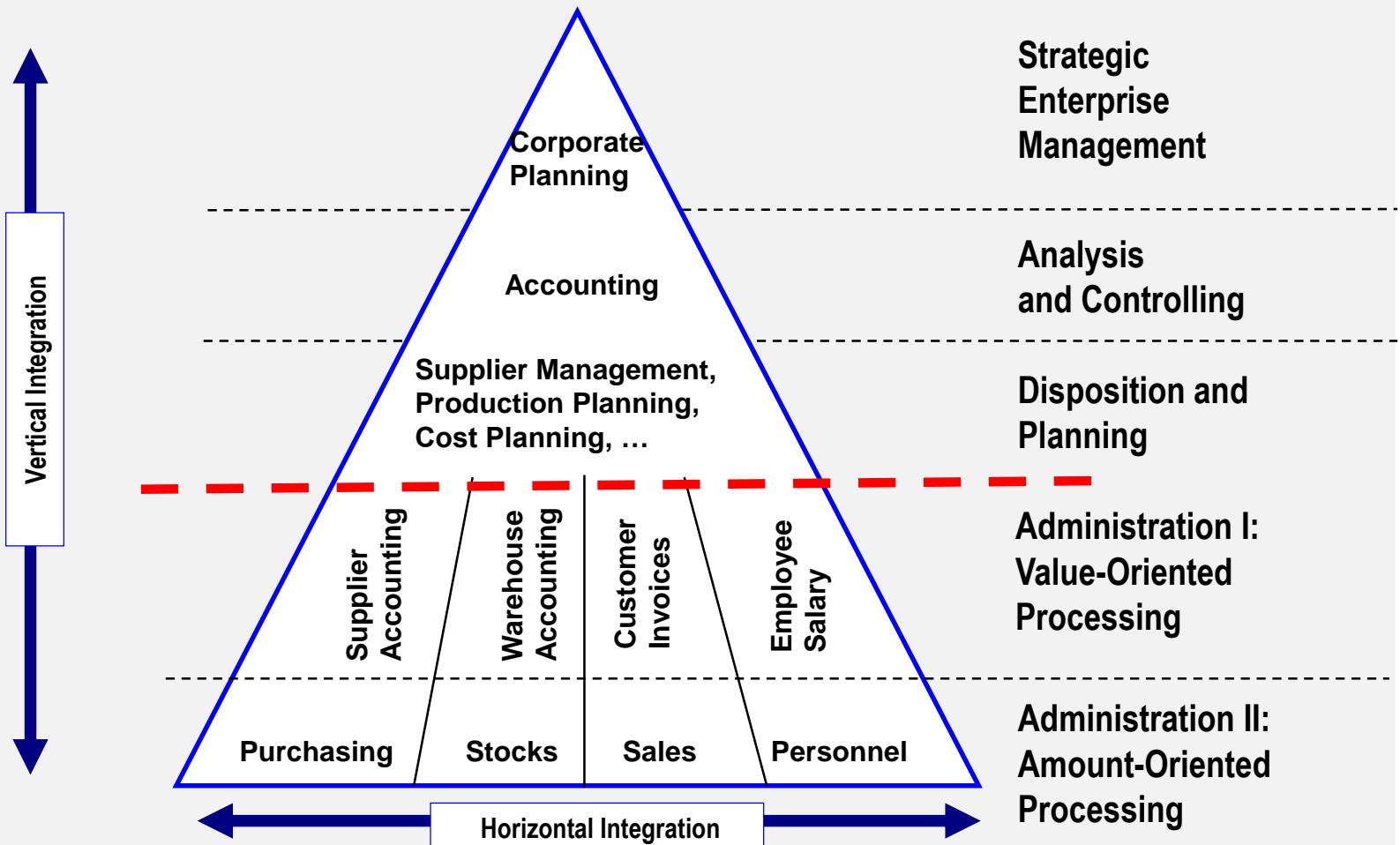


Examples

| | MS Excel PivotTable | SAP BO Advanced Analysis Office | SAP Business Explorer Web |
|--|--------------------------------|--|--------------------------------------|
| Presentation  | PivotTable | Excel with SAP Add-In | Browser |
| Model Logic  | PivotTable | SAP BI System | SAP BI System |
| Data Storage  | Excel table or local database | SAP BI Database | SAP BI Database |

- What is Business Intelligence?
- What is „Data Warehouse“?
- What are the benefits and challenges?
- What does „multi-dimensional“ mean?
- What is „OLAP“?
- OLTP versus OLAP
- Business Intelligence tool box





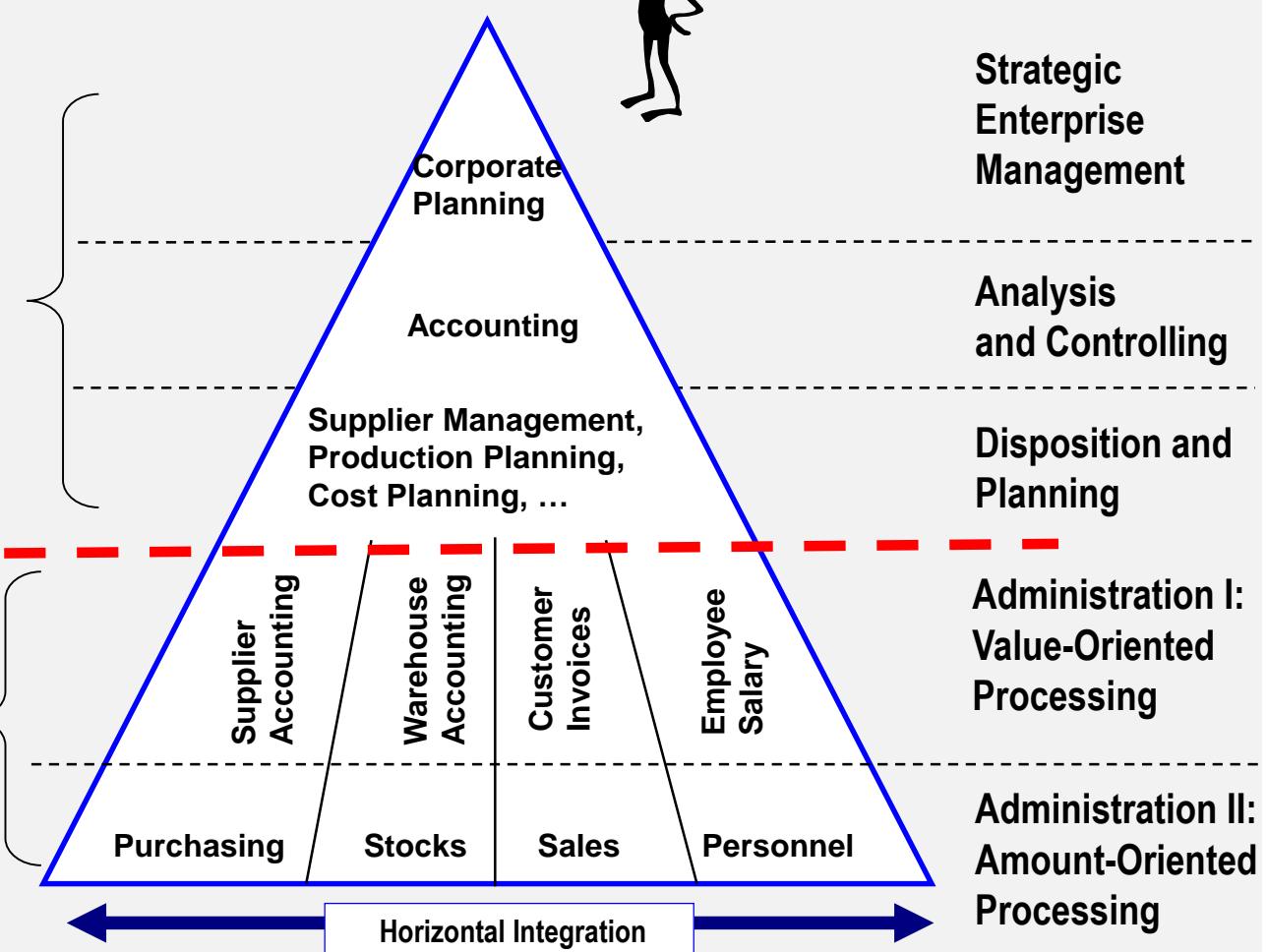
Source: Mertens, P., Meier, M.: Integrierte Informationsverarbeitung (2009), 1.

OLTP versus OLAP



► On-line
Analytical
Processing

► On-line
Transactional
Processing



OLTP Versus OLAP (1)

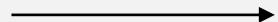
OLTP

- Optimized to get data **in**
- For management and daily **business**
- Processes a **small** amount of data per transaction
- **Business-critical** availability
- Data updates **online**
- Data **overwritten**

OLAP

- Optimized to get data **out**
- For administration and daily **decisions**
- Processes a **large** amount of data per transaction
- **Less critical** availability
- Data updates **regularly**
- Data are **time-dependent**

OLTP Versus OLAP (2)

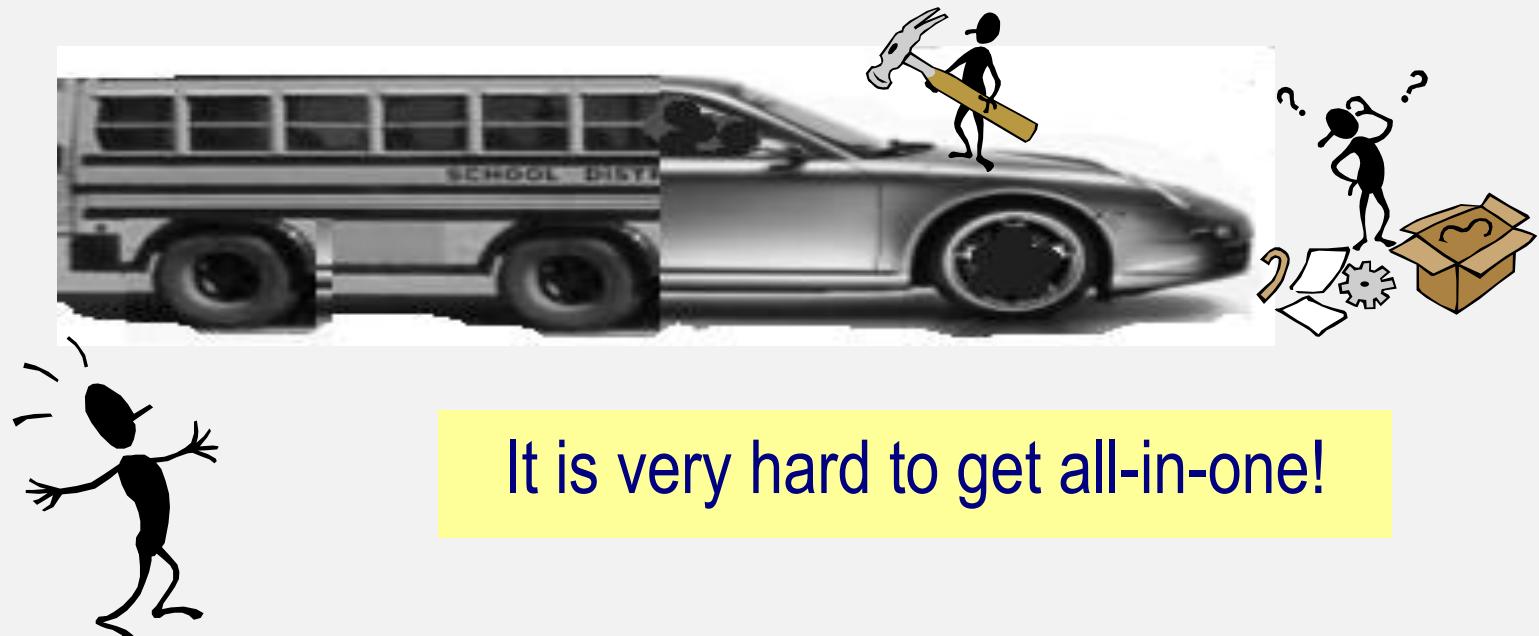


OLTP

- Optimized to get data **in**
- For management and **daily business**
- Processes a **small** amount of data per transaction
- **Business-critical** availability
- Data updates **online**
- Data **overwritten**

OLAP

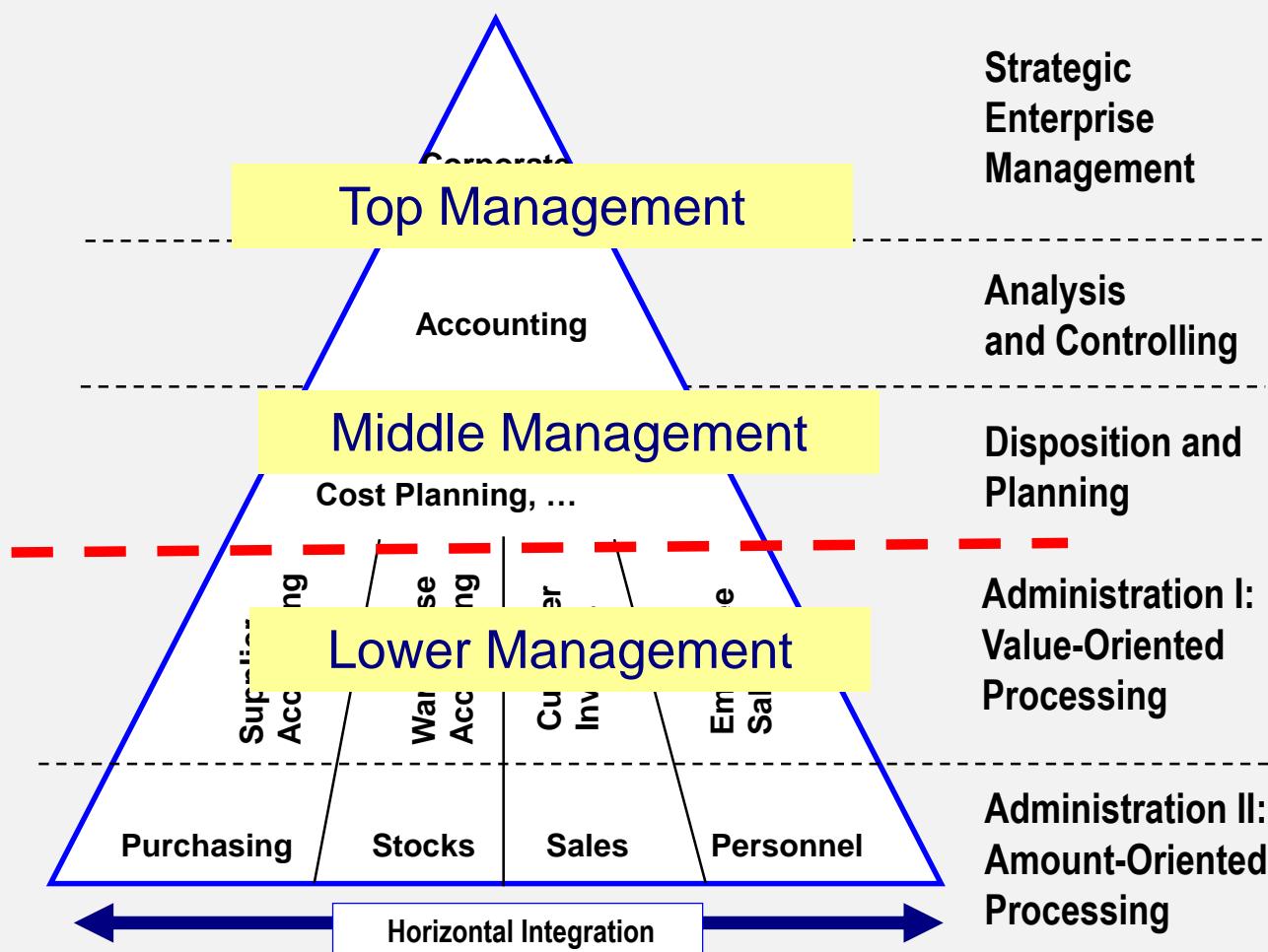
- Optimized to get data **out**
- For administration and **daily decisions**
- Processes a **large** amount of data per transaction
- **Less critical** availability
- Data updates **regularly**
- Data are **time-dependent**



