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ICT for society

Streamlining Analytics

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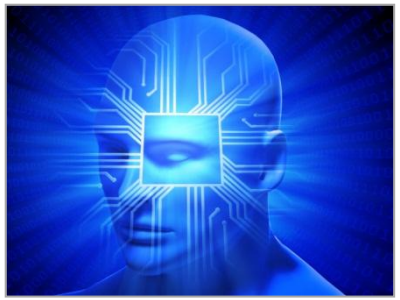
Onderzoek - @SmalsResearch
http://blogresearch.smalsrech.be

Streamlining Analytics

Predictive analytics

De **data supply chain**



Barrières bij de introductie van analytics

Hardware appliances voor analytics

Data quality

Analytics **project management**

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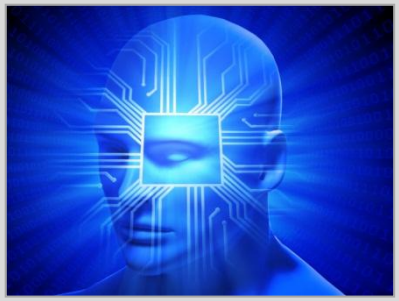


Barrières bij de introductie van analytics

Hardware appliances voor analytics

Data quality

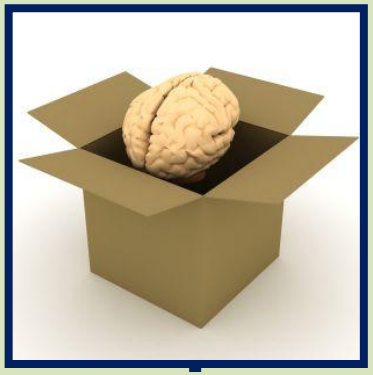
Analytics **project management**

Data

Voorspellingen
over de
toekomst

Fase 1: Training

Predictief
Model



Algoritmes

Historische data

Nieuwe data

Voorspellingen
over de
toekomst

Fase 2: Toepassing

Smals

PA voorbeeld: **marketing analytics**

Voorspel wat kopers nodig hebben

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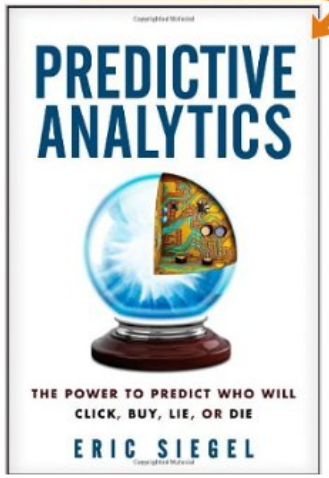

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Eric Siegel (Author), Thomas H. Davenport (Foreword)

(5 customer reviews)

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> Robert Nisbet
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Hardcover
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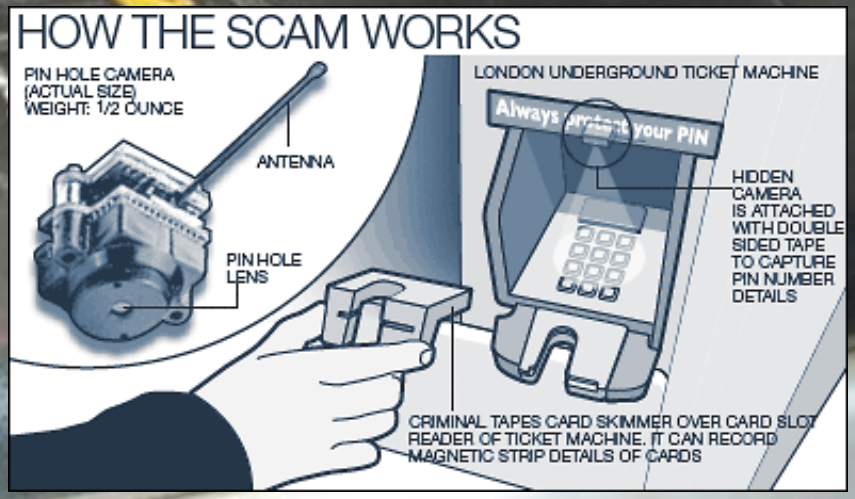
PA voorbeeld: **fraudebestrijding**

Voorspel of een transactie frauduleus is

Blokkeer automatisch kaarten, rekeningen,…



PA voorbeeld: **churn prediction**

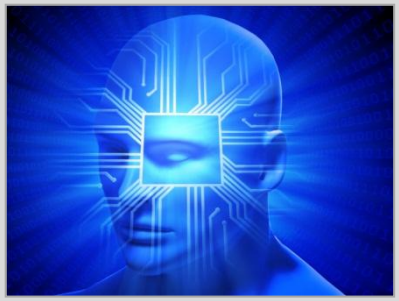
Voorspel of een klant gaat overlopen naar de concurrentie

Aangepaste acties om potentiële overlopers te behouden

Streamlining Analytics

Predictive analytics

De **data supply chain**



Barrières bij de introductie van analytics

Hardware appliances voor analytics

Data quality

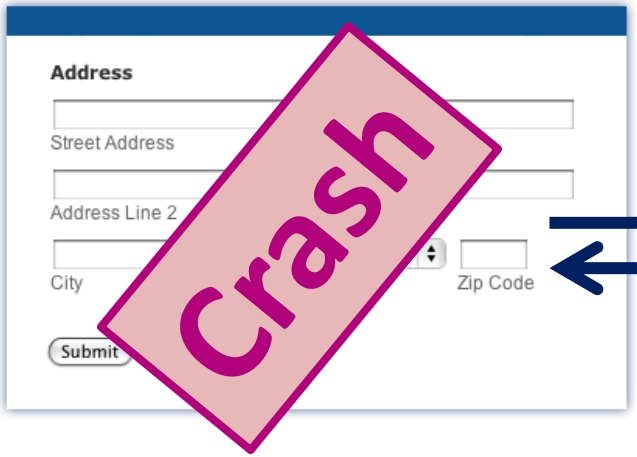
Analytics **project management**

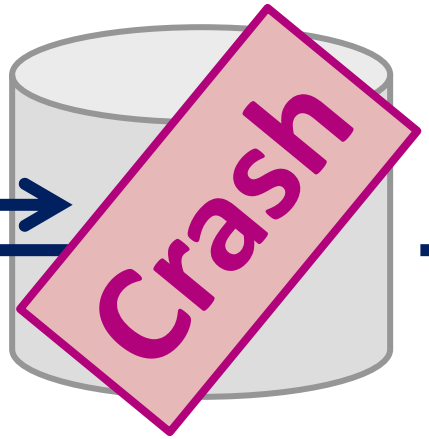
Analytics vs. **Productie**-applicaties

Applicatie

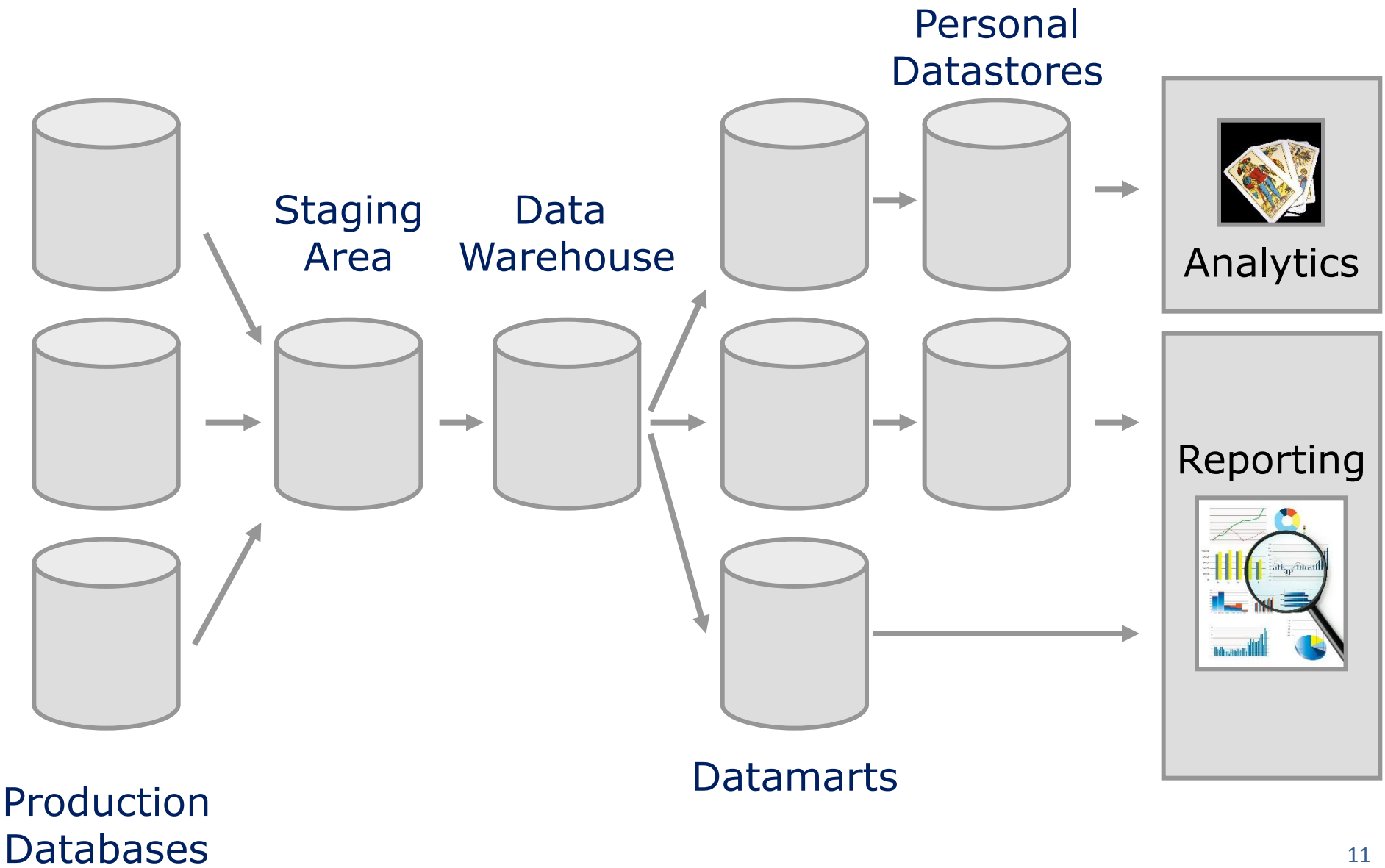
Data

Analytics





De « **data supply chain** »



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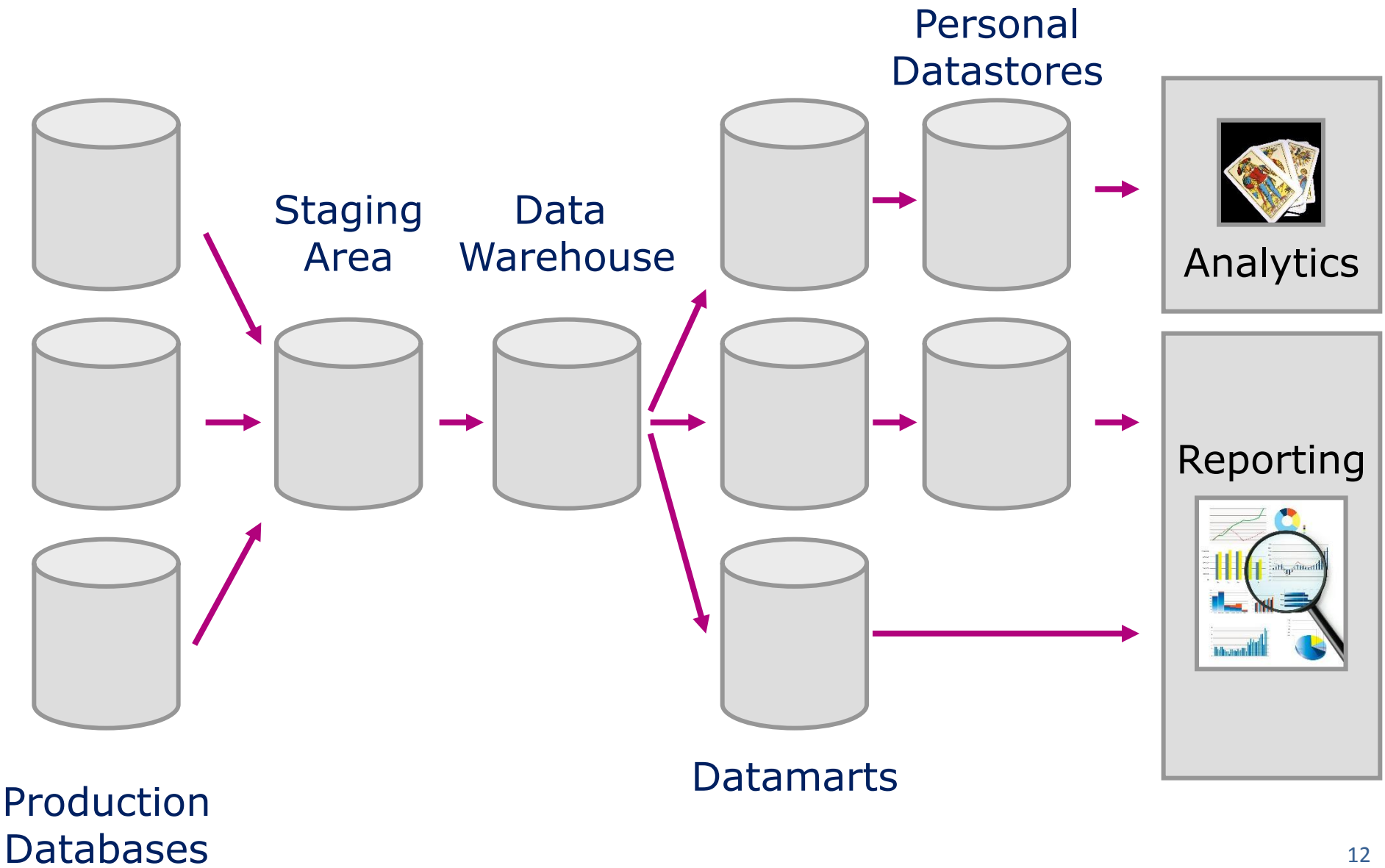
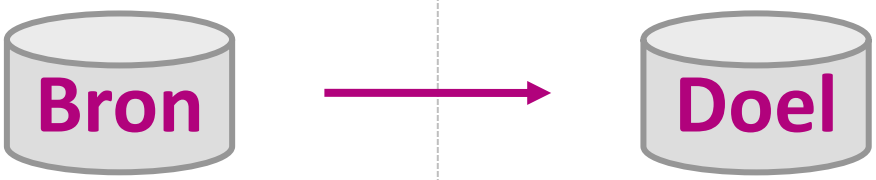
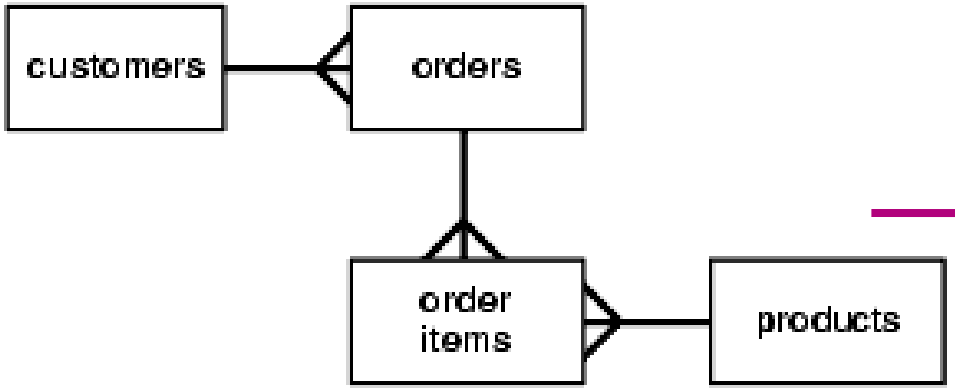
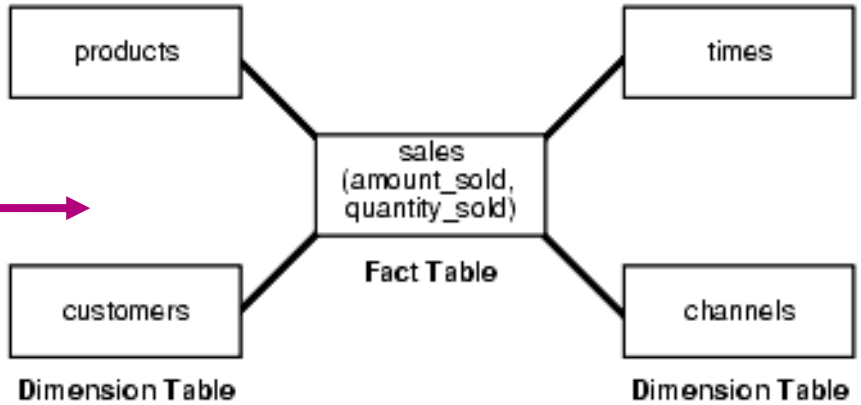


ETL: Extract Transform Load



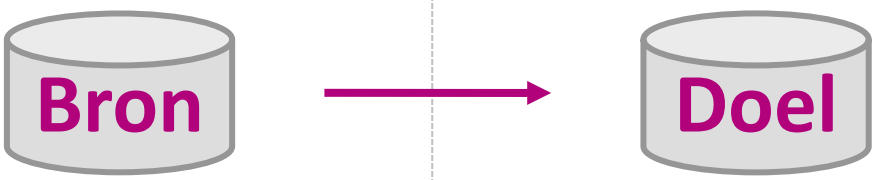
Omvormen **data-schema**





Derde normaalvorm **Ster-schema**

ETL: Extract Transform Load



Data-quality operaties

Adres correcties

Fonsnylaan/Avenue Fonsny 20 → Fonsnylaan~~/Avenue Fonsny~~ 20

Harmonisatie afkortingen

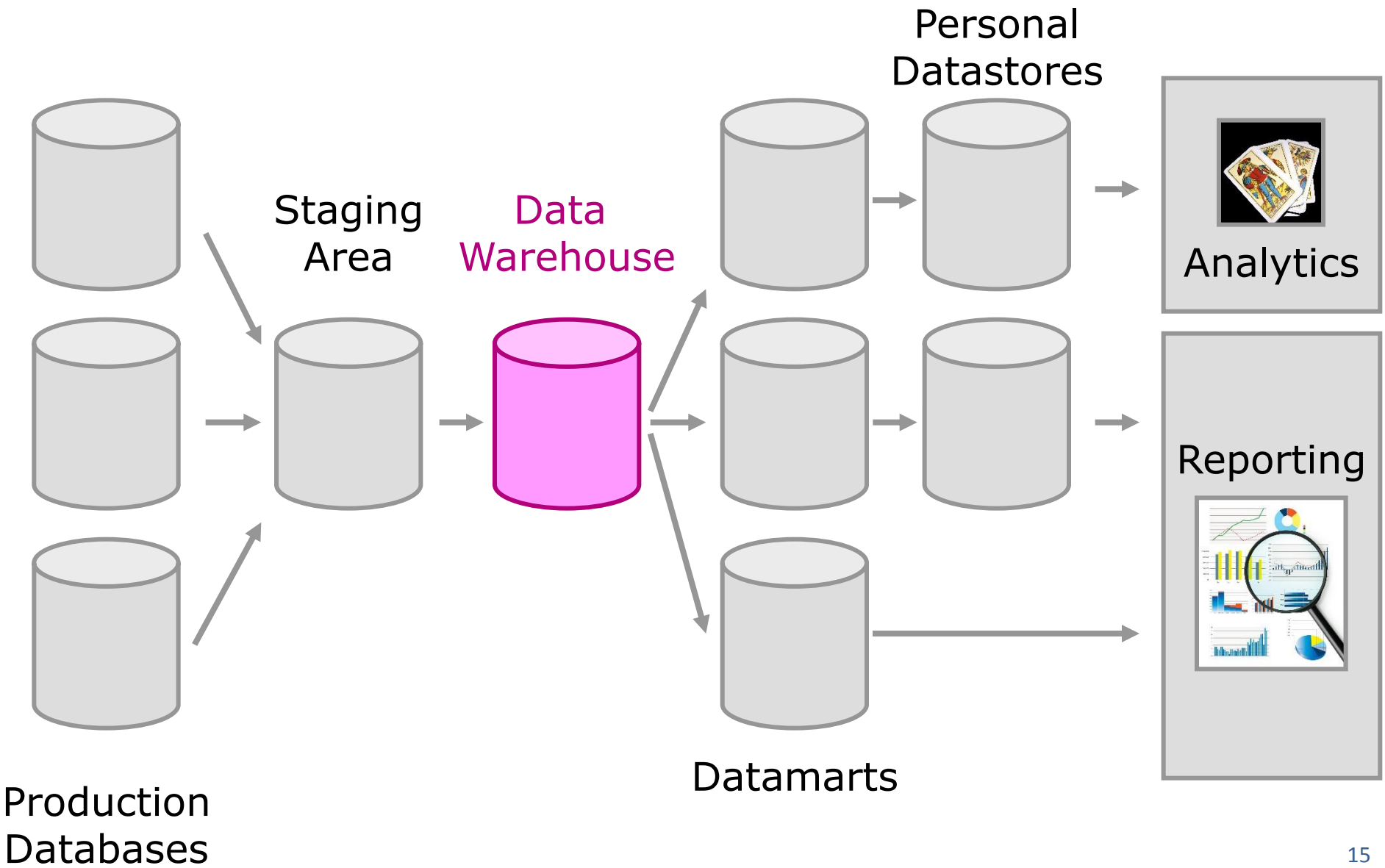
SPRL → 2200

N.v.. → NV

Missing values?

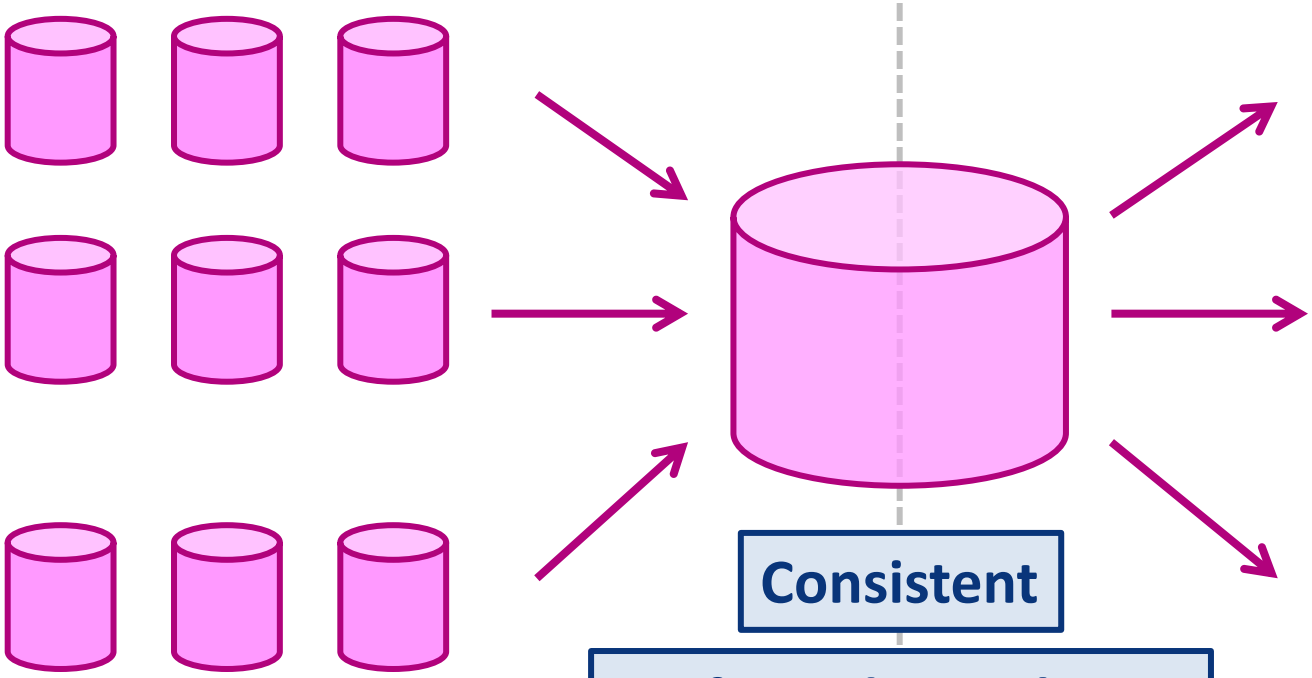
...

De « **data supply chain** »

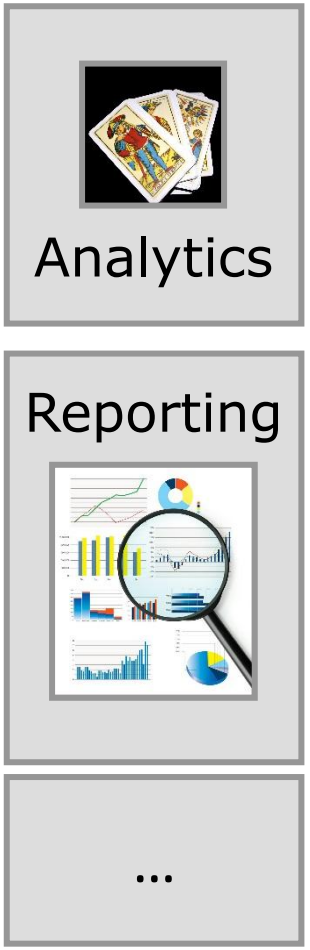


Het **data warehouse (DWH)**

Veel operationele
data sources



Veel **toepassingen**



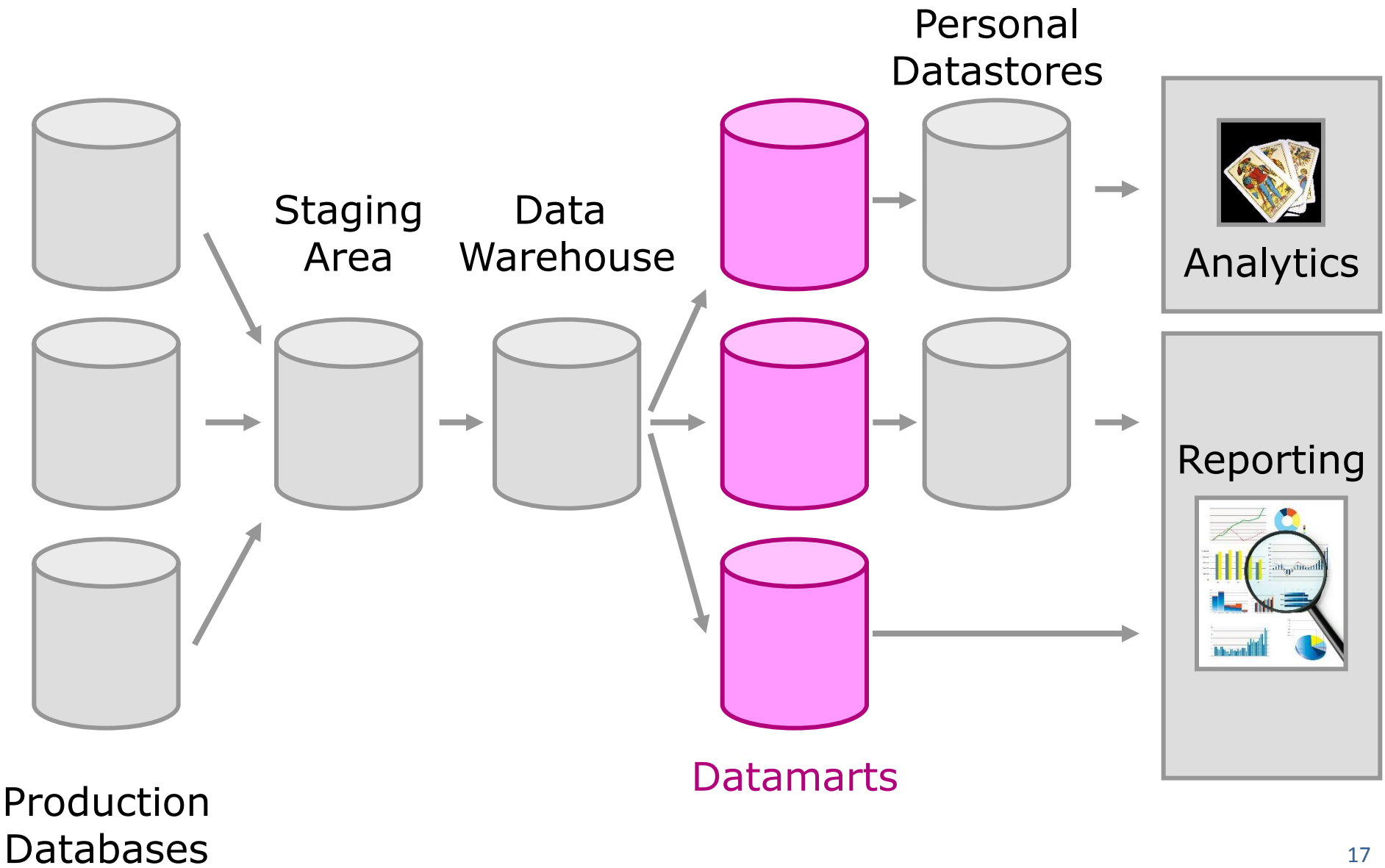
Consistent

Uniform data-schema

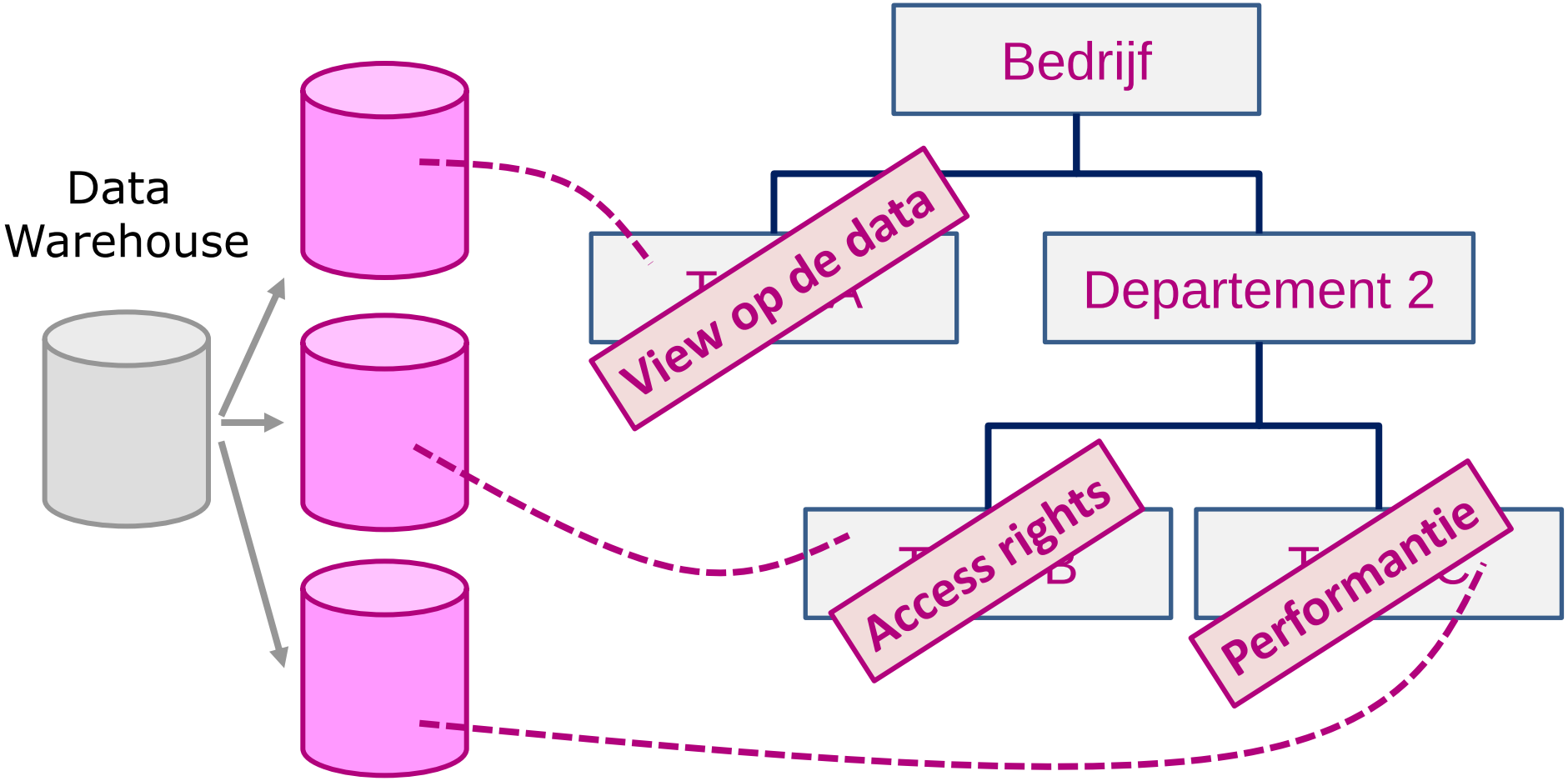
Historieken - versies

Geoptimaliseerd voor output

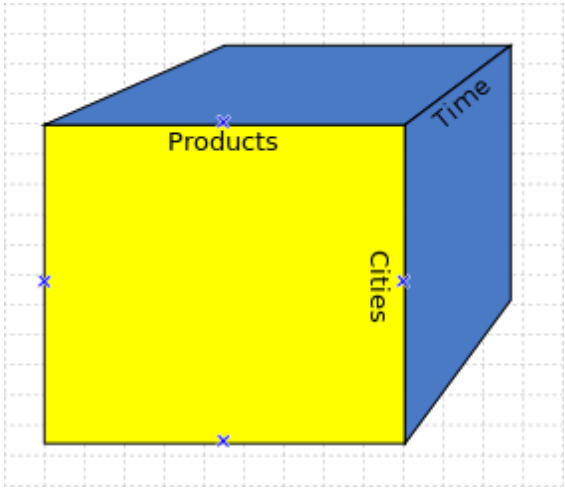
De « **data supply chain** »

