# Big Data
# Technological Challenges

François Bourdoncle
Co-founder & CTO
3DS Exalead
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# Big Data

## Context & Main Challenges

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# Why Big Data? Why Now?

- More data available now
  - HTML Web pages
    - 32 billion pages = 1 Peta-bytes = 1.000 Tera-bytes = 1 million Giga-bytes
  - Social networks (Facebook, Twitter)
  - Transaction records
  - Application logs
  - Internet of Things (including smartphones)
- More processing power
  - Cloud Computing
  - Google : 1 million servers
  - Distributed computing frameworks (e.g, Hadoop Map/Reduce)
  - IBM « Watson »
    - Beats humans at« Jeopardy »
    - Reasonning on Wikipedia contents

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POWER7
POWER7
POWER7
WATSON
POWER7
POWER7

# How Big is “Big”?

- Two approaches
  - When the volume of data becomes larger than usual
    - Tera, Peta (Web), Exa, Zetta
  - Or when the problem becomes untractable using traditional tools & techniques
    - The end of relational databases supremacy
    - The new NoSQL trend (No-SQL / Not-only SQL)
- Moore’s law
  - The volume of data grows much faster than our ability to process it
  - Exponential laws
  - Difference in parameters
  - Massively parallel processing

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# Big Data and “Emergence”

- The business approach
  - More hardware, new software, new services, etc.
  - Very limited way of looking at the problem
- A more philosophical approach
  - Self-organization from noise
  - Ilya Prigogine, Isabelle Stengers, Fancisco Varela, etc.
- The scientific approach
  - Physics laws and emergence
  - The end of reductionism ?
- The end of social sciences ?
  - The end of the normative and inductive approaches ?
  - The new study of emerging social laws (with the proper tools)

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# Exalead

## Some background

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# Exalead at a Glance

- European leader of Enterprise Search platforms
  - 1/3 customers are « online » customers
  - 2/3 customers are « entreprise » customers
- Created 12 years ago
  - By AltaVista veterans
  - Acquired by Dassault Systèmes in June 2010
- 170 employees worldwide

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# Exalead Application Domain

- Software vendor (B2B)
  - Infrastructure software for unified information access
  - Licenses, maintenance & services
- Next-generation business applications
  - Beyond classical« Enterprise Search »
  - Search-Based Applications (SBA)
  - CRM, BI, logistics, etc.
  - Machine-generated & social data

- Large online applications
  - Skyrock, 118218.fr, ViaMichelin, Lagardère, Rightmove, etc.
  - 110 million unique visitors./month
- www.exalead.com
  - 16 billion Web pages (soon to be 32 billion)
  - 1 million unique visitors/month

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# B2C Applications

Restminer

Search

Advanced Search

## Pure Food And Wine

54 Irving Pl, New York, NY 10003, USA
**Phone:** (212) 477-1010
**Subway:** 4, 5, 6, L, N, Q, R, W at 14th St.-Union Sq.
**Website:** http://www.purefoodandwine.com - **Book Online !**
**Kind of food:** Vegetarian, Health Food, Vegetarian/Vegan

Overview | Comments | Menu

## Overview

### Review

«pure food and wine serves upscale raw vegan cuisine - food in its natural and purest state. in order to preserve the food's natural enzymes, vitamins and minerals, nothing is heated above 118 degrees. only the freshest seasonal, organic ingredients are used to produce handcrafted flavors that rejuvenate the mind, body and spirit. an extensive collection of organic and biodynamic wines and sakes are available.»

From OpenTable

### Most viewed comment

«Having hesitated for months to try a raw dining experience, we finally made our way to PF&W;, with hesitant optimism. What we found was a restaurant with pleasant atmosphere, warm staff, attentive service, and tasteful food delicately prepared. rnrnThe cocktails were fun--a blackberry mojito-style, and a glass of vegan Pinot Grigio--and generously large. An appetizer of the Spicy Thai Lettuce Wraps was refreshing and stimulating. And entrees of the Tamales and Ravioli were bursting with flavor and beautifully served. Light but filling, both main dishes boast fillings and sauces th... More >>

From New York Magazine

### Bloggers entries about Pure Food And Wine

- Raw-Food Guru Matthew Kenney Tries His Luck in Orlando *(Grub Street)*

### Opening Hours

| | |
|---|---|
| monday | 12pm - 3pm |
| tuesday | 12pm - 3pm |
| wednesday | 12pm - 3pm |
| thursday | 12pm - 3pm |
| friday | 12pm - 3pm |
| saturday | 5:30pm - 12am |
| sunday | 5:30pm - 11pm |

