Geospatial Platforms For Enabling Workflows

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Evolution of Enabling Workflows

• HENRY FORD

• 100 YEARS AGO

• Industrialized the Manufacturing Workflow

• Popularized the use of
  – Assembly Line in Manufacturing

• One Automated Machine Driven Platform
  – for the entire car assembly process
  – Used STANDARD, INTERCHANGEABLE, SHARABLE parts
  – Lowered the priced of a car by factor of 10, in 3 years.

• His success led to widespread adoption

Procurement Leveraging

- Hardware
- Software
- Services

- $100B
- $200B
- $300B
- $400B
- $500B
- $600B
- $700B
- $800B
- $900B
- $1000B
Future Trends

- Technology Trends in Data Creation, Maintenance, and Management
- Reliance on ‘big data’ technologies
- The right information at the right time
- Machine-processable descriptions of data.
- Semantic technologies will play an important role
- Skills and Training: train the individuals is at least five years

Requirement for enhanced Data Management Systems
SHAREABLE, REUSABLE, LOCATION DATA REQUIRES WORKFLOWs

• SHARING Requires Semantics / Ontologies / Linked Open Data and Interoperability

• BIG DATA / REAL TIME INFORMATION –
  – Data Arriving too fast for humans to process – Need AUTOMATED WORKFLOWs
  – Must use Real Time Filtering and Analytics
    - Including Big Data / Hadoop filtering; CEP - Complex Event Processing
  – Too much to store it all
    - User Sets policies on what to keep, what to expunge
  – Deletions due to Volume (Cost), and also Privacy- Country Laws
  – Must SHARE data among your many Organizations, enabling Repurposing/Reusing
    • Geography/Mapping/Location, Health Care, Statistics, Commerce, Taxation, Threat Identification

• This is a DATA MANAGEMENT and CLOUD TOPIC, not a GIS issue.
Your Employee: Workflow for Doing Analysis

Real-time Data Streams

External Data Sources
- Transactional & Operational Systems
- Contents Repository
- Databases
- Web resources
- Blogs, Mails, news
- Satellite Imagery, UAVs

Search, Presentation, Report, Visualization, Query

Enterprise Data Management Infrastructure
- GeoSpatial
- Documents
- Historical Records
- POIs
- