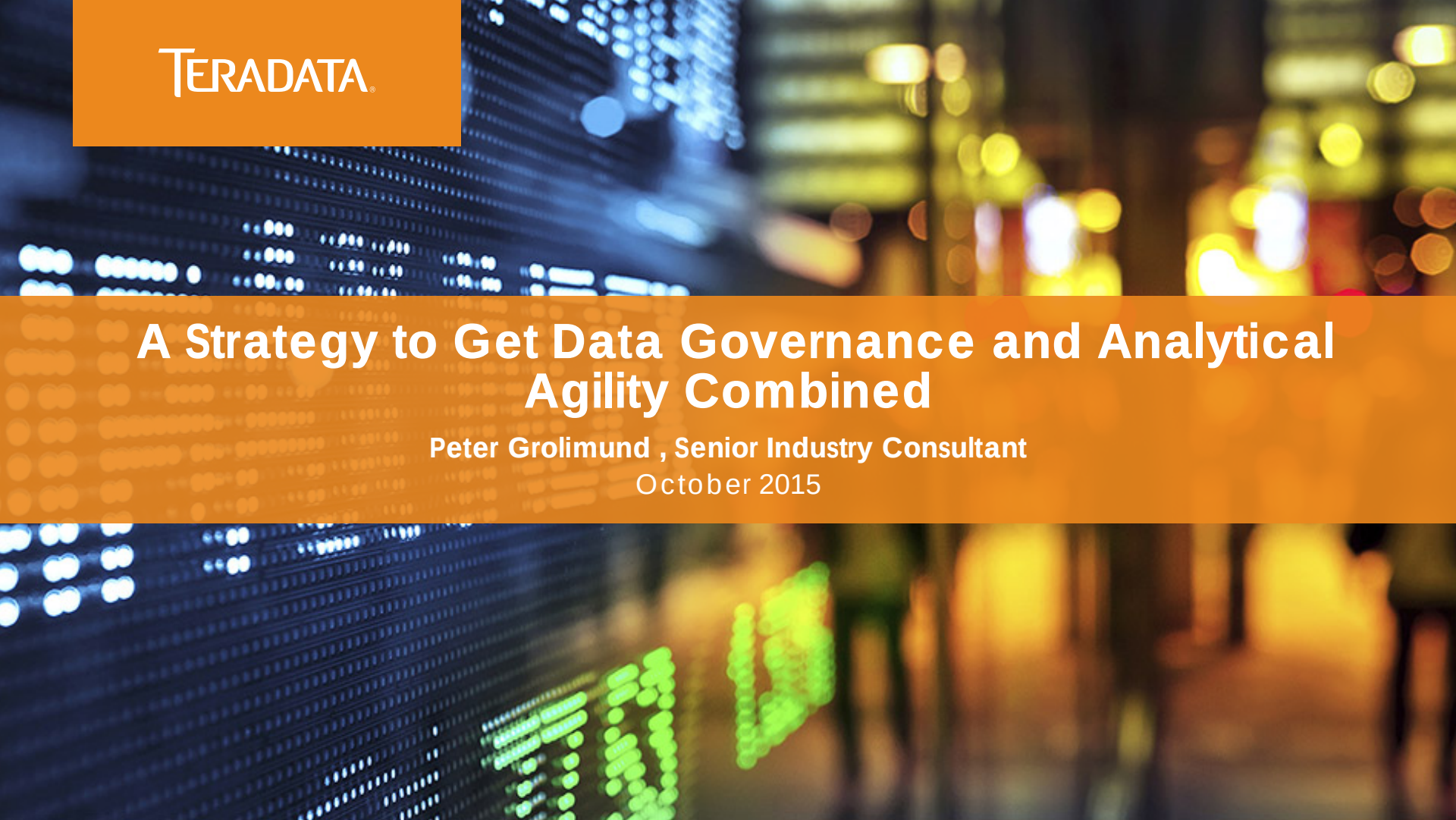

A Strategy to Get Data Governance and Analytical Agility Combined

Peter Grolimund , Senior Industry Consultant

October 2015

Agenda

Company

Drivers and Changes

Core of “our” business

Data – Analytics- Governance

Summary

TERADATA.

Teradata Company Background

Corporate Vision
Enabling data-driven business

Mission
Providing the world's best analytic data solutions to drive competitive advantage for our customers

2,600+ CUSTOMERS in **77** COUNTRIES

10000+ EMPLOYEES

TOP 10 public U.S. software company

Member of **S&P 500**

Financially **STRONG** and **GROWING** (Revenue of $2,732M)

1 End-to-End Solutions and Services

- Data warehousing
- Big data analytics
- Marketing applications

2 Industry Expertise and Experience

- Financial Services
- Communications
- Retail
- Manufacturing
- Healthcare
- Healthcare
- Government
- Travel/Transportation
- Media/Entertainment
- Energy/Utilities

3 Data Analytics Leadership

- Deep expertise
- Analytic engines
- Advanced algorithms
- Industry acclaimed

What Does This Mean For You?

TERADATA.

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TERADATA.

Personalized medicine and..data

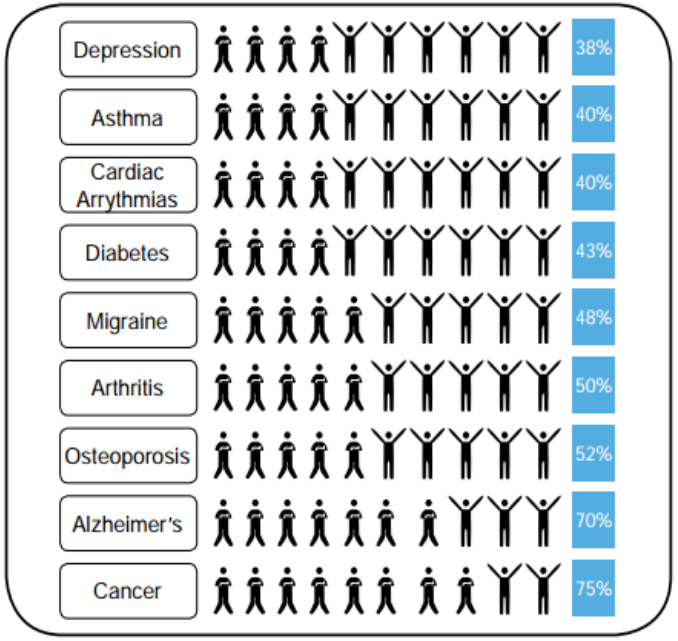

Figure 2. Percentage of patients for whom drugs are ineffective. (Source of data: Spear, B.B., Heath-Chiozzi, M., & Huff, J. (2001). Clinical application of pharmacogenetics. *TRENDS in Molecular Medicine, 7(5),* 201-204.) (Note that lack of efficacy in a given patient may reflect a complex interaction of factors and can also result from inadequate or inappropriate dosing regimens of a drug that would otherwise be effective, as well as lack of adequate patient compliance.)

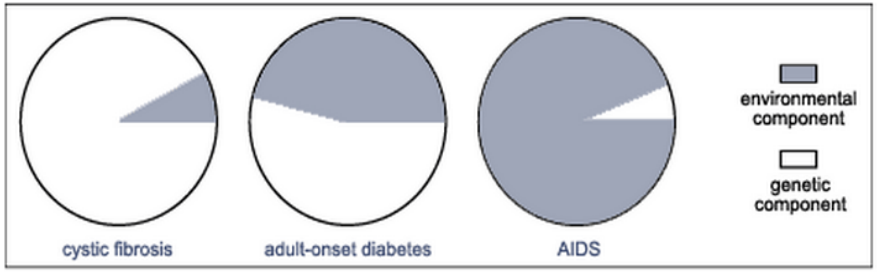

Figure 5 - Virtually all human diseases, except perhaps trauma, have a genetic component.