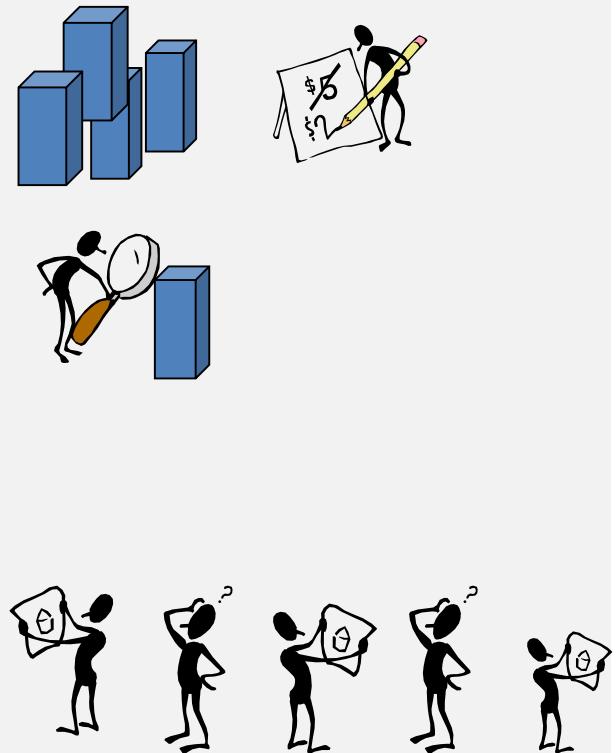
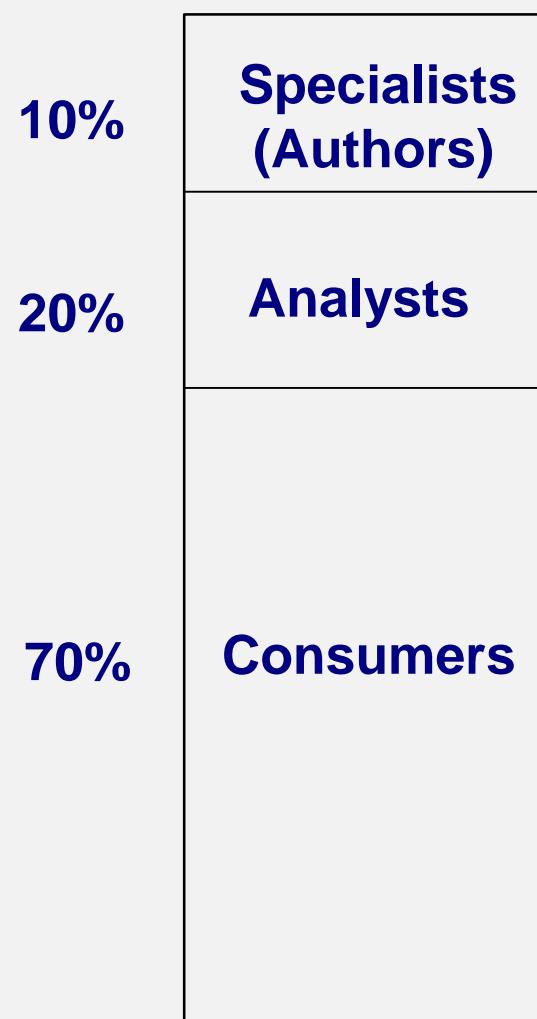
- What is Business Intelligence?
- What is „Data Warehouse“?
- What are the benefits and challenges?
- What does „multi-dimensional“ mean?
- What is „OLAP“?
- OLTP versus OLAP
- Business Intelligence tool box



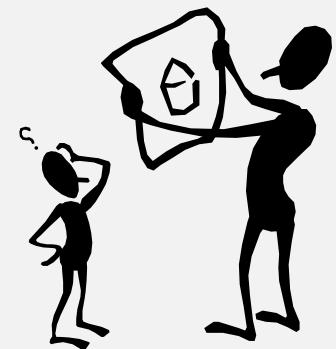
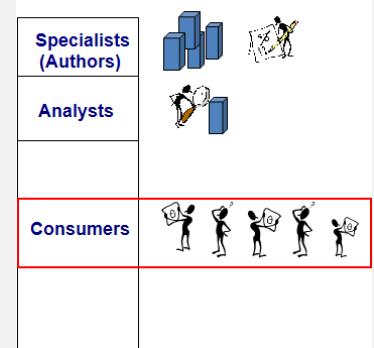
Where Are the End Users?



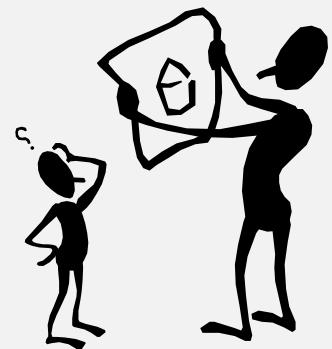
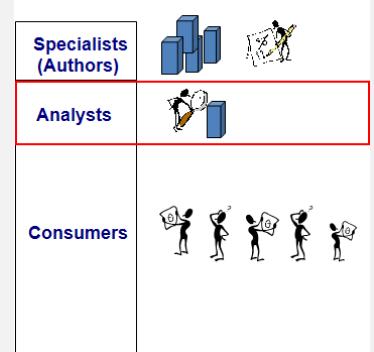
What Do They Do?



- Get reports on a regular base
- Look over huge amount of data
- Occasionally stumble on something that proves to be useful
- Sporadic usage of data
- Sometimes find areas for further exploration
- Heavy reliance on tools for displaying data

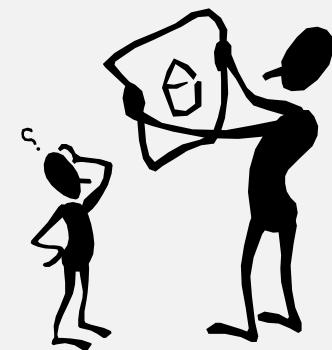
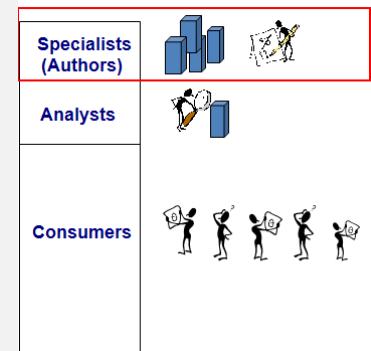


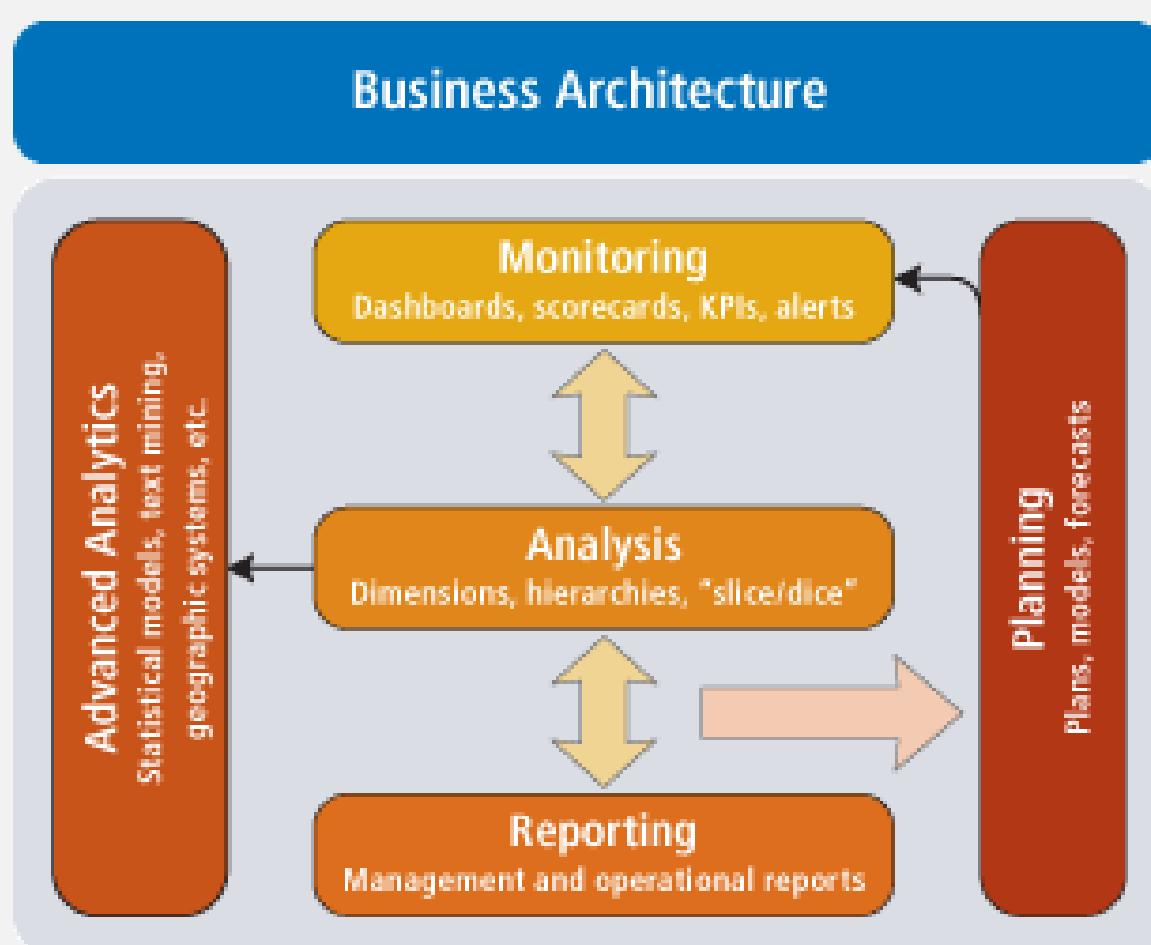
- Regular access to data
- Know what they are looking for
- Requirements known before search for data starts
- Find small flakes of gold regularly
- Make use of tools for analysis and presentation



Specialists (Authors)

- Requirements are known
- Irregular access to data
- Look over massive amounts of data
- Sometimes find huge nuggets of gold
- Unpredictable pattern of access
- Access detailed data regularly
- Look at relationships of data
- Make use of tools of discovery, analysis and presentation
- Make results available to others (consumers, analysts)





Source: [Eckerson, W. \(May 2006\). Business intelligence 2006 - only the beginning. What Works, 21.](#)

- What is Business Intelligence?
- What is „Data Warehouse“?
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- Business Intelligence tool box



Version 2.0

Author Klaus Freyburger

Global Bike Inc.

Product

SAP BI

Level

Beginner

Focus

Global Bike Inc.

Integration

Abstract

This material explains the company on which the business example is based on.

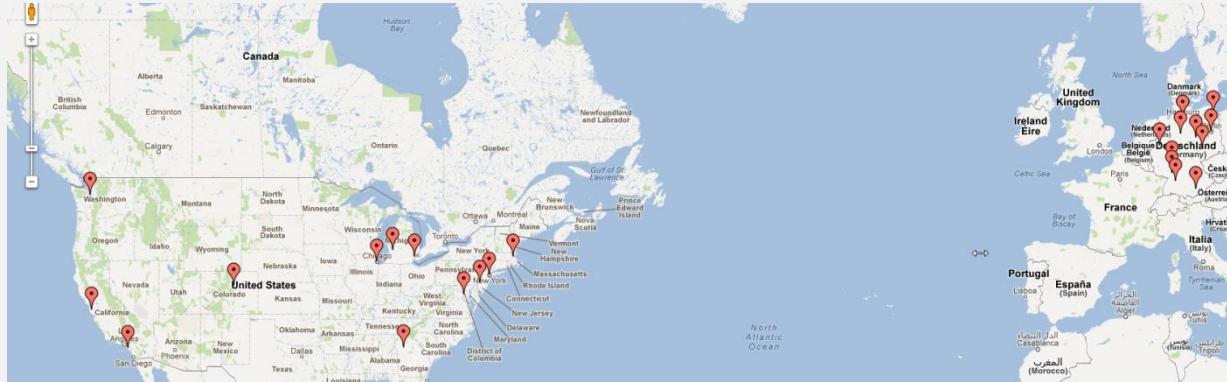
Global Bike

Global Bike Incorporated



- Company in the bicycle business
- Manufactures and distributes different product lines of high quality bicycles
- Re-sells accessories for bicycles
- Sells to **wholesale – procure and distribute**

- Customers in Germany and United States



- Bicycles and Accessories
- Product Categories:

[Accessories](#)
[E-Bikes](#)
[Offroad Bikes](#)
[Road Bikes](#)
[Touring Bikes](#)
[Trend Bikes](#)



Global Bike

Business Case



- Monitoring sales activities
- Typical questions:
 - Which country generated the most revenue?
 - Which were the most successful product groups / products?
 - What discounts were given?
 - Which sales organization made the most profit?
 - What were the revenues compared to last year?

Sales looks at different KPIs in relation to sales organizations, product, time

SAP University Alliances

Version 3.0

Authors Tobias Hagen
Klaus Freyburger

SAP Business Objects Analysis for Office

Product

SAP Netweaver 7.3 BI

Level

Undergraduate
Beginner

Abstract:

This chapter covers the basic aspects and concepts of multidimensional Analysis with SAP Business Objects Advanced Analysis for Office. It does not cover multidimensional concepts like OLAP in general



Learning objectives

- Understand how OLAP technology is used for multidimensional analysis
- Use OLAP concepts with SAP Business Objects Analysis for Office

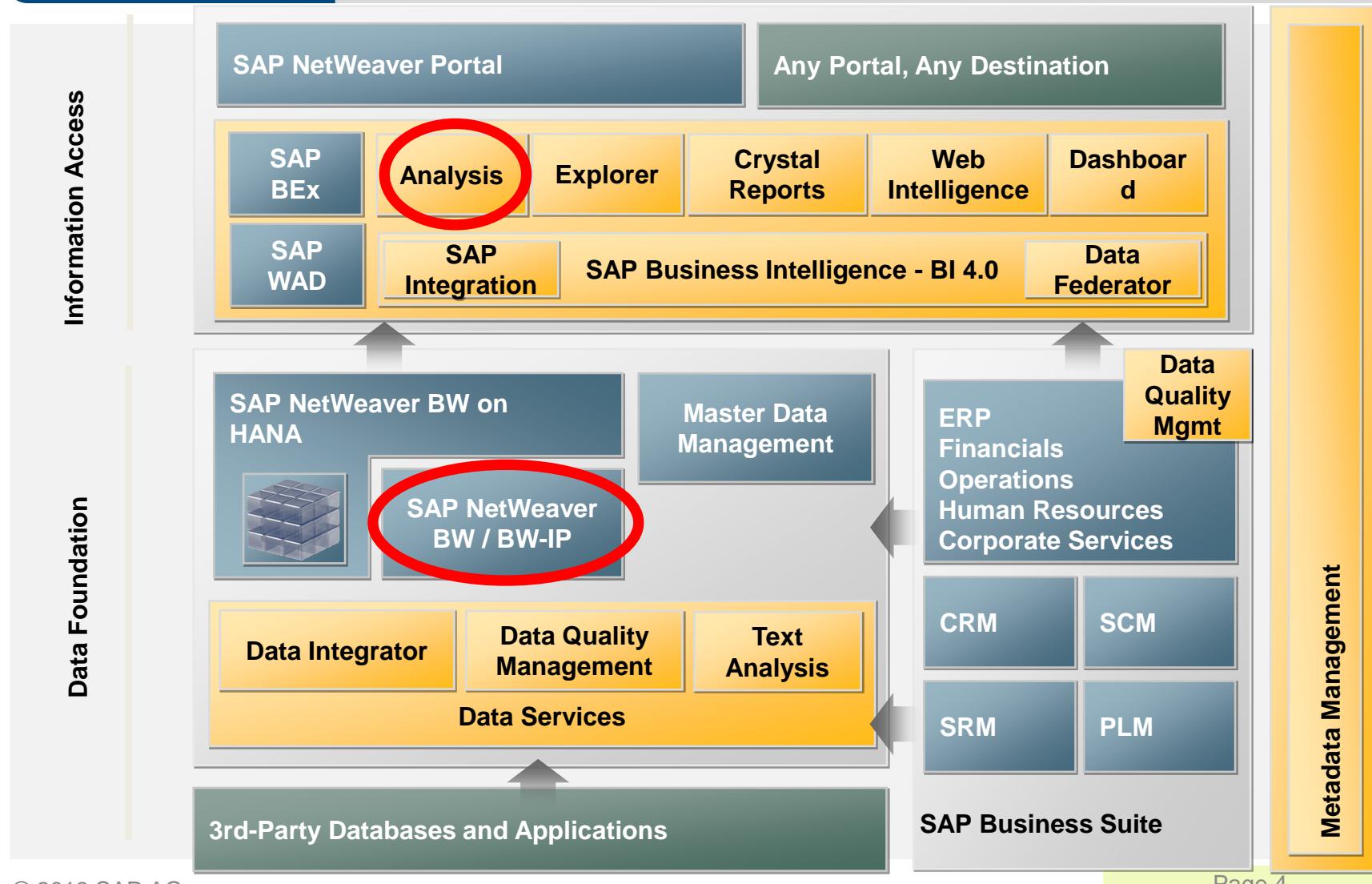
Prerequisites

- You are familiar with multidimensional concepts like measures and dimensions, OLAP cubes
- You are familiar with Excel Pivot tables