### Details

**Payment options:** AMEX, Diners Club, MasterCard, Visa

**Chef:** Matthew Kenney and Sarma Melngalis

**Price range:** Moderate, Expensive

**Dining style:** Casual Elegant

**Special features:** Bar/LoungePatio/Outdoor DiningPersonal wines welcome (corkage fee applies)Takeout, Good for Groups, Outdoor Dining, Take-Out, Outdoor Dining, Tasting Menu, Online Reservations

### People sentiments

exceptional gracious intense flavorful astounding refreshing disappointing hard titillating inexpensive pleasant extortionate peculiar responsible surprising spicy smaller delicious apologetic sloppy fascinated honored unpleasant pretty creative cozy unlikely sour tasteful selected huge good flavourful high great tiresome minded charming superb liked base exquisite cute phenomenal subtle rich shocking healthy wealthy dramatic delectable okay outrageous mushy interested arranged mixed baked peaceful available impressed pretentious incredible irritating attentive excellent acceptable decorated needless demanding big comfortable amazed beautiful advanced gorgeous high-class excited outstanding fantastic discouraged undiscovered impeccable modern unappetizing impressive ecstatic rude fair

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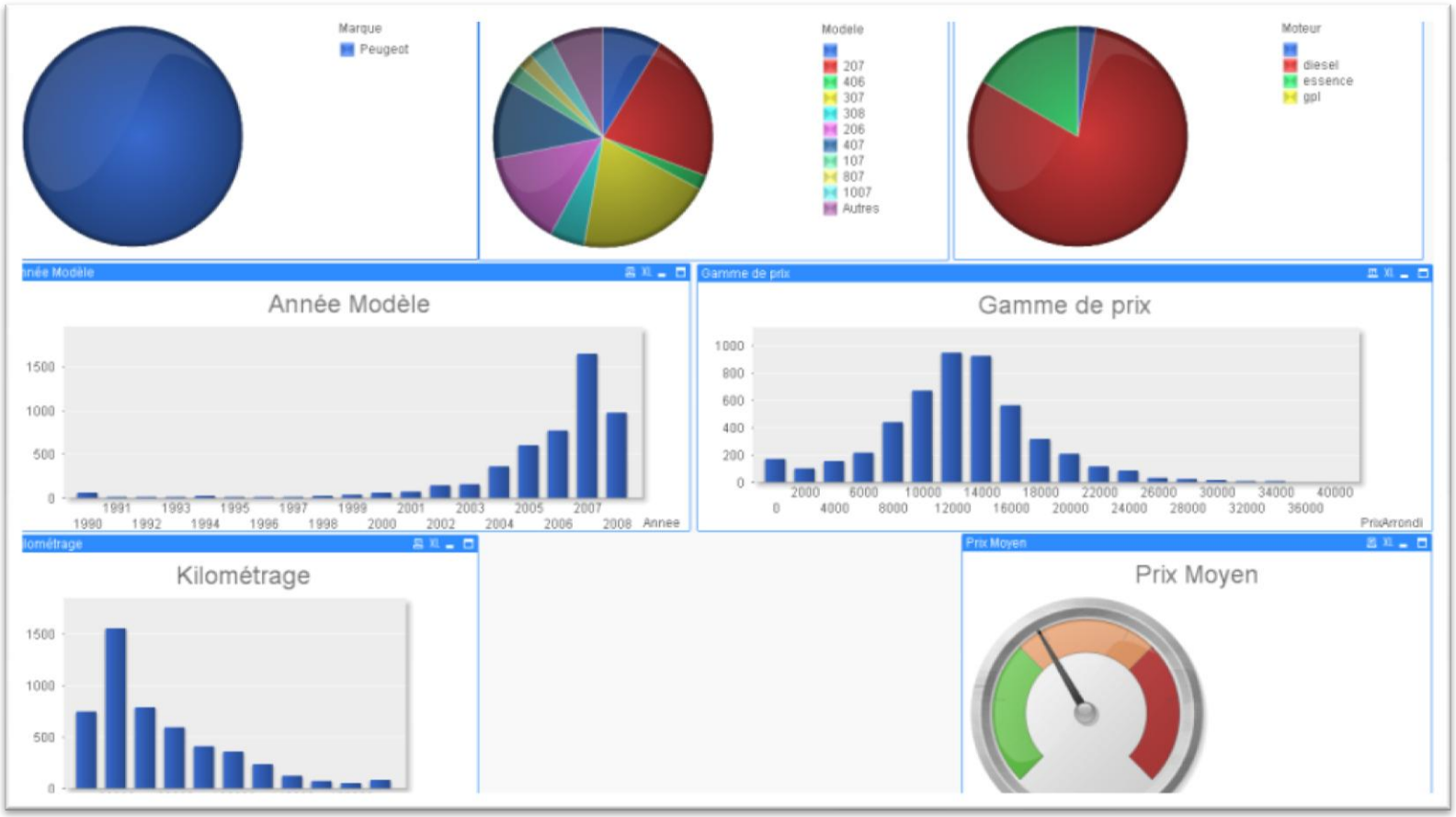
# Market Monitoring