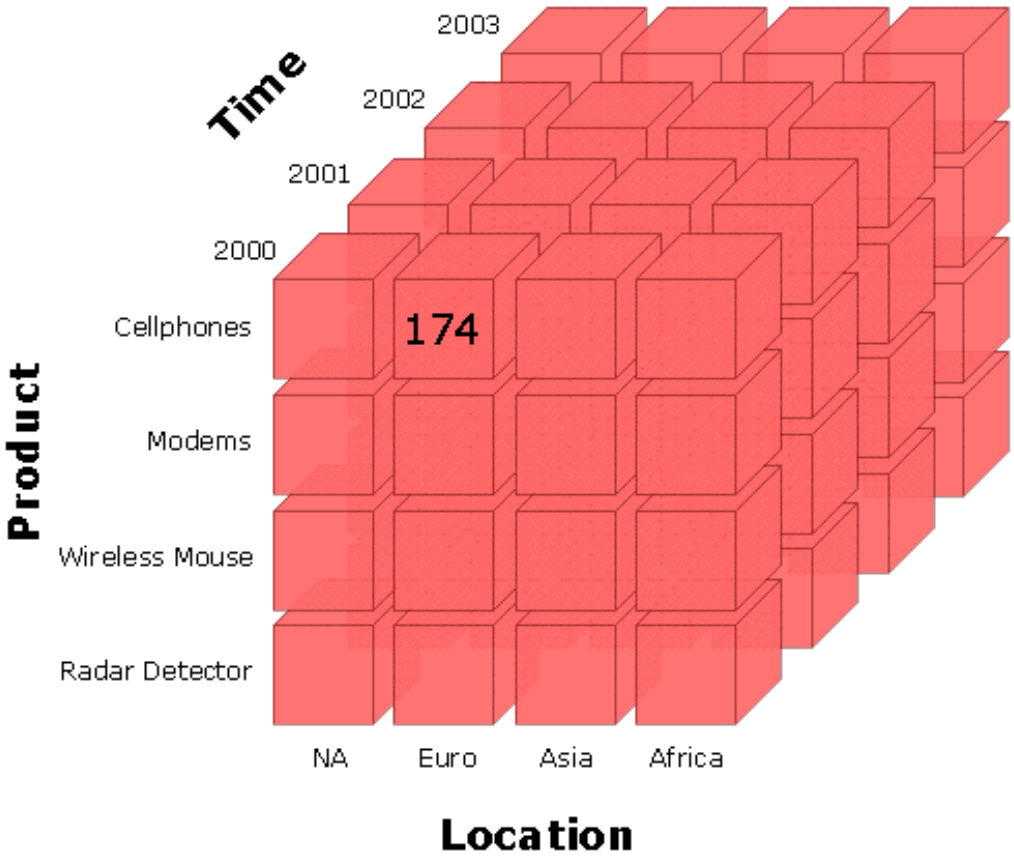


Data marts


Data Warehouse
Bedrijf
Departement 2
View op de data
Access rights
Performantie

Vaak gebruikt **data-model:** **O**n**L**ine **A**nalytical **P**rocessing (OLAP)





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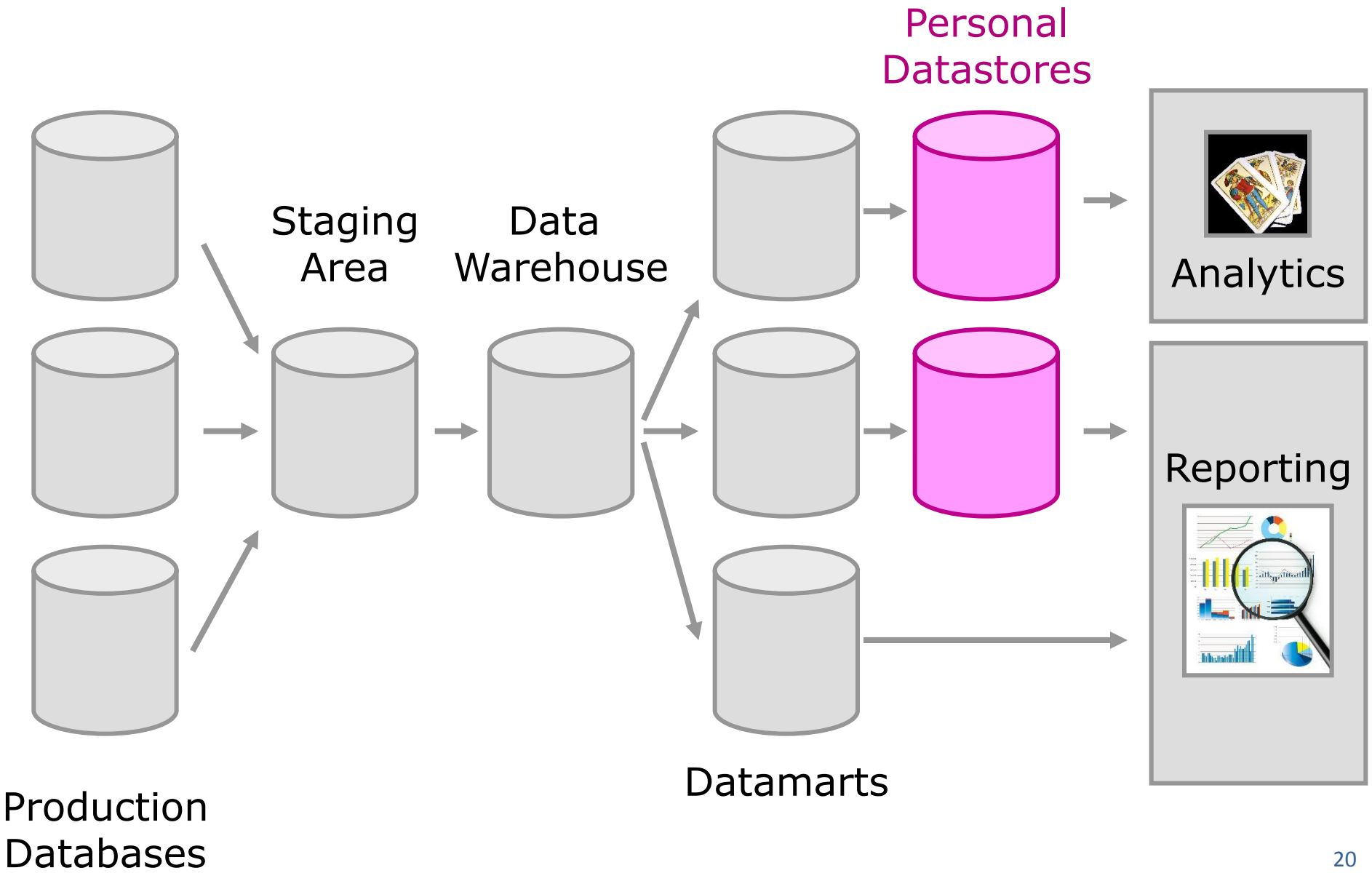

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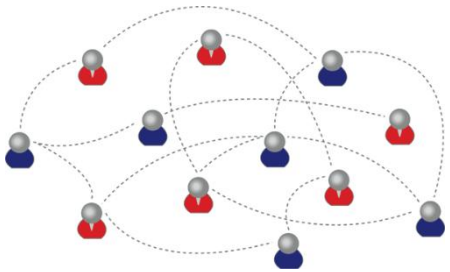
Data-warehouse / data-mart

Images, Video



Netwerk data

Continuous data

Time series

Analytics
personal datastore

	A	B	C	D	E
1	**X1**	**X2**	**X3**	**X4**	**Y?**
2	1	2	1	1	**TRUE**
3	1	1	1	1	**TRUE**
4	0	3	1	1	**FALSE**
5	1	2	1	1	**TRUE**

Set independent variables (X1,…,Xn) en 1 dependent variable (Y)

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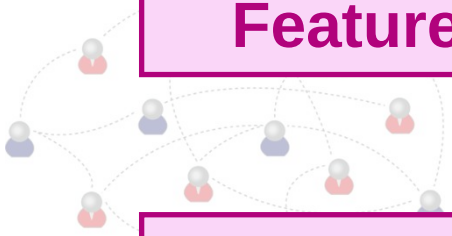
Data-warehouse / data-mart

Analytics
personal datastore

Images, Video



Netwerk data

Continuous data

Time series

	A	B	C	D	E
			X3	X4	Y?
		2	1	1	TRUE
3	1	1	1	1	TRUE
4	0	3	1	1	FALSE
5	1	2	1	1	TRUE

Set independent variables (X1,…,Xn) en 1 dependent variable (Y)

Feature extraction

Graaf algoritmes

Discretisatie

Herschaling

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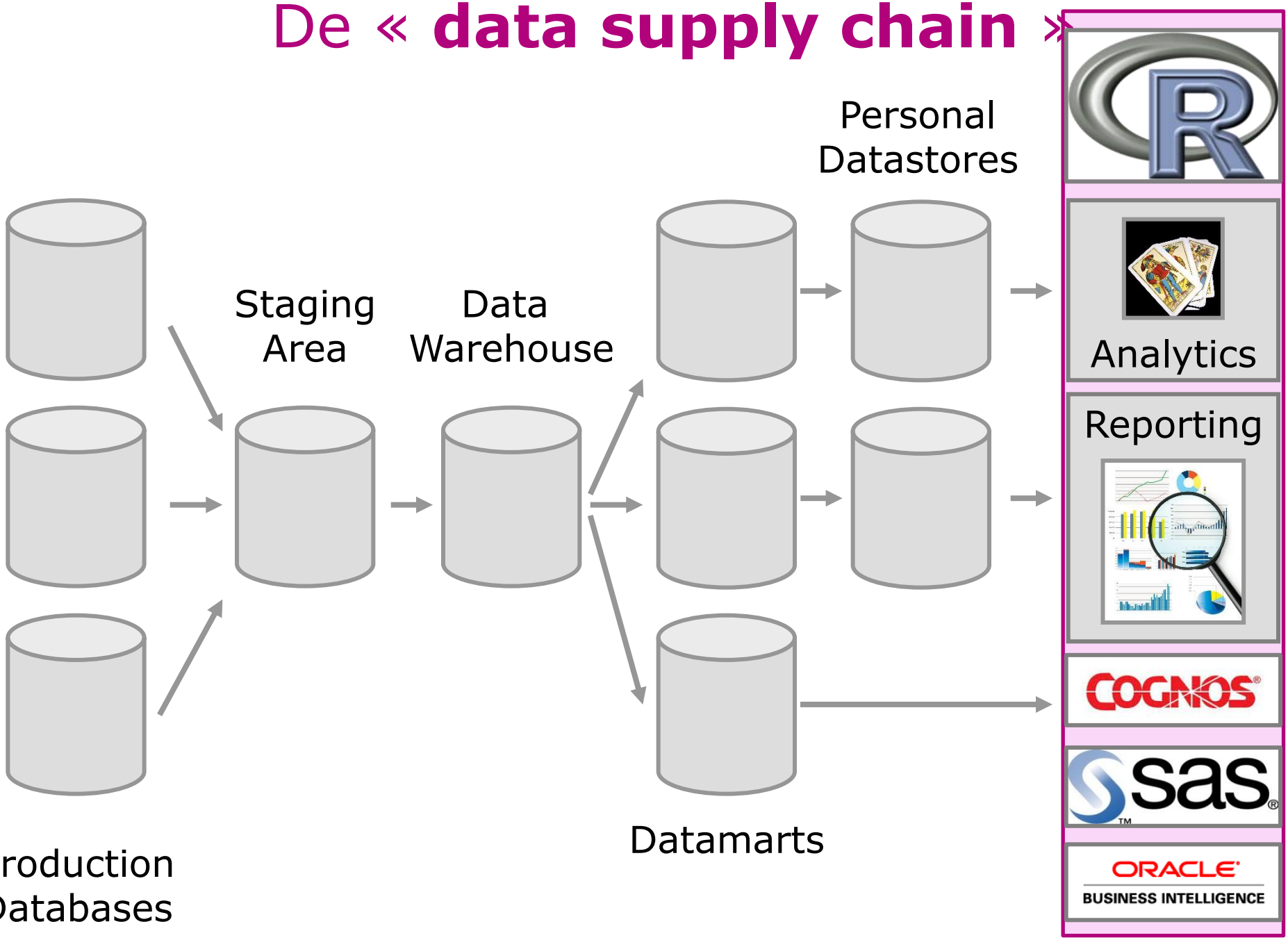
De « **data supply chain** »



Streamlining Analytics

Predictive analytics

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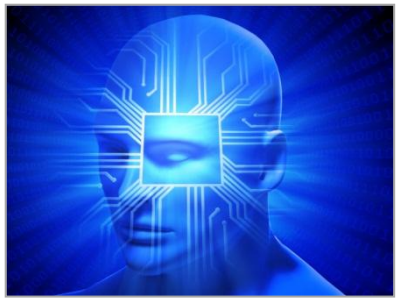


Barrières bij de introductie van analytics

Hardware appliances voor analytics

Data quality

Analytics **project management**

Lancering van het **predictive analytics project**!

Uitstel, uitstel, uitstel, … , afstel?

« Atypische/onbekende techniek »

« Modellen verouderd »

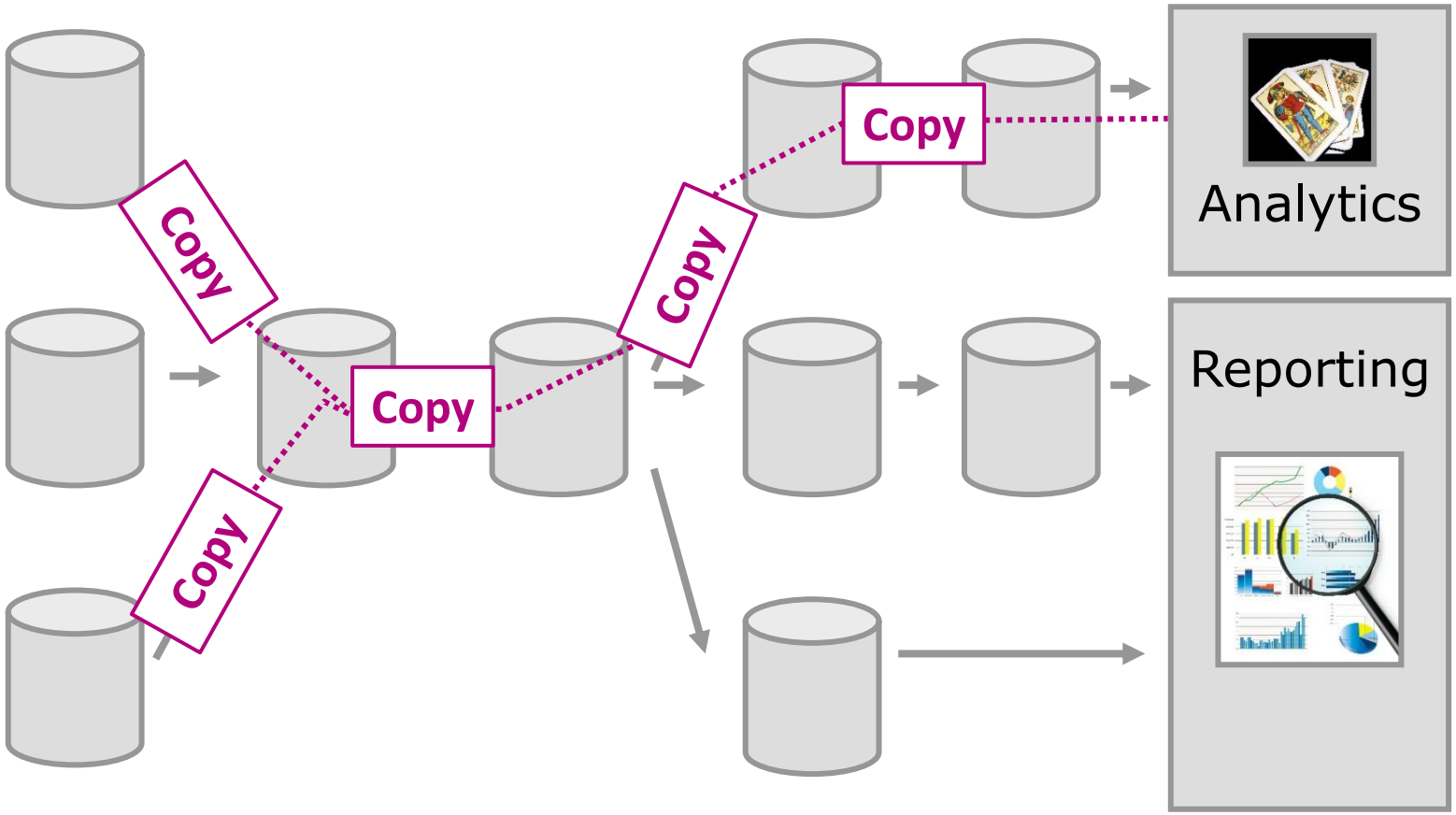
« Servers niet krachtig genoeg »

« Waar is de data? »

« Betrokkenheid van veel rollen/teams »

[Eric Siegel, Predictive Analytics, 2013]

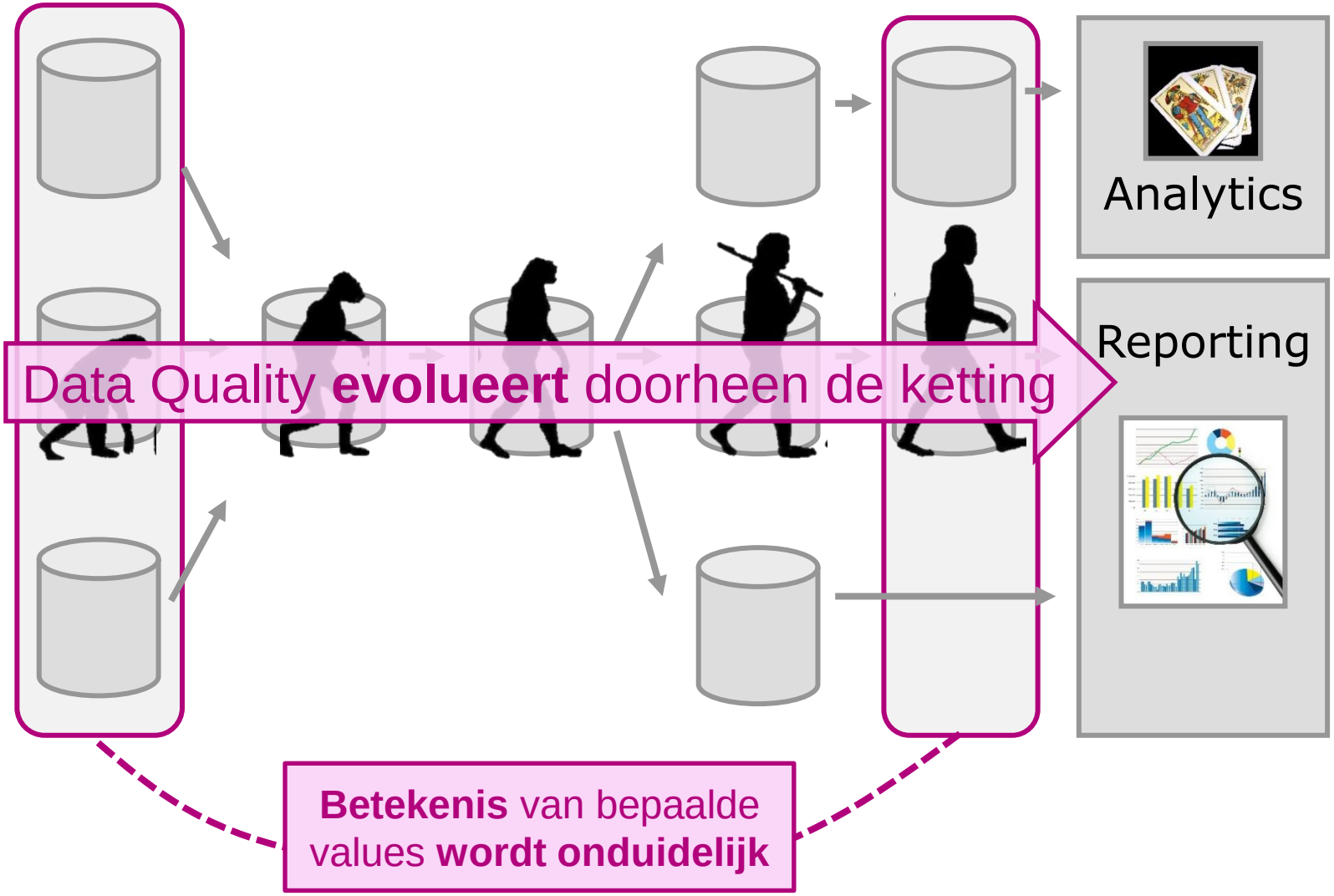
Barrière 1:
Complexe en trage architectuur



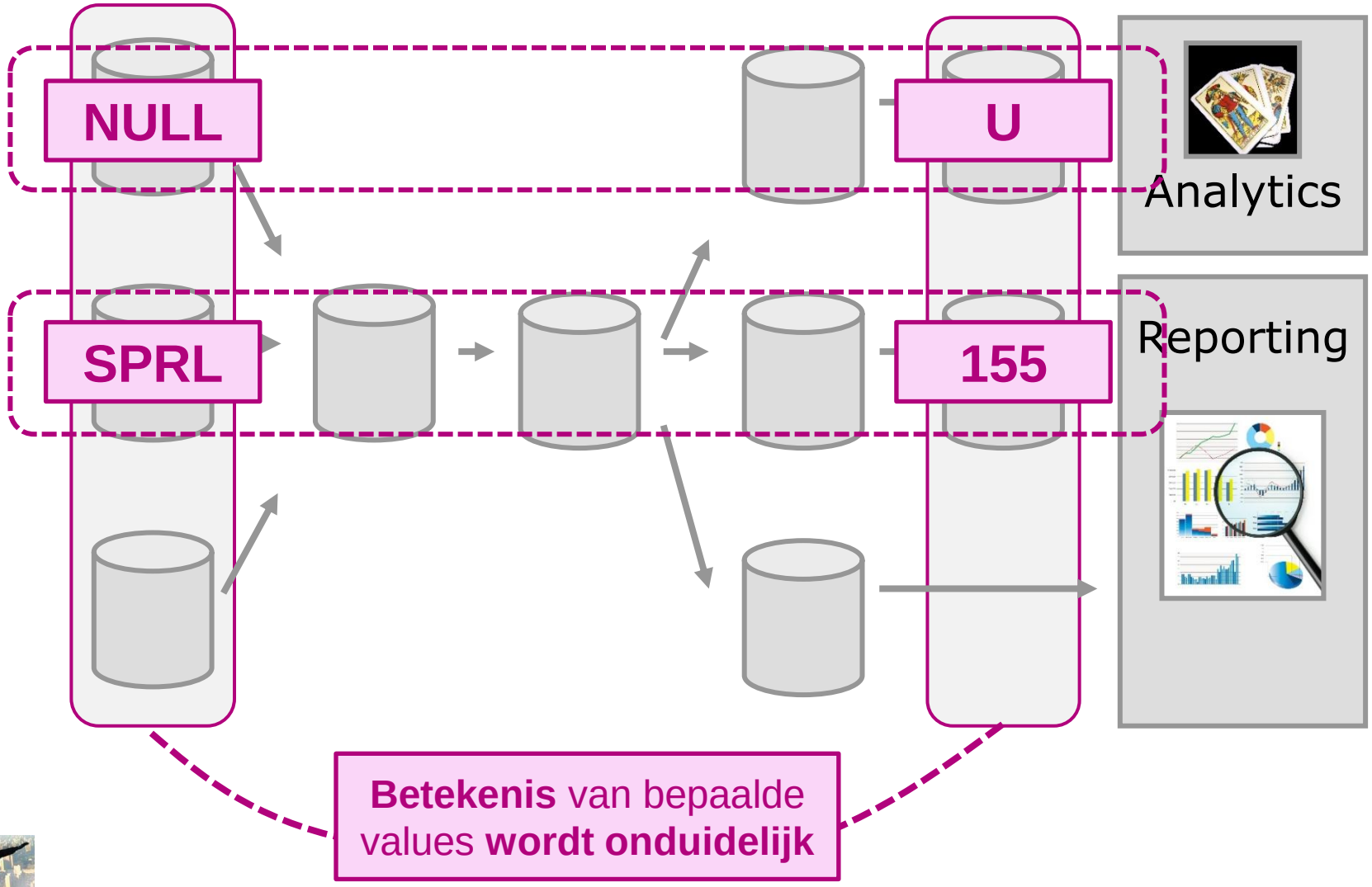
Barrière 1:
Complexe en **trage** architectuur

Maandag	Dinsdag	Woensdag	Donderdag	Vrijdag	Zaterdag	Zondag
Copy 1						
		Copy 3				Copy 5
Copy 2				Copy 4		