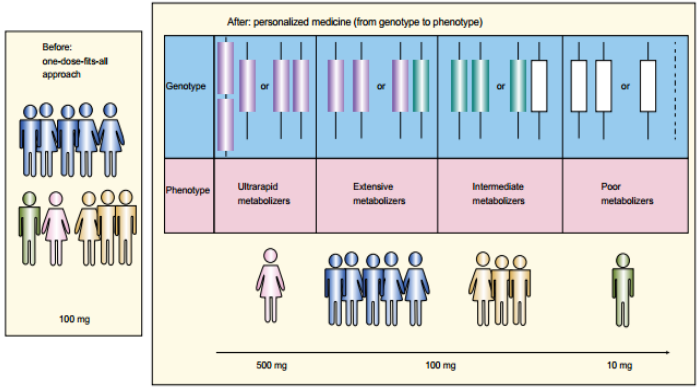

Figure 1. Representation of the trial-and-error or one-dose-fits-all approach versus personalized medicine. The left panel shows a situation in which everyone gets the same dose of a drug, regardless of genotype. The right panel shows a personalized medicine approach in which the dose of the drug is selected based upon genotypical, and therefore phenotypical, variability of the metabolizing enzyme. (Source: Xie, H., Frueh, F.W., (2005). Pharmacogenomics steps toward personalized medicine. *Personalized Medicine, 2(4),* 333.)

TERADATA.

Personalized medicine in the most extreme

Examples of "Personalized" Medical Devices

- ***Tinnitus masker*** *is personalized by the manufacturer to patient tinnitus. The tinnitus treatment custom-tailors the audio signals to suit the individual patient's hearing requirements*
- ***Pedicle screw spinal systems-*** *Spinal systems consisting of a rod/screw/hook/ connector kit are assembled by a surgeon to accommodate a patient's unique anatomy/physiology using MRI/CT imaging.*
- ***Software-based quantitative EEG analysis*** *to predict an individual's response to various psychotropic drugs. The device provides the probability of response to various medications to guide clinician in decision making.*
- ***The Zenith Fenestrated AAA Endovascular Graft*** *is indicated for the endovascular treatment of patients with abdominal aortic or aortoiliac aneurysms having morphology suitable for endovascular repair. The fenestrated device allows for treatment of patients with shorter proximal neck lengths (i.e., length of healthy aorta between the renal arteries and the aneurysm) as compared to those who can be treated using other endovascular grafts. Each device is tailored to the patient's individual aortic anatomy with openings in the graft material placed appropriately to maintain blood flow to branch vessels of the aorta.*
- ***The Artificial Pancreas Device System*** *is a device under clinical investigation that automatically monitors patient glucose levels and delivers patient-tailored insulin doses in people with diabetes. A computer-controlled algorithm connects the continuous glucose monitoring system and an insulin infusion pump to allow continuous communication between both devices and deliver a personalized treatment based on individual glucose patient readings.*

3D Printed Tracheal Splint

Physicians at the University of Michigan and Akron Children's Hospital utilized a computed tomography image, computer-aided design, and 3D printing to create a bioresorbable airway splint to treat a critically-ill infant with tracheobronchomalacia – a life-threatening condition that occurs when the airway walls are weak and the airways collapse during breathing or coughing.

The "personalized" tracheal splint for the patient was constructed based on CT images of the patient's airway and lungs. The device itself was "printed" by the 3D printer using polycaprolactone (PCL) – a degradable material that, over time, will dissolve, allowing the body to heal and grow around it. Upon receiving Institutional Review Board approval for use under FDA's emergency-use provisions, physicians successfully implanted the tracheal splint overlying the patient's airway, basically creating a placeholder for the cells to properly grow around it. One year after surgery, imaging and bronchoscopy showed an open airway while full resorption of the bioresorbable stent is expected to take 3 years.

This story serves as a powerful example of how parallel advances in multiple fields can come together to result in extraordinary advances in personalized medicine, and offers a glimpse into a future where truly individualized, anatomically-specific devices may become a standard part of patient care.

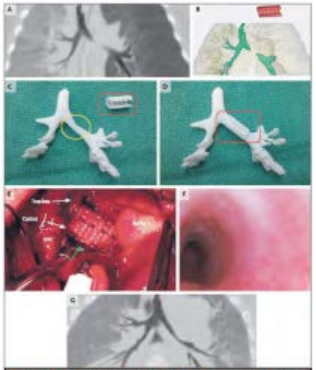

Figure 1. Placement of the Printed Airway Splint in the Patient.
Panel A shows the airway in expiration before placement of the splint; the image was reformatted with minimum-intesity projection. Panel B shows the patient-specific computed tomography-based design of the splint (red). Panel C shows an image-based three-dimensional printed cast of the patient's airway without the splint in place, and Panel D shows the cast with the splint in place. Panel E shows intraoperative placement of the splint (green arrow) overlying the malacic left mainstem bronchial segment. SVC denotes superior vena cava. Panel F shows the bronchoscopic view, from the carina, of the left mainstem bronchus after placement of the splint. Panel G shows the airway in expriration 1 year after placement of the splint; the image was reformatted with minimum-intensity projection.

From: Bioresorbable Airway Splint Created with a Three-Dimensional Printer N Engl J Med 2013; 368:2043-2045.

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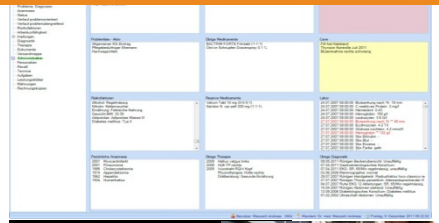
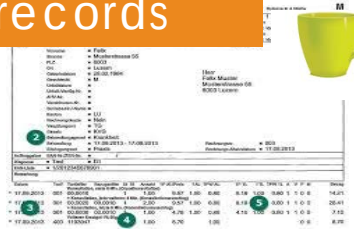
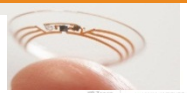
And more…

Traditional Patient records



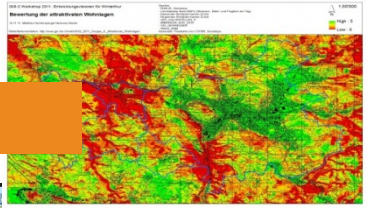


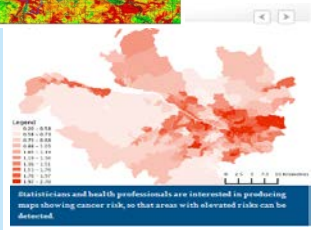
Sensors/apps

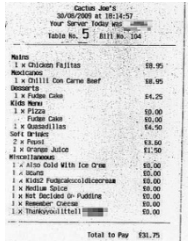


Behavior

Environment







Genome

TERADATA

EHR…

imshealth
INTELLIGENCE APPLIED.

500+ million
patient-anonymous records

100,000
suppliers

716,000
reporting facilities

1,400,000
products

45+
billion
healthcare
transactions
processed annually

CPRD
MORE DIMENSIONS TO DATA

CPRD observational data contributes to research in the following areas:

Medication and devices
- Drug utilisation, compliance and persistence
- Pharmacovigilance
- Pharmacoepidemiology
- Pharmacoeconomics
- Life cycle planning
- Licence extension research

Health care interventions
- Comparative effectiveness research

Outcomes
- Clinical outcomes
- Patient Reported Outcomes

Public health research
- Epidemiology
- Health Services research
- Risk management research
- Risk-benefit research
- Risk score development

Cutting edge research
- Clinical trials
- Genetic, geno-pheno studies

CPRD observational data resources and services
- Disease and drug registers
- Pan European and US data

FDA wants to use EHRs to assess drug side effects

January 16, 2014, by Kevin McCarthy

TERADATA.