- Overview
- Basic concepts of SAP BO Analysis for Office
 - Introduction
 - Analyze data
 - Charts
 - Calculations
- Advanced Features of SAP BO Analysis for Office
 - Hierarchy
 - Conditional Formatting
 - Filter by measure (e.g. Top N)
 - Currency Conversion
 - Powerpoint integration
 - Additional functions*

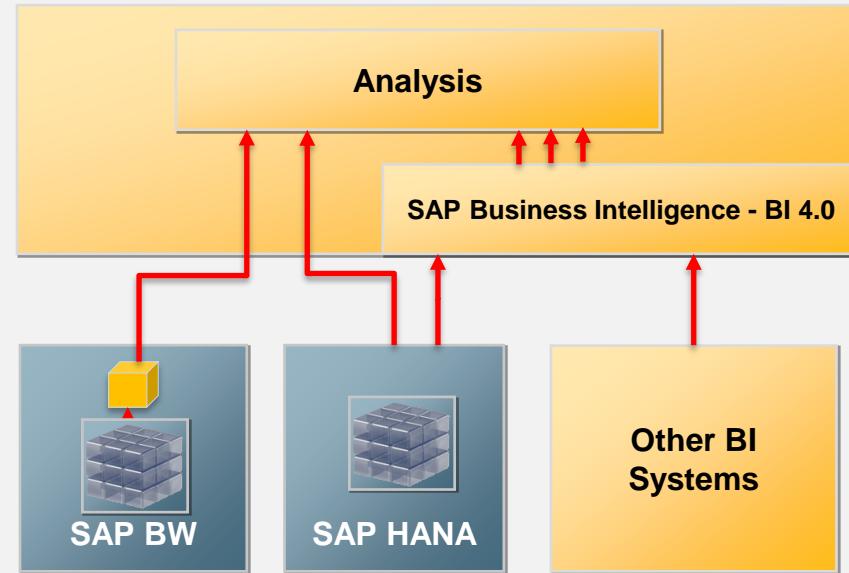
* Not part of the case studies

SAP Business Intelligence Platform



SAP BO Analysis for Office

- Add-In for MS Excel and Powerpoint
- Ad hoc analysis of multidimensional data with Excel frontend
- Build Excel based applications/dashboards
- Data sources
 - SAP BEx Queries
 - SAP HANA
 - SAP BI Platform 4.0



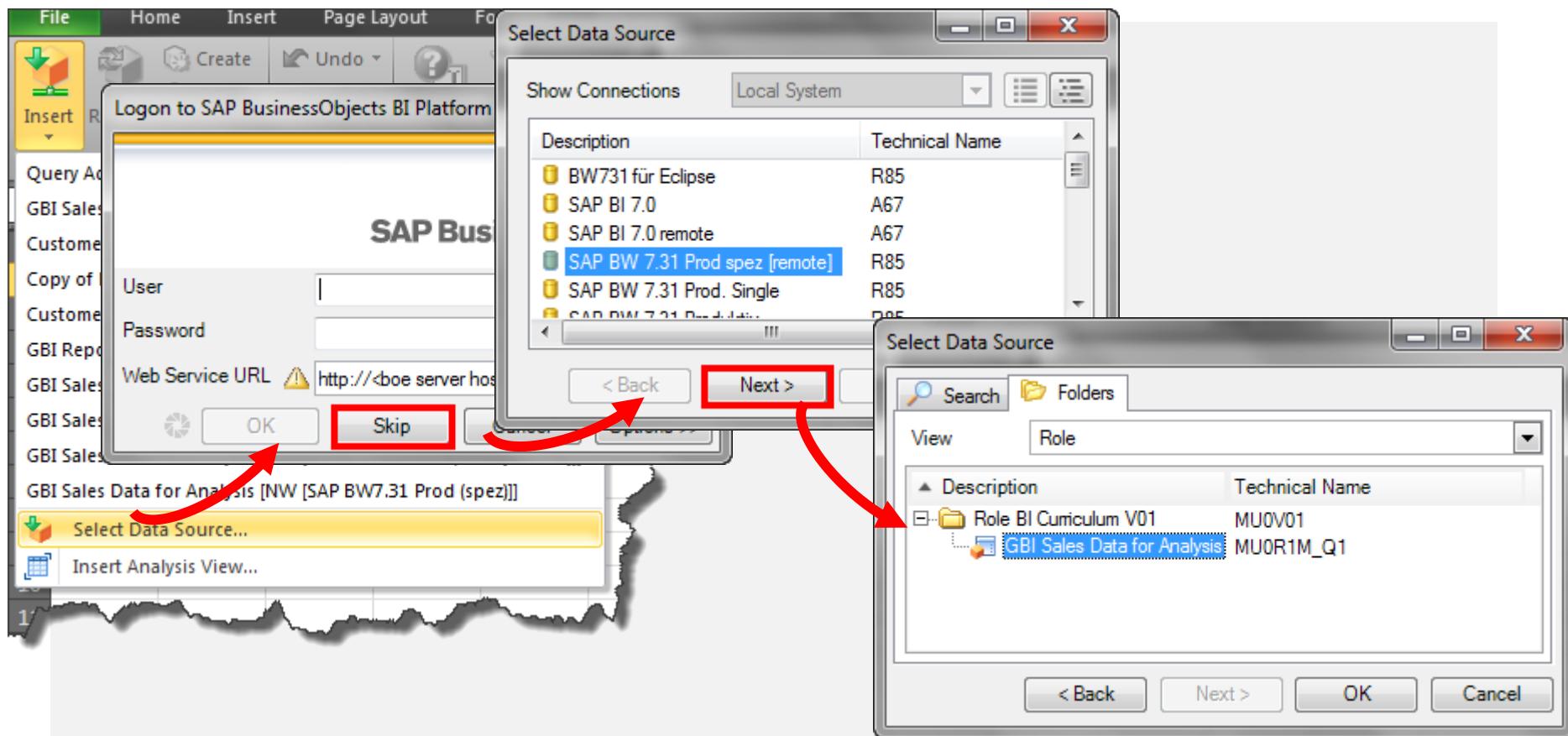
Note: Analysis for Office **uses** a *BEx Query* and displays the initial view.

- End users can change many of the settings done in *BEx Query Designer* also in Analysis for Office.
- *Query Designer* is much more powerful e.g. with calculations
- *Analysis for Office* is only one client to use a *BEx Query*. You can use the same Query also in other BI tools (dashboards, web applications,...)

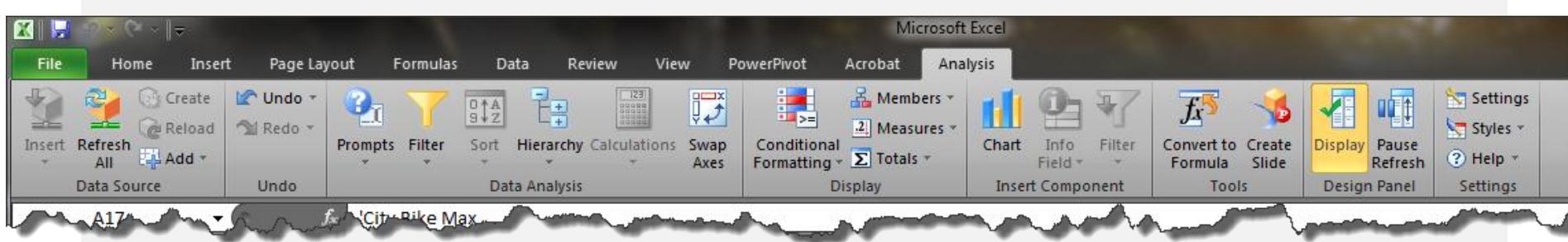
- Overview
- Basic concepts of SAP BO Analysis for Office
 - Introduction
 - Analyze data
 - Charts
 - Calculations
- Advanced Features of SAP BO Analysis for Office
 - Hierarchy
 - Conditional Formatting
 - Filter by measure (e.g. Top N)
 - Currency Conversion
 - Powerpoint integration
 - Additional functions*

* Not part of the case studies

Insert Data Source



- Start with inserting a data source = BEx Query from BW Server (in our case)



- Analysis for Office adds an extra *Analysis* ribbon
- Analysis for Office adds an extra design panel if a data source is open
- Design panel can be hidden

A screenshot of the SAP Analysis for Office Design Panel, which is a floating window with a red border. It displays a hierarchical tree structure of data sources and their members. The tree includes 'GBI Sales Data for Analysis' (Measures, Cal. year / month, Calendar month, Calendar year, Country), 'Customer' (Attributes: Airport Bikes, Alster Cycling, Bavaria Bikes, Beantown Bikes, Big Apple Bikes, Capital Bikes, Cruiser Bikes, DC Bikes, Drahtesel, Fahrtott, More Members Available), and 'Division'. To the right of the tree are sections for 'Columns' (Measures, Country) and 'Rows' (Calendar year). At the bottom are tabs for 'Analysis', 'Information', and 'Components', and a status bar showing '100%'.

SAP BI Curriculum BI1-M1 Analysis for Office

Screen

**Extra tab on
Excel ribbon**

The screenshot shows a Microsoft Excel window with the following details:

- Ribbon:** The ribbon has a green "Analysis" tab selected, which is highlighted with a red box. The "Analysis" tab contains various icons for data analysis, such as Data Source, Refresh, Undo, Prompts, Filter, Sort, Hierarchy Calculations, Swap Axes, Conditional Formatting, Data Analysis, Members, Measures, Totals, Display, Insert Component, Tools, and Settings.
- Data:** The main worksheet area displays two crosstabs. The first crosstab (rows 2-10) shows revenue by Country (DE, US) and Calendar year (2007-2011). The second crosstab (rows 13-20) shows revenue by Product (Air Pump, City Bike Max, Deluxe Road Bike (Shimano), Deluxe Road Bike (SRAM), Deluxe Touring Bike) across Q4.2010 and Q4.2011. A red box highlights the result area of the first crosstab.
- Analysis Design Panel:** A floating window titled "Analysis" is open, also highlighted with a red box. It contains a tree view of data structures:
 - Measures:** GBI Sales Data for Analysis, Cal. year / month, Calendar month, Calendar year.
 - Rows:** Country, Customer, Attributes (listing various bike models like Airport Bikes, Alster Cycling, Bavaria Bikes, Beantown Bikes, Big Apple Bikes, Capital Bikes, Cruiser Bikes, DC Bikes, Drahtesel, Fahrpott), Division.
 - Columns:** Measures, Country.
 - Background Filter:** A large yellow triangle icon.

**Result area with
crosstabs and
charts**

**Analysis design panel (c.f. Pivot
tables)**
**Additional information on
components and data sources**

SAP BI Curriculum
BI1-M1 Analysis for Office

Screen enlarged

Book1 - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View PowerPivot Acrobat Analysis

Insert Refresh Create Undo Redo Prompts Filter Sort Hierarchy Calculations Swap Axes Conditional Formatting Members Measures Totals Display Chart Info Field Filter Convert to Formula Create Slide Design Panel Tools Help Styles Settings

A7 f_x '2009

| | A | B | C | D | |
|----|----------------------------------|-------------|---------------|----------------|-----------------|
| 1 | | Revenue | | | |
| 2 | Country | DE | US | Overall Result | |
| 3 | | Germany | United States | | |
| 4 | Calendar year | EUR | \$ | | |
| 5 | 2007 | 22.986.729 | 29.764.202 | * | |
| 6 | 2008 | 23.353.620 | 27.998.418 | * | |
| 7 | 2009 | 23.590.854 | 20.845.731 | * | |
| 8 | 2010 | 25.393.053 | 21.662.670 | * | |
| 9 | 2011 | 26.102.295 | 21.479.002 | * | |
| 10 | Overall Result | 121.426.551 | 121.750.023 | * | |
| 11 | | | | | |
| 12 | | | | | |
| 13 | | Q4.2010 | Q4.2011 | Deviation | xx1-029 revenue |
| 14 | Product | PC | PC | % | EUR |
| 15 | Overall Result | 1.110 | 1.309 | 17,9 | 90.419.622,91 |
| 16 | [+] Air Pump | 138 | 196 | 42,0 | 223.630,40 |
| 17 | [+] City Bike Max | | | | 186.948,08 |
| 18 | [+] Deluxe Road Bike (Shimano) | 86 | 112 | 30,2 | 8.129.996,34 |
| 19 | [+] Deluxe Road Bike (SRAM) | 20 | 27 | 35,0 | 2.238.982,31 |
| 20 | [+] Deluxe Touring Bike (black) | 21 | 27 | 28,6 | 4.150.727,92 |
| 21 | [+] Deluxe Touring Bike (red) | 22 | 21 | -4,5 | 4.078.410,82 |
| 22 | [+] Deluxe Touring Bike (silver) | 53 | 62 | 17,0 | 8.969.804,31 |
| 23 | [+] Elbow Pads | 5 | 7 | 40,0 | 43.047,46 |

Analysis

Find... X

GBI Sales Data for Analysis

Columns

- + Measures
- + Cal. year / month
- + Calendar month
- + Calendar year
- + Country

Rows

- + Customer
 - + Attributes
 - Airport Bikes
 - Alster Cycling
 - Bavaria Bikes
 - Beantown Bikes
 - Big Apple Bikes
 - Capital Bikes
 - Cruiser Bikes
 - DC Bikes
 - Drahtesel
 - Fahrpott
 - More Members Available
- + Division

Background Filter

Analysis Information Components

Sheet1 Sheet2 Sheet3

Ready 100%

- Behaviour is in general similar to **Pivot tables**
- Buttons on the ribbon (depends on cursor position!)
- Context menu (depends on cursor position!)
- Drag and Drop
 - Between analysis design panel and crosstab
 - Within design panel
 - Within crosstab
- Undo/Redo for each step

The screenshot illustrates the SAP Analysis for Office interface. On the left is a crosstab showing sales data by Product and Calendar year. The top row includes columns for Revenue (EUR) and Overall Result (\$). The first column lists products like Air Pump, City Bike Max, and various Deluxe models. The second column shows Q4.2010 values (e.g., 1.110 for Air Pump), and the third column shows Q4.2011 values (e.g., 1.309 for Air Pump). The fourth column is Deviation (%), and the fifth column is Overall Result (EUR). Red arrows highlight the movement of data between the crosstab and the Analysis design panel on the right.