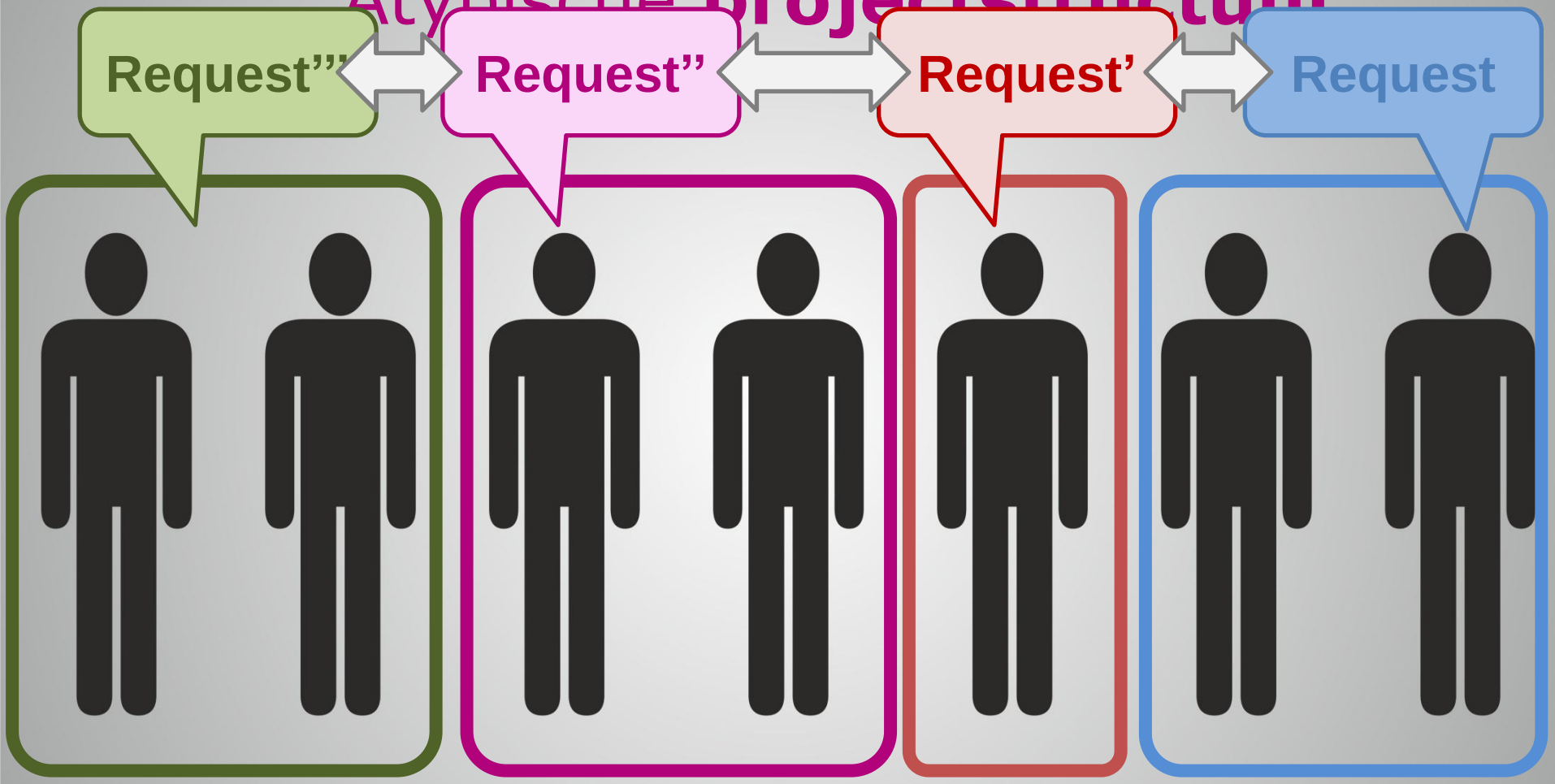
Barrière 2: **Dataquality** management



Barrière 2: **Dataquality** management



Barrière 3:
Atypische projectstructuur



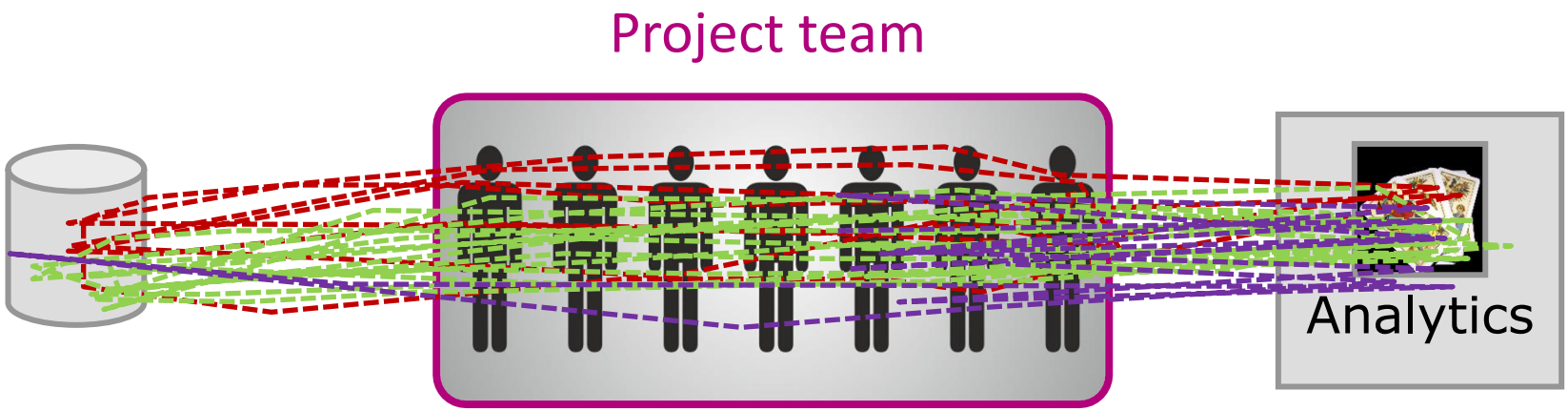
Operationele systemen

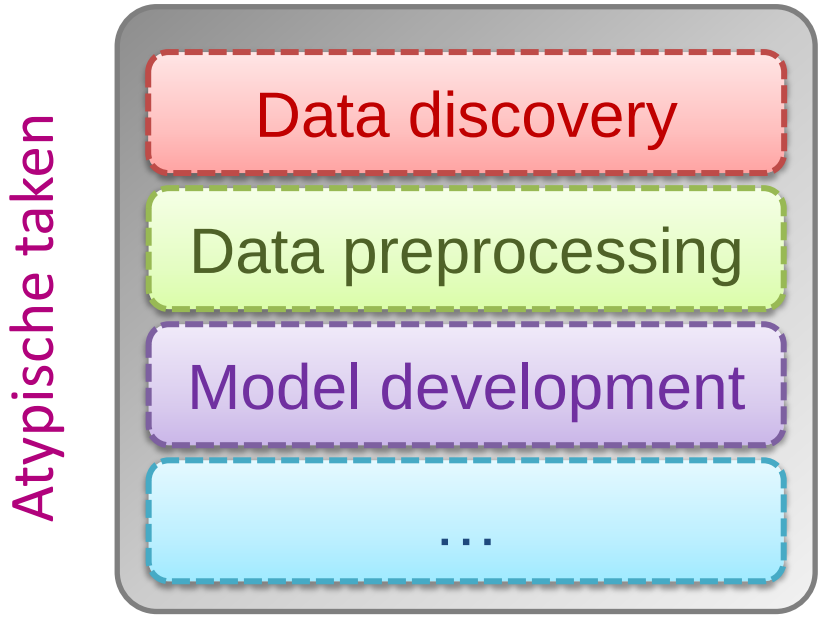
Data warehouse

Data-mart

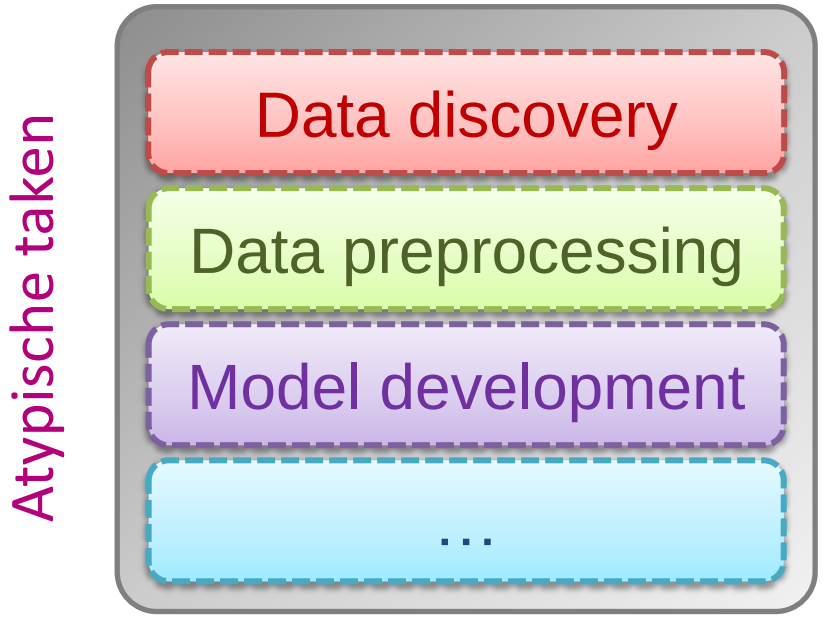
Analytics

Barrière 3:
Atypische **projectstructuur**





Barrière 3:
Atypische **projectstructuur**



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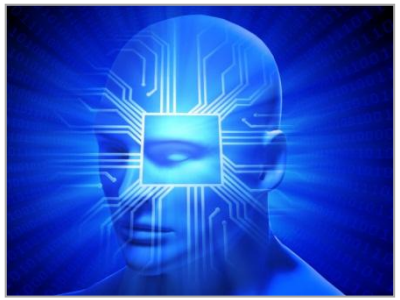
De **data supply chain**



Barrières bij de introductie van analytics

Hardware appliances voor analytics

Data quality

Analytics **project management**

Hardware **appliances?**

Hardware **appliances?**

An appliance has **one function** (toasting, making coffee, …), is **easy to use** and **its internals are not relevant**

A **hardware appliance for analytics** has one function (executing complex queries), is easy to install, manage, tune, … and its internals are not relevant

[Rick van der Lans, http://www.b-eye-network.com/view/13506]

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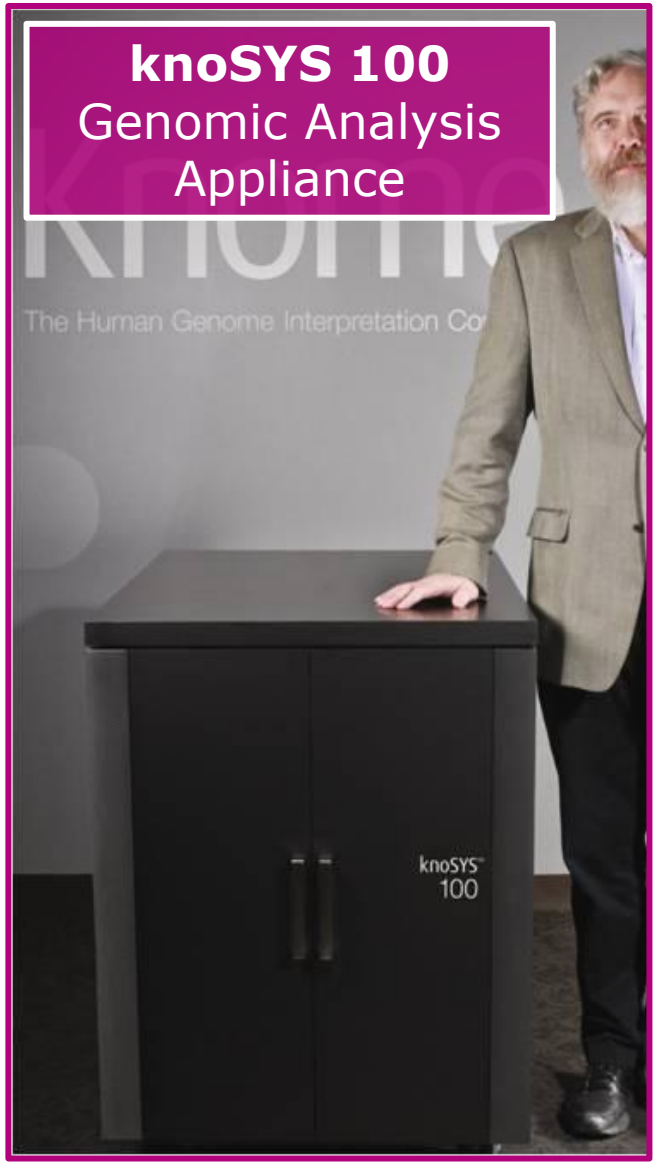
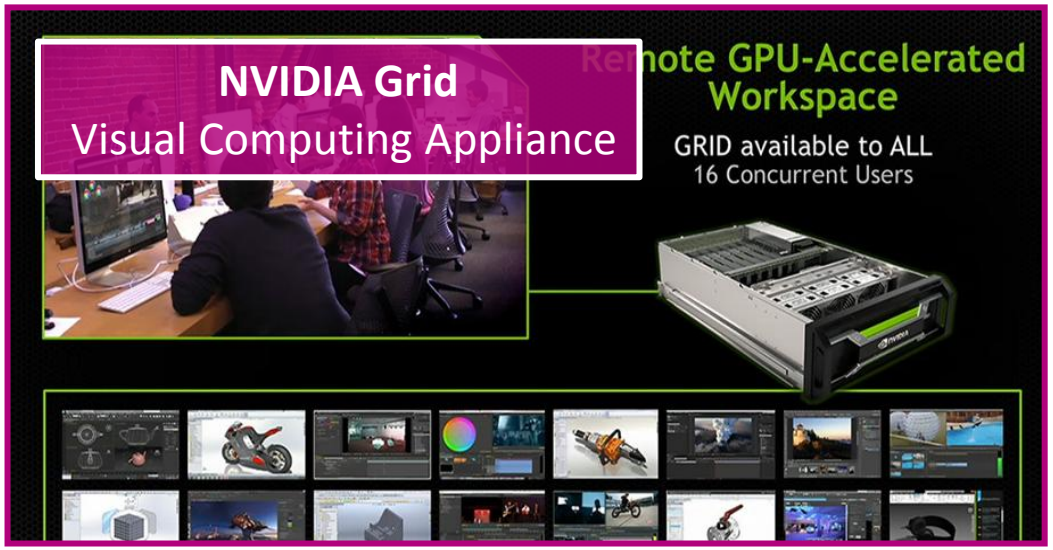
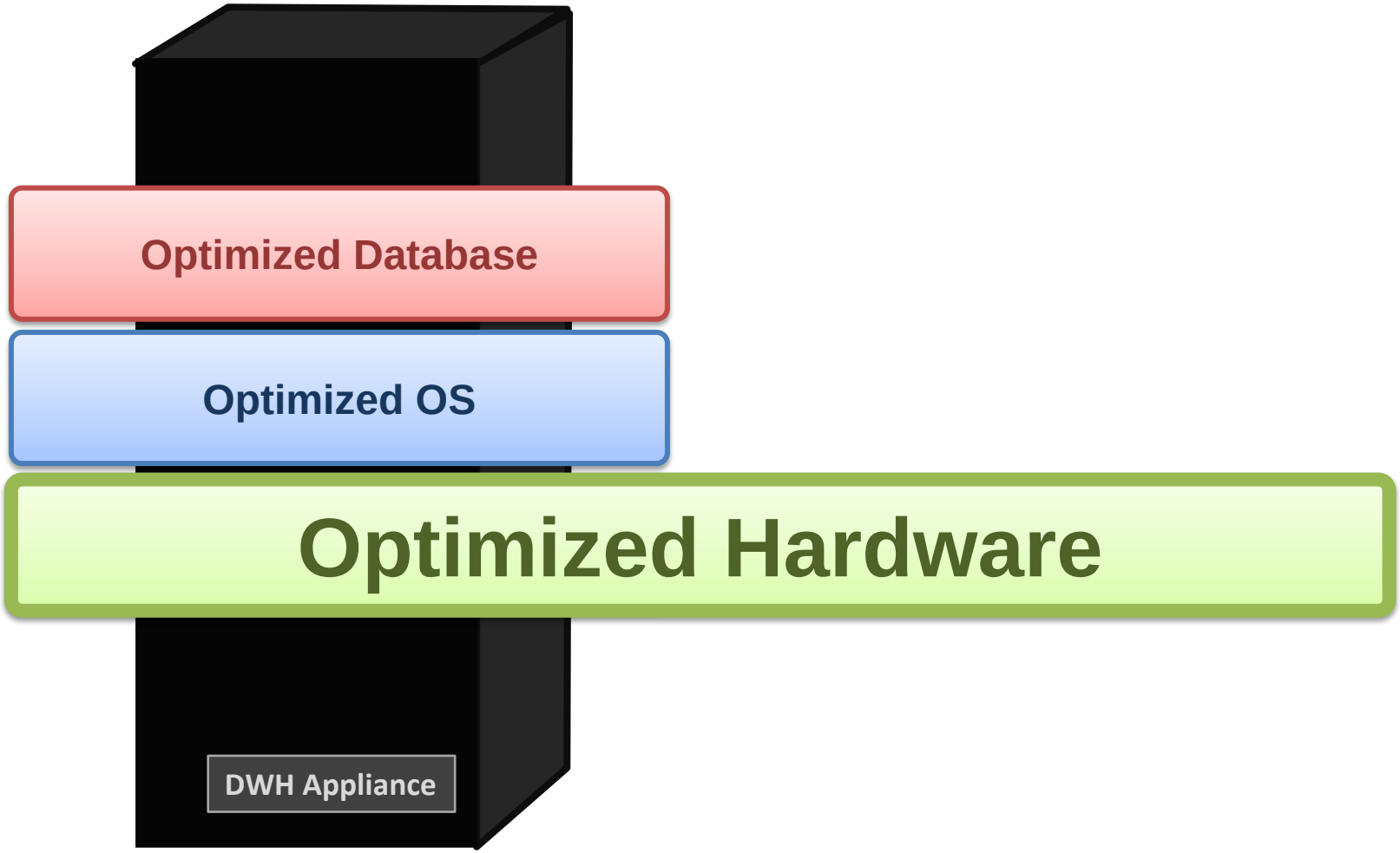
« Supercomputers voor analytics »

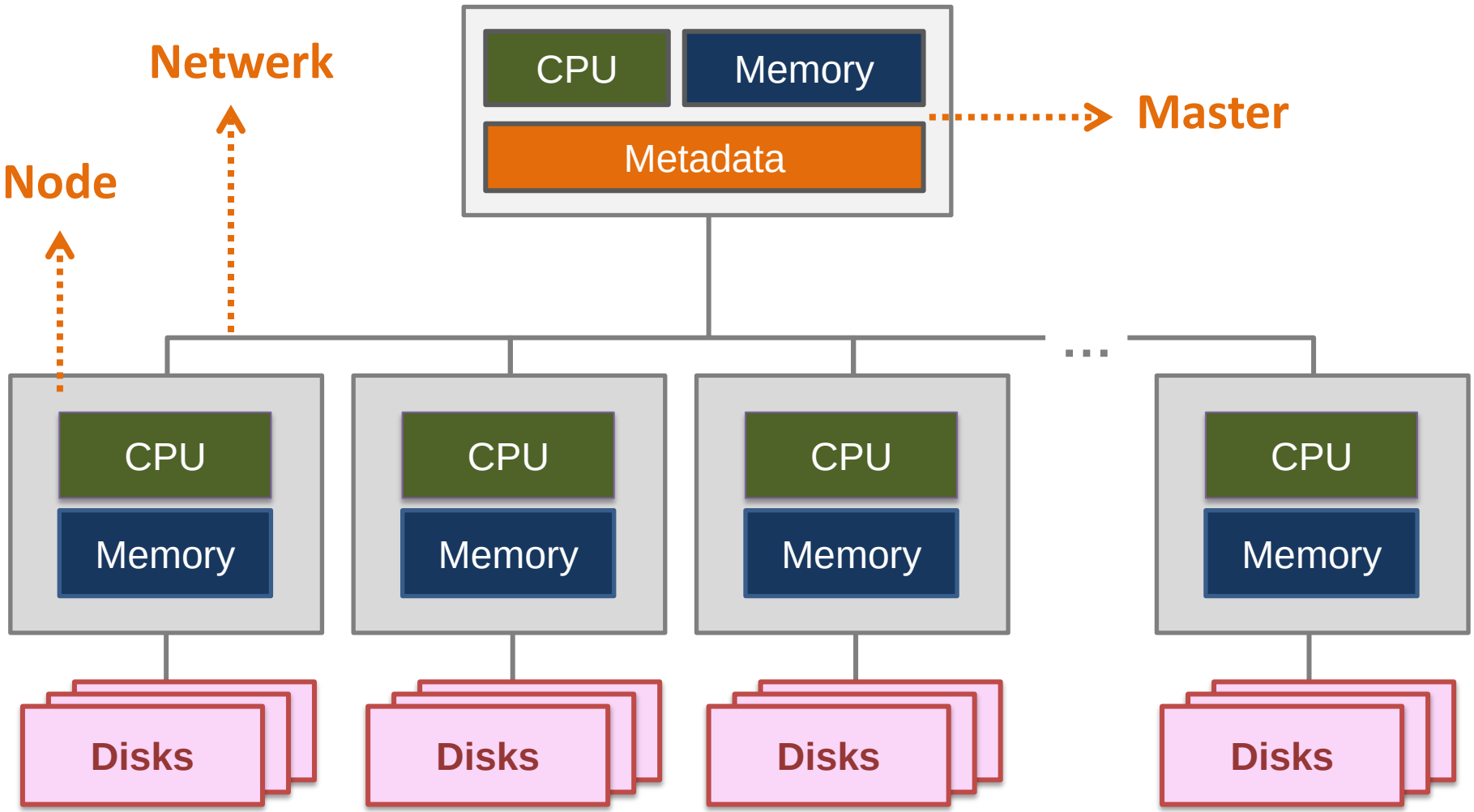




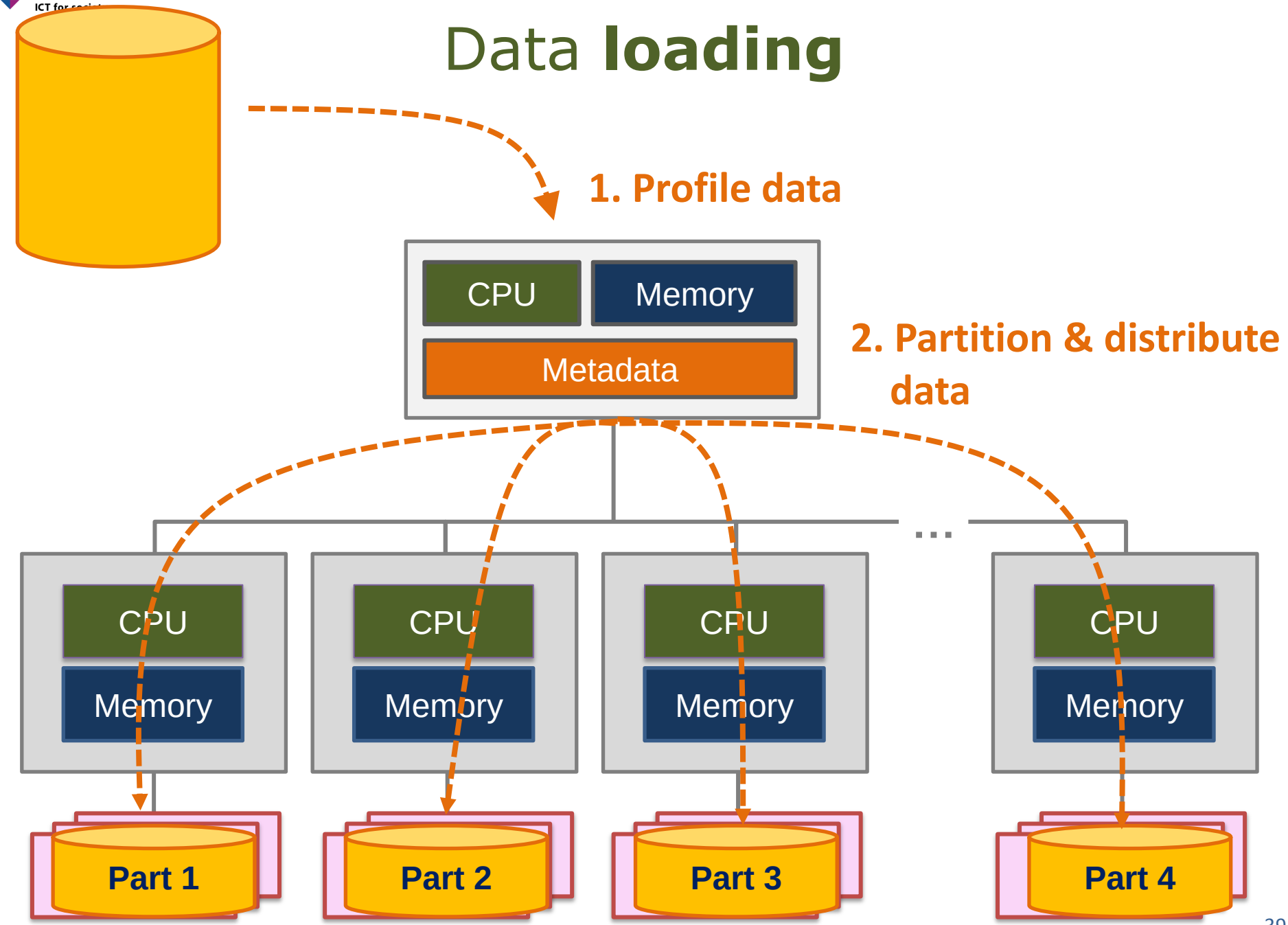
Hardware **appliance voor analytics**
(Data Warehouse appliance)



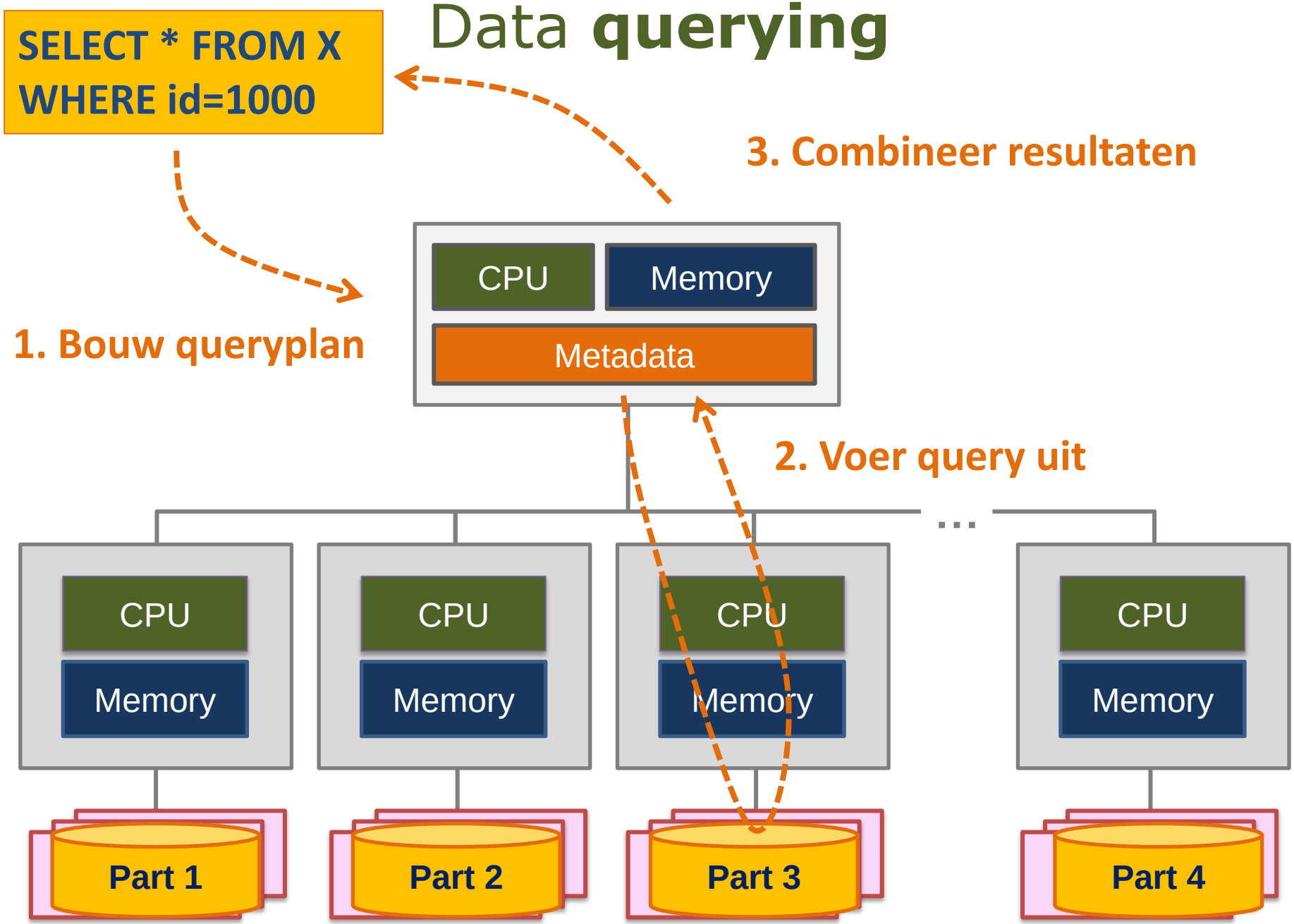
Massively Parallel Processing (MPP)



Data **loading**



Data **querying**

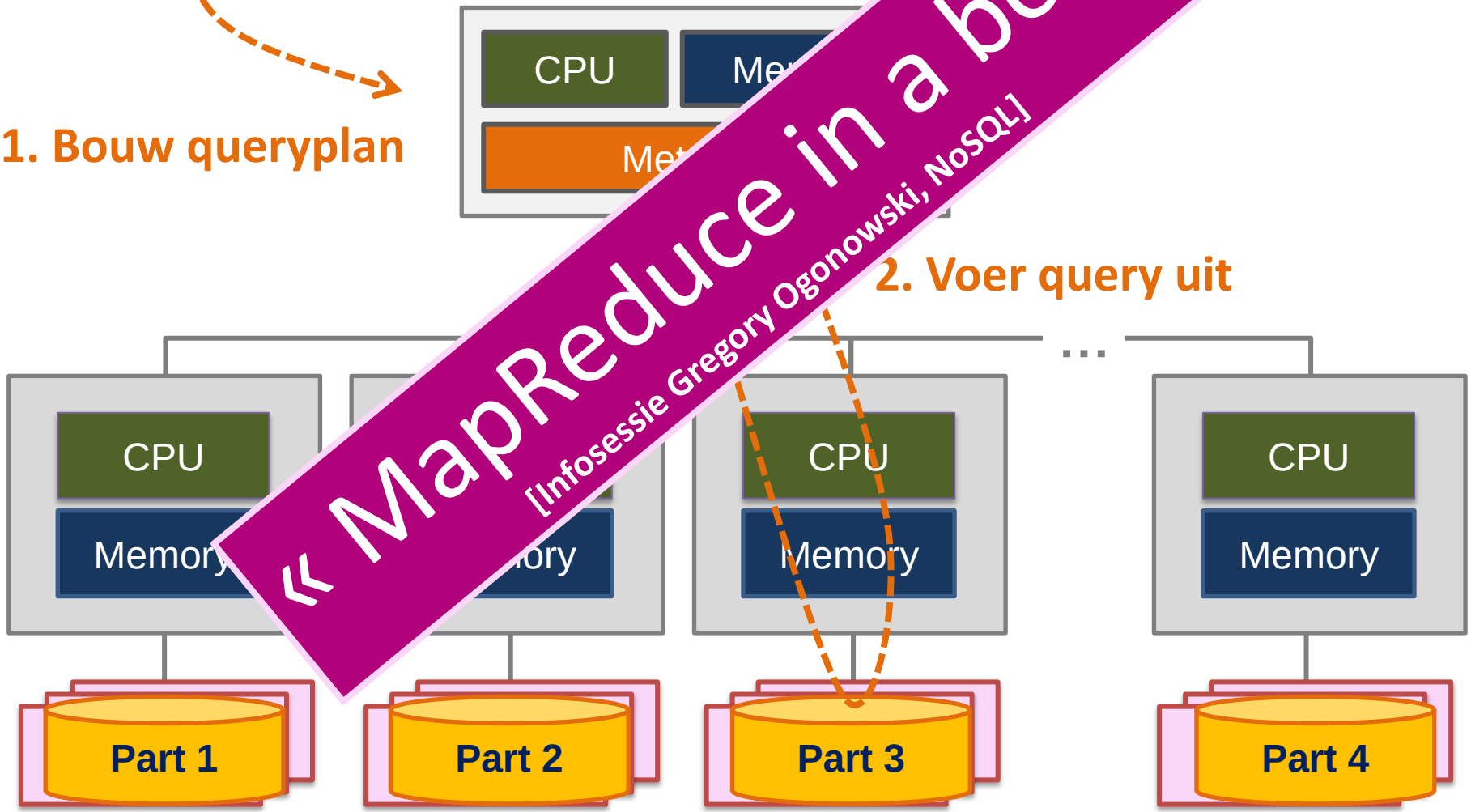


Data **querying**

SELECT * FROM X WHERE id=1000

1. Bouw queryplan

3. Co ltaten

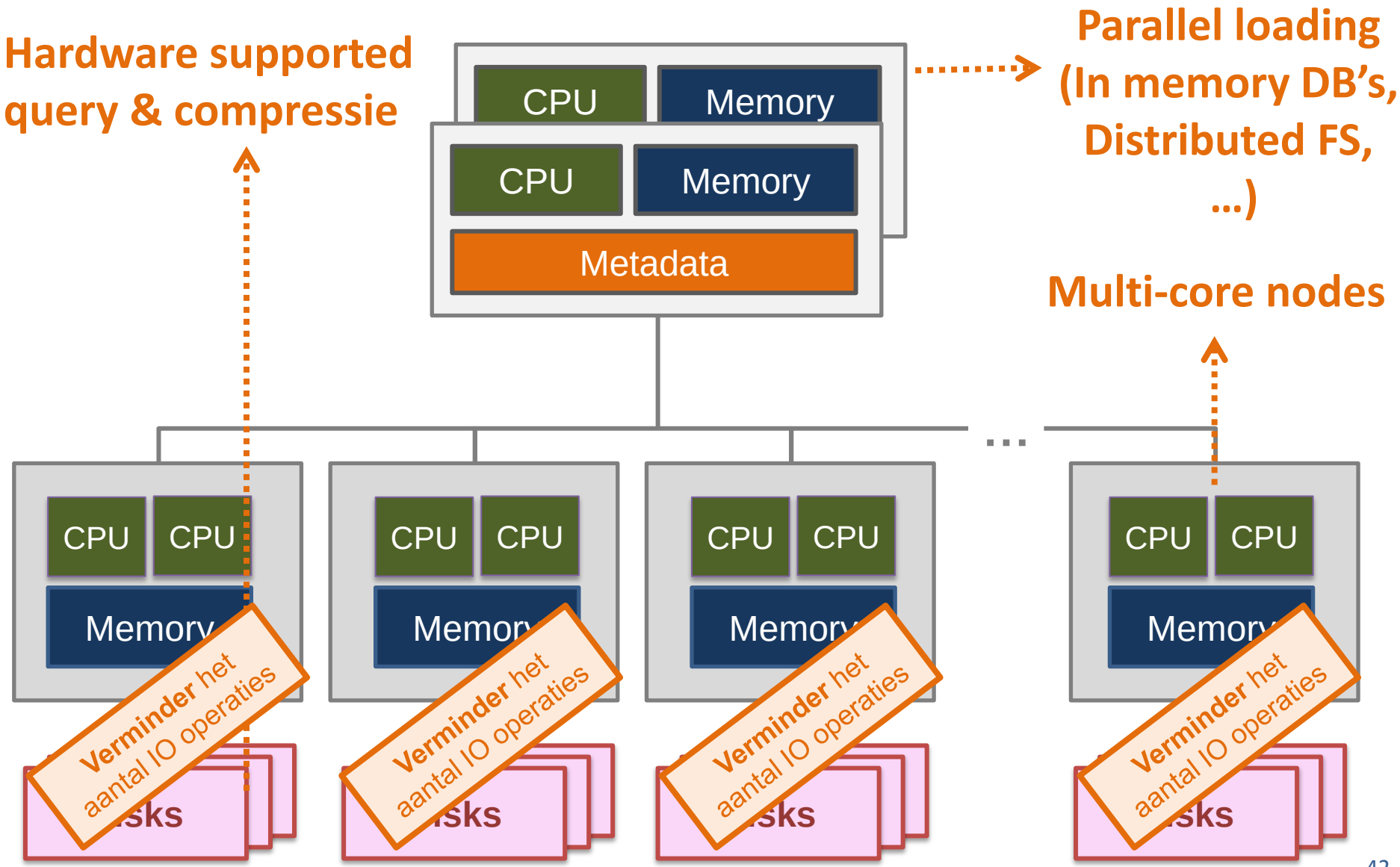


2. Voer query uit

« MapReduce in a box »