Agenda

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Drivers and Changes

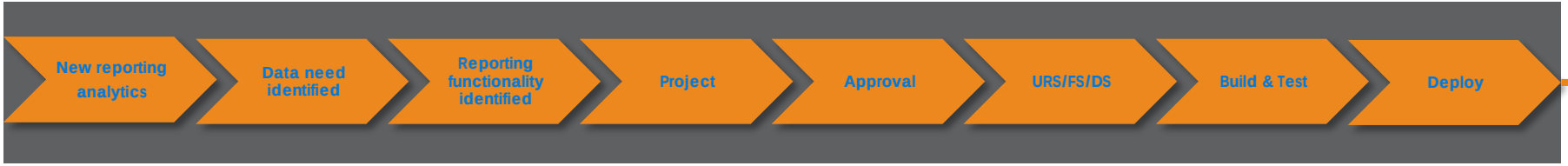
Core of “our” business

Data – Analytics- Governance

Summary

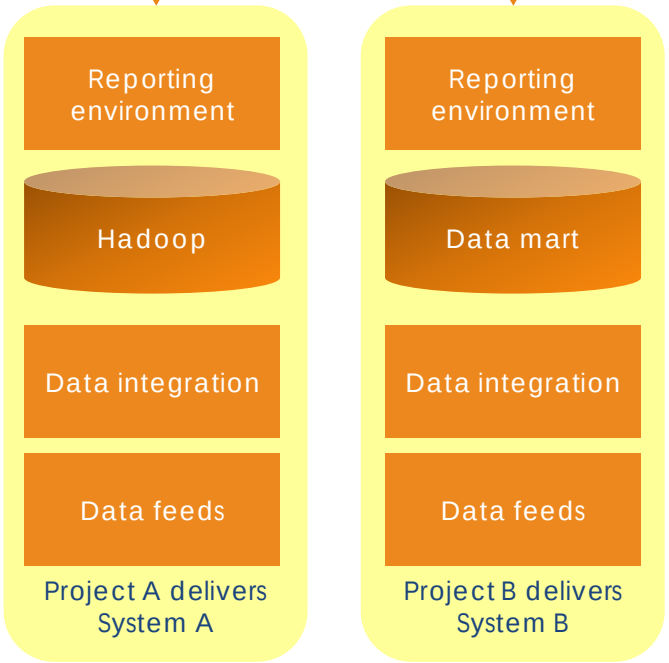
TERADATA.

A new system and a new syste...

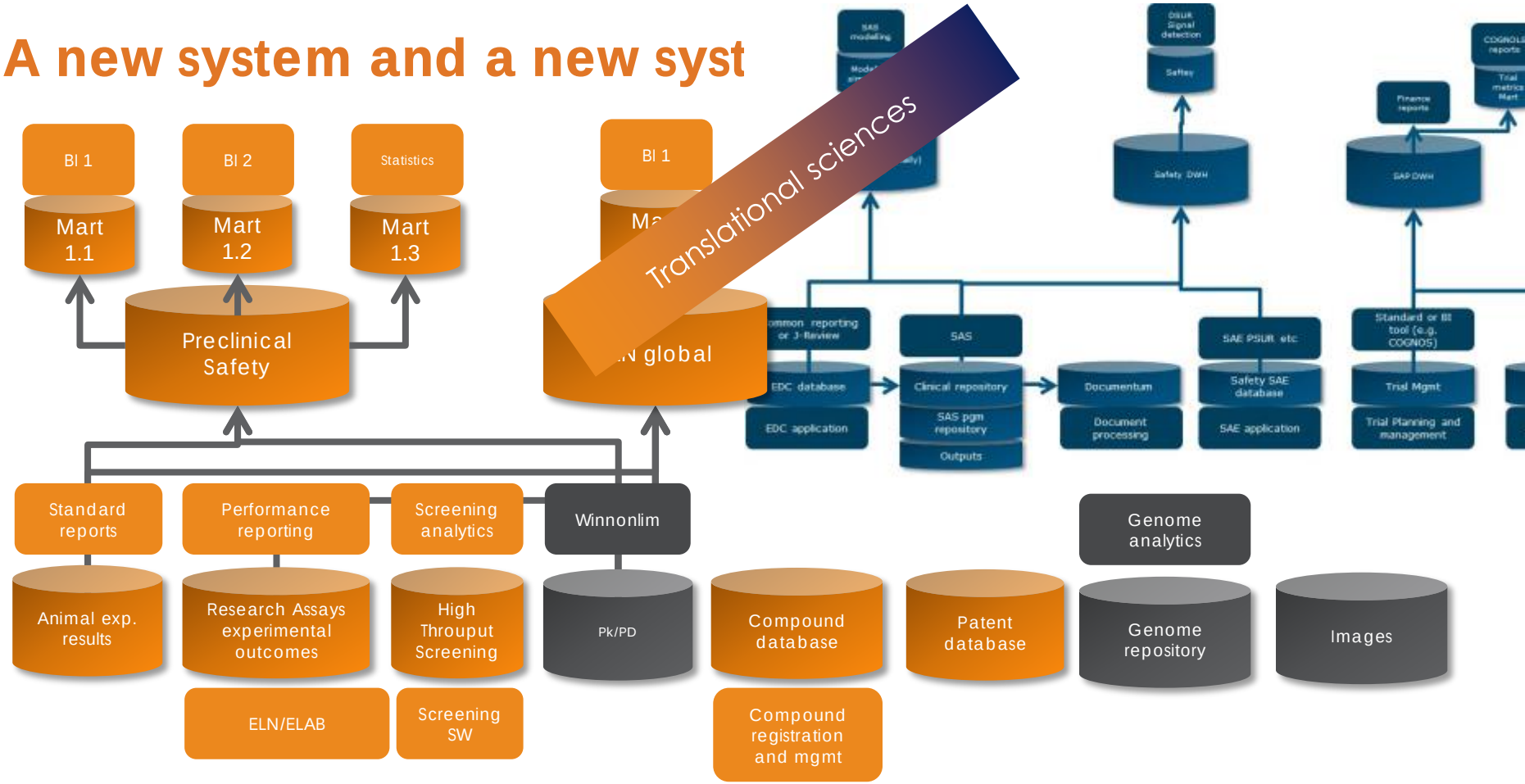


- New data categories ('non' structured)
- New analytical tools and methods (MapReduce, SPOTFIRE, R....)
- New modeling tools (SAS, R, ...)
- Validation cycle takes time (several months)
- URS/FS/DS built on 'ideas' (documents)
- Data integration performed with different technologies and different ways (semantic not aligned)
- Code lists and references in different versions (WHO, SNOMED, ...)
- Time-dependent analytics not always possible
- Geographic analytics not always possible
- Public data integration performed several times (governance)

- Data integration impacts those who do not profit
- Internal standards
- CRO connectivity and usage of analytics not easy to handle (access rights etc.)
- Transactional systems change, provide their own reporting tools