Analysis Design Panel:

- Measures:** Cal. year / month, Overall Result
- Rows:** Country, Customer, Attributes, Division
- Columns:** Measures, Country, Calendar year
- Background Filter:** Calendar year

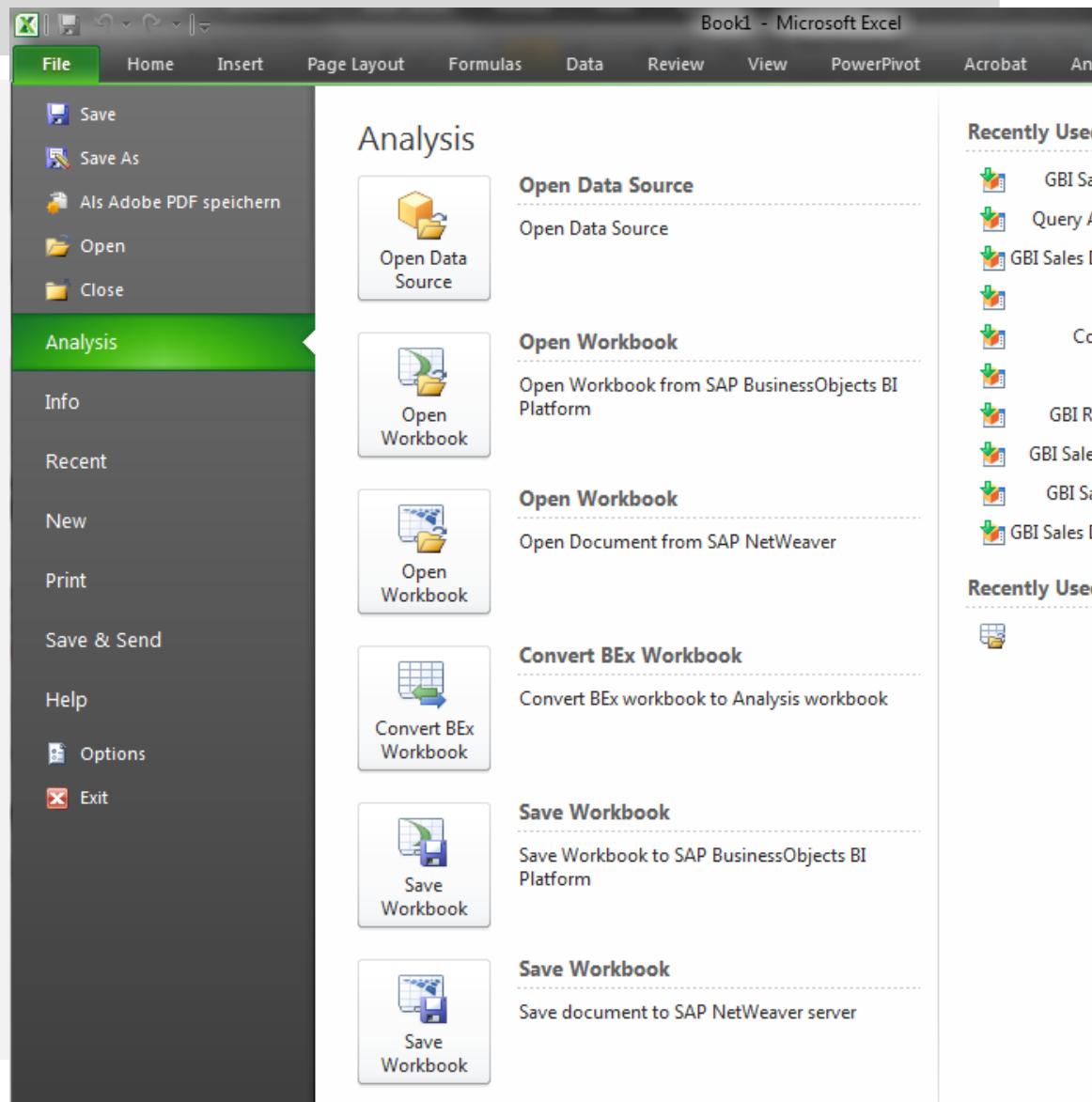
| Product | Q4.2010 | Q4.2011 | Deviation | Overall Result |
|----------------------------------|--------------|--------------|-------------|----------------------|
| Overall Result | 1.110 | 1.309 | 17,9 | 90.419.622,91 |
| [+] Air Pump | 138 | 196 | 42,0 | 223.630,40 |
| [+] City Bike Max | | | | 186.948,08 |
| [+] Deluxe Road Bike (Shimano) | 86 | 112 | 30,2 | 8.129.996,34 |
| [+] Deluxe Road Bike (SRAM) | 20 | 27 | 35,0 | 2.238.982,31 |
| [+] Deluxe Touring Bike (black) | 21 | 27 | 28,6 | 4.150.727,92 |
| [+] Deluxe Touring Bike (red) | 22 | 21 | -4,5 | 4.078.410,82 |
| [+] Deluxe Touring Bike (silver) | 53 | 62 | 17,0 | 8.969.804,31 |
| [+] Elbow Pads | 5 | 7 | 40,0 | 43.047,46 |

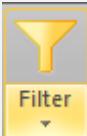
File Menu

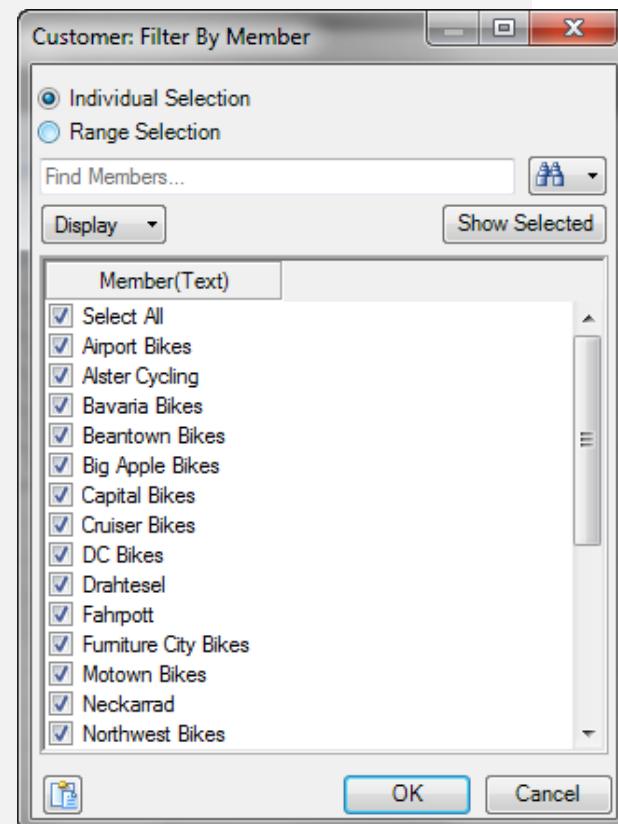
Additional tab in file menu

- Open/save workbooks to server (BW or BI platform)
- Convert BEx workbooks
- Open data sources

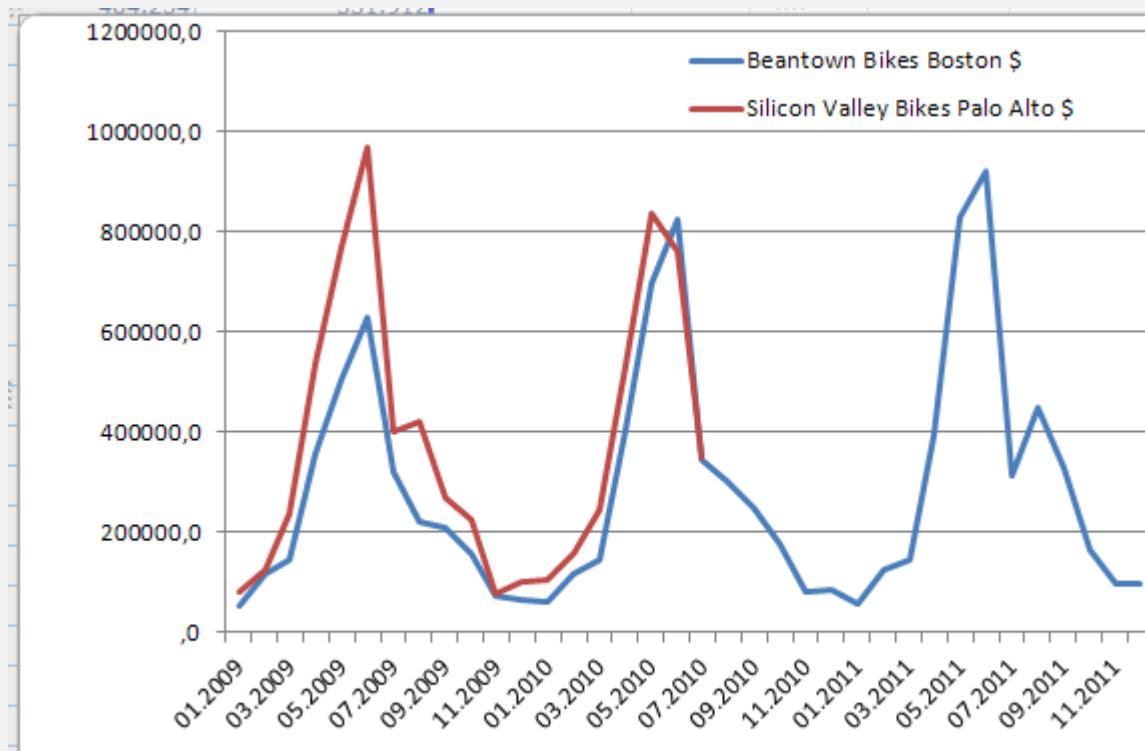
(In *settings* you can set your preferred BI platform)



- Add members to columns or rows
- Add measures to columns or rows
- Filter by member 
- Swap axes 
- Sort
 - By member (text, key, attribute)
 - By measures
- Display
 - Members: Texts and/or keys
 - Measures: Decimals
 - Hide/show totals



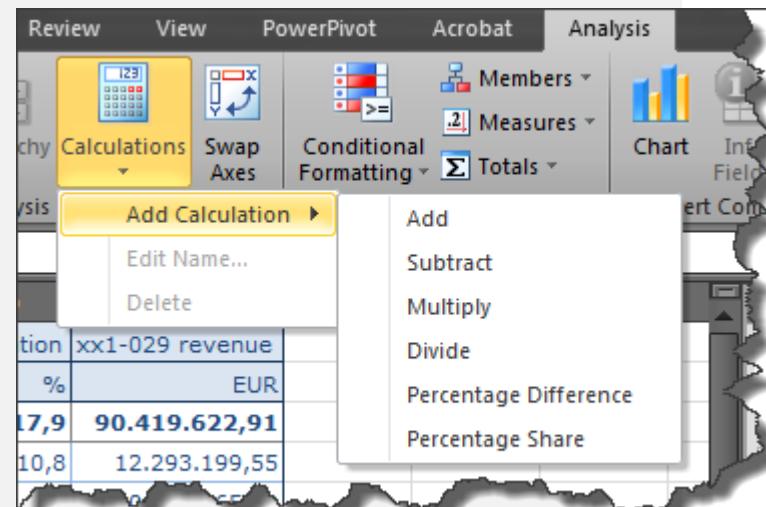
- Attach a chart to a crosstab



Calculations

- Calculations create new measures on the fly
- Calculation based on a single measure
 - Position cursor on the measure
- Simple calculations based on two measures
 - There is no formula editor
 - Select both measures with cursor (sequence of selecting determines sequence in formula!)

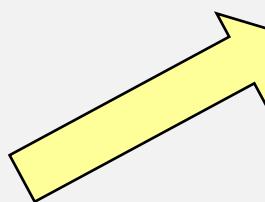
Moving Minimum Value
Moving Maximum Value
Accumulative Sum
Accumulative Sum of Rounded Values
Accumulative Count of All Detailed Values
Accumulative Count of All Detailed Values that are Not Zero, Null or Error
Moving Average
Moving Average that is Not Zero, Null or Error
Rank Number
Olympic Rank Number
Percentage Contribution



- Overview
- Basic concepts of SAP BO Analysis for Office
 - Introduction
 - Analyze data
 - Charts
 - Calculations
- Advanced Features of SAP BO Analysis for Office
 - Hierarchies
 - Conditional Formatting
 - Filter by measure (e.g. Top N)
 - Prompts (Variables)
 - Currency Conversion
 - Powerpoint integration
 - Additional functions*

* Not part of the case studies

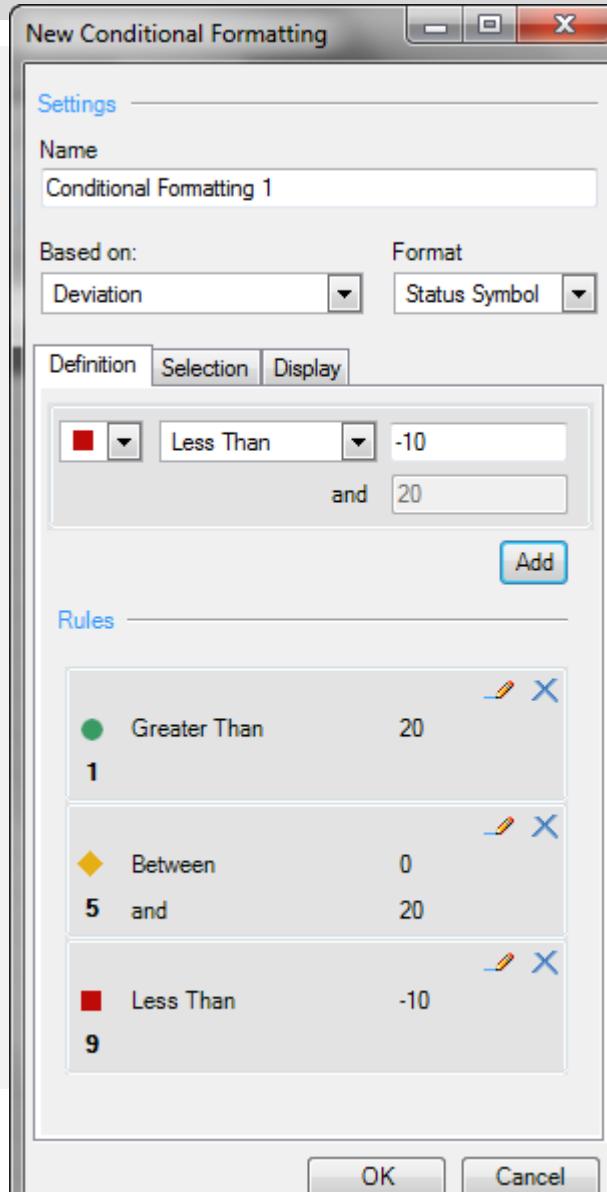
- Hierarchical display in rows or columns
- BW hierarchies are supported



| Product | PC | PC | % | |
|--|--------------|--------------|-------------|---------------|
| Overall Result | 1.110 | 1.309 | 17,9 | 90.41% |
| [+] Professional Road Bike (Shimano) | 65 | 72 | 10,8 | 12,1 |
| [+] Professional Touring Bike (silver) | 63 | 60 | -4,8 | 10,1 |
| [+] Deluxe Touring Bike (silver) | 53 | 62 | 17,0 | 5,6 |
| [-] Men's Off Road Bike Fully | 67 | 90 | 34,3 | 6,6 |
| Rocky Mountain Bikes | 14 | 26 | 85,7 | 1,1 |
| Beantown Bikes | 12 | 15 | 25,0 | 1,4 |
| Silicon Valley Bikes | | | | 1,1 |
| Big Apple Bikes | 6 | 7 | 16,7 | 0,6 |
| Peachtree Bikes | 6 | 8 | 33,3 | 0,6 |
| [-] Deluxe Road Bike (Shimano) | 86 | 112 | 30,2 | 8,1 |
| town-Bikes | 10 | 12 | 5,6 | 1,1 |

Conditional Formatting

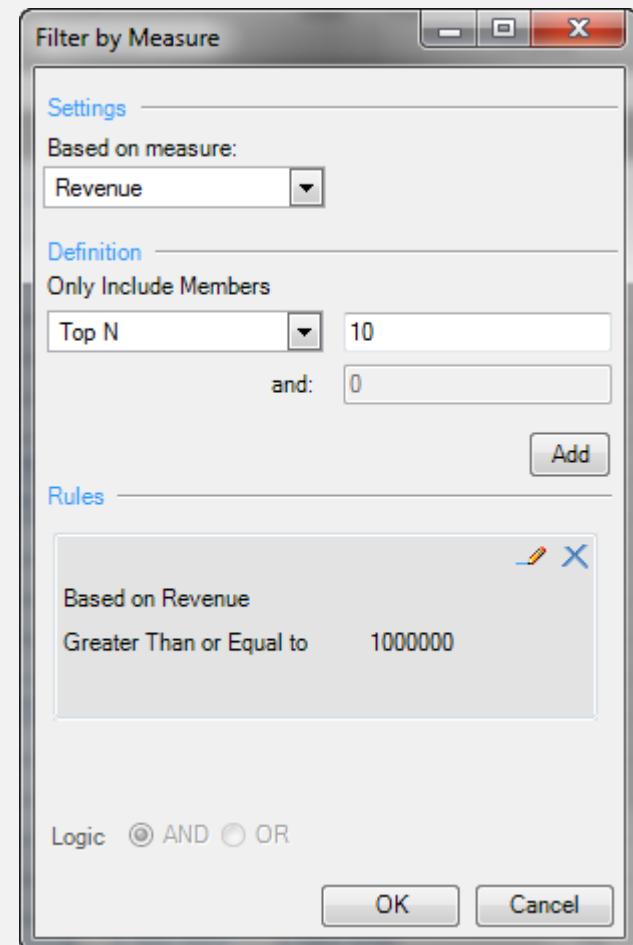
- Apply rules to measures for formatting purposes
- Various formatting options
- Main difference to Excel based conditional formatting: Rule is applied to a measure NOT to a cell



| 10 | Q4.2011 | Deviation | xx1-029 rev |
|----|---------|-----------|-------------|
| PC | PC | % | |
| 10 | 1.309 | 17,9 | 90.419,1 |
| 65 | 72 | 10,8 | 12.293,1 |
| 63 | 60 | -4,8 | 10.169,1 |
| 53 | 62 | 17,0 | 8.969,1 |
| 67 | 90 | 34,3 | 8.692,5 |
| 86 | 112 | 30,2 | 8.129,1 |
| 85 | 102 | 20,0 | 7.945,0 |
| 65 | 56 | -13,8 | 4.913,1 |
| 23 | 22 | -4,3 | 4.599,9 |
| 17 | 17 | 0,0 | 4.401,1 |
| 21 | 27 | 28,6 | 4.150,1 |
| 22 | 21 | -4,5 | 4.078,1 |
| 27 | 23 | -14,8 | 3.974,1 |
| 4 | 6 | 50,0 | 2.593,1 |
| 4 | 3 | -25,0 | 2.288,1 |
| 20 | 27 | 35,0 | 2.238,1 |
| 38 | 196 | 42,0 | 223,1 |
| | | | 186,9 |
| 52 | 168 | 10,5 | 111,1 |
| | 115 | 18,3 | 8,1 |