[Infosessie Gregory Ogonowski, NoSQL]

Extra **optimalisaties**

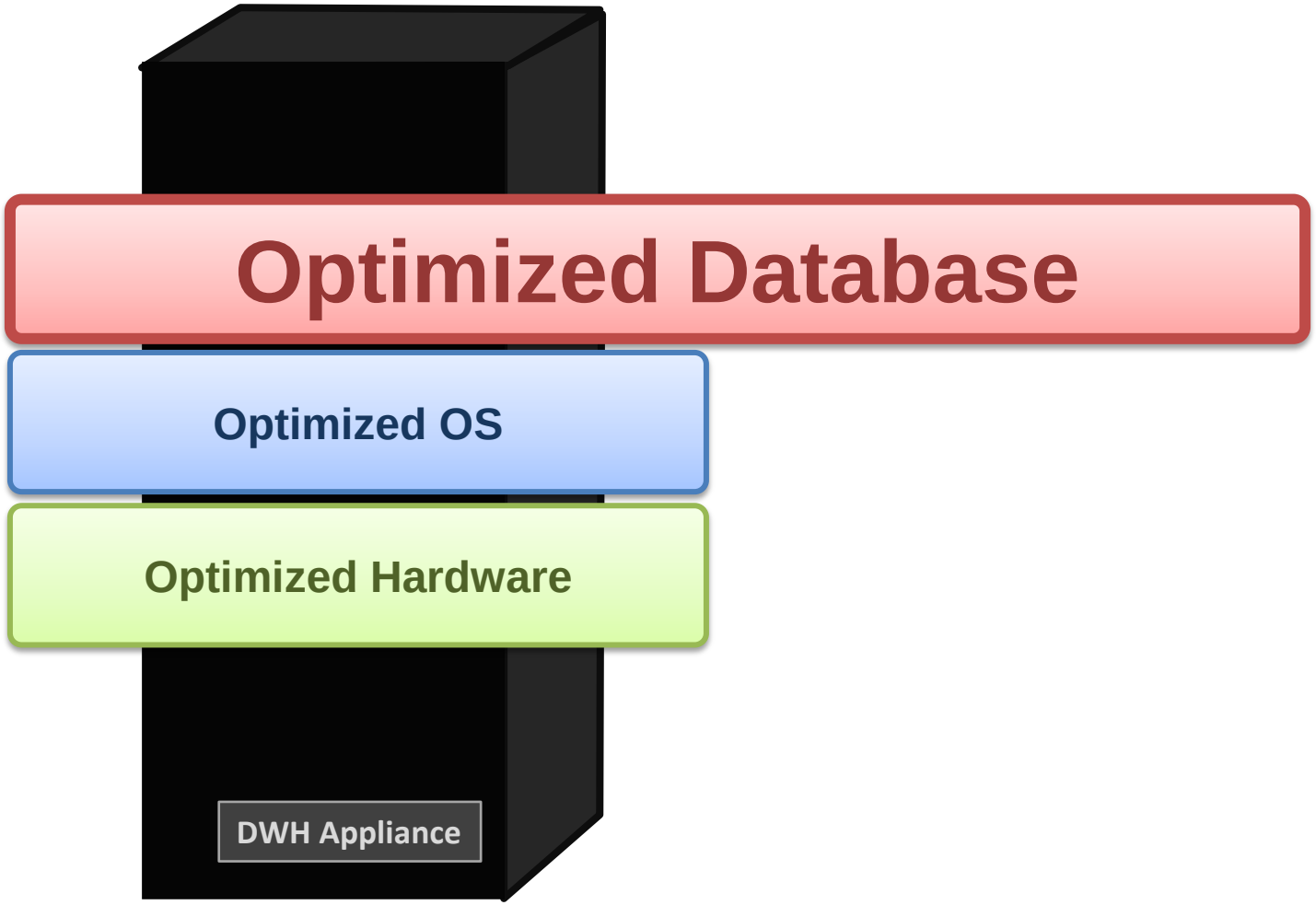


Data **querying** vs. data **loading**

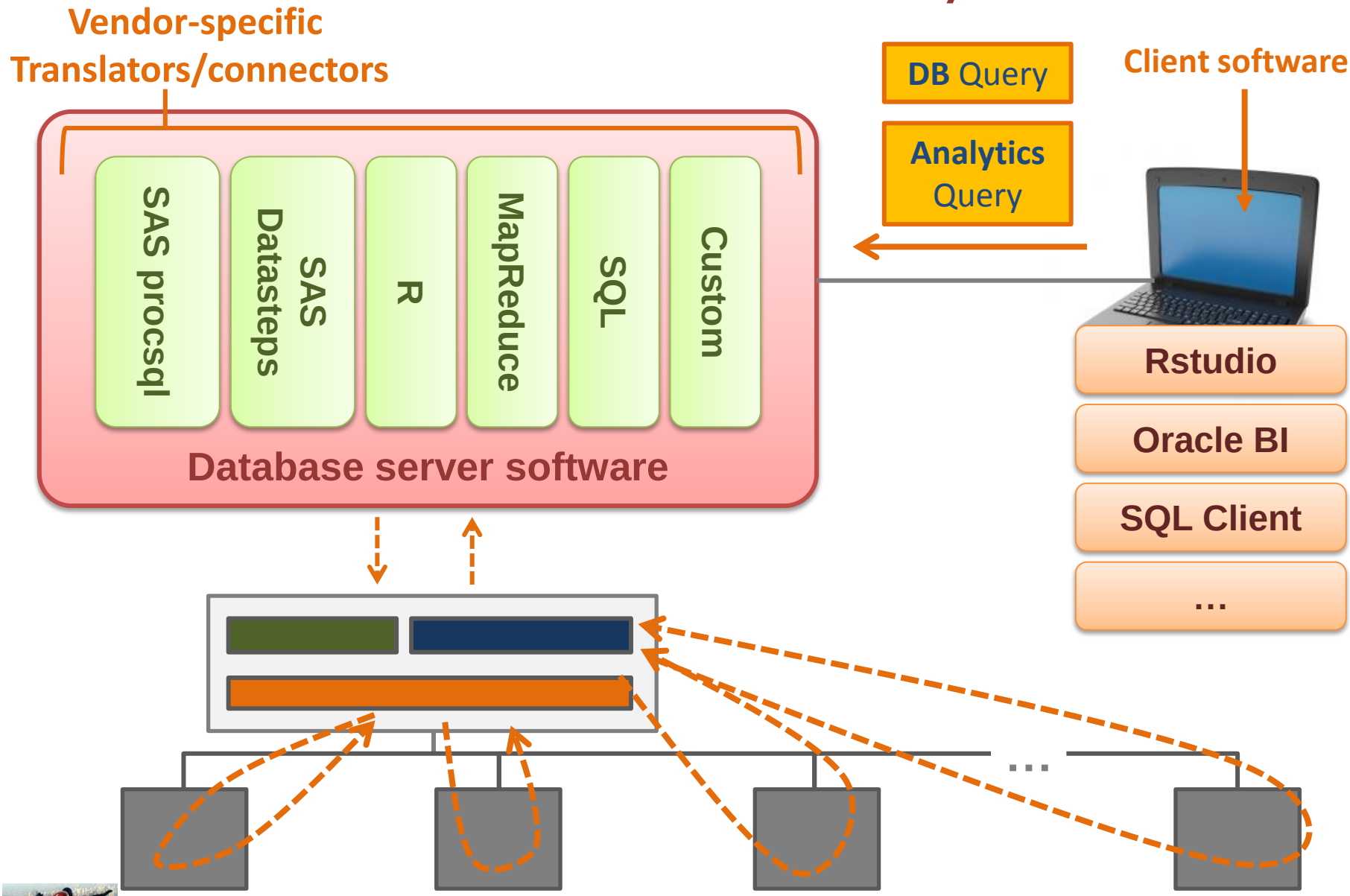
- Performant
- Benut MPP optimaal
- **Maar**: afhankelijk van hoe dataloading gebeurd is!

- Traag
- Veel processing & scanning
- Optimalisaties mogelijk

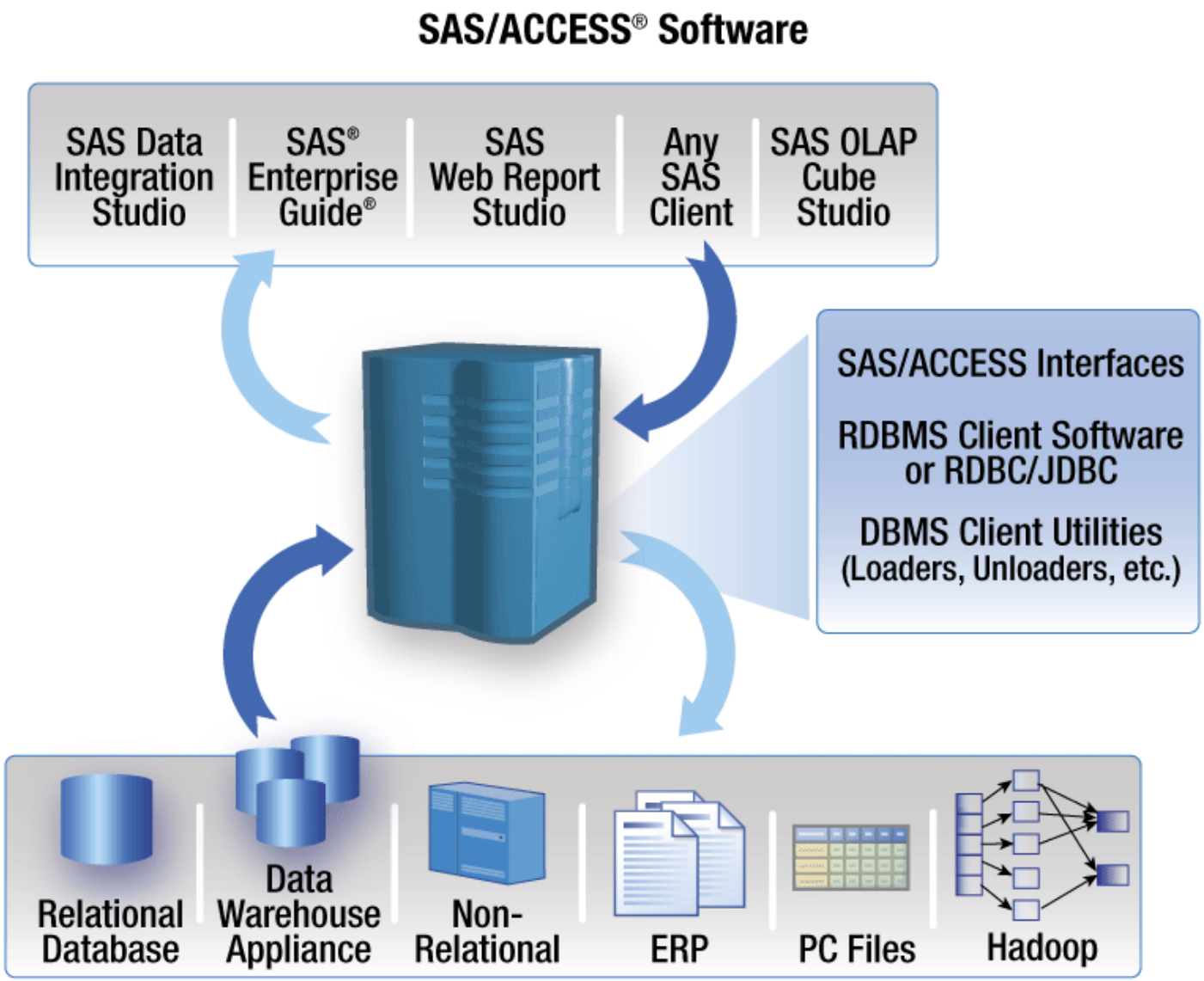
Hardware **appliance voor analytics**
(Data Warehouse appliance)



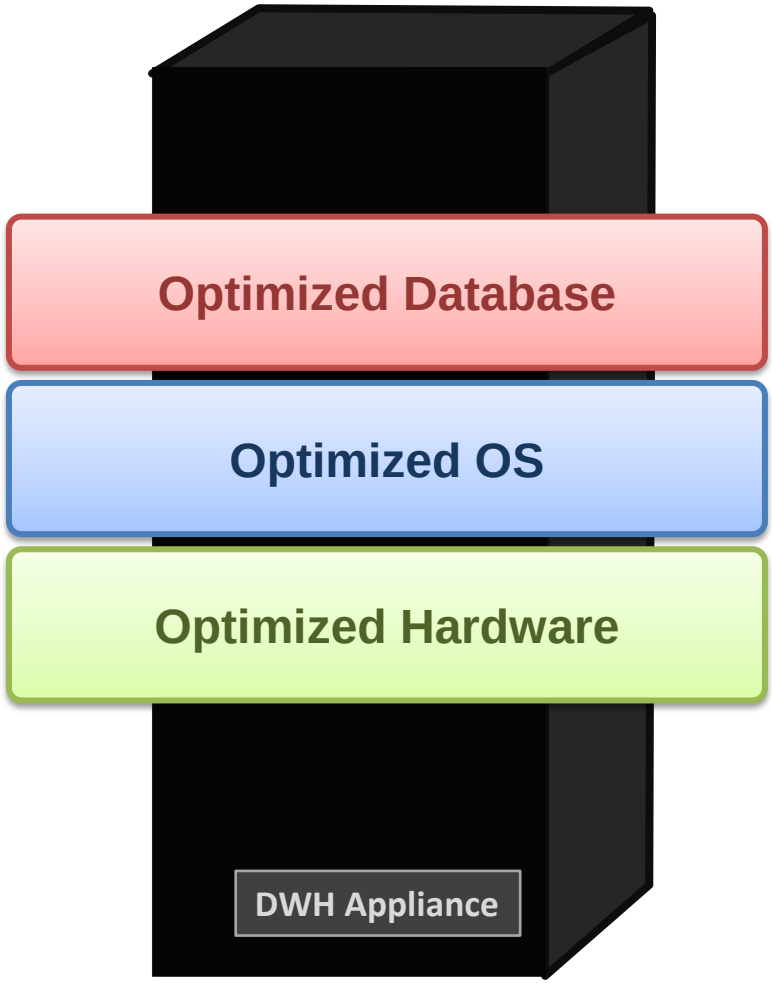
In-database analytics



SAS connectoren



DWH Appliances samengevat



- Heel performante MPP architectuur
- Queries worden snel uitgevoerd
- Data loading gaat vrij traag
- Connectoren voor 1 of meerdere (analytics) softwares

Marktoverzicht

EMC²
GREENPLUM

TERADATA. ASTER

NETEZZA
an IBM Company

ORACLE
EXADATA
READY

SAP HANA

VERTICA
An HP Company

Microsoft
SQL Server 2012
Parallel Data Warehouse

PARACCEL

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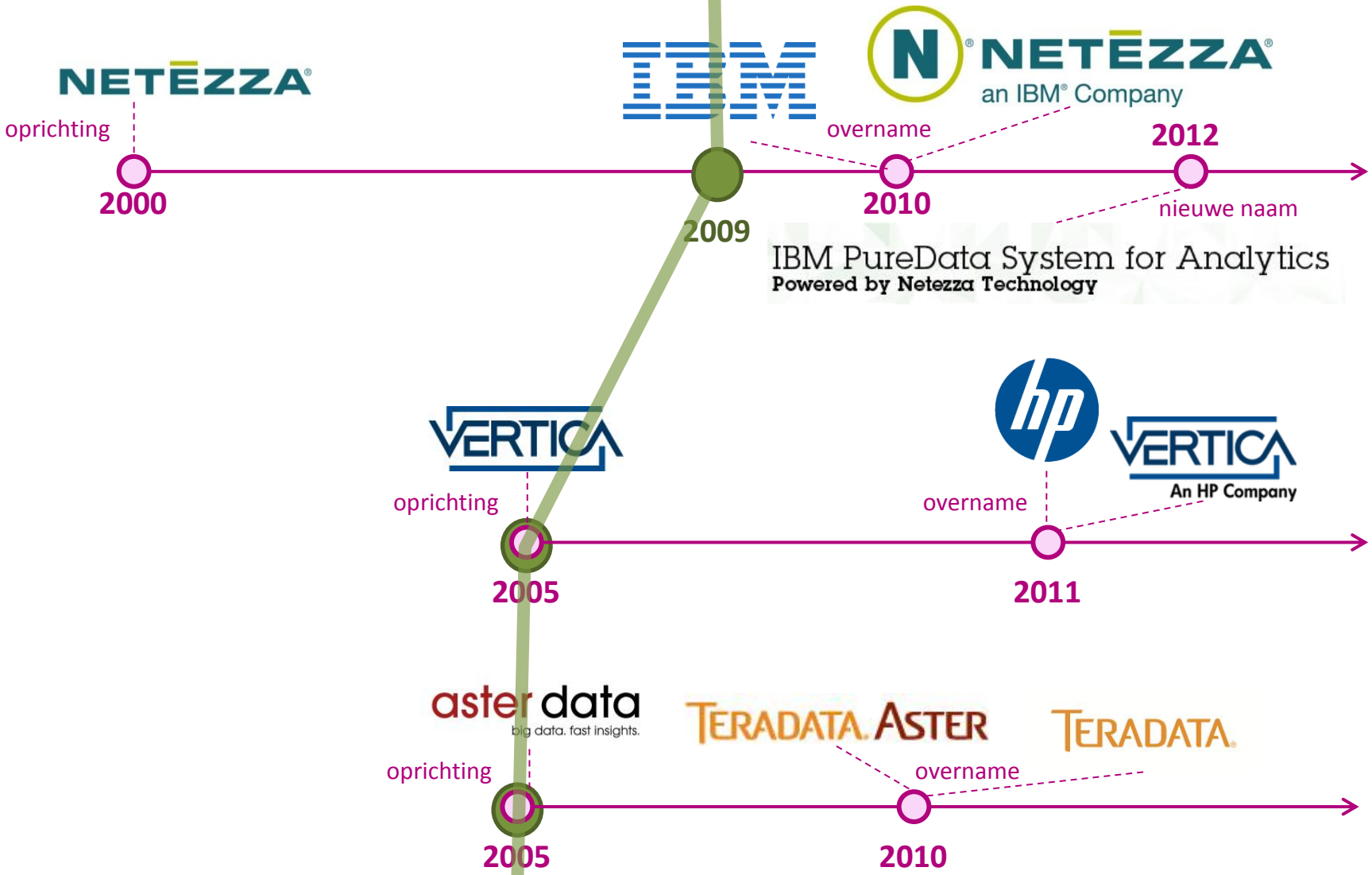
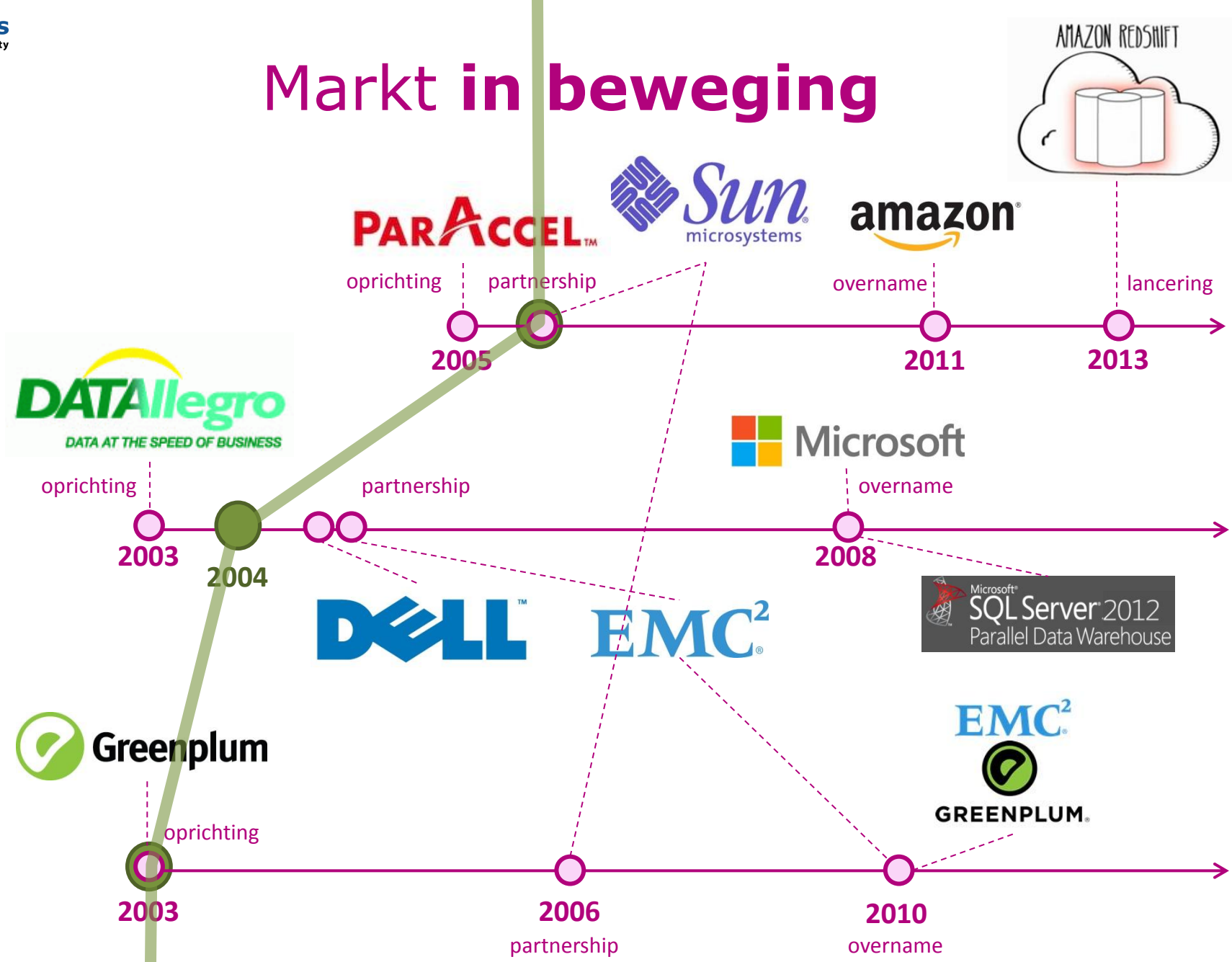
Markt **in beweging**



Proprietary Hardware | **Commodity Hardware**

Markt **in beweging**



Commodity Hardware

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Generic

Meer info over dit kwadrant: contacteer Smals Onderzoek

Software-stack

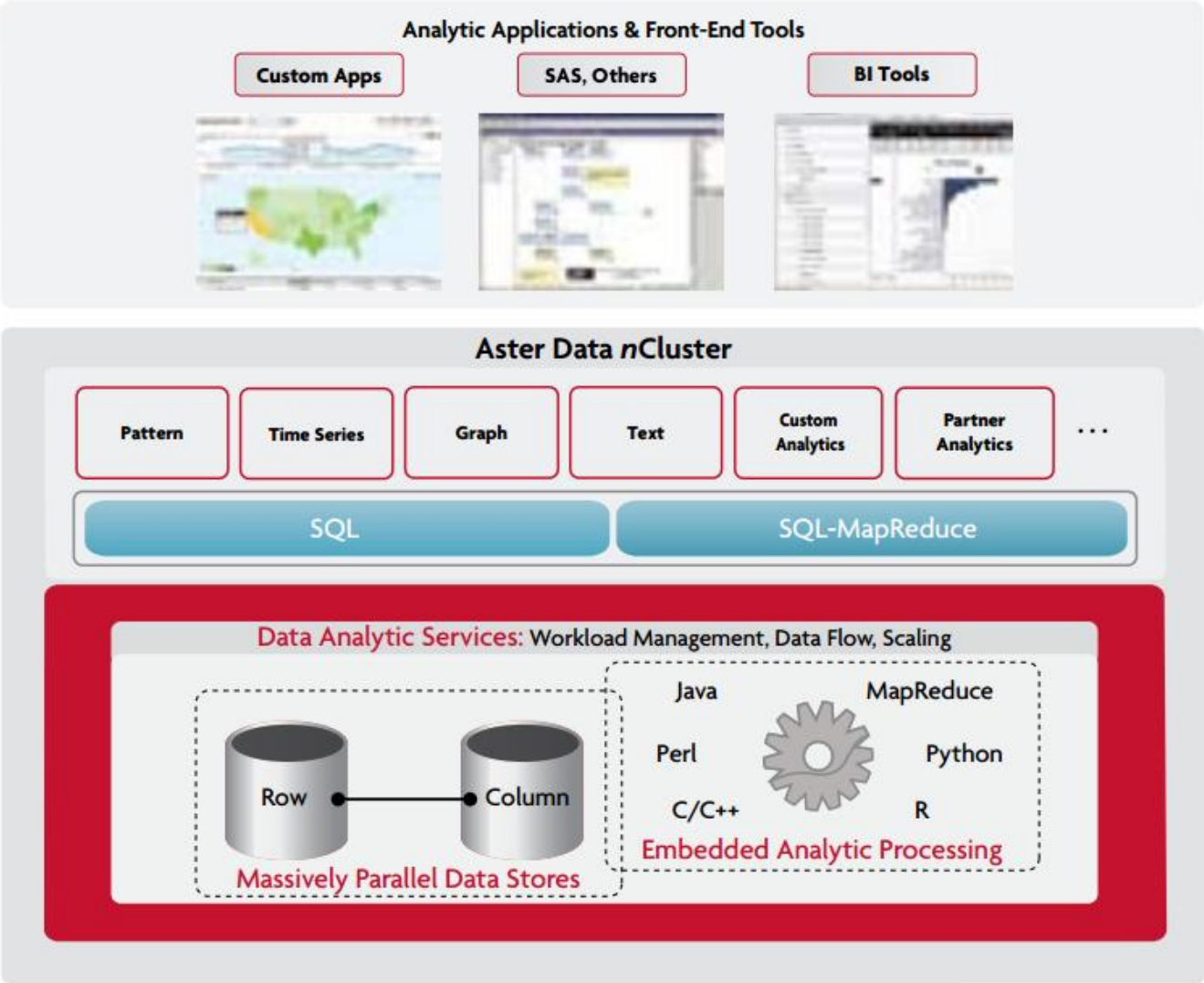
Accelerator

Architectuur

MPP

Specific

TERADATA ASTER *n*Cluster



Get all the flights to London for which another flight exists to London that leaves within an hour on the same day

16:45 →

< 60 min

17:20 →

Alle vluchten | Mijn vluchten | Laatst bijgewerkt op: 13:52

Tijd | Vluchtnr. | Bestemming

Tijd	Vlucht	Bestemming	Status		Track
Vluchten op: 17/06/2013					
16:40	LH5579	Hamburg	Voorzien	16:40	···
16:45	SQ2825	Londen Heathrow	Voorzien	16:45	···
17:00	JAF1711	Palma Mallorca	Voorzien	17:00	···
17:05	SN2705	Bazel Mulhouse	Voorzien	17:05	···
17:05	LX4537	Bazel Mulhouse	Voorzien	17:05	···
17:05	SN2721	Geneve	Voorzien	17:05	···
17:05	LX4559	Geneve	Voorzien	17:05	···
17:10	LH2291	München	Voorzien	17:10	···
17:10	A31429	München	Voorzien	17:10	···
17:10	SN7059	München	Voorzien	17:10	···
17:15	SN2307	Stockholm Bromma	Voorzien	17:15	···
17:15	EY7217	Stockholm Bromma	Voorzien	17:15	···
17:15	TF2222	Stockholm Bromma	Voorzien	17:15	···
17:20	EZS1536	Geneve	Voorzien	17:20	···
17:20	BA397	Londen Heathrow	Voorzien	17:20	···
17:25	EI847	Cork International	Voorzien	17:25	···
17:30	SK1594	Copenhagen Kastrup	Voorzien	17:30	···
17:30	LH1015	Frankfurt	Voorzien	17:30	···
17:30	SN7007	Frankfurt	Voorzien	17:30	···
17:30	HQ1992	Kos	Voorzien	17:30	···
17:30	DE198	Kos	Voorzien	17:30	···
17:30	JAF1603	Enfidha	Voorzien	17:30	···
17:30	SN3661	Strasbourg	Voorzien	17:30	···
17:30	TP7476	Strasbourg	Voorzien	17:30	···
17:30	UA9905	Strasbourg	Voorzien	17:30	···
17:35	JAF1651	Pristina	Voorzien	17:35	···
17:40	AT833	Casablanca	Voorzien	17:40	···

« 12 13 14 15 16 »

http://www.teradata.be/white-paper/Using-SQL-MapReduce-for-Advanced-Analytical-Queries/

Get all the flights to London for which another flight exists to London that leaves within an hour on the same day

SQL

```
SELECT *
FROM DEPARTURES AS D1

WHERE
DESTINATION = 'London'
AND
DEP_TIME + 60 MINUTES >=
(
SELECT MIN(DEP_TIME)
FROM DEPARTURES AS D2
WHERE DESTINATION = 'London'
AND D2.DEP_TIME > D1.DEP_TIME
AND D2.DEP_DAY = D1.DEP_DAY
)
ORDER BY DEP_TIME
```