A new system and a new syst



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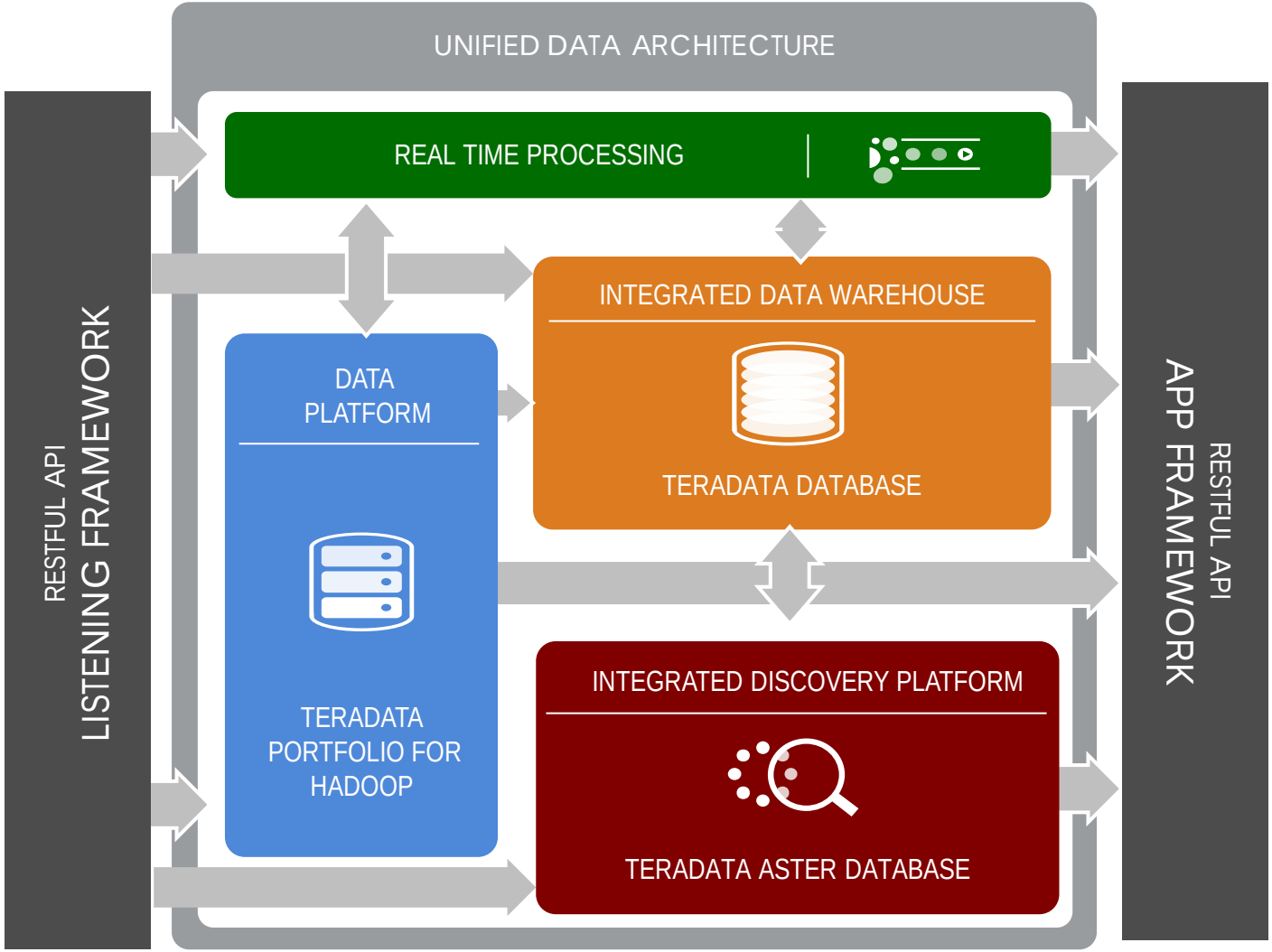

UNIFIED DATA ARCHITECTURE
RESTFUL API
LISTENING FRAMEWORK
REAL TIME PROCESSING
INTEGRATED DATA WAREHOUSE
TERADATA DATABASE
DATA
PLATFORM
TERADATA
PORTFOLIO FOR
HADOOP
INTEGRATED DISCOVERY PLATFORM
TERADATA ASTER DATABASE
RESTFUL API
APP FRAMEWORK

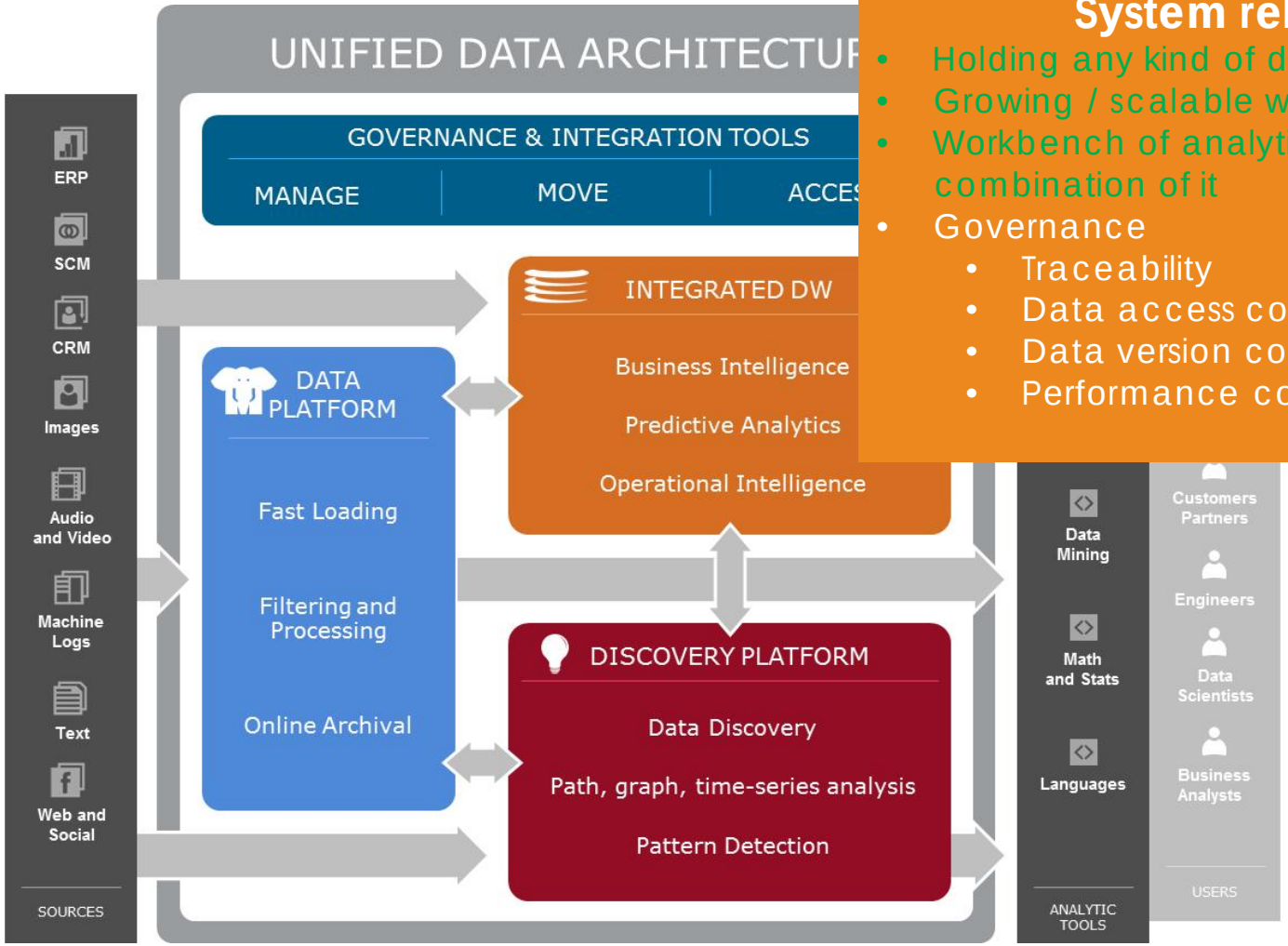
User requirements in a nut-shell

Process related

- Flexible Governance of the analytical process(es) controlled by the business
- Reproducibility
- Collaboration in the process with externals

System related

- Holding any kind of data
- Growing / scalable with the needs
- Workbench of analytical tools and combination of it
- Governance
  - Traceability
  - Data access control
  - Data version control
  - Performance control



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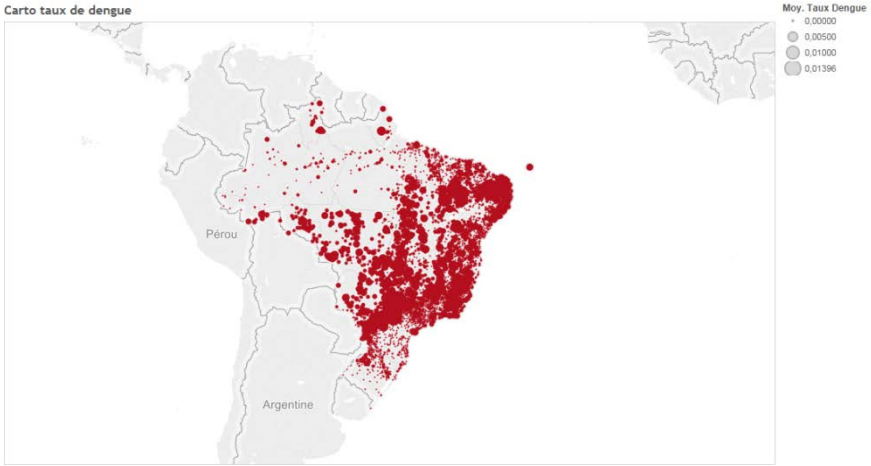
TERADATA.