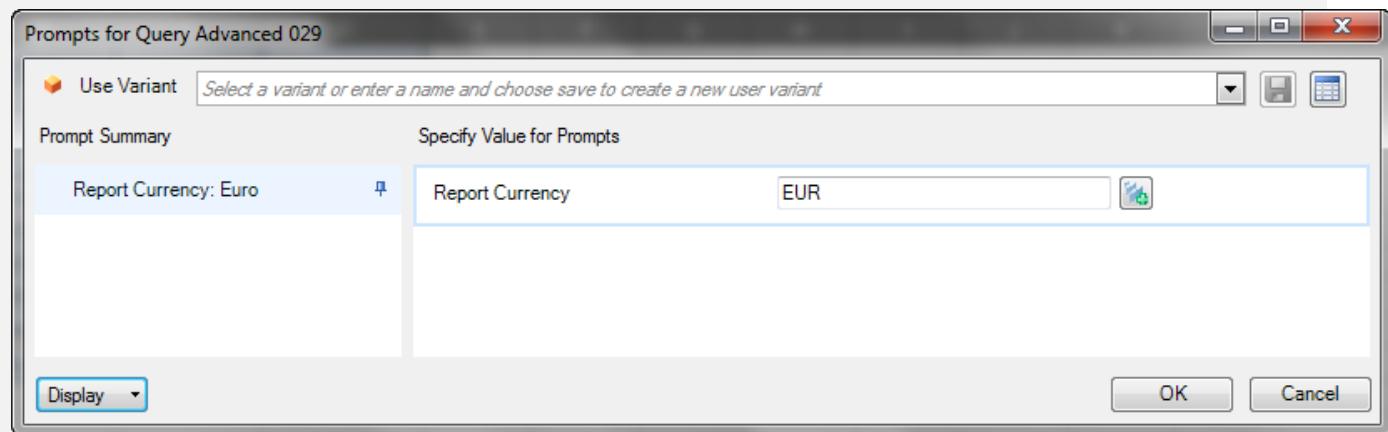
Filter by Measure

- Apply rules based on measures to filter members
 - Display only products with revenue above 1,000,000
 - Display Top 10 customers based on revenue
- (Terminology in BEx Queries: conditions)



Prompts (Variables)

- If a query has parameters that are filled in by user prompts (e.g. BEx variables), a separate screen is processed before the query result is displayed

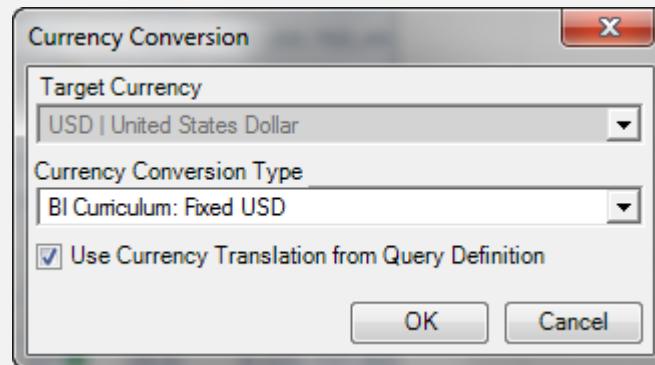


- Variable screen can be called again with a button



Currency conversion

- Convert currencies based on currency conversion types



Powerpoint Integration

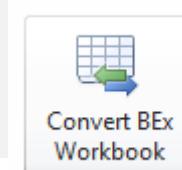
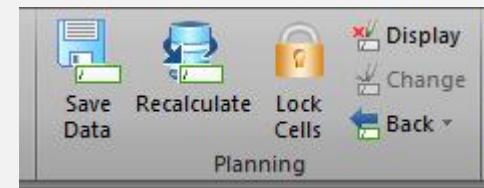
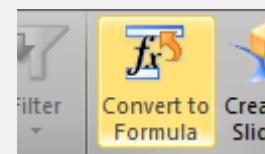
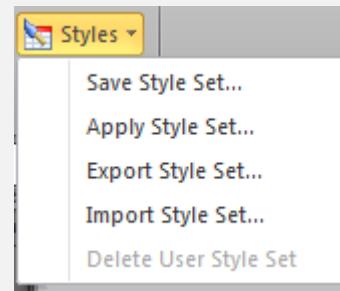
- Create slide adds your crosstab into open ppt document as new slide
- If presentation is opened with Analysis for Powerpoint, new data are read from the Server
→ Presentation contains always the latest data

The screenshot shows the SAP Analysis for Office ribbon interface. A yellow arrow points from the 'Create Slide' button in the 'Tools' group of the ribbon to a generated PowerPoint slide. The slide has a title placeholder 'Click to add title' and a table with the following data:

| Product Category | Revenue | Contr. Margin | Contr. Margin Ratio |
|------------------|------------|---------------|---------------------|
| Accessories | \$ 451.080 | 237.193 | 52,6 |
| E-Bikes | 1.998.759 | 877.156 | 43,9 |
| Offroad Bikes | 16.366.551 | 8.175.009 | 49,9 |
| Road Bikes | 16.625.058 | 7.697.729 | 46,3 |
| Touring Bikes | 21.063.649 | 11.667.844 | 55,4 |
| Trend Bikes | 120.645 | 66.797 | 55,4 |
| Overall Result | 56.625.743 | 28.721.726 | 50,7 |

Other features

- Features not covered in this presentation
 - Using style sets
 - Insert other components
 - Convert to formula
 - Data entry and planning
 - Application programming interface (API)
 - Conversion of BEx Analyzer workbooks
 - ...



- SAP BO Analysis for Office is an Excel based OLAP client with Powerpoint integration
- All standard OLAP operations are supported
- Use it for
 - Ad hoc analysis
 - Excel based dashboards or analytical applications
 - Excel based planning applications
- Tight integration with SAP BW

Authors Klaus Freyburger
Tobias Hagen

SAP BW on HANA Basics

Product

SAP Netweaver 7.5 on HANA SP4

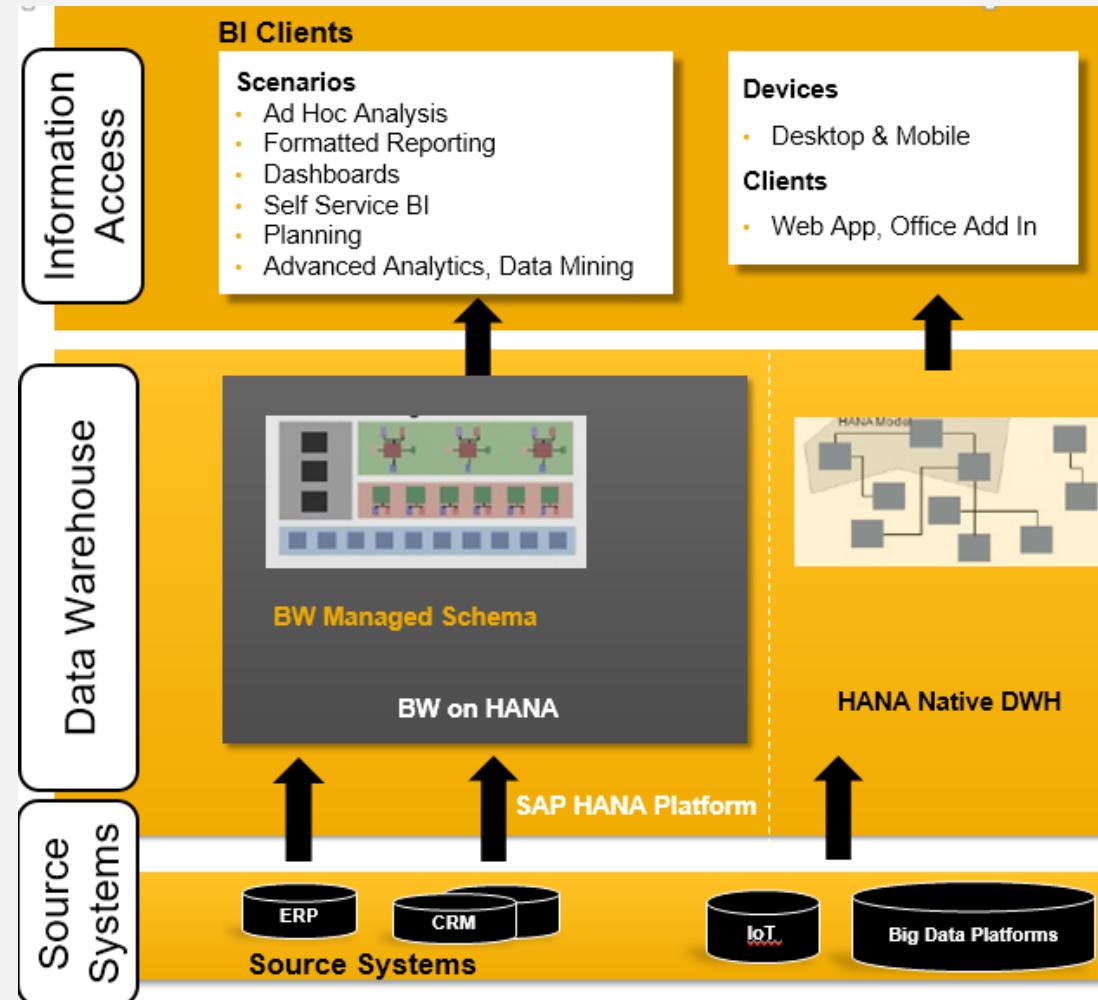
Abstract:

This chapter covers the basic aspects and concepts of data modeling with SAP Business Information Warehouse (SAP BW).

Content sponsored by mayato GmbH, SAP SE, Accenture Digital



SAP BW on HANA: Architecture



Datawarehouse: More than RDBMS?

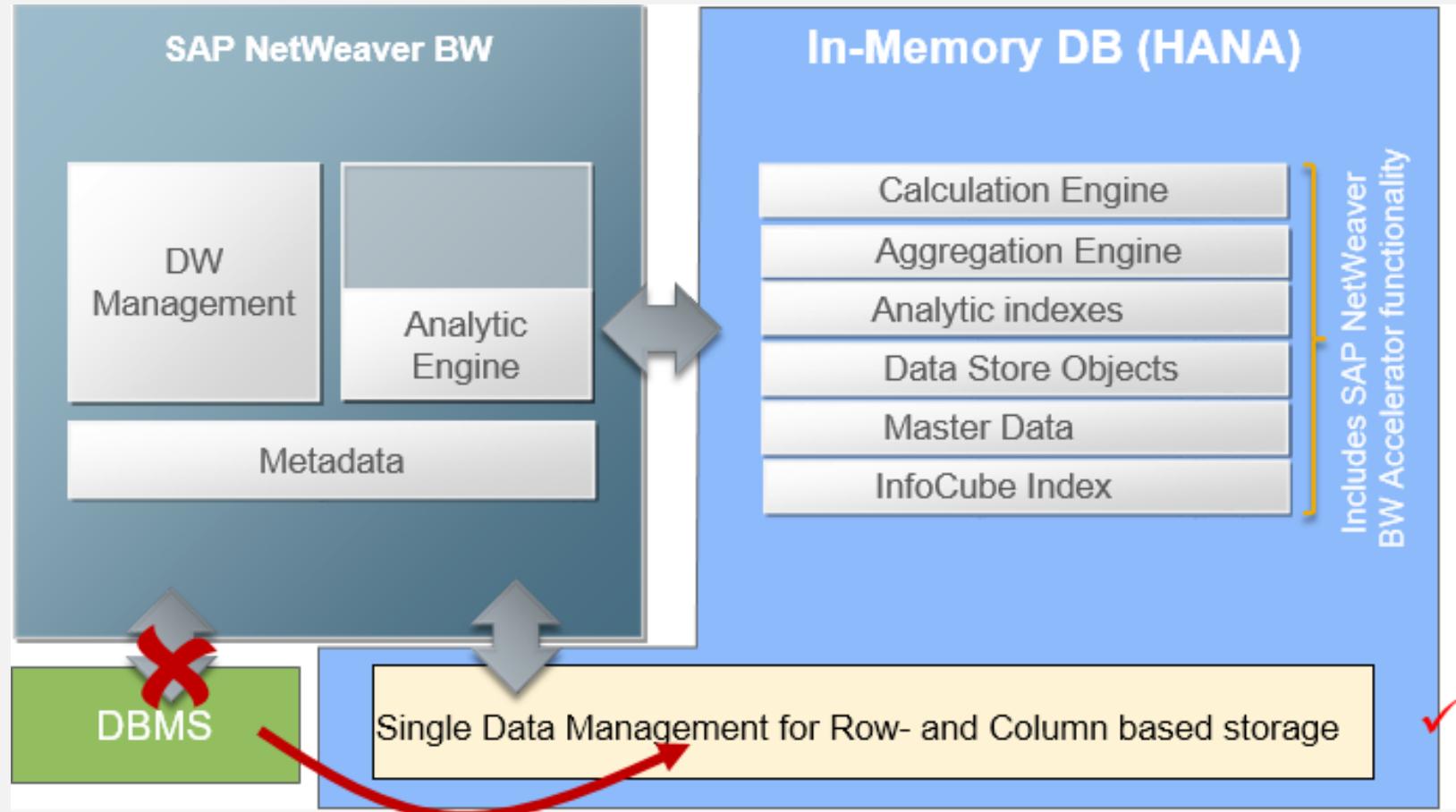
EDW = **DB** + **X***

- SQL
- storage / persistence
 - ACID
 - partitioning
 - indexing
 - clustering
- processing engines
 - calculations
 - aggregation
 - planning
 - data mining / predictive
 - search
- back-up, recovery, fail-over