SQL-MapReduce

```
SELECT *
FROM GET_NEXT_FLIGHT_1HR
(ON DEPARTURES PARTITION BY
DESTINATION)
WHERE
DESTINATION = 'London'

ORDER BY DEP_TIME
```

MapReduce table function
(kunnen zelf gedefinieerd worden)

http://www.teradata.be/white-paper/Using-SQL-MapReduce-for-Advanced-Analytical-Queries/

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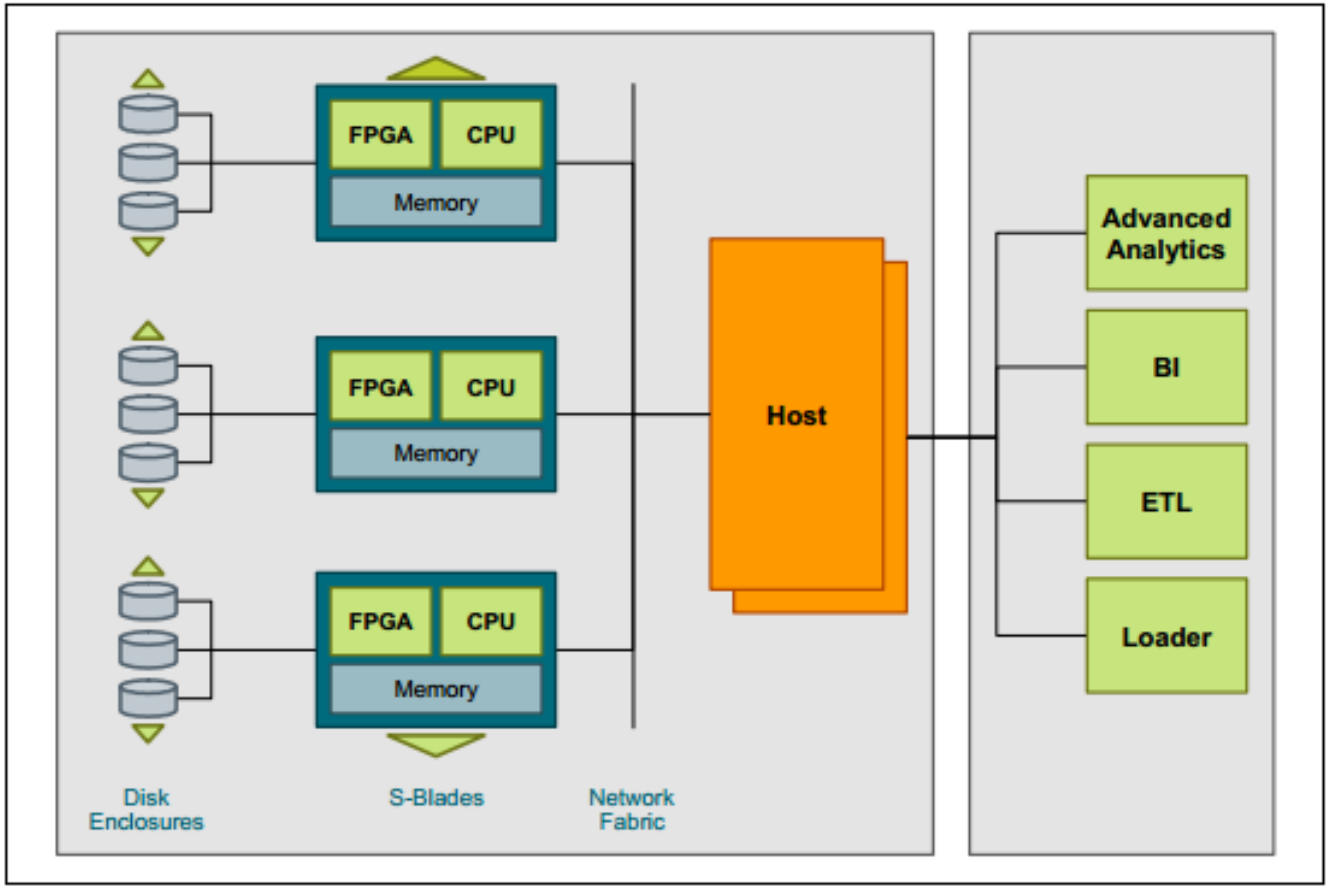
NETEZZA
an IBM® Company

IBM® PureData™ for Analytics, powered by Netezza technology



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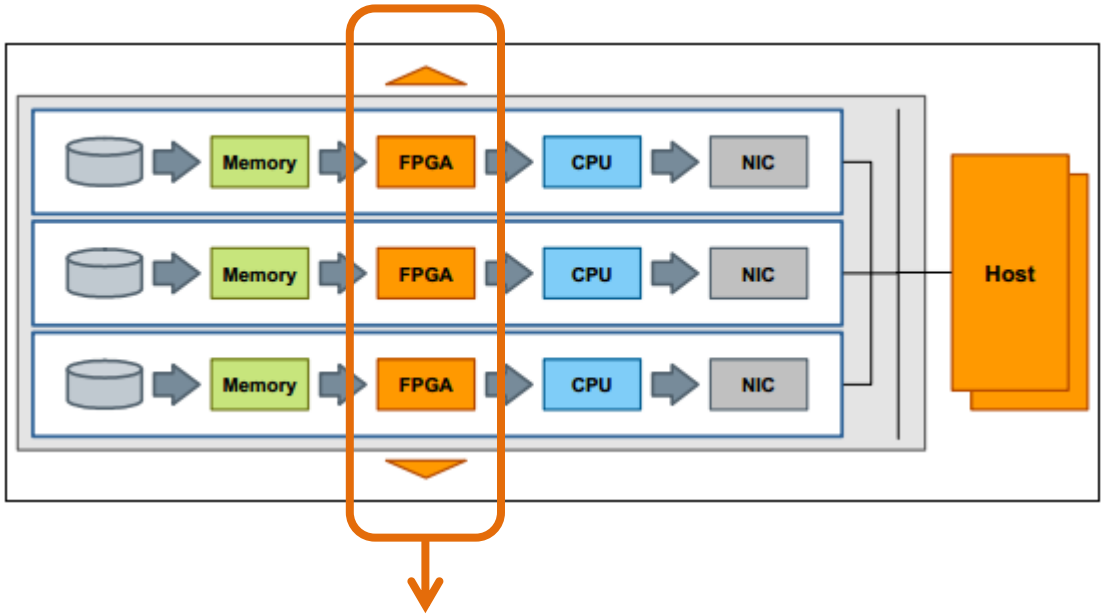
NETEZZA
an IBM® Company

IBM® PureData™ for Analytics, powered by Netezza technology

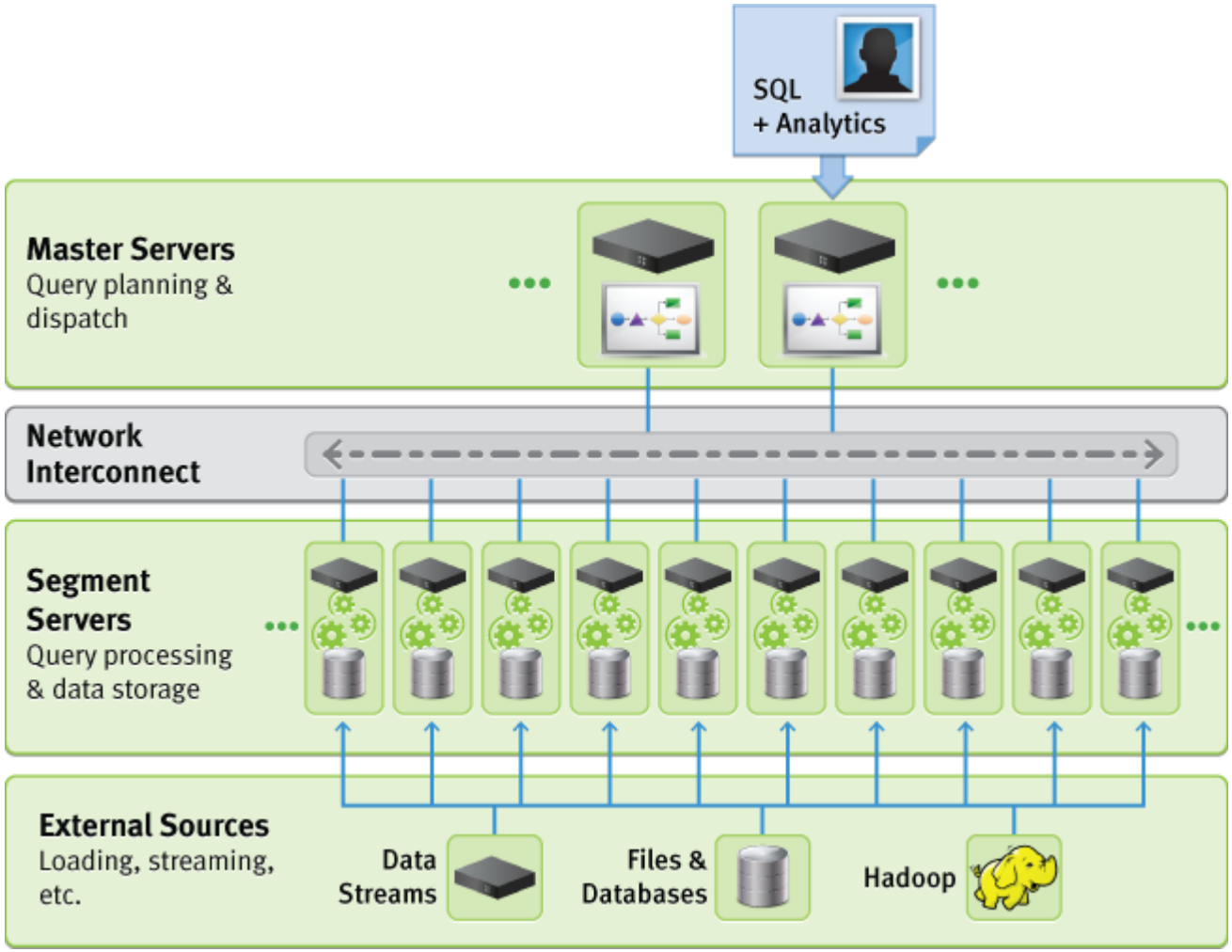
In de worker nodes:



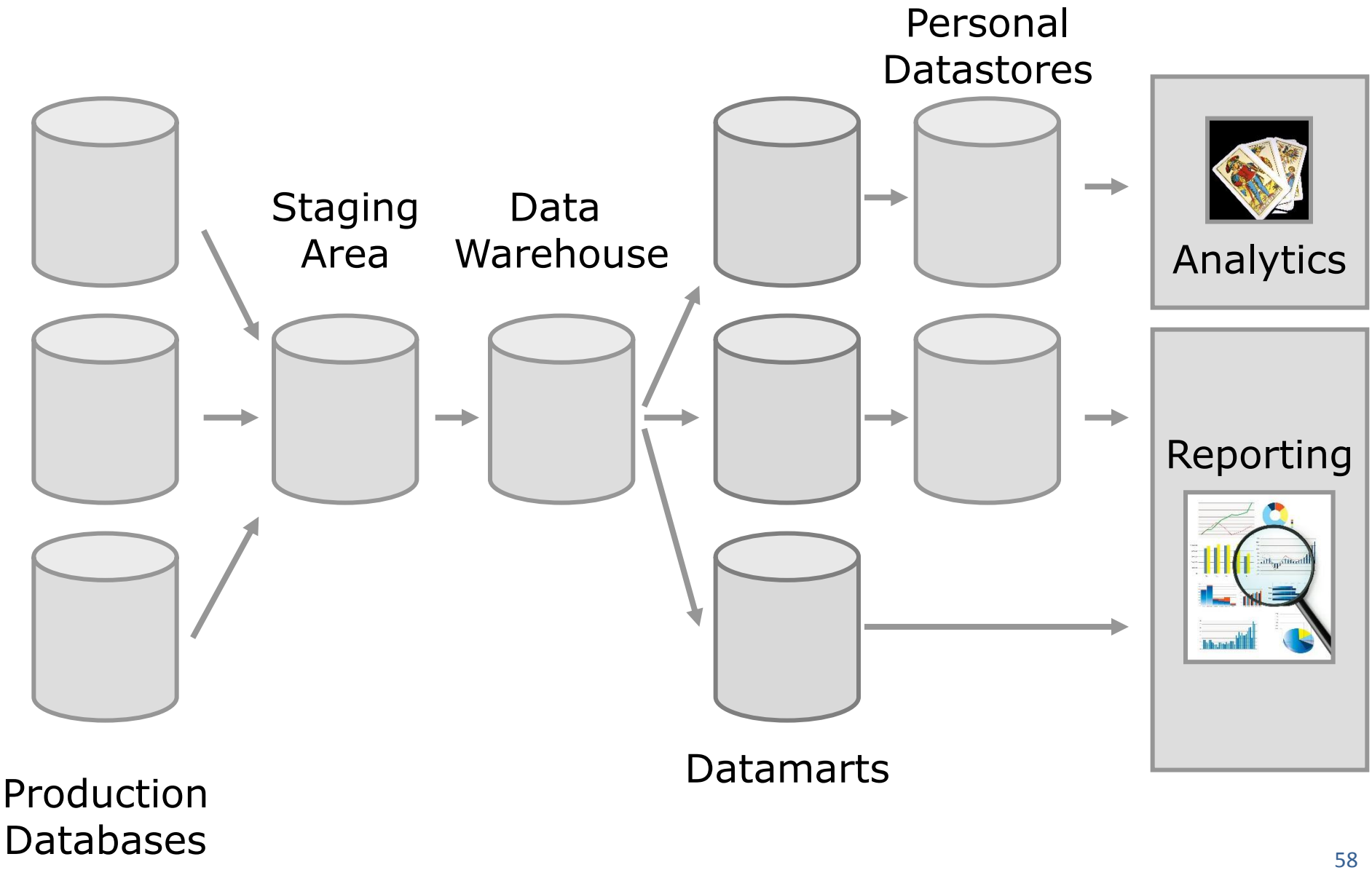
Zeer snelle decompressie en windowing

EMC²

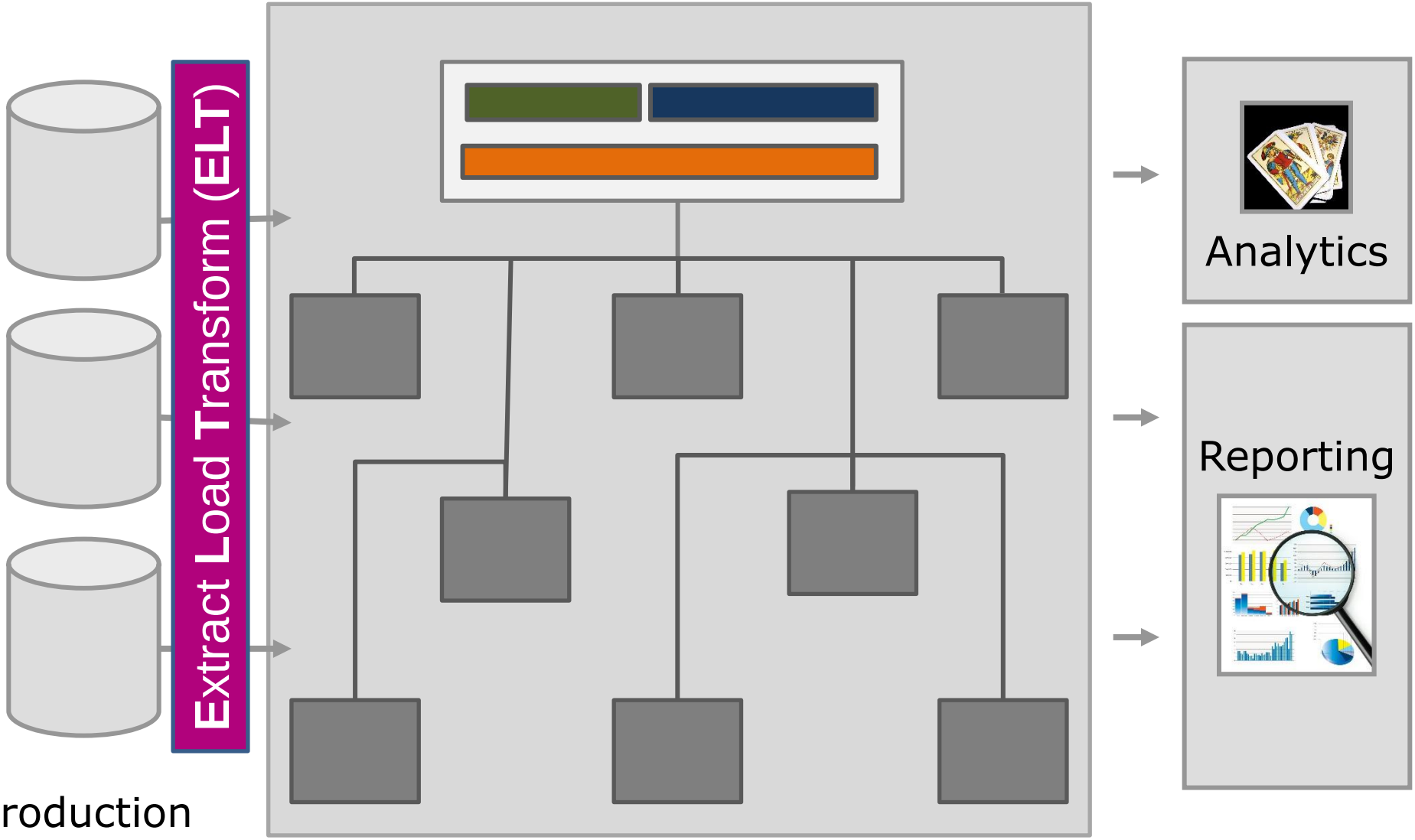
GREENPLUM



DWH Appliances in de **data supply chain**



DWH Appliances in de **data supply chain**



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Barrière 1:

Complexe en **trage** architectuur

« Data-supply chain » wordt **eenvoudiger** en **performanter** met DWH appliances

Barrière 2:

Dataquality management

Grote verbetering mogelijk dankzij vereenvoudigde architectuur mits Information/Master Data Management (Documentatie)

Barrière 3:

Atypische projectstructuur

Een stap in de goeie richting:

Analytics-experten hebben makkelijker toegang tot **alle** data (met respect voor security/privacy)

Dit was de theorie…

Nu de praktijk!

Meer info over deze POC: contacteer Smals Onderzoek

POC met IBM Netezza

Load

Query

- SAS-script 1
- SAS-script 2
- R-analyse 1
- R-analyse 2

Geanonimiseerde Data

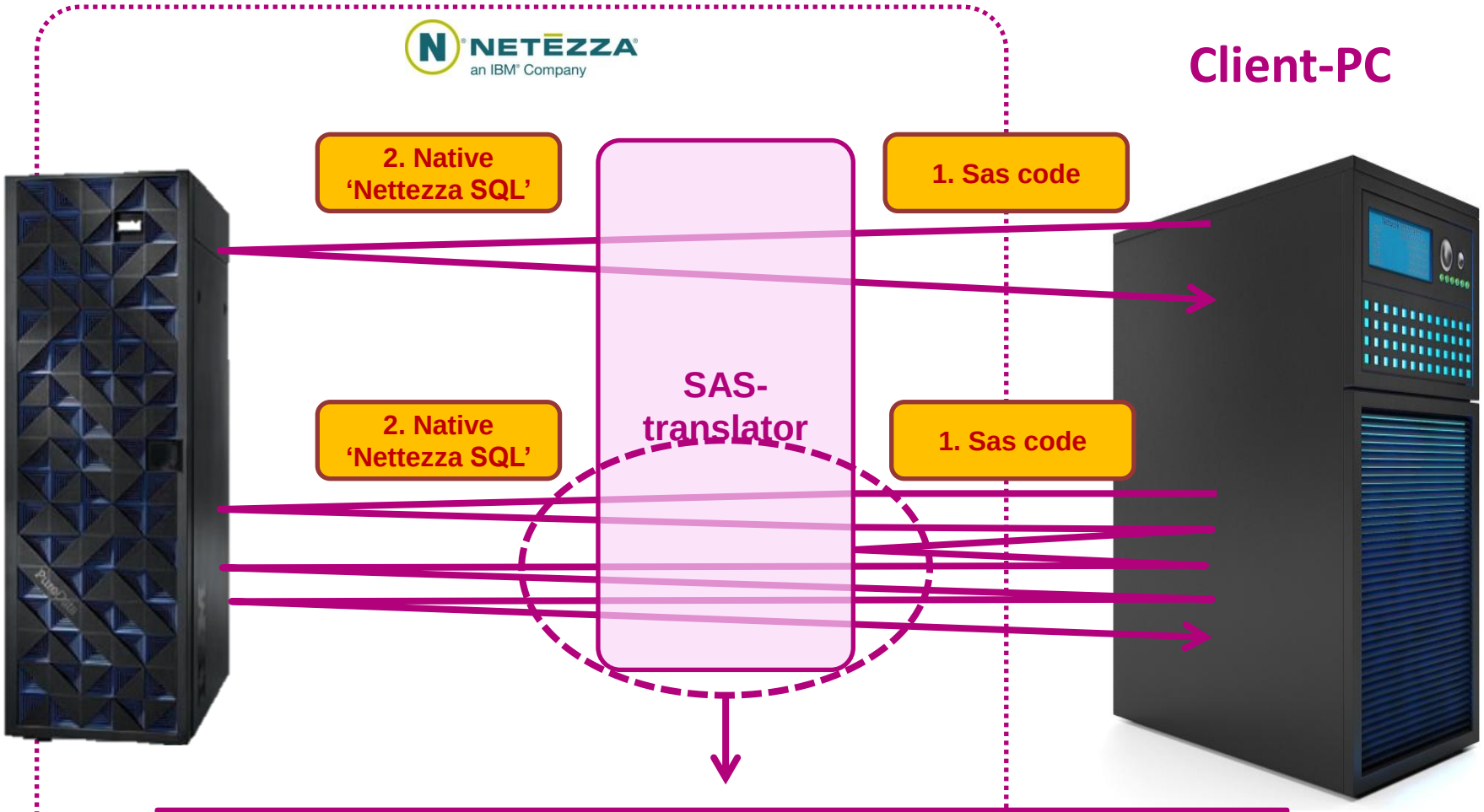
(~ 40 GB)
Sas & CSV-files

Netezza

IBM, Evere

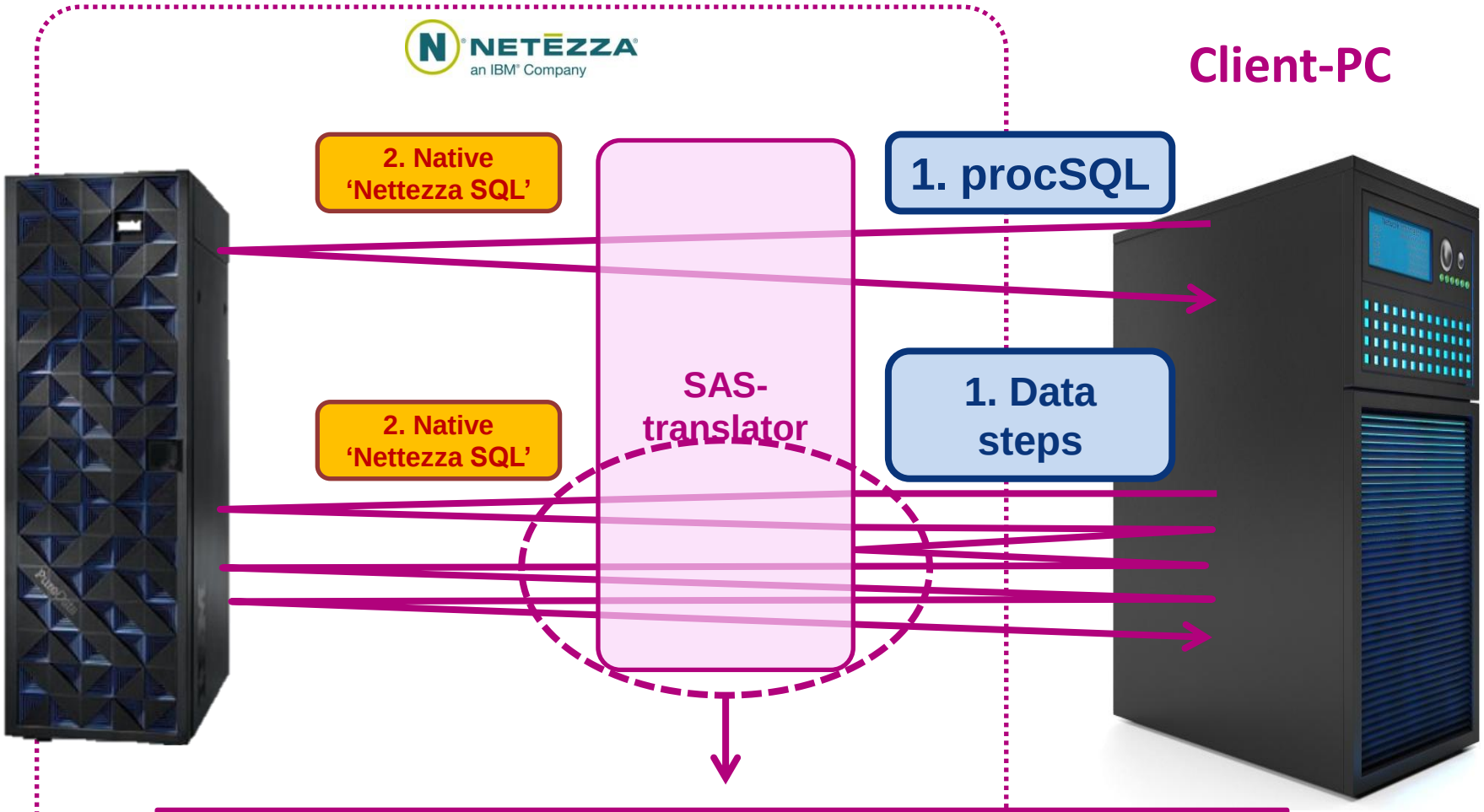
Test-scripts

SAS **code aanpassingen**



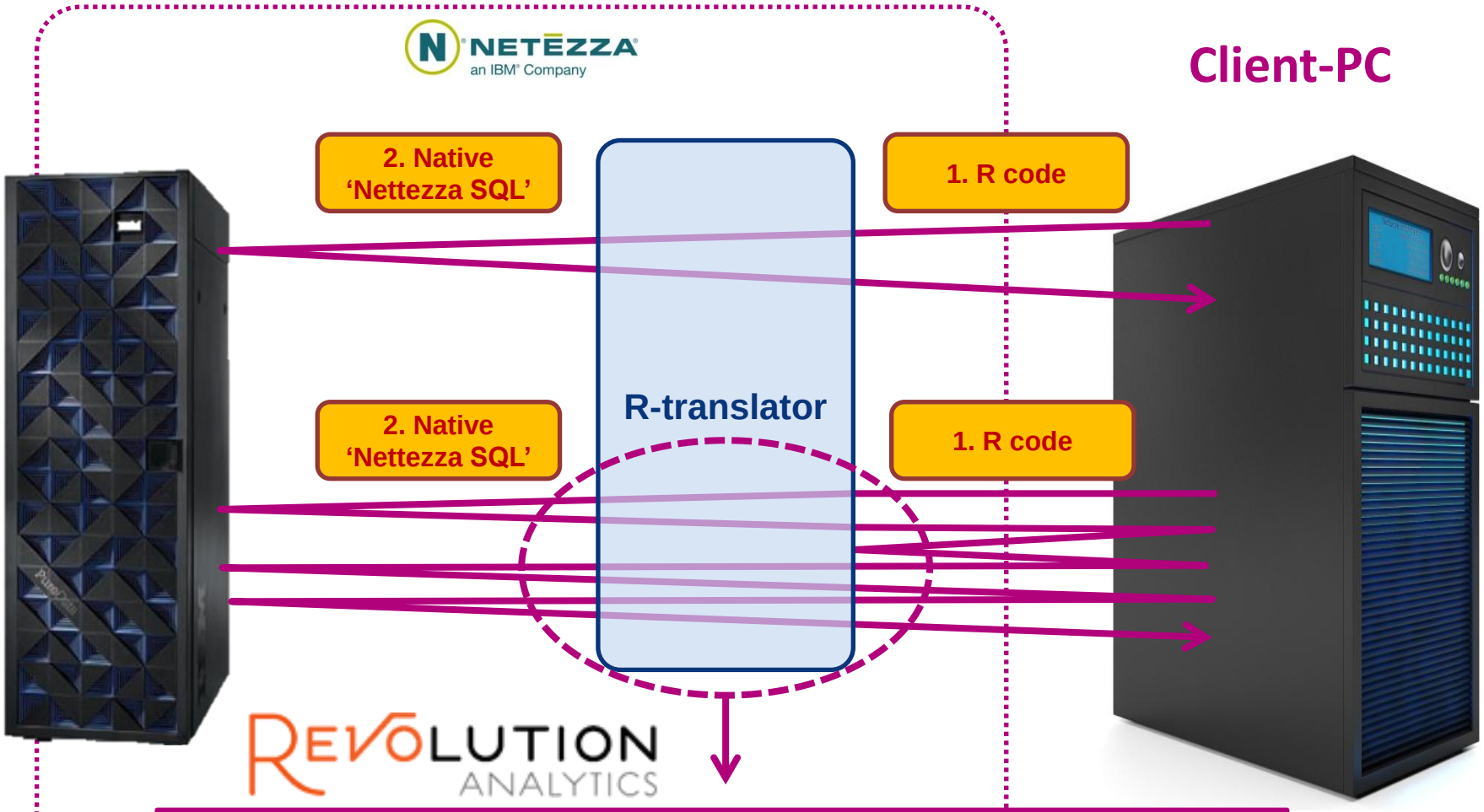
Onaangepaste code kan **niet volledig vertaald** worden :
Berekeningen worden gespreid over Client-PC & Netezza
(= veel performantieverlies)