New analytical approaches

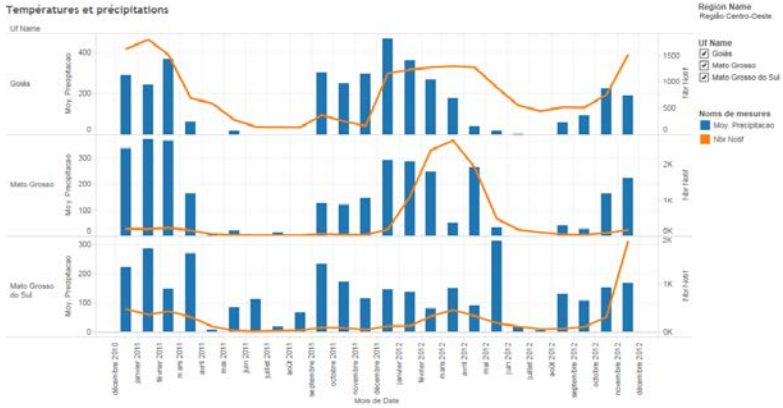
Data

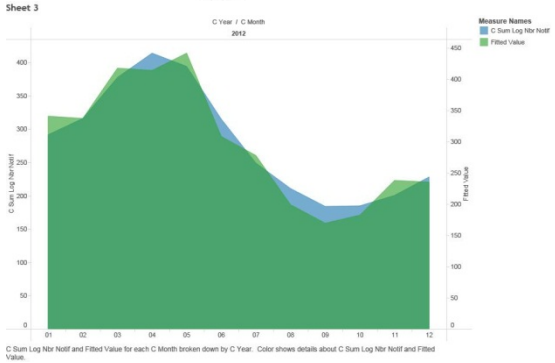
Wikipedia search

- Google Trends
- Meteorological data
- Twitter
- Existing case reporting
- Future: Topography, and population density

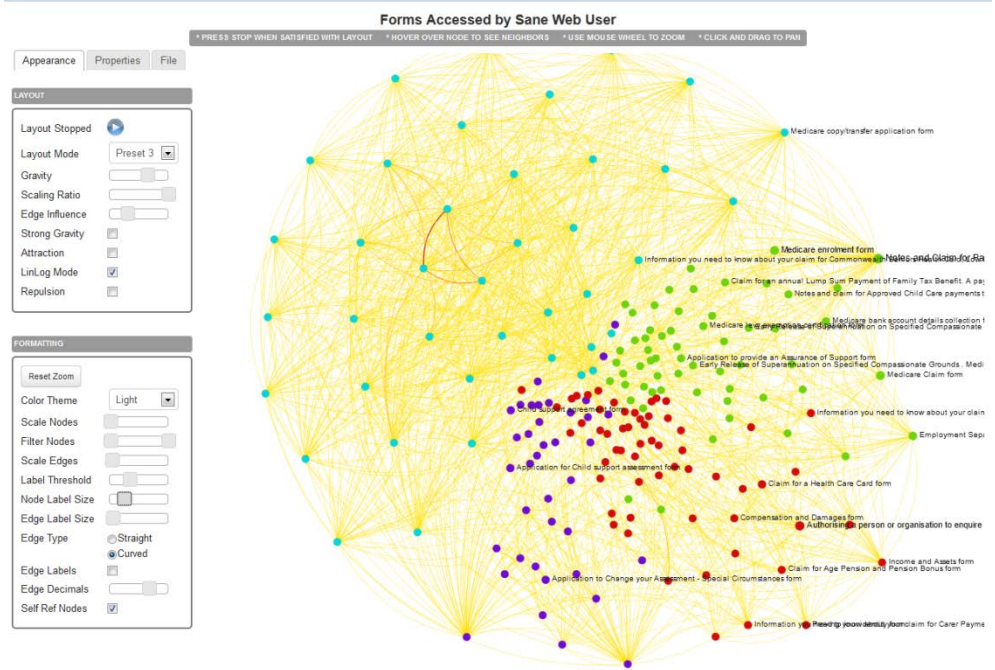


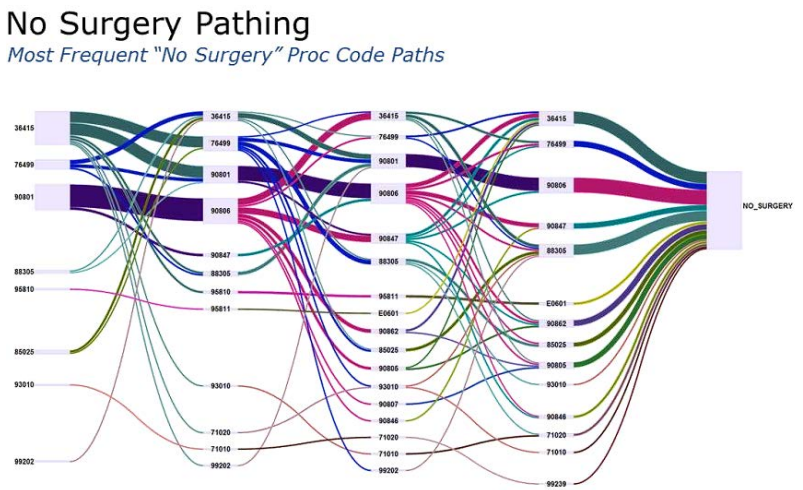
Forecast of Dengue





And visualizations





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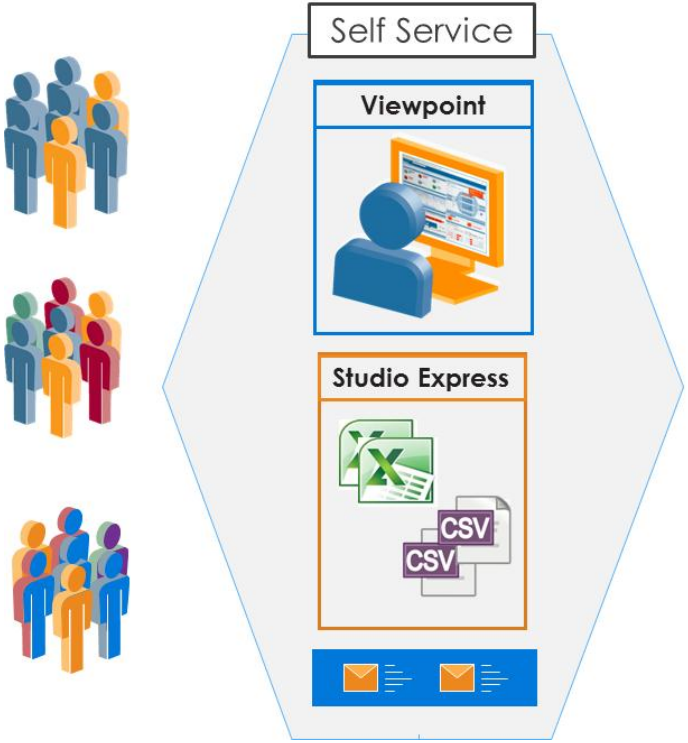
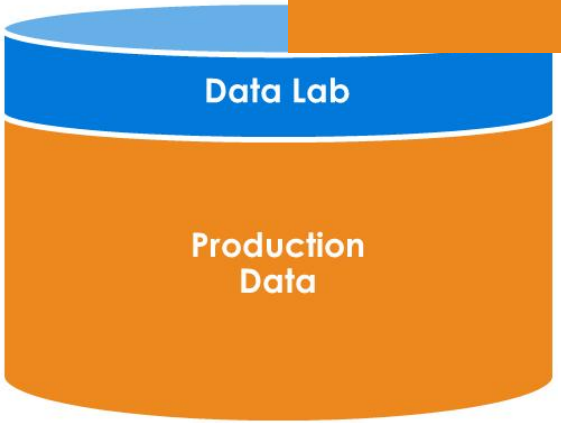
Ad hoc integration and analysis (