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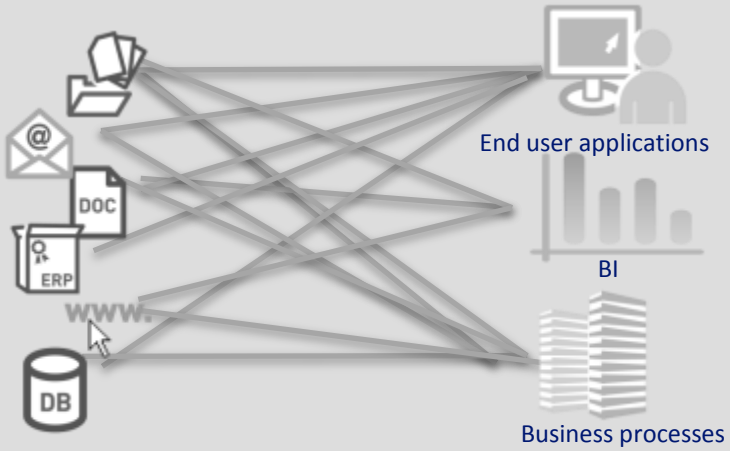
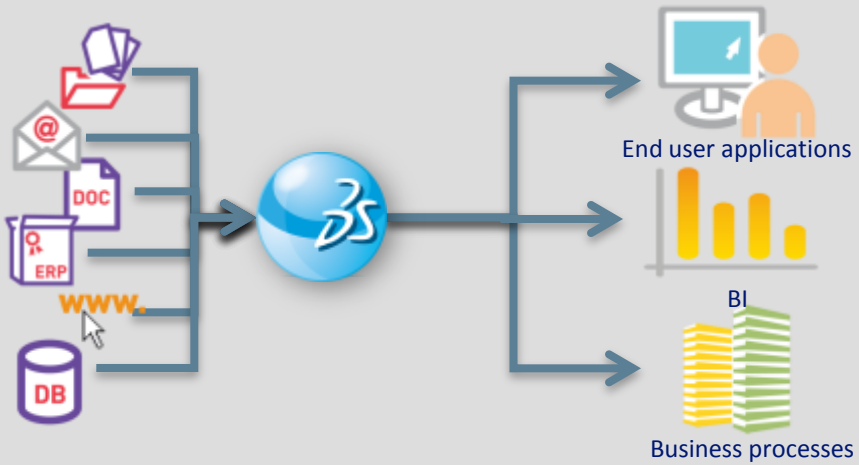
# Search-Based Applications




## Legacy Approach

High complexity/costs, Low performance/reusability




## SBA Approach

Low complexity/costs, High performance/reusability

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# Some Exalead Big Data Applications

- Anti-piracy applications
  - Software fraud (Dassault Systèmes)
  - Fiscal fraud (EQUITALIA)
- Automotive industry

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# « Big Data » Key Technologies

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# Storage and Indexing Technologies

- A new way to structure and store information
  - Semi-structured nodes (free text, business items)
  - Relations (semantic, business, etc.)
- A new type of software infrastructure
  - Massively distributed infrastructure
  - (Quasi-)linear scaling
  - Hadoop Map/Reduce
  - Analytics and aggregation capabilities
  - As « ACID » as possible
    - **A**TOMICITY
    - **C**ONSISTANCY
    - **I**SOLATION
    - **D**URABILITY

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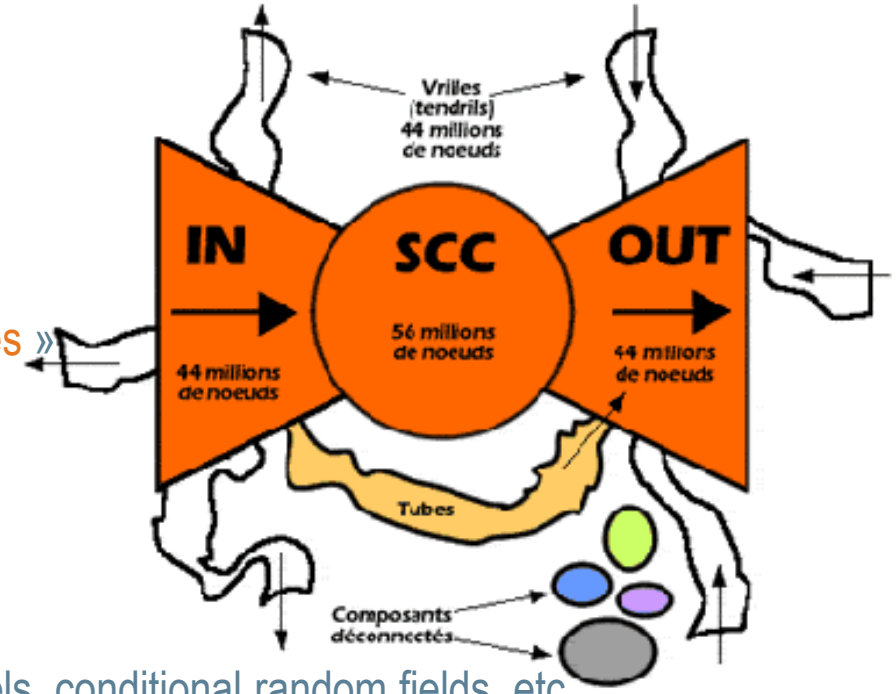
# Analytics and Discovery Technologies