SAS **code aanpassingen**



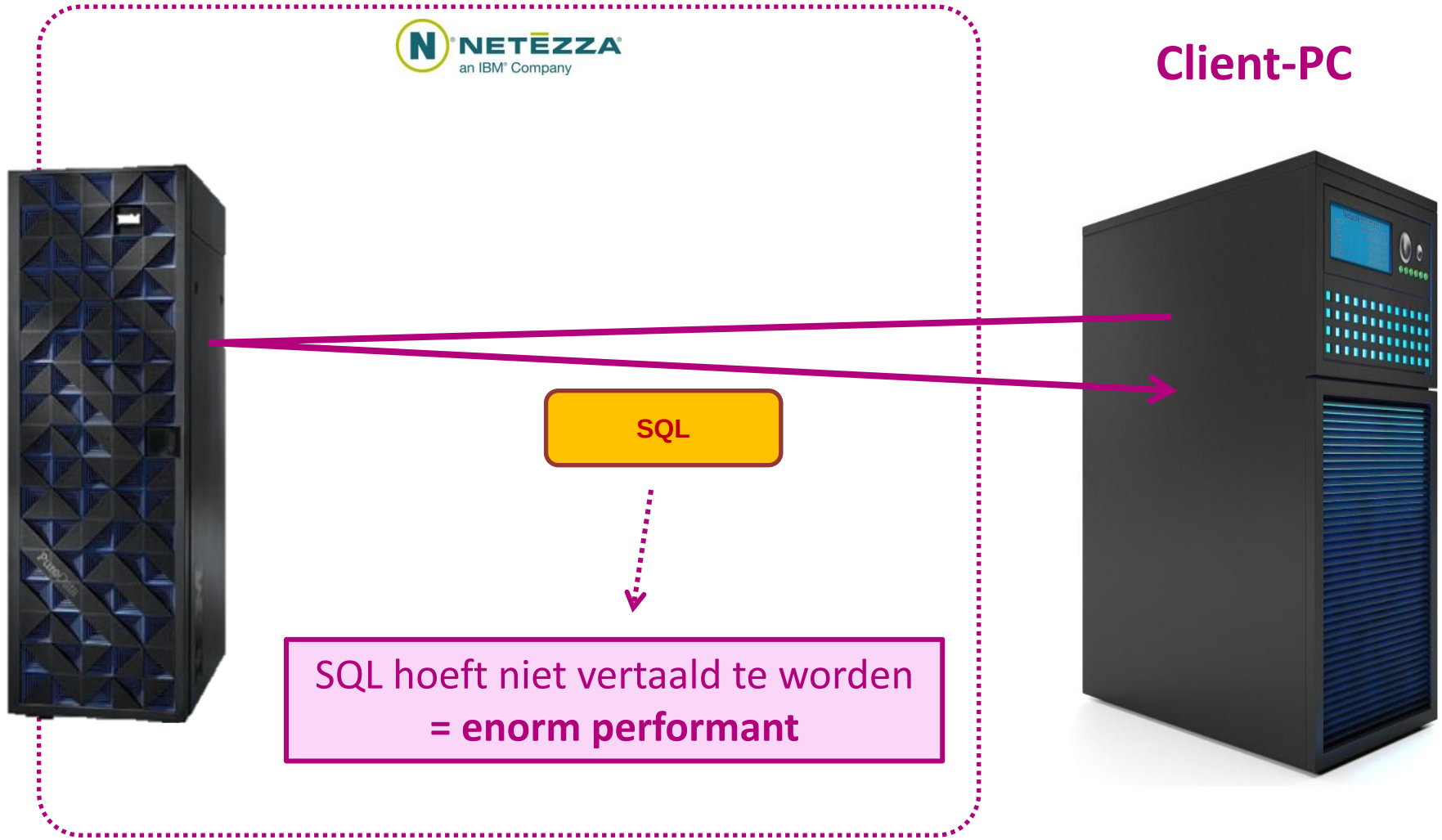
Onaangepaste code kan **niet volledig vertaald** worden :
Berekeningen worden gespreid over Client-PC & Netezza
(= veel performantieverlies)

R code aanpassingen



Onaangepaste code kan **niet volledig vertaald** worden :
Berekeningen worden gespreid over Client-PC & Netezza
(= veel performantieverlies)

SQL is **native** ondersteund



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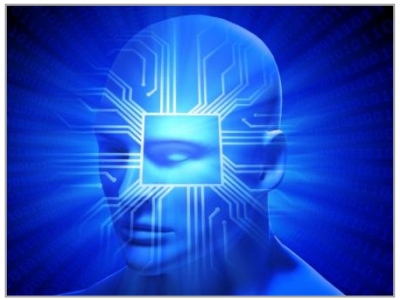
Streamlining Analytics

Predictive analytics

De **data supply chain**



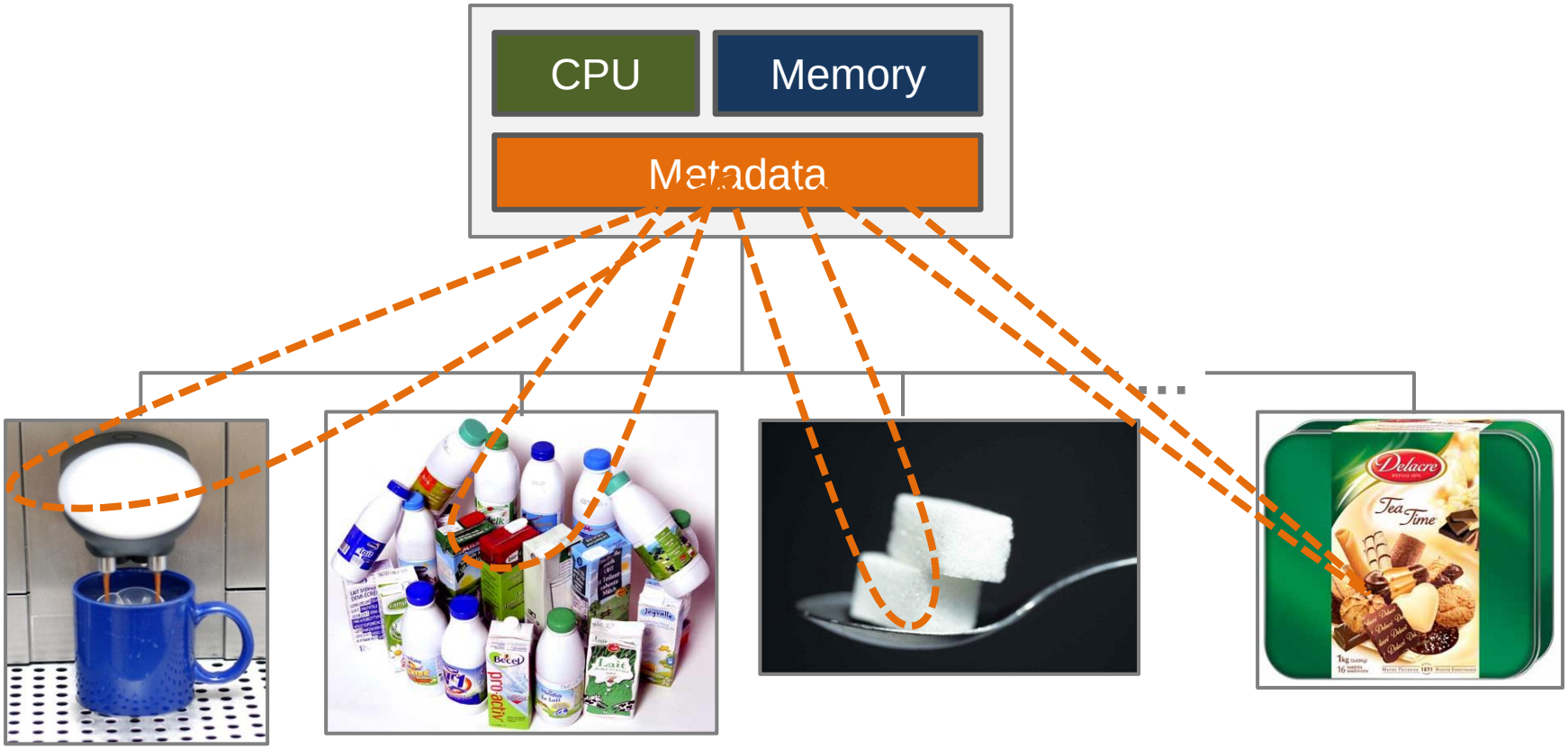
Barrières bij de introductie van analytics

Hardware appliances voor analytics

Data quality

Analytics **project management**

SELECT coffee, milk, sugar, cookies
FROM regular_break
INNER JOIN infosession_break **ON** rId = iId



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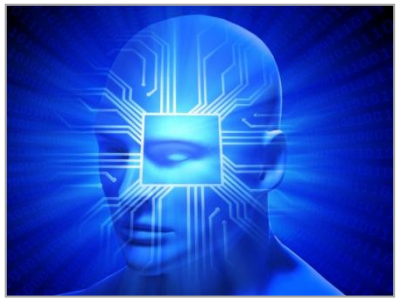
Streamlining Analytics

Predictive analytics

De **data supply chain**



Barrières bij de introductie van analytics

Hardware appliances voor analytics

Data quality

Analytics **project management**

Analytics & Data Quality

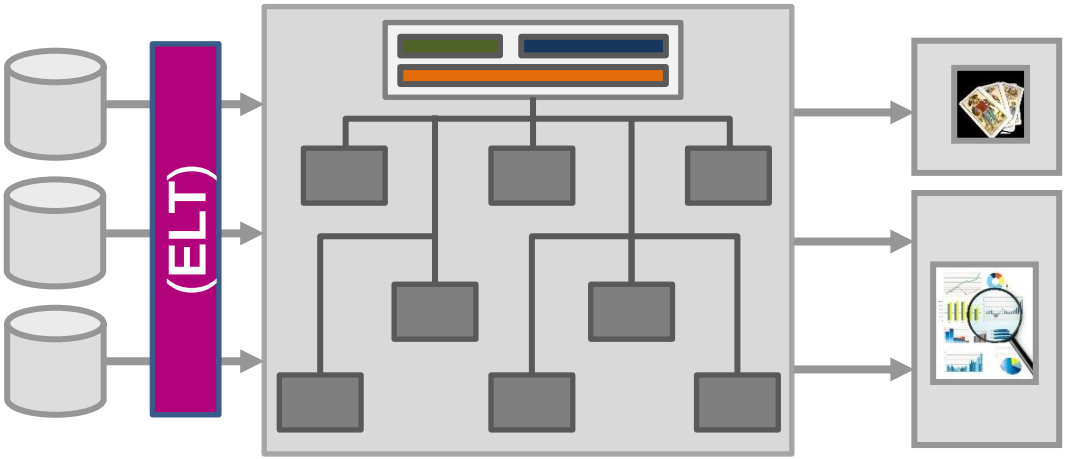
- De ideale wereld (voorgaande studies)
  - best practices
- De realiteit (praktijkvoorbeelden uit projecten)
  - typische problemen van data quality bij analytics-projecten
  - hoe data quality tools de aanpak ondersteunen

Analytics & Data Quality: de ideale wereld (1)

- Vereenvoudigde data supply chain
  - minder E**T**L, minder vertaalslagen (cfr. barrière 2)
  - opportuniteit voor data governance:
    - Data quality management
    - Master data management
    - Information management

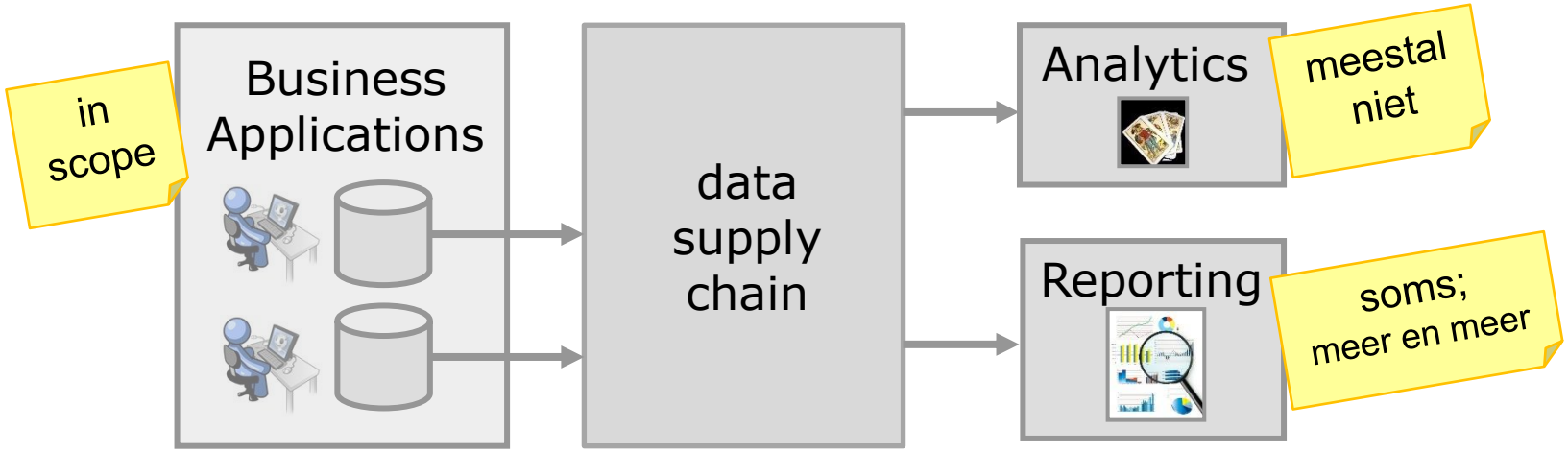
  → op één plaats enten

→ perfecte documentatie



Analytics & Data Quality: de ideale wereld (2)

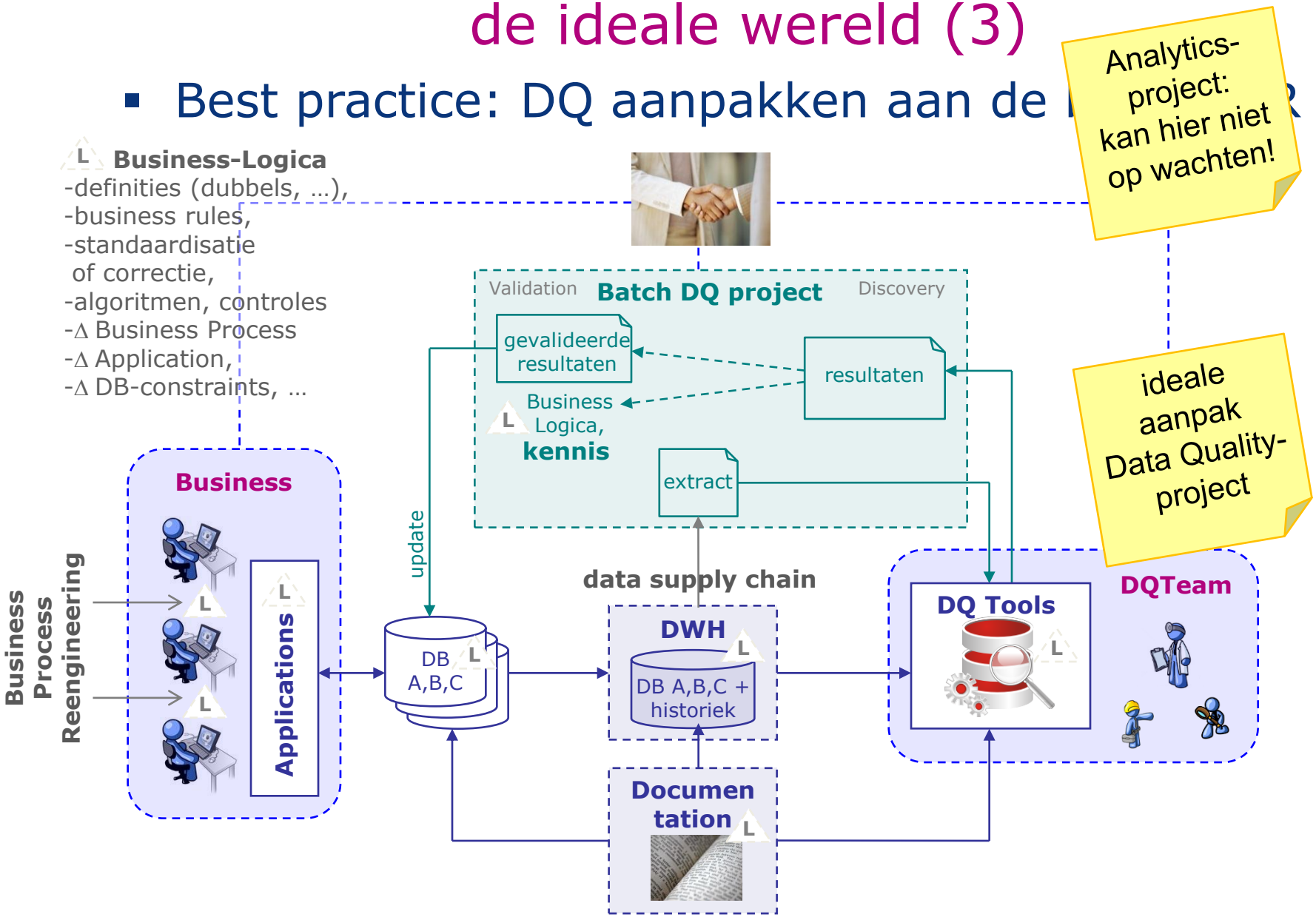
- Best practice: « fitness for use »
  - 100% data quality is onbereikbaar
  - kosten vs. baten
  - *good enough for its (all) intended use*
    - **in scope voor *intended use*?**



Smals Research publicatie « Data Quality: Best Practices », I.Boydens, 2006

Analytics & Data Quality: de ideale wereld (3)

- Best practice: DQ aanpakken aan de



Smals Research publicatie « Gestion intégrée des anomalies », I.Boydens, D. Van Dromme, e.a., 2011

Analytics & Data Quality: de realiteit

- De realiteit
  - gebrek aan data quality / best practices
  - hoe data quality tools de aanpak ondersteunen
    - a.h.v. praktijkvoorbeelden uit voorgaande projecten
    - typische problemen van data quality bij analytics-projecten
    - **waarom typisch voor analytics**-projecten?
      - net bij interessante groepen (risico's, nieuwe opportuniteiten, …) zijn applicatie en databank (nog) onaangepast en is de data quality slechter
      - uitzonderingen, outliers zijn belangrijk (bv. fraude)
      - data quality wordt soms misbruikt om aan controles te ontsnappen

1. Gebrek aan (up to date) documentatie

- Werkelijke gebruik is geëvolueerd
  - documentatie echter niet aangepast
    → bv. niet-gedocumenteerde code

REC_ID	REC_poorlyDocumentedVar
456	01
457	61
458	51

?

DESCRIPTION :
Statut indiquant s'il faut traîter l'e
réimmatriculation ou un cas d'er

DOMAINE DE DEFINITION :
01 : nouvel [redacted] avec numéro
est absent du répertoire provisoire
02 : nouvel [redacted] dont le numé
11 : réimmatriculation d'un [redacted]
l'[redacted] existe dans le répertoire
12 : réimmatriculation d'un [redacted]
l'[redacted] est en archive (off-line)
13 : réimmatriculation d'un [redacted]
complémentaire; l'[redacted] existe
61 : enquête avec statut 81 résolue
62 : enquête avec statut 82 résolue
63 : enquête avec statut 83 résolue

- Na een vertaalslag in de data supply chain
  - (E)T(L) → bv. codes gewijzigd

REC_ID	OLTP1_CODACT
456	
457	1
458	

OLTP1_CODACT

DOMAINE DE DEFINITION :
Valeurs possibles [NULL , 1].
NULL : actif.
1 : supprimé

LONGUEUR : 1
TYPE : Alpha

REC_ID	DWH_CODACT
456	A
457	S
458	A

Doc
?

Data Quality Tools ondersteuning: Data Profiling (formele audit)

DB-schema,
Constraints,
Business Rules,
Documentation, …

Metadata
(inaccurate, incomplete)

Real data
(complete, quality=?)

Data Profiling

DQTools

Metadata
(corrected)

Facts about data
(quality = !)

Business people
+Analyst

Data Quality Issues
- lack of standardisation
- schema not respected
- rules not respected

- Data Profiling met Data Quality Tools
  - Veld per veld: Column Property Analysis
  - Structuur: referentiële constraints
  - Consistency: business rules

Jack E. Olson,
"Data Quality – The Accuracy Dimension"

Data Profiling – Column Property Analyse, drill-down (1)

Entities | Analysis | Findings

unt: 6)	Statistic
Source_secondaire(60)	Rows=246496
Metadata	Keys=0 Deps=0
Attributes	Count=16
Reeksnummer(1)	Distribution=100.000
Identificatienummer(2)	Distribution=99.763
Atypemp(3)	Distribution=0.014
Anatjur(4)	Distribution=0.041
Ara(5)	Distribution=0.002
Arem(6)	Distribution=0.001
Adataffil(7)	Distribution=3.876
Adatsup(8)	Distribution=0
Adenomemp(9)	Distribution=98.672
Aadresemp(10)	Distribution=82.704
Aboxemp(11)	Distribution=0.148
Apostemp(12)	Distribution=0
Type	real
Schema Name	Apostemp
Compliance%	100.000%
Inferred type	Integer (Unkn
Unique Values	1155 (0.469%
Patterns	2
Min	0
Max	9992
Min Len	1
Max Len	4
Masks	2
Integers	1155 (100.00.
Dependencies(Discovered)	0 (2)
Attribute Created Date	2008/09/08 1
Acomemp(13)	Distribution=2.401

- (1)-(16) geanalyseerd tijdens load
  - gegenereerde metadata
    - Min, Max, Lengtes,
    - Null Values, Unique Values
    - Patronen,
    - Distributies,
    - Business Rules, …
  - detectie Keys & Dependencies
- Apostemp(12): postcode werkgever
  - vb. patronen, a.h.v. Masks
- Performantie: < 5 min op 1 miljoen records

Background Tasks
Timestamp = Mon Jun 17 15:47:09 CEST 2013

ctivity Name	Progress	State	Duration
iscover Keys and Dependencies	Processed rules	Completed	0 Days, 00:00:02
nalyze Statistics	Analyzed 25 Attributes	Completed	0 Days, 00:01:33
GREPperfTest	Rows Loaded: 848589	Completed	0 Days, 00:02:35

Data Profiling – Column Property Analyse, drill-down (2)

Entities | Analysis | Findings

unt: 6)	Statistic
Source_secondaire(60)	Rows=246496
Metadata	Keys=0 Deps=0
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Max Len	4
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Dependencies(Discovered)	0 (2)
Attribute Created Date	2008/09/08 1
Acomemp(13)	Distribution=2.401

Unique Masks

Unique Masks
Attribute = Source_secondaire(60).Apostemp

Mask	Mask Pattern	Value Count	Frequency	Dist %
NNNN	N4	1154	239983	97.358
N	N1	1	6513	2.642

Quality Project | Unique Masks

Unique Values

Unique Values
Attribute = Source_secondaire(60).Apostemp

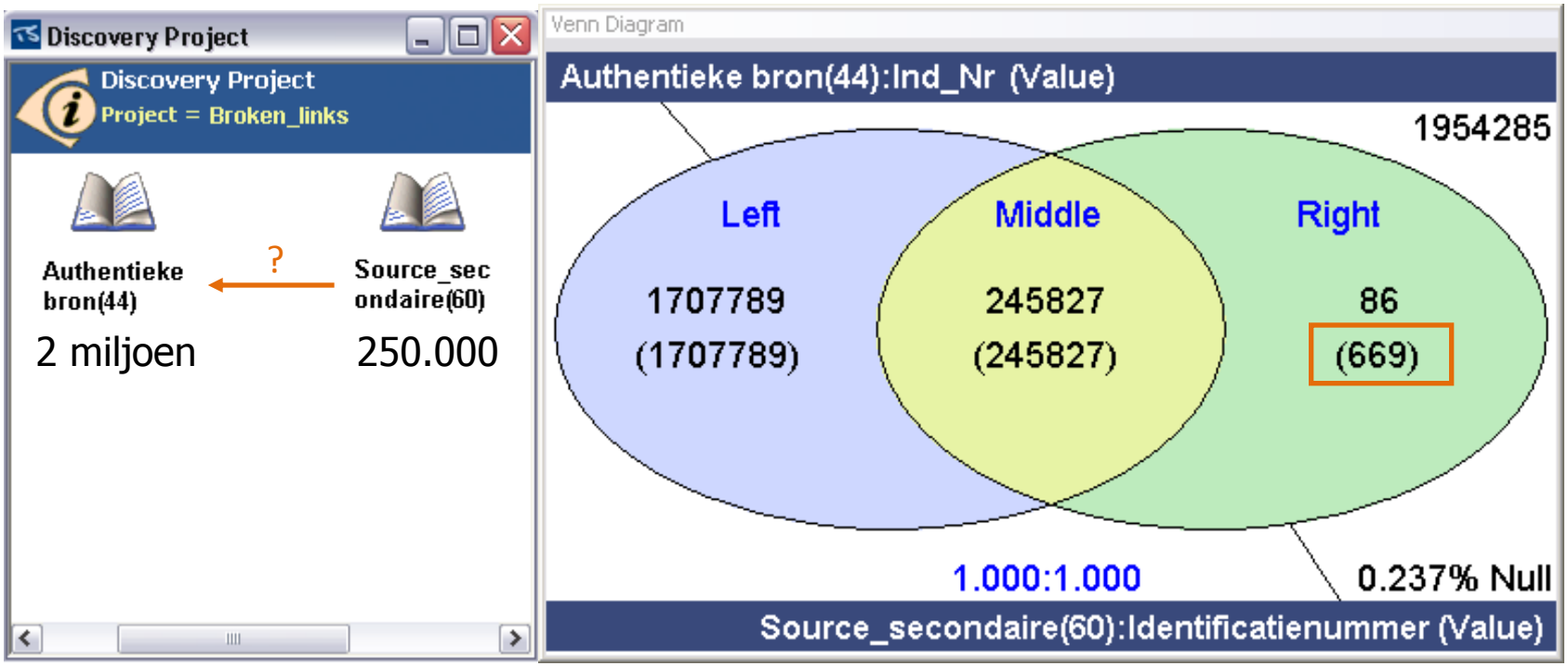
Value	Frequency	Dist %	Length	Soundex	Metaphor
0	6513	2.642	1		

Quality Project | Unique Values

Data rows filtered by selected values in 'Apostemp'

Row	Aadresemp	Apostemp	Acomemp
51	[redacted]	0	JUNGLINSTER LU
77	[redacted]	0	JA TIEL NL
90	[redacted]	0	2215RW VOORHOUT NL
137	[redacted]	0	4131 LX VIANEN NL
147	[redacted]	0	THORN NL
156	[redacted]	0	LEIDSCHENDAM NL
206	[redacted]	0	92150 SURESNES FR
220	[redacted]	0	7665SG ALBERGEN NL
296	[redacted]	0	MADRID ES
302	[redacted]	0	VENDIN LE VIEIL FR
335	[redacted]	0	BREDA NL
481	[redacted]	0	SAINT FULGENT FR

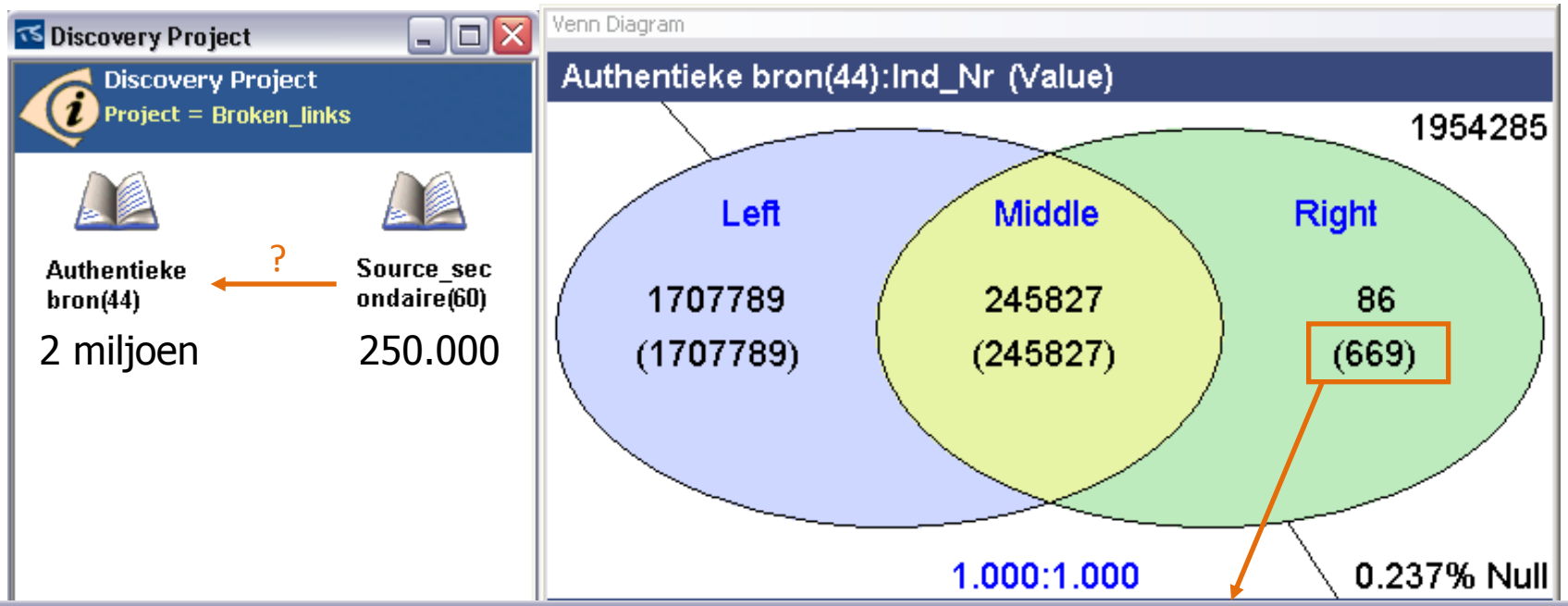
Data Profiling – Referentiële integriteit, foreign keys (1)



- bron 1: Authentieke bron(44)
  - sleutel: Ind_nr
- bron 2: Source_secondaire(60)
  - Identificatienummer verwijst naar Ind_nr's

- **Confrontatie bron 1 – bron 2**
  - 86 waarden niet in authentieke bron
  - in 669 records (er zijn dus dubbels)

Data Profiling – Referentiële integriteit, foreign keys (2)



Non-Joining Right-Hand Rows

Non-Joining Right-Hand Rows

Join = Authentieke bron(44):Ind_nr > - < Source_secondaire(60):Identificatienummer

Row	Reeksnum...	Identificatien...	Atypemp	Anatjur	Adataffil	Adatsup	Adenomemp	Aadresemp	Apostemp	Acomemp
192648	45018	01032	161		1050701		[redacted]	[redacted]ELAAN 1	8580	AVELGEM
110617	48768	01097	141	2011	1070701		[redacted]	[redacted]STRAAT 123	8660	DE PANNE
201530	35477	05395	111		1060116		[redacted]	[redacted]VOINES 11	1020	BRUXELLES
126830	43906	08998	121	4011	1030801		[redacted]	[redacted]LEI 102	2980	ZOERSEL
239099	49646	08997	111		1080609		[redacted]	[redacted]STRAAT 52	2801	MECHELEN
246142	50537	08996	121	4011	1080616		[redacted]	[redacted]LAAN 180	2260	WESTERLO
246146	51428	08993	151		1080519		[redacted]	[redacted]WEG 51	0	3044 CJ ROTTERDAM NL
241041	57168	08994	131	21	1080707		[redacted]	[redacted]RAAT 33 B	1755	GOOIK
66445	08990	62118	161		1080401		[redacted]	[redacted]PLEIN 1	9040	GENT
240701	67363	18310	141	2011	1080701		[redacted]	[redacted]EDREEF ZN	9120	BEVEREN
246421	70432	13371	131	22	1080701		[redacted]	RUE [redacted] 73	7390	QUAREGNON
239321	76964	18305	111		1080801		[redacted]	[redacted]STRA...	3800	ST TRUIDEN
51780	77459	17132	111		1080701		[redacted]	[redacted]STRAAT 15	8480	ICHTEGEM

Data Profiling – Functional Dependencies

Dependencies (Discovered)
Entity Adres Communicatie(350)