Process related

- Flexible Governance of the analytical process(es) controlled by the business
- Reproducibility
- Collaboration in the process with externals





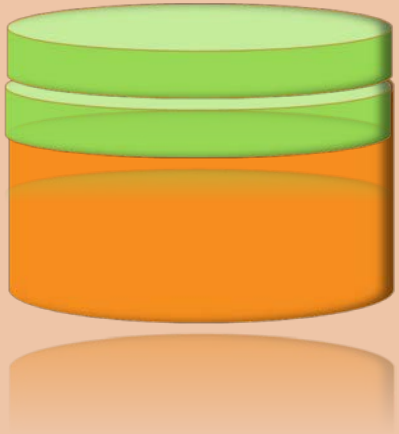
- ✓Load experimental, untested data from external sources
- ✓Rapid prototyping, exploratory and experimentation analysis
- ✓Easily join to production data

TERADATA.

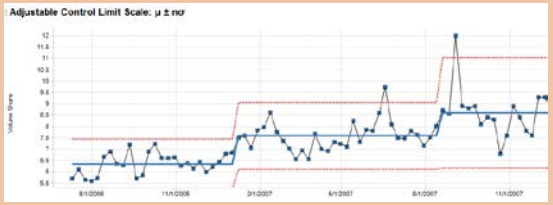
Internal data sources

External data sources

Data integration layer



The analytical layer

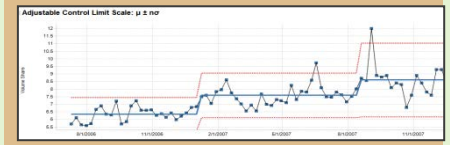


Internal data sources

External data sources

Data lab extension

The analytical layer



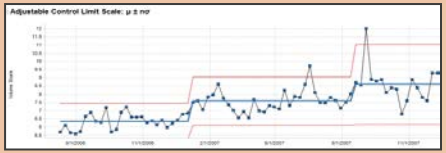
URS

Internal data sources

External data sources

Data integration layer

The analytical layer



TERADATA

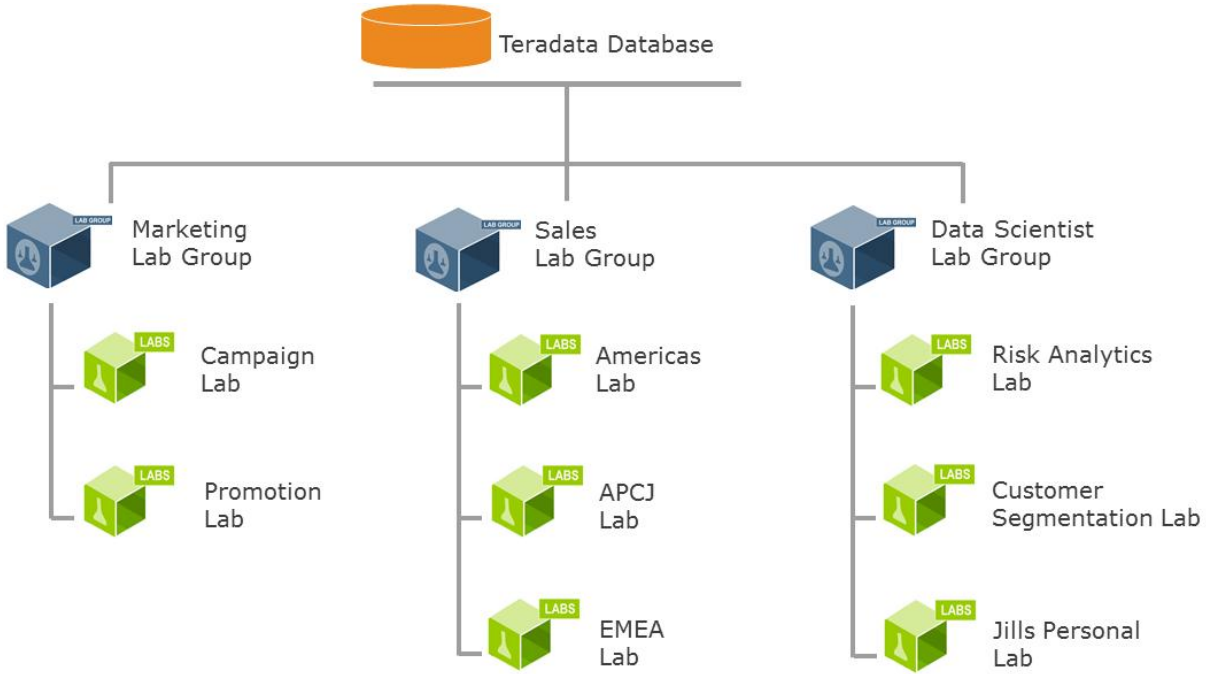
User Requirement Specification

The URS is the result of a pilot
The pilot controlled by a business process

Performance Qualification (PQ)