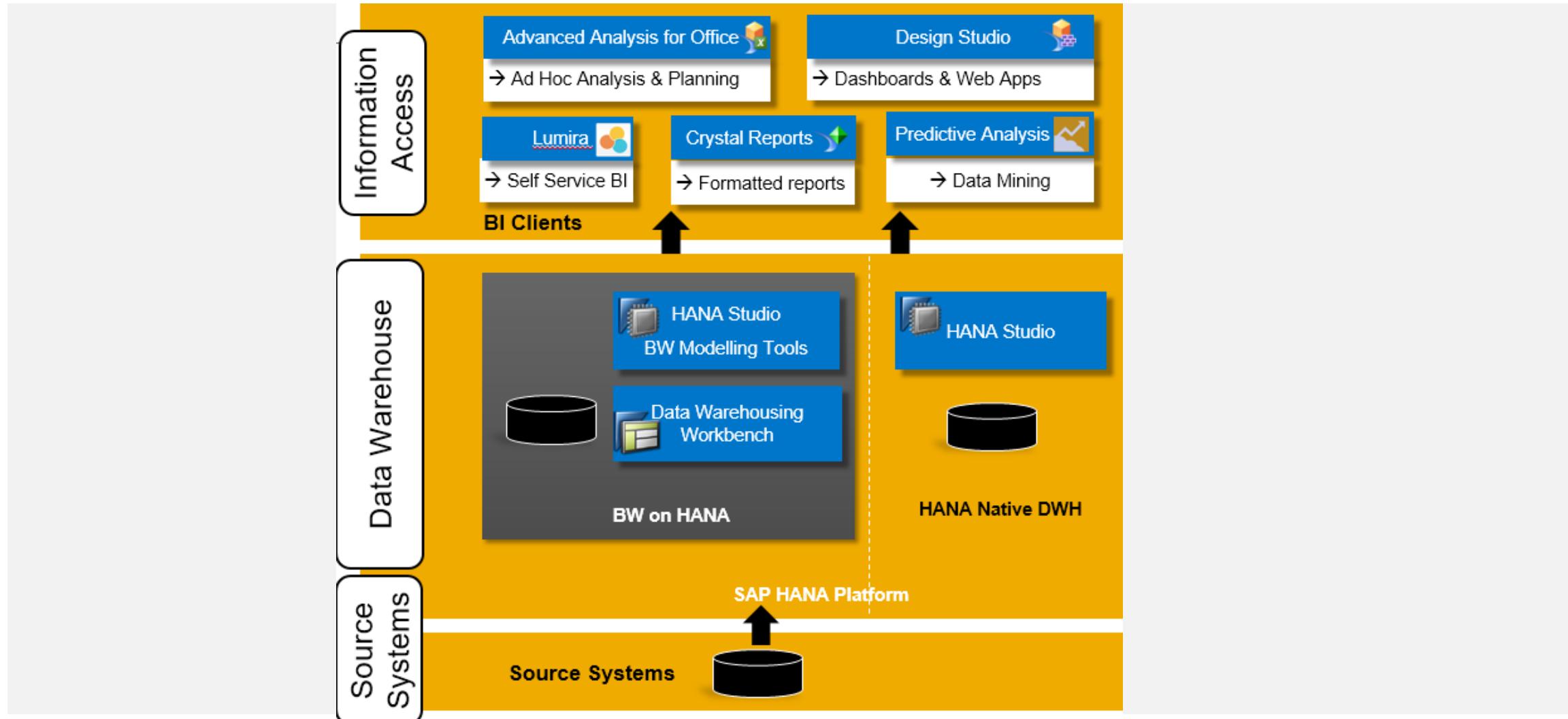
- modeling
 - analytic models
 - DW containers
 - data flows
 - transformations
 - security
 - conventions / standards (e.g. naming)
- lifecycle of models + data
 - incl. impact analysis + propagation
 - online, nearline, offline data
- scheduling + monitoring
- data integrity + compliance
- extraction + connectivity

* X is a DW application running on top of the DB

BW on Any DB vs. BW on HANA



SAP BW on HANA: Tools & Products



Übersicht Frontend- & Analyse-Tools



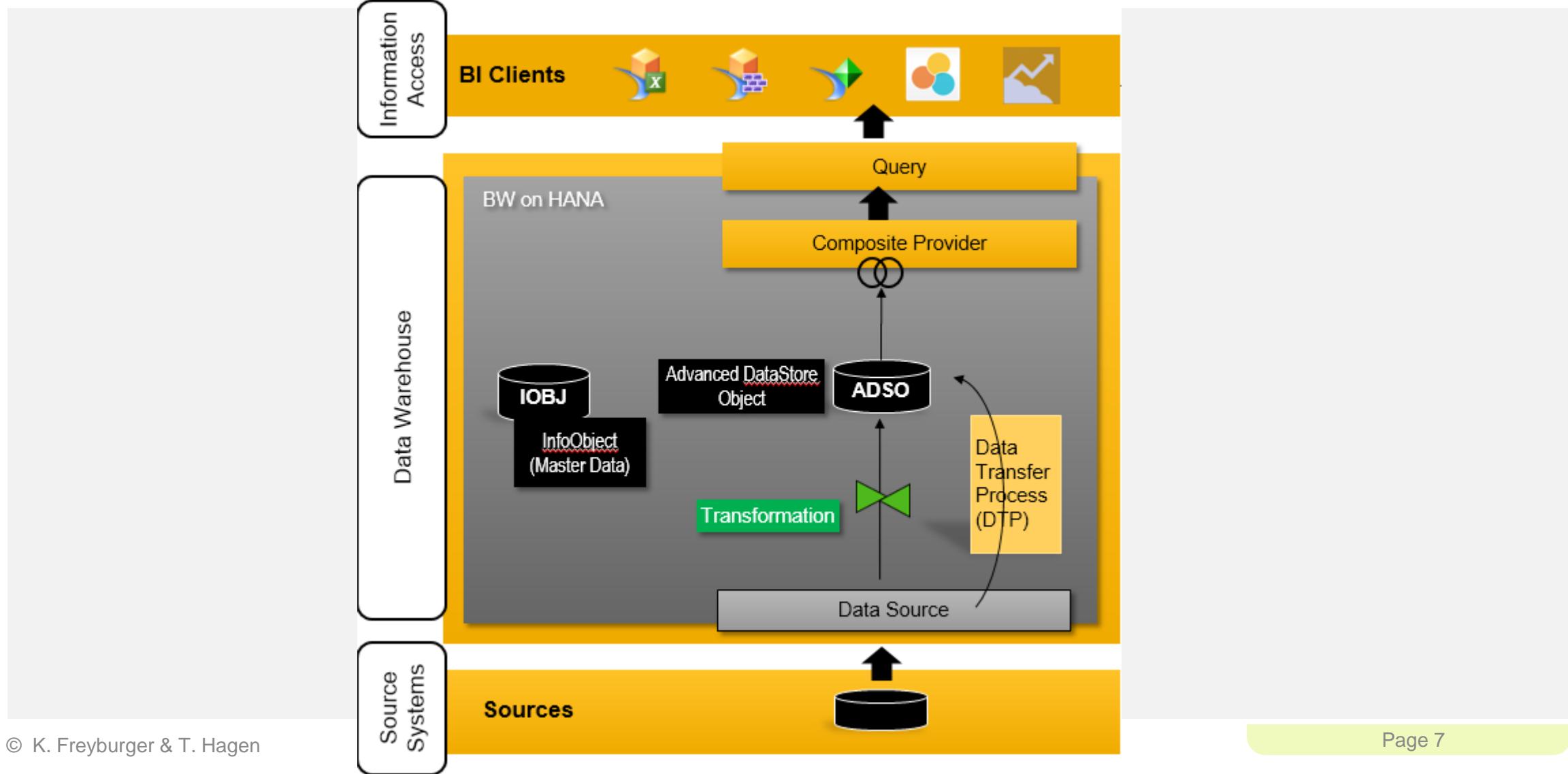
Übersicht Frontend- & Analyse-Tools 2.0

| | SAP-Produkt | Produktfamilie | aktueller Name | ggf. alte Namen | Quelle | Voraussetz. | Analyse-Zweck | Ad-Hoc | mobile | Ersteller | Endmedium | Beschreibung / Bemerkung | Hinweise | Ersatz / Alternative |
|---------------------------|-------------|----------------|---|--|---------------------------|----------------------|-----------------------------------|--------|--------|-------------|----------------------------|---|---|----------------------|
| Standard (im BW-Paket) | BEx | | WAD (Web Applikation Designer) | | BW-Query | | Analyse & Self-Service, Reporting | ↙ | ↘ | IT | Browser | Analyse- und Planungsanwendungen | ab 2017 aus der Wartung | |
| | BEx | | Analyzer | | BW-Query | | Analyse & Self-Service | ↑ | ↓ | Fachbereich | Rich-Client / Desktop | Analyse und Planung in MS Excel | nur mit 32-Bit Office | |
| | BEx | | Web Analyzer | | BW-Query | | Analyse & Self-Service | ↙ | ↘ | Fachbereich | Browser | Rahmen für Query | | |
| | BEx | | Report Designer | | BW-Query | | Reporting | ↓ | ↘ | IT | HTML, PDF | Druckoptimierte Webberichte | | |
| Premium | BO | Crystal | Dashboards, Crystal Dashboard Design, Crystal Presentation Design | Xoelius 2008, SAP BO Dashboards 4.0, SAP Crystal Dashboard Design 2011 | BW-Query, BO-Quelle | | Dashboarding & Apps | ↓ | → | IT | Browser | Flash-basierte Dashboards im Web/Excel-basisiert | | |
| | BO | Crystal | Reports (2008, 2011, 2013 & for Enterprise kurz 'CR4E') | | BW-Query, BO-Quelle | BO-Server (für CR4E) | Reporting | ↓ | → | IT | Dokument (pdf, doc etc.) | druckoptimierte Webberichte | | |
| | BO | | WeBI (WebIntelligence) | | BW-Query, BO-Quelle | BO-Server | Reporting | ↙ | → | IT | Browser, Dokument (pdf) | Druckoptimierte Analyseberichte (web-basiert), wie interaktives Crystal Reports | | |
| | BO | | Design Studio | ZEN, Analysis for Application Design | BW-Query, BO-Quelle | | Dashboarding & Apps | ↙ | ↑ | IT | Browser, mobile | Analyse im Web (druckbar) | geplant: Erweitertes Drucken u. Planung | |
| | BO | Analysis | edition for Microsoft Office (Excel, PowerPoint) | | BW-Query, BO-Quelle | | Analyse & Self-Service | ↑ | ↓ | Fachbereich | Rich-Client / Desktop | Analyse und Planung in MS Office | | |
| | BO | Analysis | edition for OLAP | Voyager, BO Voyager | BW-Query, BO-Quelle | | Analyse & Self-Service | ↑ | ↘ | Fachbereich | Browser | Abfragen im Web durch Drag'n Drop | | |
| | BO | | BO Explorer | | | | | ↑ | ↗ | | | | inhaltliche Überschneidung mit Lumira | |
| | | | Lumira | Visual Intelligence | BO-Quelle, HANA, Flatfile | | Analyse & Self-Service | ↑ | ↗ | Fachbereich | Rich-Client / Desktop, App | intuitives Navigieren, Stories erstellen | | |
| | | | Predictive Analysis | | | | Analyse & Self-Service | ↙ | ↓ | Fachbereich | Rich-Client / Desktop | Statistische Vorhersagemodelle, Clustering | | ★ |

unsere Empfehlung

Source: <http://blog.five1.de/es-wird-zeit-frontend-uebersicht-2-0/>

SAP Business Intelligence Platform



What is an InfoObject?

- InfoObjects are used to focus on **business requirements**.
 - InfoObjects are the “**bricks**” to build data structures inside SAP BW.
 - Technically it can be looked as a database field with properties (e.g. type, length, permitted values)
 - In former versions of BW all structures had to build based on InfoObjects
 - Newer Version allow usage of „ordinary“ database fields as well („Agility“)
 - InfoObjects represent business objects from an end user’s view.
 - The most important InfoObject types used for business analysis are **Characteristics** and **Key Figures**.

InfoObject: Characteristics (1)

- A **Characteristic** represents a business object (or concept, business term, business entity).
 - E.g. Customer, Product, Country, Product Category
 - In most cases every item has a key (language independent) and a description (language dependent)
 - Example:

| Customer | Language... | Medium description |
|----------|-------------|----------------------|
| 1000 | EN | Rocky Mountain Bikes |
| 2000 | EN | Big Apple Bikes |
| 3000 | EN | Philly Bikes |
| 4000 | EN | Peachtree Bikes |
| 5000 | EN | Beantown Bikes |
| 6000 | EN | Windy City Bikes |

Master Data

InfoObject: Characteristics (2)

- In addition to key and description a characteristic may have **attributes** which describes the business object in more detail.
 - Example: InfoObject “Customer” is a characteristic with attributes such as “Location”, “Sales Organisation” and “Country”

| Customer | Location | Sales Organisation | Country Key |
|----------|---------------|--------------------|-------------|
| 1000 | Denver | UW00 | US |
| 2000 | New York City | UE00 | US |
| 3000 | Philadelphia | UE00 | US |
| 4000 | Atlanta | UE00 | US |
| 5000 | Boston | UE00 | US |
| 6000 | Chicago | UE00 | US |

- Often attributes are used to form hierarchies
 - Example: Country → Sales Organisation → Customer

Note: What SAP calls a **Characteristic** is often referred to in the data warehouse community as a **Dimension**.

- A **Key Figure** (or variable, measure) is often used to **document the performance** of a business process over time.
 - It can be found in document records such as invoice, delivery note, purchase order, or goods receipt.
 - Examples: “Revenue”, “Sales Amount”
- Note: InfoObjects are unique inside SAP BW, and they are used to build the data structures for analysis requirements.
 - **Conceptually unique:** the semantics (meaning) of an InfoObject is uniquely defined system-wide inside SAP BW.
 - **Logically unique:** the data type, value range or field length is uniquely defined system-wide inside SAP BW.

InfoObjects are “Bricks” for Data Structures

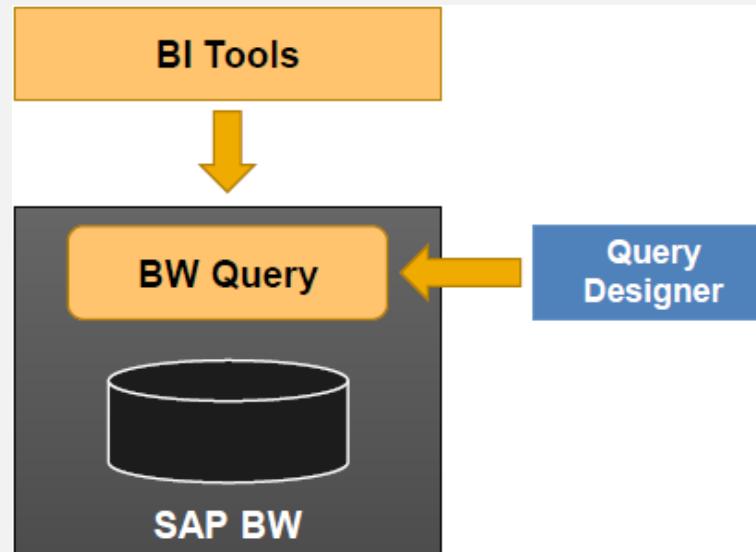
- A **Business Transaction** can be described by a data record which consists of a combination of characteristics and key figures
 - (and ordinary database fields potentially)
- When designing the Data Warehouse system granularity for storing data has to be designed (single business transactions or higher level e.g. month)

| OrderNumber | OrderItem | Calendar day | MU1CUST | MU1MATM | MU1QTYM | Base U... | MU1REVM | Currency | Discount |
|-------------|-----------|--------------|------------|----------|---------|-----------|-----------|----------|------------|
| 0000200034 | 000010 | 26.01.2007 | 0000010000 | FAID1000 | 31 | ST | 1.240,00 | USD | 62,00 |
| 0000200034 | 000020 | 26.01.2007 | 0000010000 | PRRD1000 | 6 | ST | 24.000,00 | USD | 1.200,0... |
| 0000200034 | 000030 | 26.01.2007 | 0000010000 | RHMT1000 | 8 | ST | 400,00 | USD | 20,00 |

Transaction Data

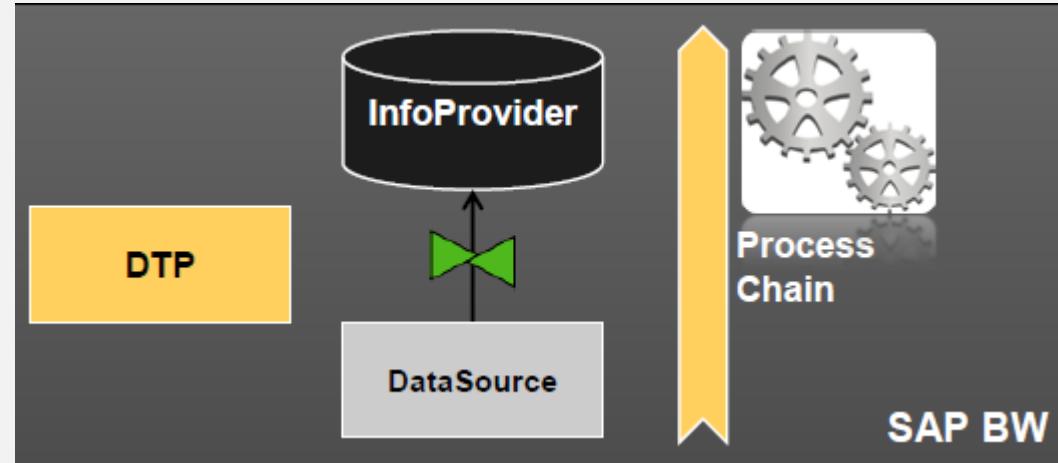
InfoProviders:

- Are the data containers inside SAP BW
- May store data records **physically** (persistent)
- May be accessed with front end tools such as SAP Business Objects Advanced Analysis for Office using a query