Detectie, tijdens load

quality | sample 10.000 | conflicten

Lh Attrs	Rh Attr	Status	Verified	Job	Quality %	Confirming LR Values	Conflicting LH Values	Conflicting Rows	Verifi
C Taalcode,Gemeentenaam	C Nis Gemeentecode	Discovered	No	60	99.800	9980	3	6	
C Taalregime,Gemeentenaam	C Nis Gemeentecode	Discovered	No	60	99.800	9980	3	6	
D Begindatum,C Postcode	C Nis Gemeentecode	Discovered	No	60	98.760	9876	62	129	
D Begindatum,Gemeentenaam	C Nis Gemeentecode	Discovered	No	60	99.990	9999	1	2	
D Ts Lwijz	D Ts Creatie	Discovered	No	60	98.450	9845	109	232	
Gemeentenaam,Landnaam	C Nis Gemeentecode	Discovered	No	60	99.800	9980	3	6	
Straatnaam 21	Straatnaam Voll	Discovered	No	60	99.350	9935	29	65	
Straatnaam Voll	Straatnaam 21	Discovered	No	60	99.140	9914	68	136	

Dependencies (Verified)
Entity Adres Communicatie(350)

Verificatie, on demand

exhaustief, 2.9 miljoen

Lh Attrs	Rh Attr	Status	Verified	Job	Quality %	Confirming LR Values	Conflicting LH Values	Conflicting Rows	Verified Date	Verified By
Landnaam	C Landcode	Permanent	Yes	-	99.960	2935363	5	10	2010/04/06 16:17:19	smals

drill-down naar
overzicht van conflicten indien
Quality < 100%

Dependency Conflicts
Adres Communicatie(350) Dependency Landnaam -> {C Landcode}

Frequency	Landnaam	C Landcode
2854		150
233		
1292	Allemagne	173
945	Allemagne	134
3	Angola	341
1	Angola	381
20	Bahamas	425
5	Bahamas	484
18	Tchécoslovaquie	130
5	Tchécoslovaquie	171

- **Drill down to Matching Rows**
- Resolve Conflicts...
- List Corrections...
- Filter...
- Bookmark
- Convert view to Entity...
- Back
- Forward
- Change View
- Export
- Export to Server
- Copy

Data Profiling – Business Rules (1)

Sub Contractor5(490) Rows=104930
- Metadata Keys=0 Deps=0
  - Attributes 12
  - Rows Loaded 104930
  - Business Rules(Passed) 2(0)
  - Keys(Discovered) 0 (3)
  - Dependencies(Discover... 0 (5)
  - Date Created 2010/07/
  - Entity State Fully Loa
- Attributes Count=12
  - Denomination(1) Distributi
  - Id_1(2) Distributi
  - Id_2(3) Distributi
  - Id_3(4) Distributi
  - Rue(5) Distributi
  - Rue Num(6) Distributi
  - Rue Box(7) Distributi
  - Commune(8) Distributi
  - Postcode(9) Distributi
  - Country Code(10) Distributi
  - Creation Date(11) Distributi
  - Max Work End Date(12) Distributi

Entity Business Rule

Enabled ☑ Name: Présence_Identifiant

Description: Au minimum 1 des 3 types d'identifiant doit être rempli

NOT (Id_1 = "" AND Id_2 = "" AND Id_3 = "")

+ - * / ( ) = <> < <= >= > AND OR NOT IN LIKE

Entity Business Rule

Enabled ☑ Name: Enregistrement à temps

Description: Date de déclaration < date de fin des derniers travaux

[Creation Date] < [Max Work End Date]

+ - * / ( ) = <> < <= >= > AND OR NOT IN LIKE

Choose expression elements from the lists below || |: IF ELSE

Attributes	Bce
Functions	Commune
Literals	Country Code
Operators	Creation Date
	Denomination

Set the threshold to be 100 % of

The test passed on 67.785% of

Save Cancel

Business Rules
Entity = Sub Contractor5(490)

Name	Description	Threshold	Result	Fail Count	Passing Fraction	Pass Count
Enregistrement à temps	Date de déclaration < date de fin des derniers travaux	100	failed	33803	67.785	71127
Présence_Identifiant	Au minimum 1 des 3 types d'identifiant doit être rempli	100	failed	3063	97.081	101867

Data Profiling – Business Rules (2)

Failing Rows (Présence_Identifiant)
Entity = Sub Contractor5(490)

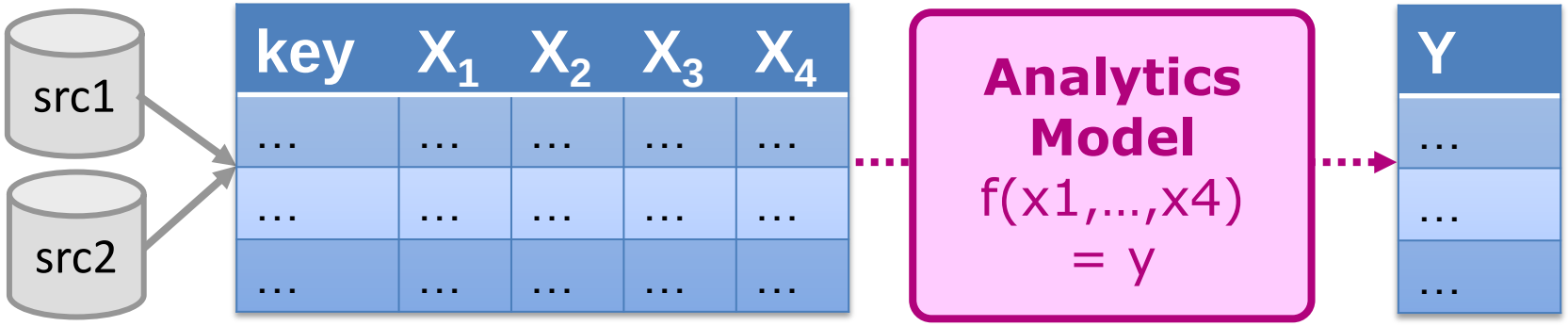
Denomination	Id_1	Id_2	Id_3	Rue	Rue Num	Rue Box	Commune	Postcode	Country...	Creation Date	Max Work End Date
[redacted] SARL				R ...	37/A		59300VA...	0	111	2009-05-20 ...	2011-10-21 00:00:0...
ENTREPRIS...				RU...	9		ANDENNE	5300	150	2005-08-18 ...	2006-06-22 00:00:0...
CONCEPT ...				AV...	15		FOREST	1190	150	2004-02-19 ...	2003-12-01 00:00:0...
[redacted] SPRL				ZO...	11	n/a	MONT D...	7750	150	2009-05-20 ...	2009-03-31 00:00:0...
[redacted] PR...				KL...	6A		OUDEN...	4730 AE	129	2007-09-26 ...	2007-12-31 00:00:0...
[redacted] B...				G...	37		HASSELT	3511	150	2007-03-20 ...	2011-07-31 00:00:0...
[redacted] JON...				RU...	80		CHARLE...	6031	150	2005-12-02 ...	2006-09-28 00:00:0...
[redacted]				BE	10		ZOUTLE	3440	150	2006-02-09	2006-07-15 00:00:0

Failing Rows (Enregistrement à temps)
Entity = Sub Contractor5(490)

Denomination	Id_1	Id_2	Id_3	Rue	Rue Num	Rue Box	Commune	Postcode	Country...	Creation Date	Max Work End Date
[redacted] ...	76...			BA...	1		WUUST...	2990	150	2007-10-09 ...	2007-08-31 00:00:0...
[redacted] ...	46...	124...		RU...	n/a	n/a	LIBRAM...	6800	150	2009-05-20 ...	2003-11-28 00:00:0...
[redacted] ...	41...	127...		R ...	63	n/a	ETTERB...	1040	150	2009-05-20 ...	2008-05-31 00:00:0...
[redacted] ...	73...		78297...	TO...	7	n/a	HOESELT	3730	150	2007-06-07 ...	2007-06-04 00:00:0...
[redacted] ...	73...		78297...	DA...	2	n/a	HOESELT	3730	150	2007-06-07 ...	2007-06-04 00:00:0...
[redacted] ...	46...	171...		P...	74	n/a	NIEL	2845	150	2009-05-20 ...	2006-04-14 00:00:0...
[redacted] ...	74...		78242...	DU...	n/a	n/a	ST KATE...	2860	150	2005-06-16 ...	2005-01-31 00:00:0...
[redacted]	44	160		G...	27	n/a	BEER ...	3990	150	2009-05-20	2003-05-15 00:00:0

2. Data-integratie vanuit heterogene bronnen

- Data Preparation & transformation
  - naar een vorm geschikt voor Analytics



src1_key	src2_key
406798006	0406.798.006
206731645	0206.731.645
…	…

src1_creationdate	src2_datstart
20060401	01APR06
19501001	01OCT50
…	…

Smals
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Ondersteuning data integratie met dqtools: Data Standardisation – simple domains

Example: country codes

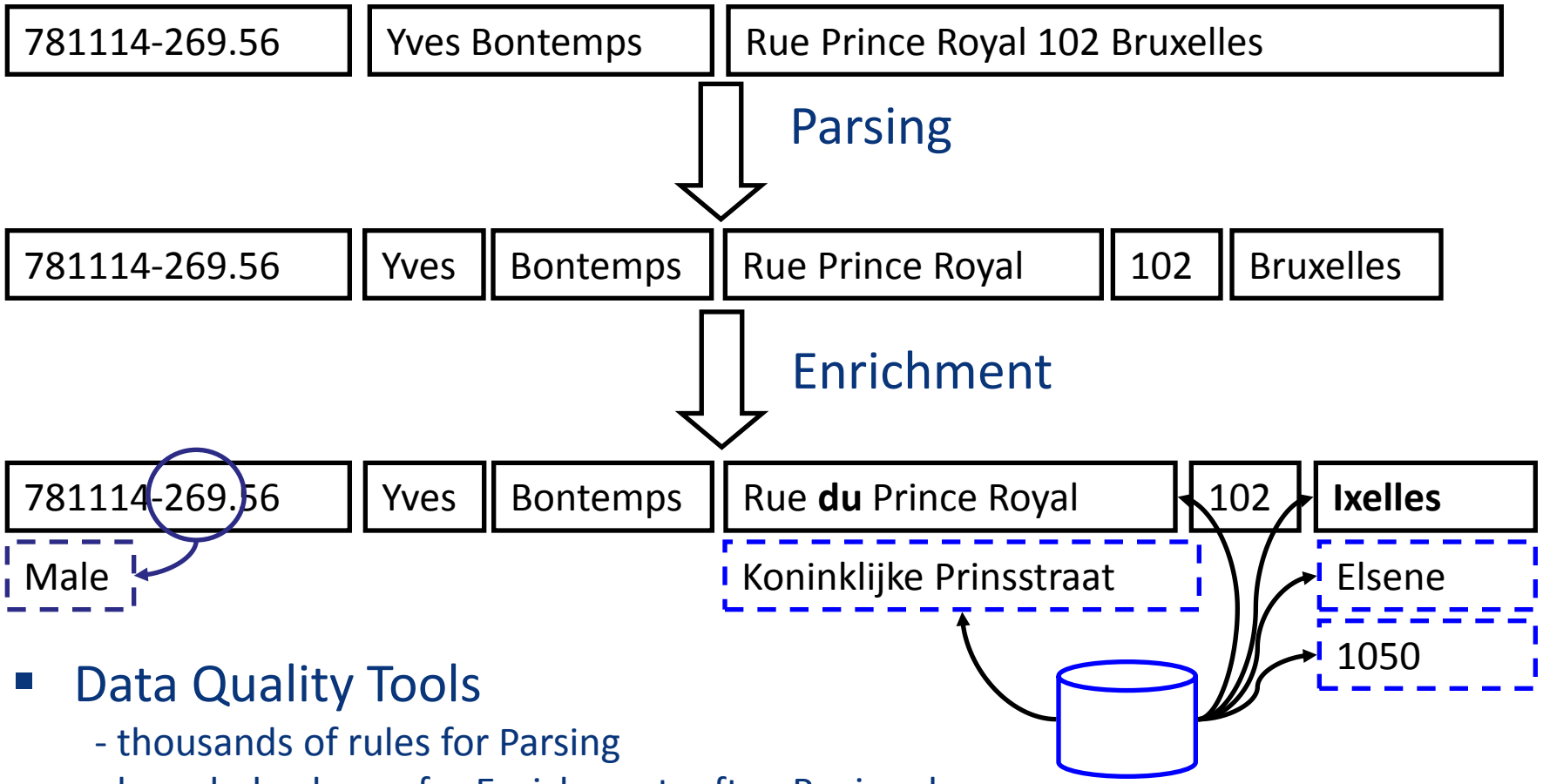
Data Rows (Dynamic)
Entity = pl tranfrmr p26(513)

origineel | toegevoegd m.b.v. data quality tool

Tsq Denom	Adres	Boite	Tsq Postcd	Tsq Commune	Orig Landcd	Iso3166 Cd	Iso3166 2l	Iso3166 3l	Iso3166 Nl	Ins Cd	Ins Nl
[redacted]					150	056	BE	BEL	België	150	België
[redacted]	MAH...			BLACKROC...	116	372	IE	IRL	Ierland	116	Ierland /Eire/
[redacted]	OLD...			WATERSFO...	IRL	372	IE	IRL	Ierland		
[redacted]	268		067 82	MODRA NAD...	141	703	SK	SVK	Slowakije	141	Slovaakse Republiek
[redacted]	HIA...		067 82	MODRA NAD...	SK	703	SK	SVK	Slowakije		
[redacted]	Vizi...		1031	BUDAPEST	115	348	HU	HUN	Hongarije	115	Hongarije (Rep.)
[redacted]	VIZI...		1031	BUDAPEST	H	348	HU	HUN	Hongarije		
[redacted]	SICI...		1045 AX	AMSTERDAM	129	528	NL	NLD	Nederland	129	Nederland
[redacted]	SICI...		1045	AMSTERDAM	NL	528	NL	NLD	Nederland		
[redacted]	MAD...		1131	BUDAPEST	H	348	HU	HUN	Hongarije		
[redacted]	POS...		1440	AP PURMER...	NL	528	NL	NLD	Nederland		
[redacted]	POS...		1440	AP PURMER...	NL	528	NL	NLD	Nederland		
[redacted]	czer...	4	20 349	LUBLIN	122	616	PL	POL	Polen	122	Polen (Rep.)
[redacted]	CZE...		20 349	LUBLIN	PL	616	PL	POL	Polen		
[redacted]	Via ...		24129	BERGAMO	128	380	IT	ITA	Italië	128	Italië
[redacted]	VIA ...		24129	BERGAMO	I	380	IT	ITA	Italië		
[redacted]	Stee...		2407 BD	ALPHEN AA...	129	528	NL	NLD	Nederland	129	Nederland
[redacted]	STE...		2407	BD ALPHEN ...	NL	528	NL	NLD	Nederland		
[redacted]	STE...		2407	BD ALPHEN ...	NL	528	NL	NLD	Nederland		

Ondersteuning data integration met dqtools: Data Standardisation – complex domains

Example: names and adresses



- Data Quality Tools
  - thousands of rules for Parsing
  - knowledge bases for Enrichment, often Regional

Data standardisation with Data Quality Tools

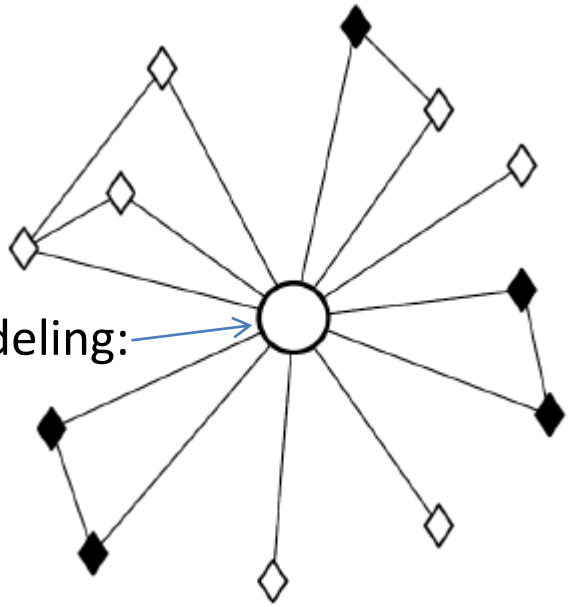
What view would you rather build analytics upon? ...

P/N	DESCRIPTION
1774-5674	TUBE, CENTRIFUGE POLY S 15ML (CS/500)CONICAL-BOTTOM
1774-5675	TUBE, CENTRIFUGE PPL 15ML (CS/500)CONICAL-BOTTOM
1774-4532	TUBE, CENTRIFUGE PPL 50ML (CS/500)CONICAL-BTTMPCK 25/RACK
1774-4538	TUBE, CENTRIFUGE POLY S 50ML (CS/500)CONICAL-BTMPK 25/RACK
645-4556	PIPET, CLEAR SEROLOGICAL 2ML (CASE/500)
195-7934	NUT, LOCK RH,11"
3324-7955	VIAL, WHEATON 33* CLEAR 4ML (CS/144)

P/N	ITEM NAME	MATERIAL	SIZE	UOM	DESCRIPTOR	PACKAGE	PACK METHOD
1774-5674	CENTRIFUGE TUBE	POLYSTERENE	15	ML	CONICAL	CASE/500	BOTTOM PACKED
1774-5675	CENTRIFUGE TUBE	POLYPROPILENE	15	ML	CONICAL	CASE/500	BOTTOM PACKED
1774-4532	CENTRIFUGE TUBE	POLYPROPILENE	50	ML	CONICAL	CASE/500	BOTTOM PACKED 25/RACK
1774-4538	CENTRIFUGE TUBE	POLYSTERENE	50	ML	CONICAL	CASE/500	BOTTOM PACKED 25/RACK
0645-4556	SEROLOGICAL PIPET		2	ML	CLEAR	CASE/500	
0195-7934	LOCK NUT		11	IN	RIGHT HAND		
3324-7955	WHEATON VIAL		4	ML	CLEAR	CASE/144	

3. Netwerk-analytics met fuzzy matching

- Eenvoudig geval: als de relaties in een (social) netwerk rechtstreeks uit de RDBMS-structuur kunnen gehaald worden
  - klanten die met elkaar getelefoneerd hebben
  - werkgever-werknemersrelatie
  - producten die samen gekocht zijn
- Complex geval: «fuzzy matching»
  - gevestigd op « gelijkaardig adres »
  - Hoe?
    - voorbereid met data quality tools



voorwerp van modeling:

- risico,
- opportuniteit,
- …

Fuzzy matching met data quality tools (1)

Source	match type	Denomination	Adres	Boite	Postcd	Commune	Cdpays
L	100	PROJEKTSERWIS [redacted]	BOHATEROW [redacted] 63	43	05-100	NOWY DWOR [redacted]	122
L	100	PROJEKTSERWIS [redacted]	BOHATEROW [redacted] 63	43	05-100	NOWY DWOR [redacted]	122
R	115	PROJEKT SERWIS ([redacted])	UL. BOHATEROW [redacted] 63	42	05-100	NOWY DROW [redacted]	PL
R	115	PROJEKT SERWIS [redacted] NOWY DWOR	UL BOHATEROW [redacted] 63	43	05-100	NOWY DWOR [redacted]	PL
R	135	PROJEKT SERWIS [redacted]	BOHATEROW [redacted] 63/43		05-100	NOWY DWOR [redacted]	PL
R	106	PROJEKT SERWIS [redacted]	BOHATREROW 63LOK	43	05-100	NOKY DWOR [redacted]	PL
R	106	PROJEKT SERWIS [redacted]	BOHATREROW [redacted] 63LOK	43	05-100	NOKY DWOR [redacted]	PL
R	128	PROJEKT SERWIS [redacted]	BOHATREROW [redacted] 63LOK	43	05-100	NOKY DWOR [redacted]	PL
R	128	PROJEKT SERWIS [redacted]	BOHATREROW [redacted] 63LOK	43	05-100	NOKY DWOR [redacted]	PL
R	128	PROJEKT SERWIS [redacted]	BOHATREROW [redacted] 63LOK	43	05-100	NOKY DWOR [redacted]	PL
R	138	SOCIETE PROJEKTSERWIS	BOHATERROW [redacted] 63/43	N/A	05-100	NOWY DWOR [redacted]	PL

2 databanken, L en R

- ✓ er bestaat geen 'vreemde sleutel'-relatie tussen L en R
- ✓ DQTool detecteert dubbels en organiseert in clusters
- ✓ DQTool legt link tussen beide databanken
- ✓ mogelijke fraude ?

Fuzzy matching met data quality tools (2)

C Postcode	Tq Gout Postal Code	Straatnaam Voll	Tq Gout Street Name	Huisnummer	Pr House N...	Gemeentenaam	Tq Gout Postal City
1020	1020	RUE E VANDER AA	RUE ERNEST VANDER AA	1	1	Brussel	BRUSSEL
1020	1020	rue Vander Aa	RUE ERNEST VANDER AA	3	3	Bruxelles	BRUXELLES
1050	1050	91 R VAN AA	RUE VAN AA		91	Elsene	ELSENE
1050	1050	27 R.VAN AA	RUE VAN AA		27	Elsene	ELSENE
1050	1050	RUE VAN AA	RUE VAN AA	94	94	Ixelles	IXELLES
1050	1050	RUE VAN AA	RUE VAN AA	94	94	Elsene	ELSENE
1020	1050	rue Van Aa	RUE VAN AA	2	2	Bruxelles	IXELLES
1050	1050	2 R VAN AA	RUE VAN AA		2	Ixelles	BRUXELLES
1000	1000	R JOSEPH II 40	RUE JOSEPH II		40	Bruxelles	BRUXELLES
1000	1000	rue Joseph II 71 (...	RUE JOSEPH II		71	Bruxelles	BRUXELLES
1040	1000	Rue Joseph II	RUE JOSEPH II	71	71	Brussel	BRUSSEL
1040	1000	Rue Joseph II 5-7	RUE JOSEPH II		5-7	Bruxelles	BRUXELLES
1040	1000	Rue Joseph II 67A	RUE JOSEPH II		67A	Bruxelles	BRUXELLES
1030	1000	rue JOSEPH II, 114 -	RUE JOSEPH II	116	114 - 116	Schaarbeek	BRUXELLES

Resultaat (fuzzy matching + adresvalidatie, adrescleansing)

- ✓ gecorrigeerde postcode
- ✓ gestandaardiseerde straatnaam
- ✓ correct ingedeelde adreselementen (parsing)
- ✓ gecorrigeerde gemeentenaam
- ✓ dubbels gedetecteerd en georganiseerd in clusters

Fuzzy matching met data quality tools (3)

- Performantie is cruciaal
  - in principe kwadratisch in f(aantal records)*
  - voorbeeld: « gelijkaardige adressen »
    - parsing
    - adresvalidatie
    - matching
    - post-processing (inspectiedistricten)
  - 250.000 actieve: 10 min
  - 850.000 +historiek: 1u

Background Tasks
Timestamp = Tue Jun 18 02:06:15 CEST 2013

Ref	Activity Name	State	Duration
93	TSQ Process 'WG_zelfde_adres' execution	Completed	0 Days, 01:01:23
92	TSQ Process 'WG_zelfde_adres' execution	Completed	0 Days, 00:10:15

* Cfr. Performance, Blocking → Smals Research publicatie « Data Quality II: Tools », D. Van Dromme, 2007

Analytics & Data Quality: conclusie

- Belangrijke taken van de Analytics-expert, hebben te lijden aan een gebrek aan dq
  1. Kennis opbouwen bij gebrek aan (up to date) documentatie en standaardisatie
  2. Data-integratie vanuit heterogene bronnen
  3. Netwerk-analytics met fuzzy links
- Data Quality Tools-functionaliteiten kunnen de Analytics-expert helpen
  - Profiling – Standardisation – Fuzzy Matching

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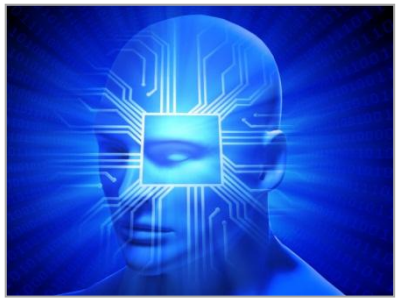
Streamlining Analytics

Predictive analytics

De **data supply chain**



Barrières bij de introductie van analytics

Hardware appliances voor analytics

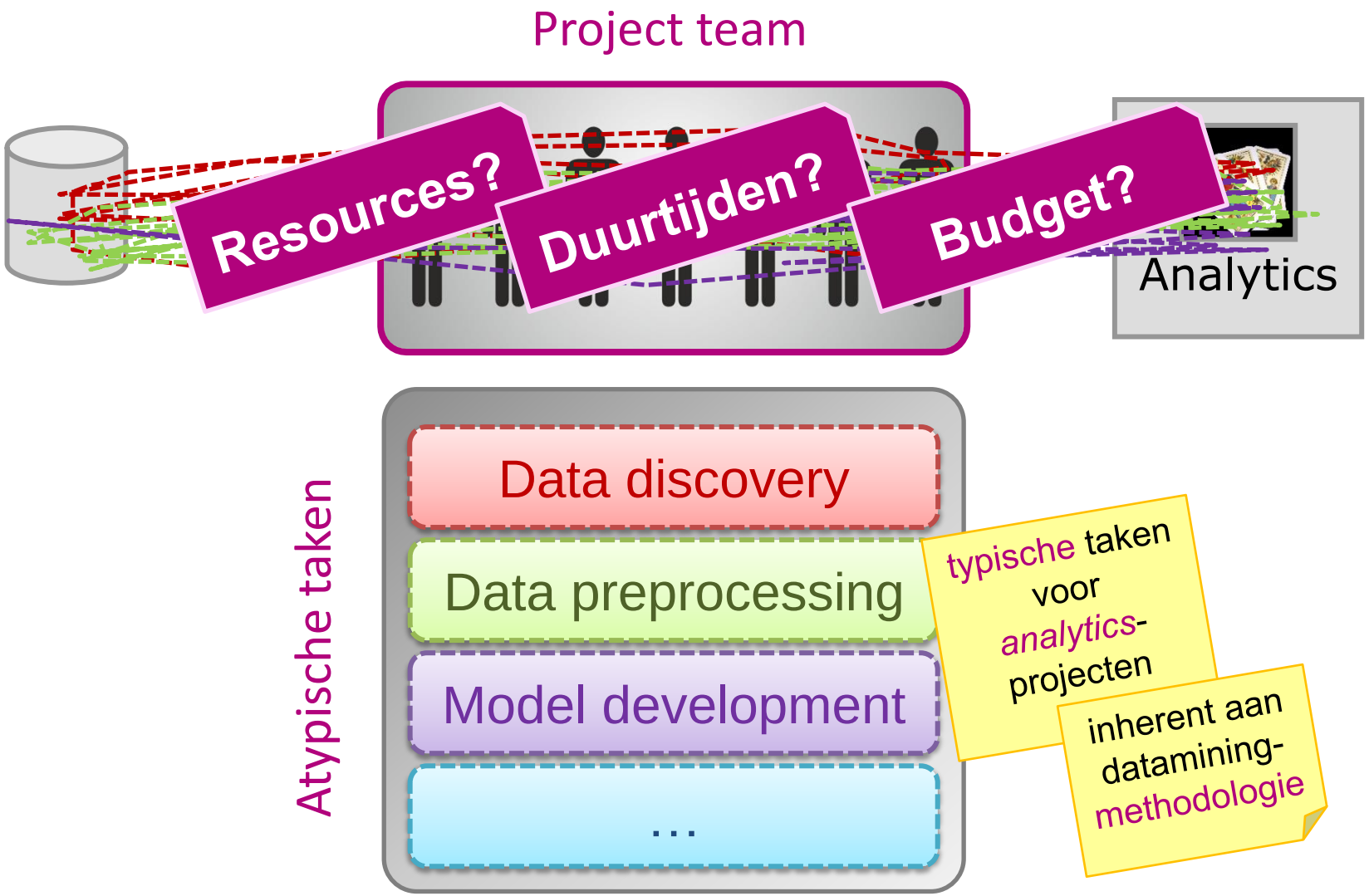
Data quality

Analytics **project management**

Analytics **project management**

- Probleemstelling (barrière 3)
- Data Mining Methodologie
- Resource & project planning
- Critical data miner tasks

Probleemstelling - barrière 3: atypische projectstructuur



Analytics-project-**methodologie**

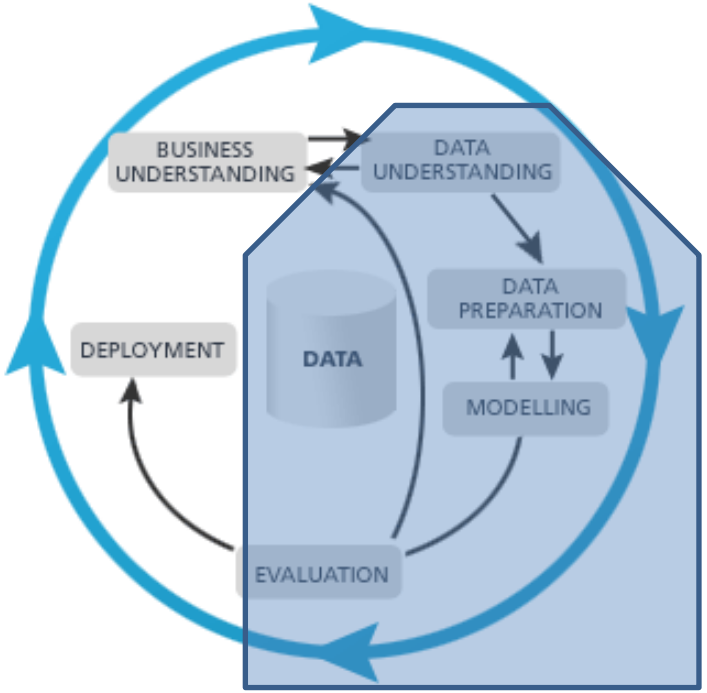
- Gelijkaardige, iteratieve methodologieën
  - KDD original approach: 5 key processes (Fayyad, 1996)
  - CRISP-DM 1.0 (1999+), 2.0 (2006+)
  - SEMMA by SAS

KDD	SEMMA	CRISP-DM
Pre KDD	- -	Business understanding
Selection	Sample	Data understanding
Pre-processing	Explore	
Transformation	Modify	Data preparation
Data Mining	Model	Modeling
Interpretation	Assess	Evaluation
Post KDD	- -	Deployment

http://www.kdd.org/

Analytics-project-**methodologie**

- « CRISP-DM » Cross-Industry Standard Process for Data Mining



« SEMMA »