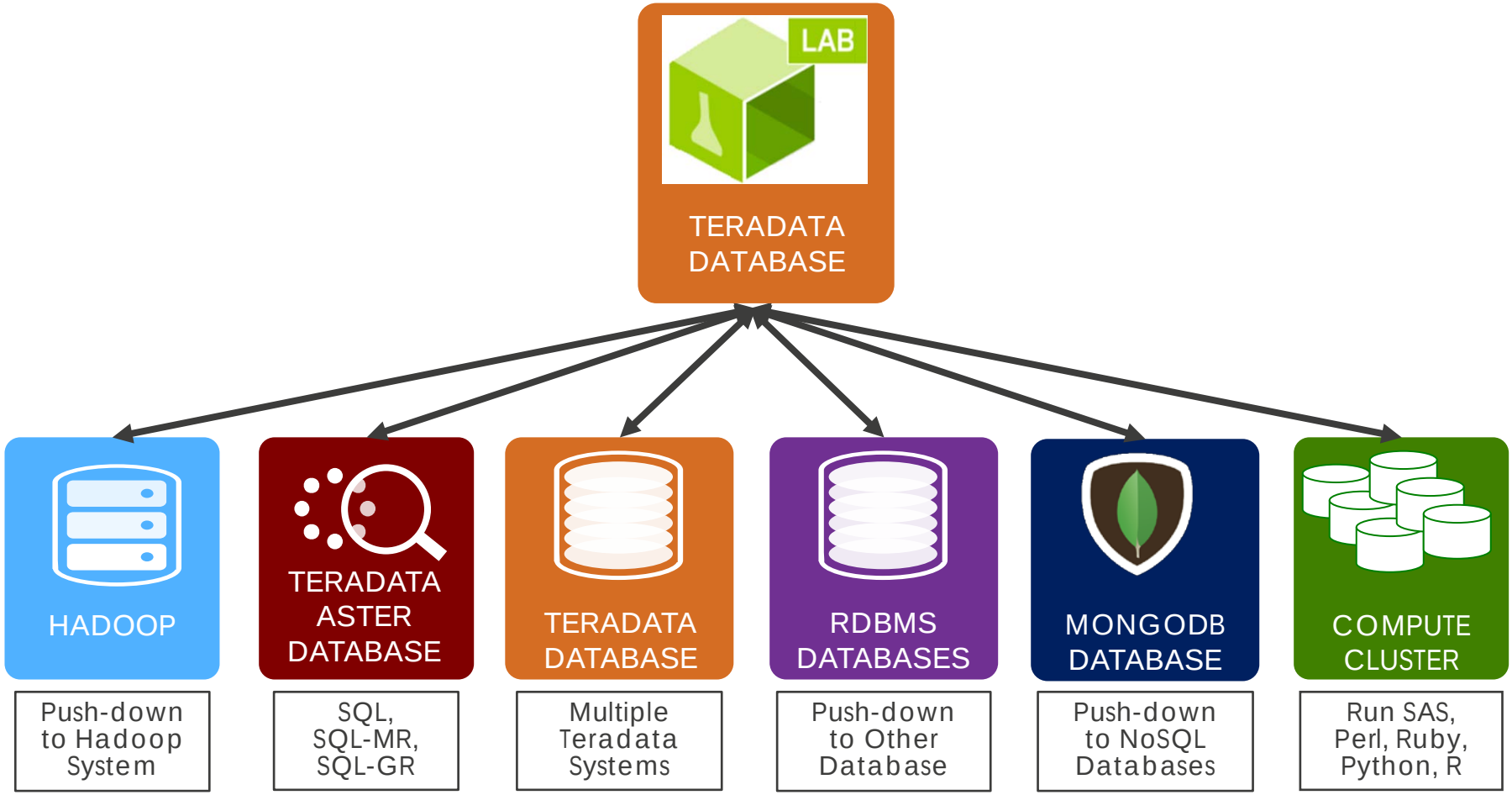
This part should be provided by ‘standard’ qualified tools (we are not validating WORD, EXCEL....)

Across the organization with a well controlled environment

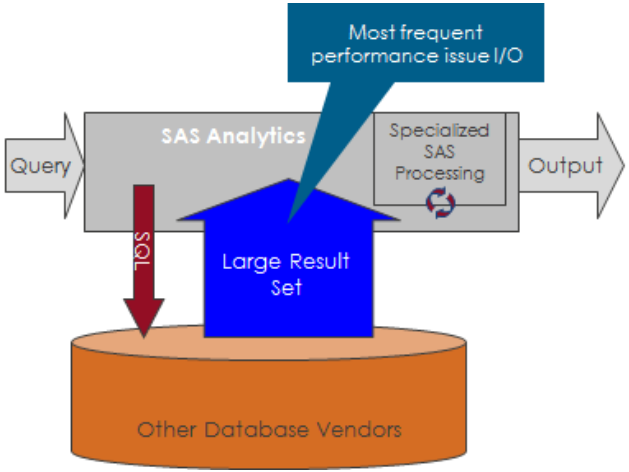


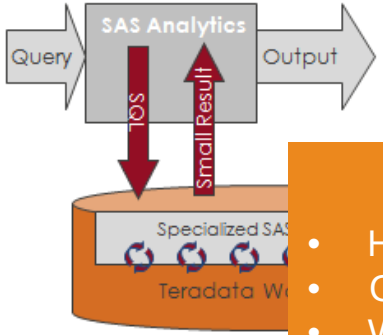
TERADATA.

Access to any data: Teradata QueryGrid™



Agility by assured performance: In database analytics e.g. with using SAS (Storing data in a performing database)





System related

- Holding any kind of data
- Growing / scalable with the needs
- Workbench of analytical tools and combination of it
- Governance
  - Traceability
  - Data access control
  - Data version control
  - Performance control

Agility by assured performance: In database

#	Business Line	SAS Log Name	# of Steps	SAS Only			SAS + Teradata			% of SAS Only	X Times Faster
				Days	Hours	Minutes	Days	Hours	Minutes		
1	oscar	oscar_mdcd_v3.log	945	9.6	231.6	13,894.1		1.83	110.0	1%	126.3
2	GE	mk_text_observation_f_sort.log	3	4.3	103.0	6,178.0			3.8	0%	1,625.8
3	ingenix	dcf ~ i3_qc.log	3,401		15.1	908.2			45.8	5%	19.8
4	humana	humana_dups.log	28		5.6	333.3			18.8	6%	17.7
5	ingenix	analysis ~ 100_indentifying_initial_patients.log	12		1.7	99.4			1.5	2%	66.3
6	ingenix	analysis ~ 200_extracting_mx_claims.log	11		1.1	68.1			1.0	1%	68.1
7	ingenix	analysis ~ 210_extracting_rx_claims.log	12			28.5			0.4	1%	71.3
8	ingenix	dcf ~ mk_s2009_r12q2.log	20		1.6	98.2			3.8	4%	25.8
9	ingenix	dcf ~ mk_s2010_r12q2.log	20		1.5	87.8			3.6	4%	24.4
10	ingenix	dcf ~ mk_s2011_r12q2.log	20		1.0	61.8			3.4	6%	18.2
11	ingenix	dcf ~ mk_m2011_r12q2.log	20			56.8			2.3	4%	24.7
12	ingenix	dcf ~ mk_r2011_r12q2.log	20			41.9			3.3	8%	12.7
13	pharmetrics	130_af_all_claims.log	12		1.7	101.2			4.7	5%	21.5
14	pharmetrics	110_af_claims.log	6			52.0			2.7	5%	19.3
15	pharmetrics	183_table8d.log	43			30.8			3.4	11%	9.1
16	pharmetrics	183_table8b.log	39			30.4			1.5	5%	20.3
17	pharmetrics	162_table2b.log	30			20.6			2.8	13%	7.4
18	pharmetrics	182_table8d.log	43			23.8			1.8	8%	13.2