- Text-mining
  - Extraction of noun groups
  - Extraction of semantic relations
- Graph-mining
  - Isolation of« clusters »
  - Computation of « hubs » & « authorities »
  - Computation of « Page rank »
  - The Web graph looks like a bowtie
- Machine learning
  - Core technology for this domain
  - Neural networks, hidden markov models, conditional random fields, etc.
  - Numerous and diverse applications
- Data vizualisation

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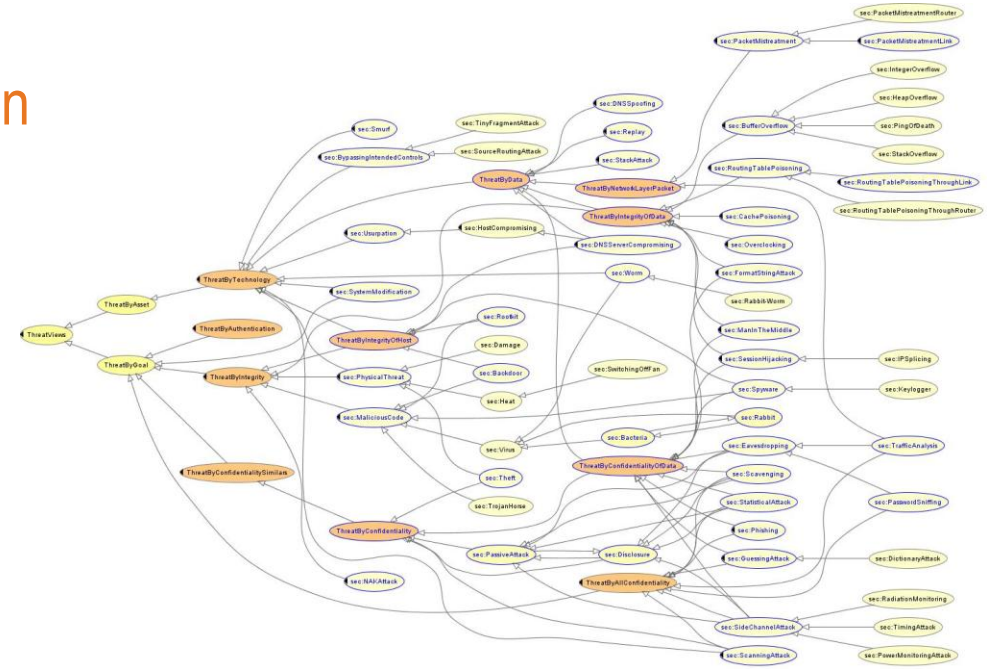
# Other Technologies

- Natural Language Processing
  - Speech-to-text
  - Machine translation
- Image processing
- Knowledge representation
  - Ontologies
    - Taxonomies (RDF)
    - Reasoning (OWL)
  - Ontology alignement
  - Ontology construction
    - Supervised
    - Non-supervised



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# A Few Challenges for the Future

- Semantic Web
  - Normative approach (Sir Tim Berners-Lee)
    - Meaning is defined by the “author”
  - Emerging approach
    - Meaning is defined by the “reader”
- Graph analysis
  - Facebook (social graph)
  - Business or design relationships (e.g, 3D design)
- Scaling
  - O(n), or O(n.log n) algorithms
- Reasoning (logical inferences, Datalog-style)
  - Example: WATSON d'IBM
  - Facts inferred from DBPedia (~ Wikipedia)

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# Reasonning

## Example of inference rules

```
-- Define the notion “follows” of being a
-- direct or indirect follower of someone
X follows Y WHEN X isFollowerOf Y
X follows Y WHEN X isFollowerOf Z
            AND Z follows Y
```

```
-- Define the notion of being a grand-parent from
-- that of being the son or daughter of someone
X isChildOf Y WHEN X isSonOf Y
X isChildOf Y WHEN X isDaughterOf Y

X isGrandParentOf Y WHEN Y isChildOf Z
                  AND Z isChildOf X
```

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