Sample
Explore
Modify
Model
Assess

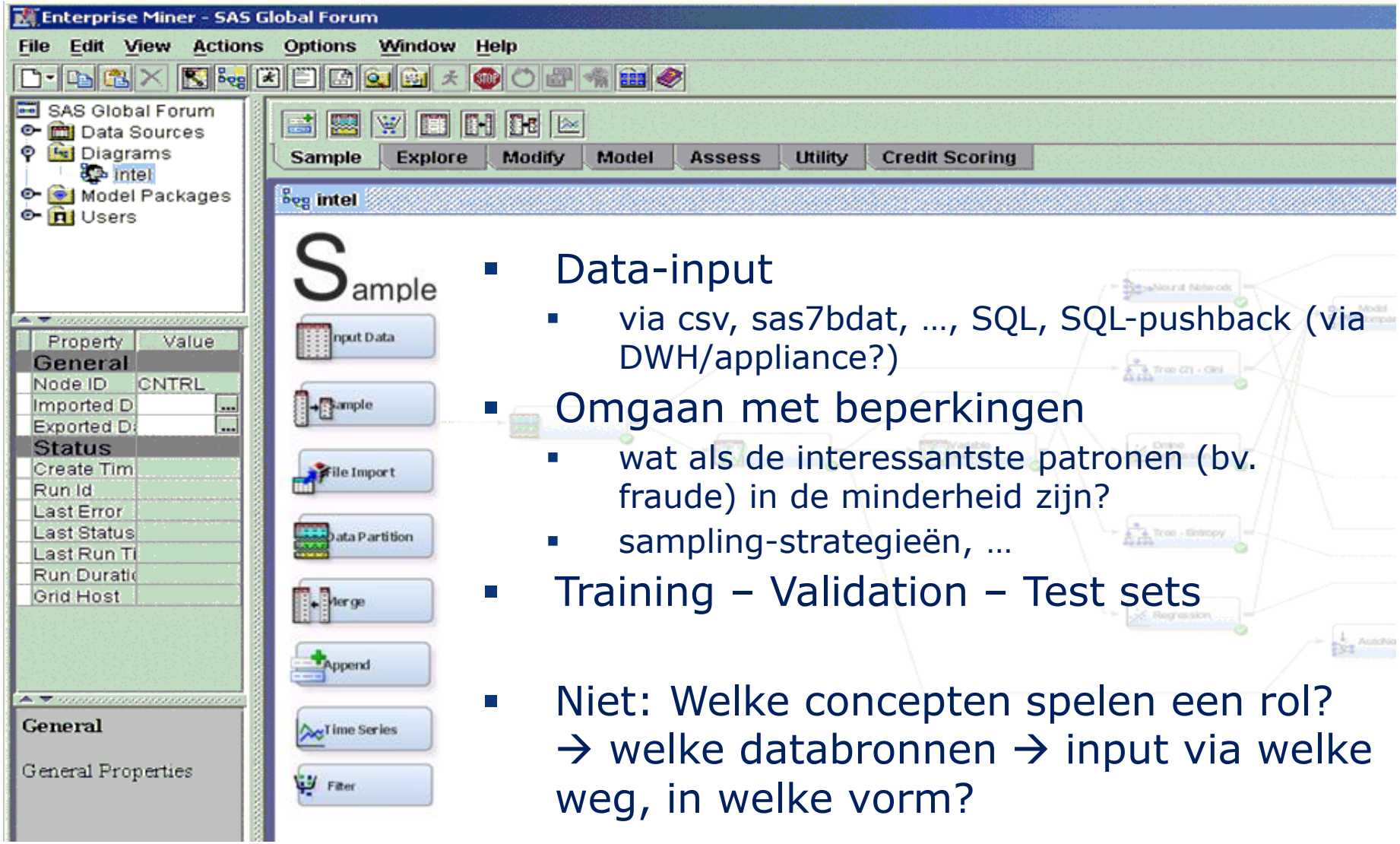
Karakteristieken: iteratief proces, multidisciplinair

→ samenstelling projectteam

→ projectfasen

DM Methodologieën in tools

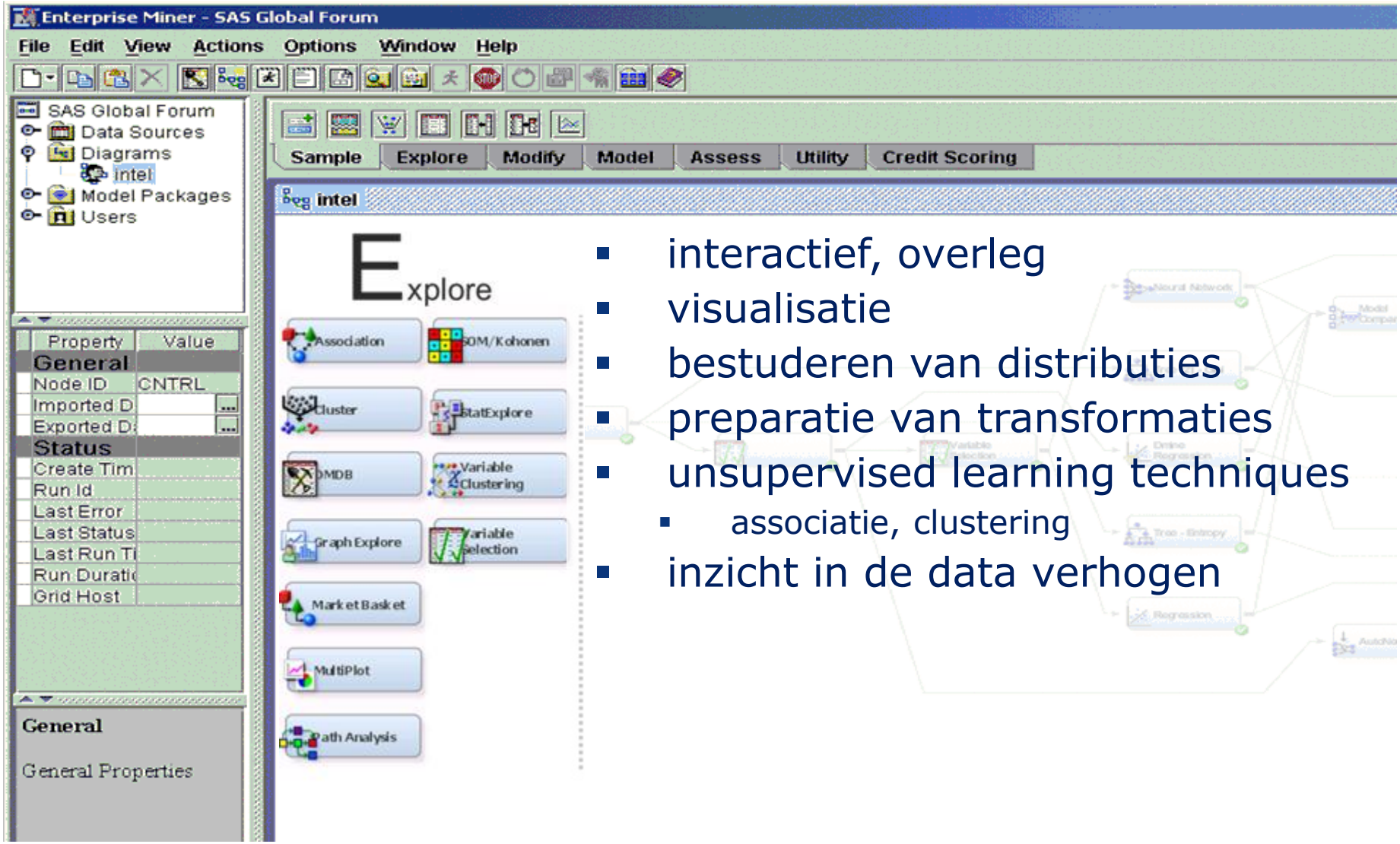
SAS Enterprise Miner (SEMMA)



- Data-input
  - via csv, sas7bdat, …, SQL, SQL-pushback (via DWH/appliance?)
- Omgaan met beperkingen
  - wat als de interessantste patronen (bv. fraude) in de minderheid zijn?
  - sampling-strategieën, …
- Training – Validation – Test sets
- Niet: Welke concepten spelen een rol? → welke databronnen → input via welke weg, in welke vorm?

DM Methodologieën in tools

SAS Enterprise Miner (SEMMA)



- interactief, overleg
- visualisatie
- bestuderen van distributies
- preparatie van transformaties
- unsupervised learning techniques
  - associatie, clustering
- inzicht in de data verhogen

DM Methodologieën in tools

SAS Enterprise Miner (SEMMA)

- Transformatie
  - naar geschikte vorm voor Data Mining
- Extraheren van « gedrag », « events » en « netwerkvariabelen » uit de ruwe variabelen

DM Methodologieën in tools

SAS Enterprise Miner (SEMMA)

- Welk algoritme?
  - interpreteerbaarheid
  - karakteristieken van de inputvariabelen en gezochte patronen
  - meervoudige classificatie
  - …

DM Methodologieën in tools

SAS Enterprise Miner (SEMMA)

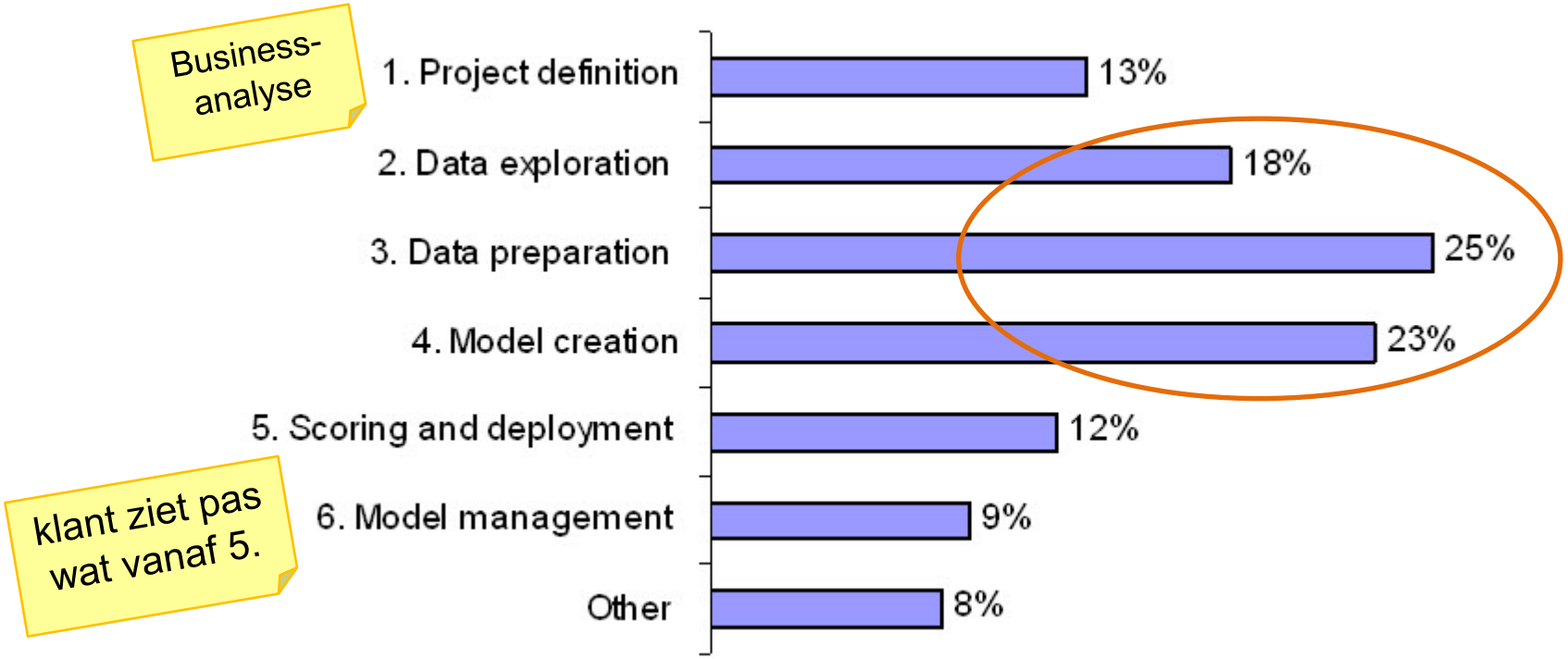
- « model scoring »
  - hoe goed *fit* het model de data?
  - training – validation – test
- Niet: feedback vanuit de acties ten gevolge van het toepassen van het model → « Monitor & maintain »

Analoog bij andere tools, zoals IBM-SPSS (CRISP-DM)

Analytics project (resource) planning

naar een inschatting van benodigde effort …

- Predictive modeler tasks



Ontbreken:

- betrokkenheid andere stakeholders (Business, IT)
- solution architecture
- deeltaken

Wayne Eckerson, "Predictive Analytics: Extending the Value of Your Data Warehousing Investment," 2007 [166 respondents]

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CRISP-DM: onder de motorkap …

Phases

Determine Business Objectives
Background
Business Objectives
Business Success Criteria
(Log and Report Process)

Assess Situation
Inventory of Resources, Requirements, Assumptions, and Constraints
Risks and Contingencies
Terminology
Costs and Benefits
(Log and Report Process)

Determine Data Mining Goals
Data Mining Goals
Data Mining Success Criteria
(Log and Report Process)

Produce Project Plan
Project Plan
Initial Assessment of Tools and Techniques
(Log and Report Process)

Collect Initial Data
Initial Data Collection Report
(Log and Report Process)

Describe Data
Data Description Report
(Log and Report Process)

Explore Data
Data Exploration Report
(Log and Report Process)

Verify Data Quality
Data Quality Report
(Log and Report Process)

Data Set
Data Set Description
(Log and Report Process)

Select Data
Rationale for Inclusion/ Exclusion
(Log and Report Process)

Clean Data
Data Cleaning Report
(Log and Report Process)

Construct Data
Derived Attributes
Generated Records
(Log and Report Process)

Integrate Data
Merged Data
(Log and Report Process)

Format Data
Reformatted Data
(Log and Report Process)

Select Modeling Technique
Modeling Technique
Modeling Assumptions
(Log and Report Process)

Generate Test Design
Test Design
(Log and Report Process)

Build Model Parameter Settings
Models
Model Description
(Log and Report Process)

Assess Model
Model Assessment
Revised Parameter
(Log and Report Process)

Evaluate Results
Align Assessment of Data Mining Results with Business Success Criteria
(Log and Report Process)

Approved Models
Review Process
Review of Process
(Log and Report Process)

Determine Next Steps
List of Possible Actions
Decision
(Log and Report Process)

Plan Deployment
Deployment Plan
(Log and Report Process)

Plan Monitoring and Maintenance
Monitoring and Maintenance Plan
(Log and Report Process)

Produce Final Report
Final Report
Final Presentation
(Log and Report Process)

Review Project
Experience Documentation
(Log and Report Process)

Generic Tasks
Specialized Tasks
(Process Instances)

a visual guide to CRISP-DM methodology

SOURCE CRISP-DM 1.0
http://www.crisp-dm.org/download.htm
DESIGN Nicole Leaper
http://www.nicoleleaper.com

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werkbare
CRISP-DM based project breakdown

Effort	Proces/fase	Taken	Stakeholder		
			Business	Analyst	IT
5%-10%	**Problem understanding**	Determine & refine objective	B	**A**	
		Define success criteria	B		
		Determine data mining goals	B	A	
10%-15%	**Data Understanding**	Collect initial data	B	A	
		Explore data & enhance insight	**B**	A	
		Verify data quality		A	I
30%-60%	**Data Preparation**	Select data, extract 'events' & 'behaviour'		A	
		Cleanse data		A	I
		Format data		A	I
20%-30%	**Modeling**	Select modeling technique(s)		A	
		Build models		A	
		Revise sampling strategy & cost functions		A	
20%-30%	**Evaluation of Results**	Compare & select model		A	
		Validate model	B	A	
		Explain model	B	A	
5%-10%	**Deployment**	Deploy model		A	I
		Score deployment (feedback)			I
		Monitor & maintain	B	A	

met enkele toevoegingen op basis van onze ervaring

Analytics Project Management - caveat

Effort	Proces/fase	Taken	Stakeholder		
					IT
5%-10%	**Problem understanding**	Determine **& refine** objective			
		Define success criteria			
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		Score deployment (feedback)			I
		Monitor & maintain	B	A	

al te vaak
te vaag
gedefinieerd

Een project is immers niet « Data Mining » of « Fraudebestrijding »

→ dat is een dienstverlening

→ **een project** richt zich op een **welbepaalde modeling-taak** (risico, fraudetype, …)

Analytics Project Management - caveat

Effort	Proces/fase	Taken	Stakeholder		
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		Monitor & maintain	B	A	

Data quality & Visualisation tools, clustering & association

Pitfall: blijven exploreren en verfijnen

Remedie: « agile », « timeboxing », milestones ← bv. 1ste model na 3 maand

iteratief karakter maakt oplevering van telkens accuratere modellen mogelijk

Analytics Project Management - caveat

Effort	Proces/fase	Taken	Stakeholder		
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individuele Skills van de Analytics-expert zijn bepalend

Extract 'events', 'behaviour', 'network' vars uit ruwe variabelen

→ bv. Aantal adreswijzigingen in bepaald tijdsvenster vóór event X

Een woordje extra uitleg over het selecteren van de juiste modeling-techniek

Selecteren van modeling-techniek:
bestaat een « beste » techniek?

- Een ideale techniek
  - moet kunnen omgaan met:
    - mixed datatypes (continu, discreet, ordinaal, categorisch)
    - missing values
    - irrelevante input
    - gecorreleerde input
    - grote datasets
  - en is bovendien:
    - robuust t.o.v. outliers in de input
    - ongevoelig voor monotone transformaties van invoervariabelen
    - vlot interpreteerbaar
    - accuraat & stabiel
- Zo'n techniek zou dan zonder veel pre-processing van invoerdata en zonder veel tuning van parameters toepasbaar zijn

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Selecteren van modeling-techniek

vuistregels Smals Research Predictive Analytics Competence Center

Criterium	Perceptron	Logistic Regression	Linear Discriminant Analysis	Decision Trees	Neural Nets	Nearest Neighbors	Support Vector Machines	Boosted/ Bagging Trees*
Mixed data	No	No	No	Yes	No	No	No	Yes
Missing values	No	No	Yes	Yes	No	+/-	No	Yes
Outliers	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Monotone transfo	No	No	No	Yes	+/-	No	No	Yes
Schaleerbaar	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Irrelevante input	No	No	No	+/-	No	No	Yes	Yes
Gecorreleerde input	Yes	Yes	Yes	No	Yes	+/-	Yes	+/-
Interpreteerbaar	Yes	Yes	Yes	Yes	No	No	+/-	« No »
Accuraat/Stabiel	Yes	Yes	Yes	No	Yes	No	Yes	Yes

ingezet voor Sociale Fraudebestrijding

*gebruikte techniek: Random Forest

vrij naar: cursussen Data Mining, KUL Leerstoel “FAIR”, Fraud Analytics Training, BI-Community, ir. PhD Patrice Latinne, CSC

Analytics Project Management - caveat

Effort	Proces/fase	Taken	Stakeholder		
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5%-10%	**Deployment**	Deploy model			I
		Score deployment (**feedback**)			I
		Monitor & maintain			

Niet te onderschatten!

Succes van het project is slechts meetbaar, traceerbaar ALS ook de feedback (de resultaten van acties ten gevolge van het toegepaste model) deftig geregistreerd en opnieuw geëxploiteerd geraakt

Analytics Project Management - caveat

Succes van het project is slechts meetbaar, traceerbaar ALS ook de feedback (de resultaten van acties ten gevolge van het toegepaste model) deftig geregistreerd en opnieuw geëxploiteerd geraakt

- **Dit vergt**:
  - nieuwe business-processen
    - afhandelprocessen
    - actie t.g.v. modelpredicties
  - registratie van feedback
    - gestructureerd → exploiteerbaar
    - gestuurd → de juiste informatie met de juiste granulariteit
  - bijsturen van modellen in f(feedback)

- Dit betekent meestal dat de solution architecture voor dit volledige proces een stuk ruimer is dan typisch voorzien
  - positief is dat vele elementen hiervan herbruikbaar zijn voor een volgende predictief model

Analytics Project Management - caveat

"You can't model what you don't have (examples for)"

- De meeste methodologieën en succesverhalen gaan ervan uit dat supervised learning-technieken toepasbaar zijn

- **Dit veronderstelt**:
  - voldoende voorbeelden zijn beschikbaar
    - voor de trainingsfase van een eerste (predictief) model
    - van het welbepaald type probleem waarvoor men een predictief model wenst te deployen

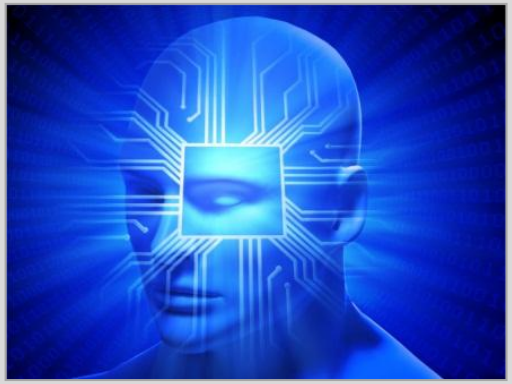
evenals tegen-voorbeelden

- **Zoniet**
  - dient men te vertrekken van hypothesen,
  - zullen andere technieken ingezet worden, en
  - zullen de eerste resultaten slechts dienen om echte feedback / de gezochte feedback te verzamelen

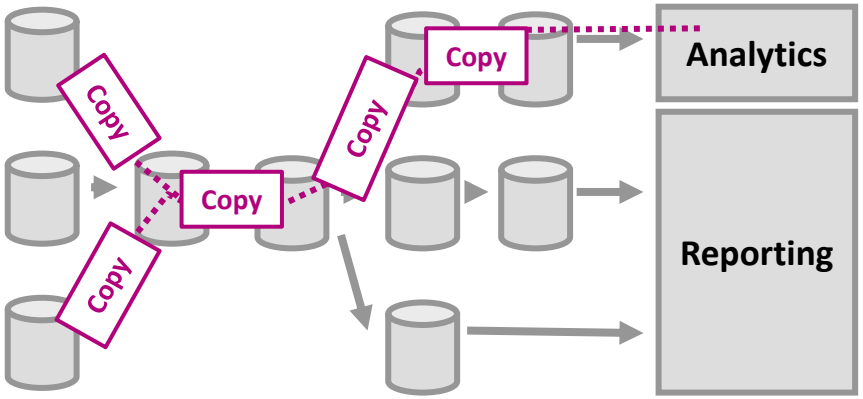
dit komt vaker voor dan men denkt!

- Ook dit zijn **nieuwe business-processen**
  - waarvoor de organisatie doorgaans niet klaar is

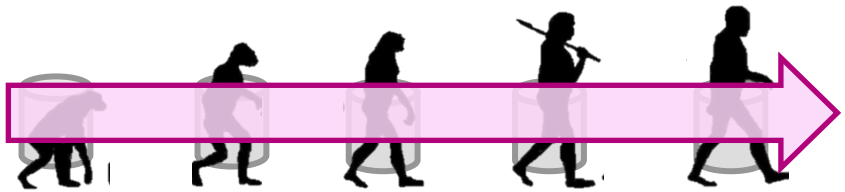
Conclusie



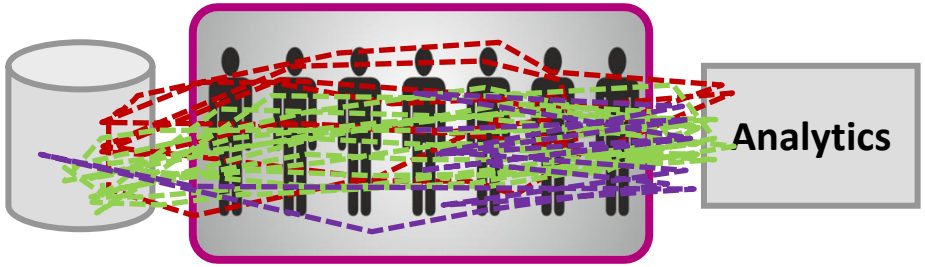
Barrières bij de introductie van analytics



1. Complexe & trage architectuur

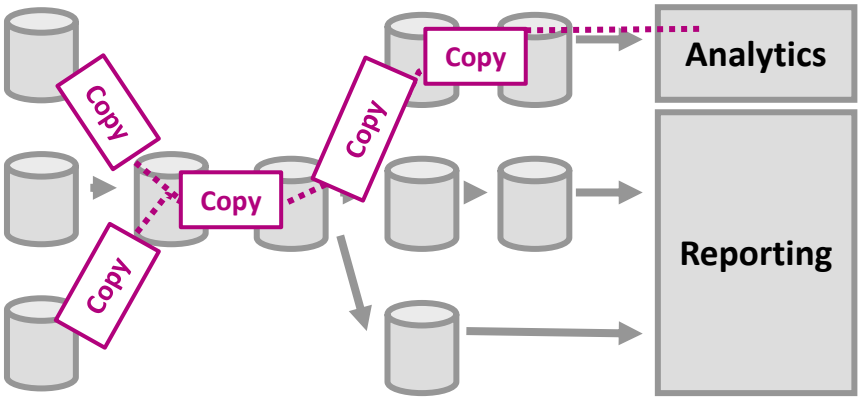


2. Data quality doorheen de supply chain

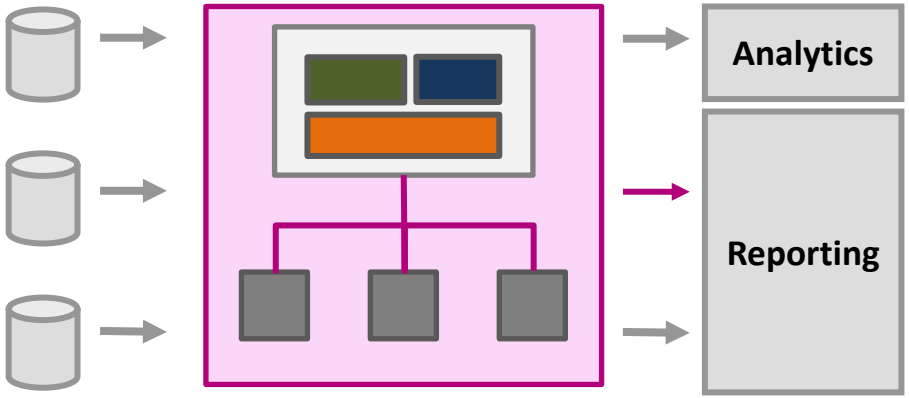


3. Atypische projectstructuur

Streamlining analytics

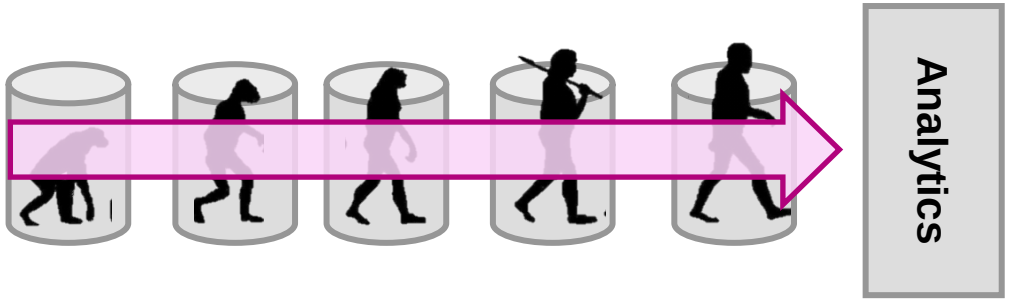


Complexe & trage architectuur



Hardware appliance

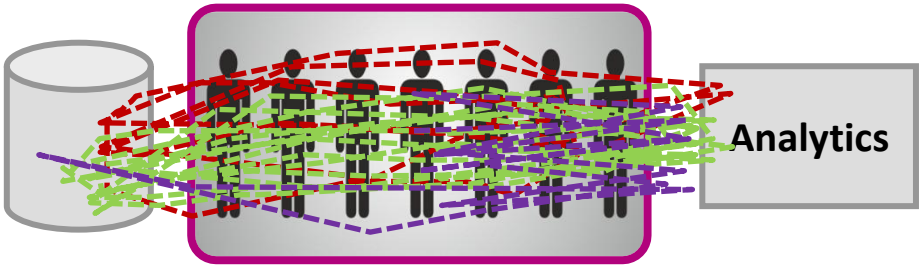
Streamlining analytics



Data quality doorheen de supply chain

Data quality aan de bron

Streamlining analytics

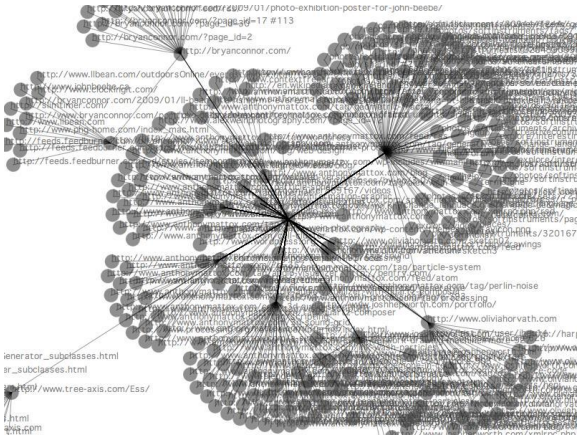


Effort	Proces/fase
5%-10%	**Problem understanding**
10%-15%	**Data Understanding**
30%-60%	**Data Preparation**
20%-30%	**Modeling**
20%-30%	**Evaluation of Results**
5%-10%	**Deployment**

Atypische projectstructuur

CRISP-DM based project breakdown

Barrières hangen samen met de **analytics/BI behoeftes**



Interactieve visualisatie van Big Data

Operational BI

Mobile BI

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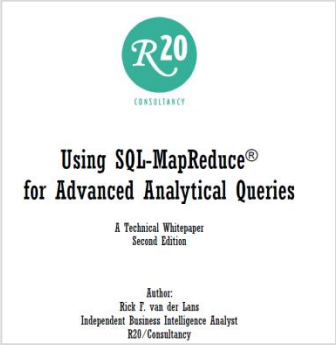

http://www.b-eye-network.com/view/13506

The Advantages of Data Warehouse Appliances Revisited

by Rick van der Lans

ORIGINALLY PUBLISHED MAY 4, 2010

Much has already been written about data warehouse appliances and their advantages. In most articles, query performance improvement is described as the primary advantage. In this article, we take a slightly different viewpoint. Data warehouse appliances can definitely improve performance, but query performance improvement is not really an advantage – it's a property. However, this performance improvement property is the basis for certain advantages, and this articles focuses on those advantages.

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http://www.teradata.be/white-paper/Using-SQL-MapReduce-for-Advanced-Analytical-Queries/

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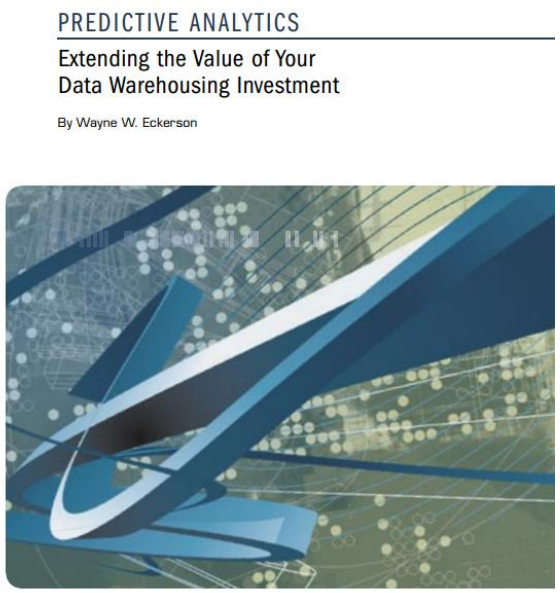
KDD bringing together the data mining, data science and analytics community

http://www.kdd.org



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[166 respondents]

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- *Grégory Ogonowski*, **NoSQL – Hype ou Innovation?**

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Vragen?

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