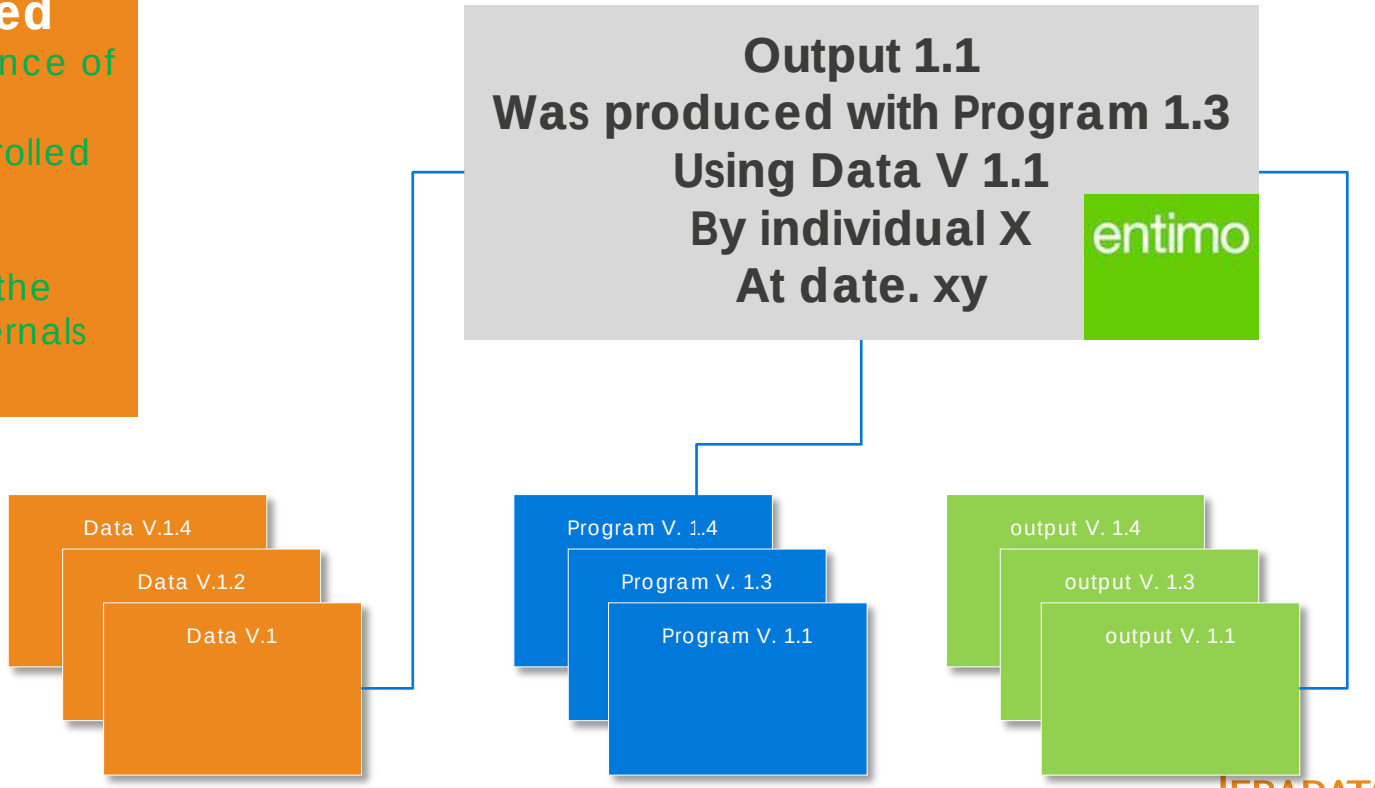
In-Database Analytic Tools and Partners

TERADATA

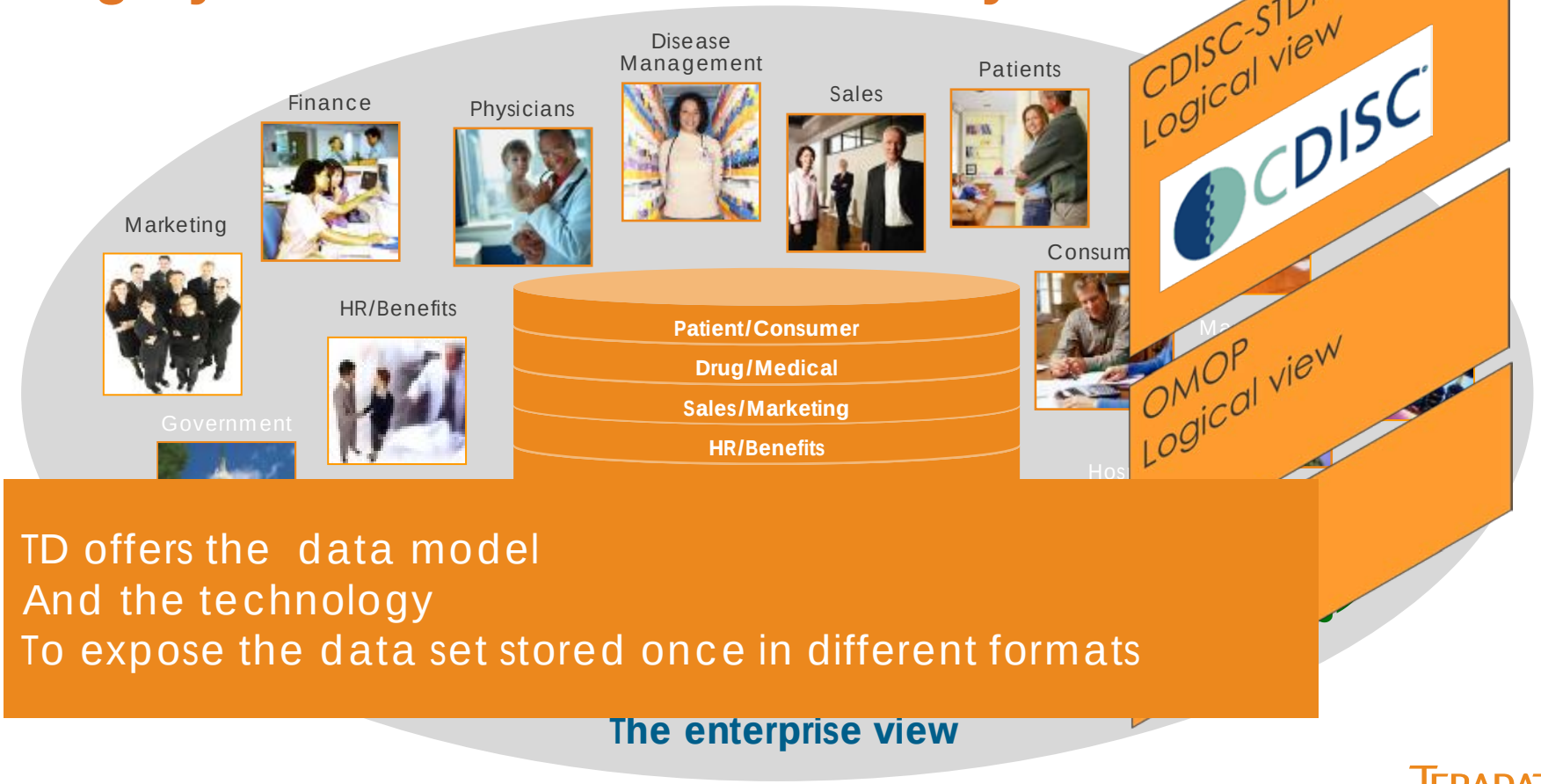
User requirements in a nut-shell: process controlled by partner software

Process related

- Flexible Governance of the analytical process(es) controlled by the business
- Reproducibility
- Collaboration in the process with externals



Agility in clinical: Become visionary...



TD offers the data model
And the technology
To expose the data set stored once in different formats

TERADATA.

Teradata LS-LDM Overview

Subject Areas Covered

Life Sciences Activity
Life Sciences Adverse Event
Life Sciences Biologic Entity
Life Sciences Conceptual Model
Life Sciences Development
Life Sciences Document
Life Sciences Ethnicity
Life Sciences Fact
Life Sciences Material
Life Sciences Measurement
Life Sciences Minor Entities
Life Sciences Product
Life Sciences Project
Life Sciences Protocol
Life Sciences Race
Life Sciences Recruitment
Life Sciences Regulatory
Life Sciences Research
Life Sciences Standard Coding
Life Sciences Strategy
Life Sciences Study
Life Sciences Study Event
Life Sciences Genomic

Account Budget
Activity Based Costing
Advertisement
Bid
Channel
Claim
Contact
Contract
Customs
Demographics
Document
Equipment
Event
Forecast
Geography
General Ledger
Goods Receipt
Human Capital Management
Inventory
Invoice
Item
Legal Case Management

Location
Measurement
Multimedia Component
Party
Plan
Point Of Sale Register
Privacy
Procurement
Project Resource
Promotion
Return Management
RFID/Track And Trace
Sales
Shipment
Survey
Time Period
Trait
Warranty Management
Web
Work Order
Work Process

Agenda

Company

Drivers and Changes

Core of “our” business

Data – Analytics- Governance

Summary

TERADATA.

Foundation for agility

- The system should enable where ever possible business process based extensions rather than IT-projects and System-diversity

Empower the business

System related

- Holding any kind of data
- Growing / scalable with the needs
- Workbench of analytical tools and combination of it
- Governance
  - Traceability
  - Data access control
  - Data version control
  - Performance control