Data Flows in SAP BW

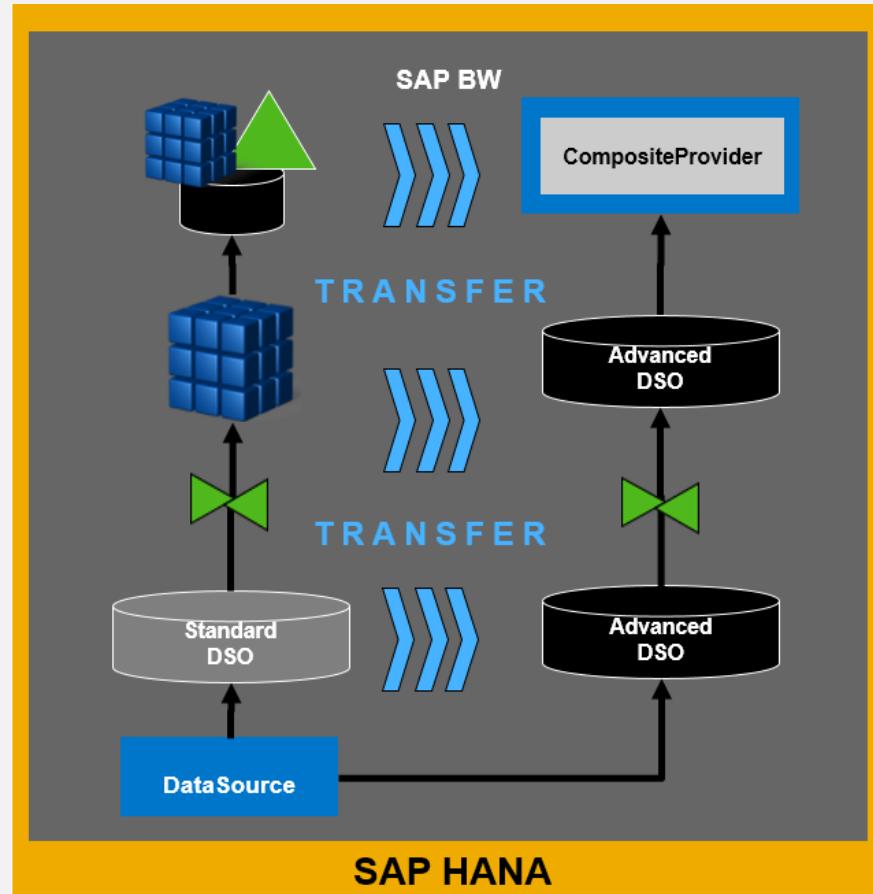
- **DataSource** – interface object to source system representing the source data structure
- **Transformation** – transforms the data according to defined rules
- **Data Transfer Process (DTP)** – triggers the data transfer between a source and target
- **Process Chain** – a sequence of processes that get triggered in a specified order



- InfoProviders in **BW on HANA**:
 - **physical data**: Advanced Data Store Objects (aDSO)
 - Can data optimized for fast multi-dimensional analysis or fast update (different settings)
 - **virtual data**: Composite Providers
- InfoProviders in **BW on AnyDB**:
 - **physical data**:
 - InfoCubes: optimized for fast multi-dimensional analysis.
 - DataStore Objects: can store high data volumes stored in normal database tables.
 - **virtual data**:
 - MultiProviders: Often used to create “views” above two or more InfoCubes (e.g. Plan / Actual)
 - VirtualProviders: Data stored somewhere outside SAP BW

Transition

- New projects should use the objects on the right!





- Can consist of InfoObjects and / or ordinary database fields
- Can be used in different layers depending on properties set
 - Templates can be used to define modelling properties

Modeling Properties

Activation:

Activate Data
 Write Change Log
 Keep Inbound Data, Extract from Inbound Table
 Unique Data Records

Special Types:

Planning Mode
 Direct Update
 All Characteristics are Key, Reporting on Union of Inbound and Outbound Data

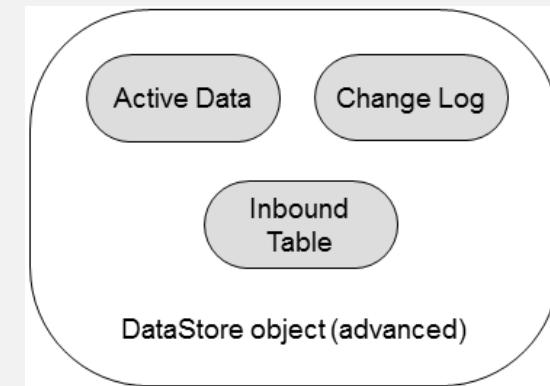
The selected properties match to a warehouse layer - data mart.

Model Template

- Enterprise data warehouse architecture
 - Data acquisition layer (including corporate memory)
 - Corporate memory - compression capabilities
 - Corporate memory - reporting capabilities
 - Data warehouse layer - delta calculation
 - Data warehouse layer - data mart**
- Classic objects

aDSO Structure and Modeling Properties

- consists of a maximum three tables: the **Inbound Table**, the **Change Log** and the table of **Active Data**.
- Activate Data
 - In general, the data is always written to the inbound table. In mode *Activate Data*, the data is written to the table for active data during the activation/compression process
- All Characteristics are Key, Reporting on Union of Inbound and Active Table
 - The properties are comparable to the InfoCube.
- Direct Update
 - data is written directly to the table of active data.
- Planning Mode
 - object can be used for planning.

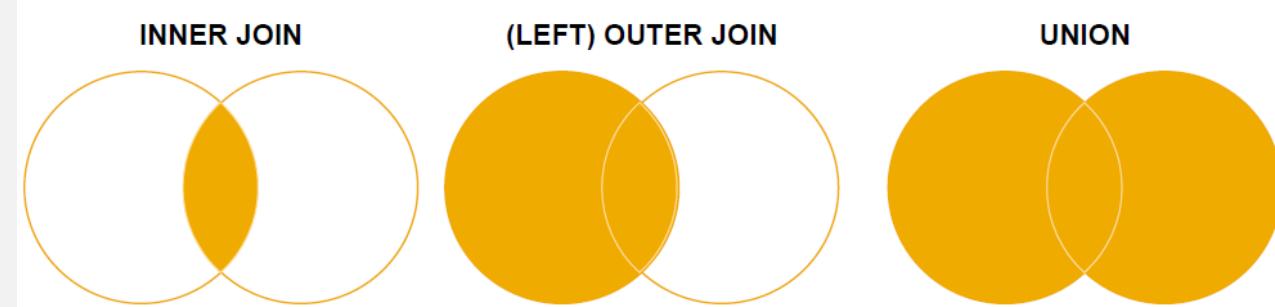


Composite Provider

- does not persist data
- can merge data from different BW InfoProviders and / or HANA views



- Can use union and join, supported join types:



- It is good practice to use a virtual provider for query = reporting

Database values

- Are stored in **internal format** appropriate to the database
 - Date as YYYYMMDD
- Are presented to a user in **external format** according to his local settings, e.g., in
 - Europe: Date DD.MM.YYYY, Numbers 1.234,56
 - US: Date MM/DD/YYYY, Numbers: 1,234.56

Transformation external \leftrightarrow internal format is performed by a **conversion routine**

- Example:

| Field | Descript. | Data type | Length | Exter... | Conv. Routines | Format |
|-----------|-----------|-----------|--------|----------|----------------|------------|
| SALESDATE | Salesdate | DATS | 8 | 10 | RSDAT | External ▾ |

Alphanumeric database fields

- Datatype **CHAR** in SAP
- Can store character and number values
- Have conversion exit ALPHA as default
 - Eliminates leading blanks after user input
 - User input of ,1000' and , 1000' refers to same object
 - Stores numbers with leading 0s in database
 - Numeric values are stored in natural order in database, e.g. 9000 first, then 10000

| Characteristic MUOCUST - I | | | | |
|----------------------------|----------|----|------------|-------|
| | Customer | L | Valid To | Valid |
| | 1000 | EN | 31.12.9999 | 01.0 |
| | 2000 | EN | 31.12.9999 | 01.0 |
| | 10000 | EN | 31.12.9999 | 01.0 |

Version 1.0

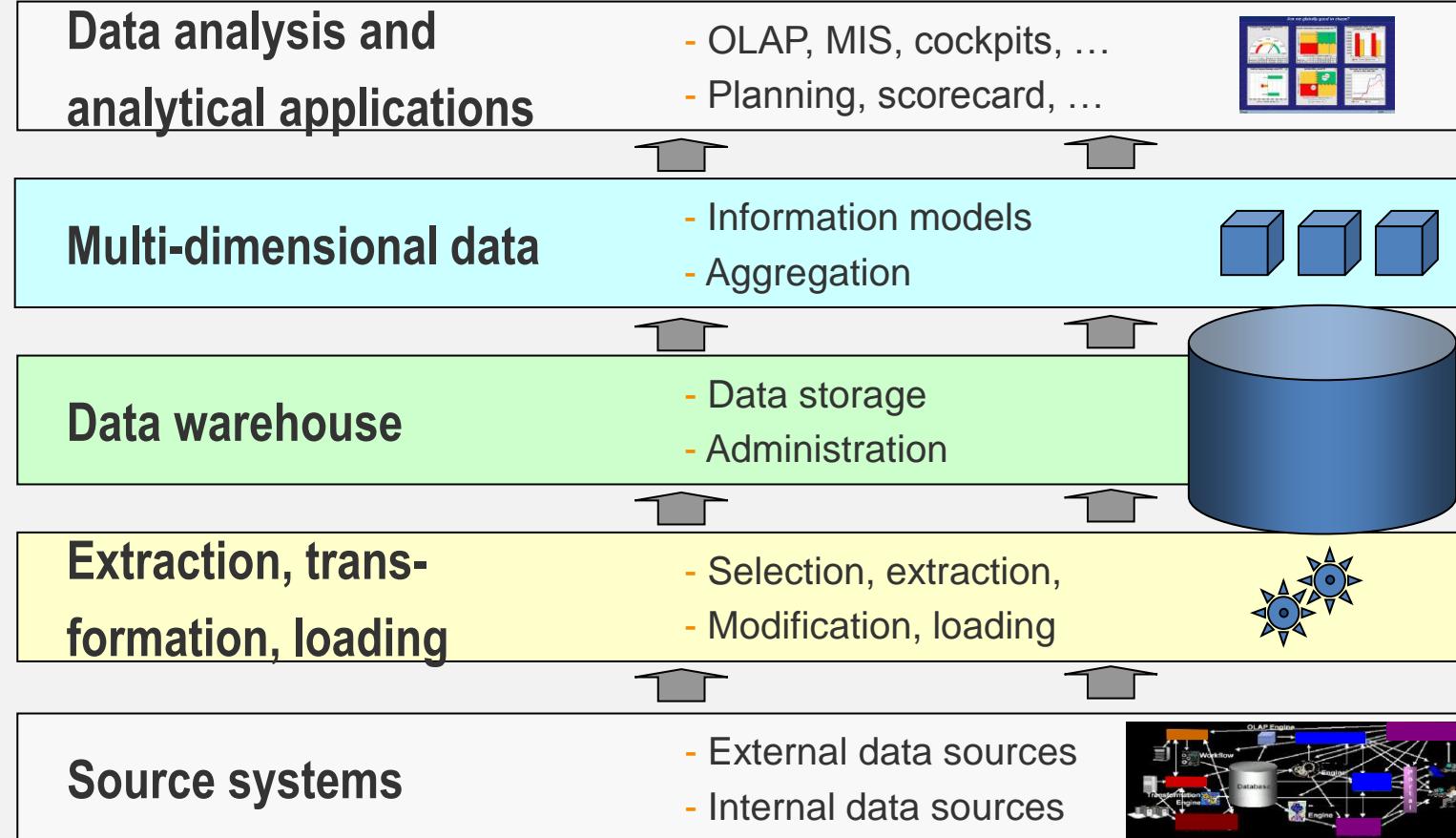
Authors Klaus Freyburger

Data Warehouse Architecture

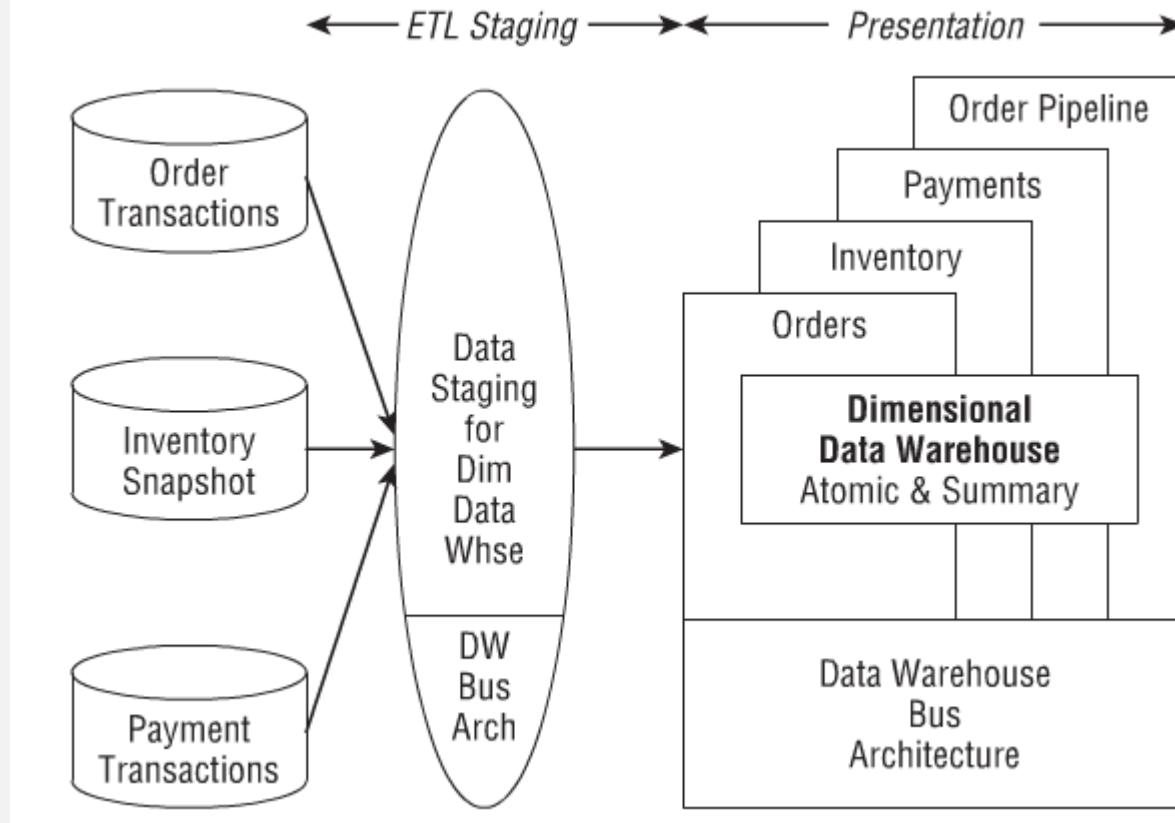
“The truth, the whole truth,
and nothing but the truth ...”



Source: Inmon, B. (September 9, 2006). The single version of the truth. *Business Intelligence Network*. Retrieved February 22, 2008 from <http://www.b-eye-network.com/view/282>

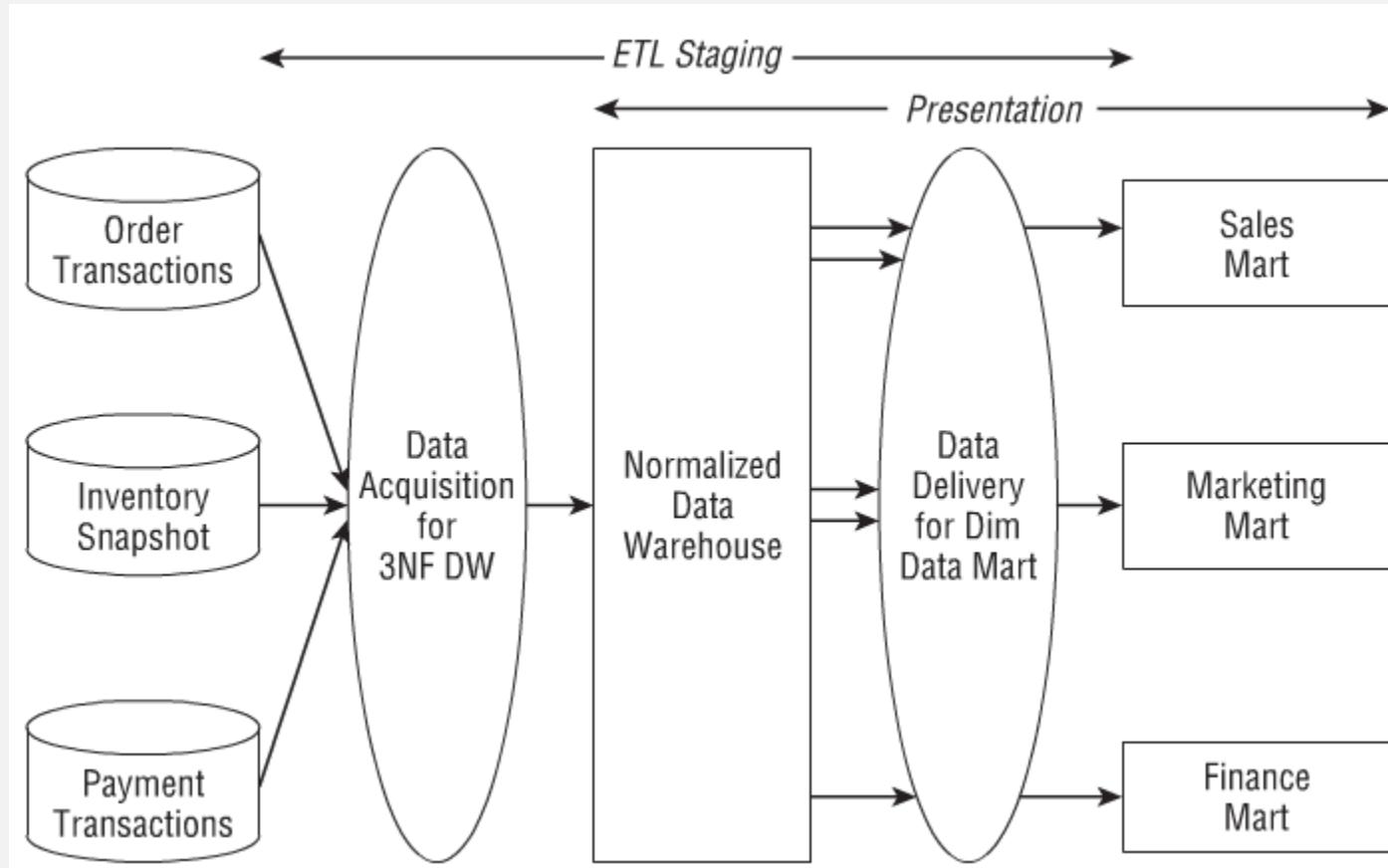


Kimball's Dimensional Data Warehouse



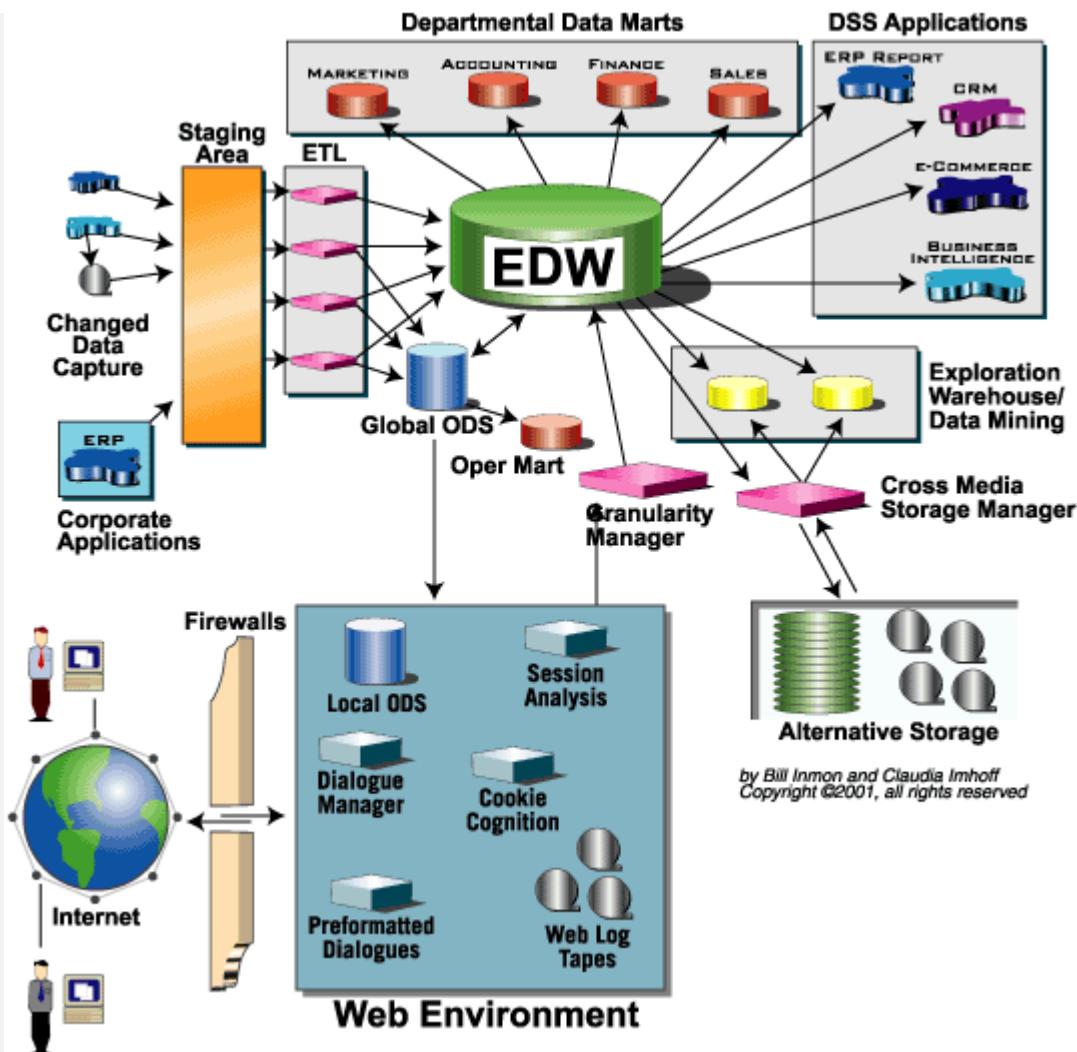
Source: Kimball/Ross, Kimball Group Reader, Wiley 2010, p 173

Inmon's Normalizes Data Warehouse

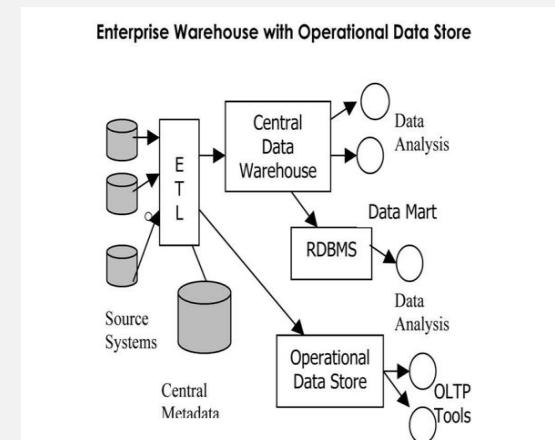
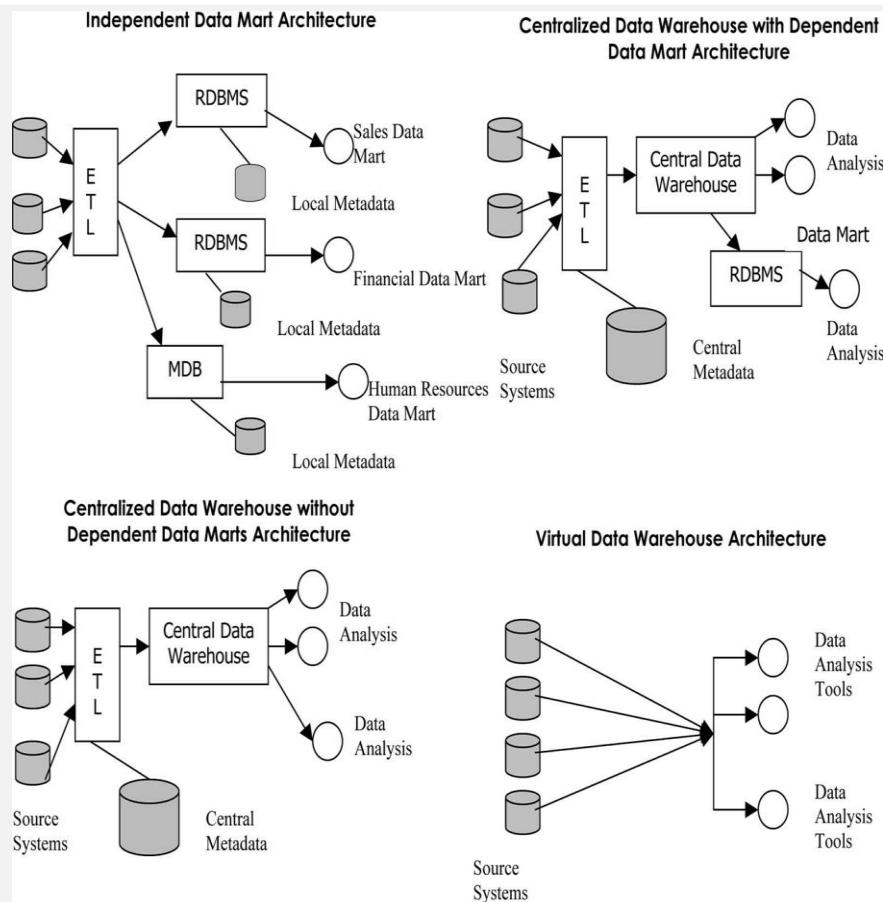


Source: Kimball/Ross, Kimball Group Reader, Wiley 2010, p 174

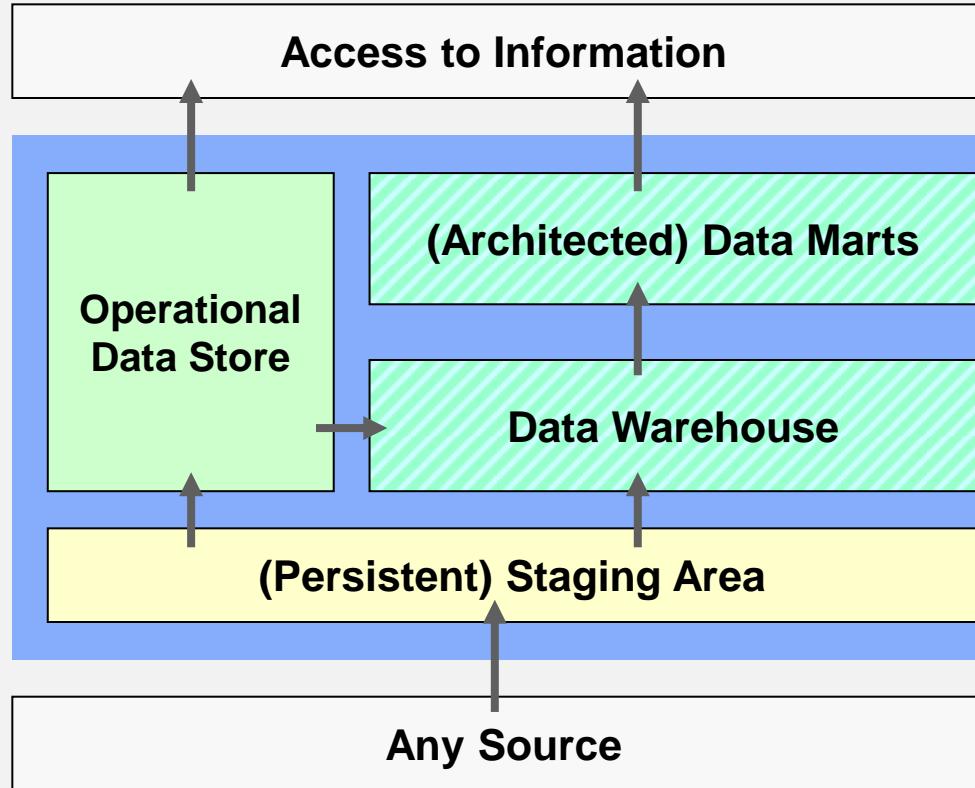
Inmon's Corporate Information Factory (CIF)



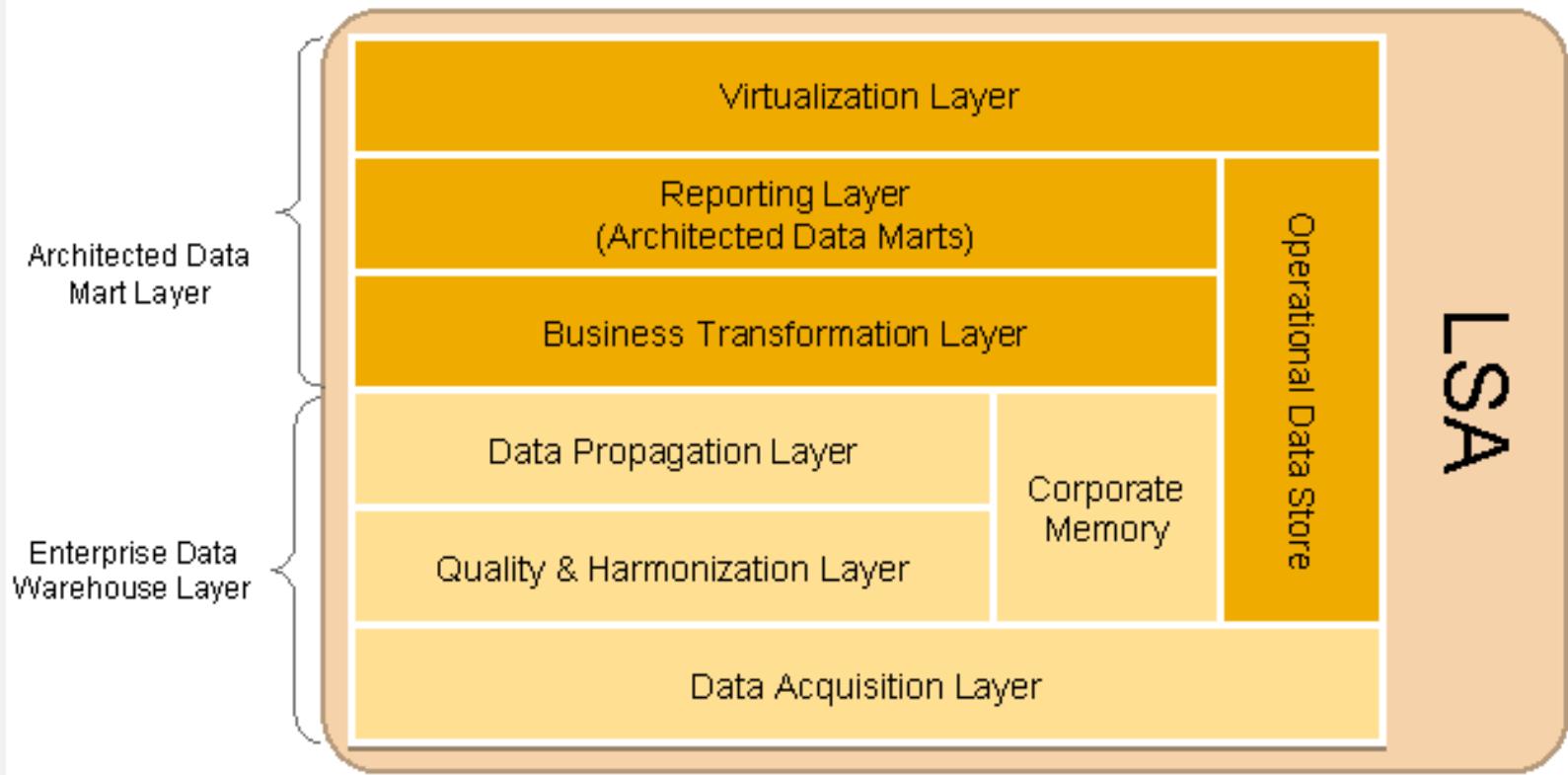
Data Warehousing Architecture Alternatives



Source: Sen, A., & Sinha, A. P. (January 2007). Toward developing data warehousing standards: an ontology-based review of existing methodologies. *IEEE Transactions on Systems, Man, and Cybernetics*. 37, 17-31.



Source: Architecture of a data warehouse. SAP AG. Retrieved February 22, 2008 from http://help.sap.com/saphelp_nw70/helpdata/en/43/4a86b4224847b6e10000000a11466f/content.htm



Source: Building and Running a Data Warehouse. SAP AG. Retrieved September 08, 2012 from http://help.sap.com/saphelp_nw73/helpdata/en/3a/2aad7b37e843d9bbb7a640335ddb4c/frameset.htm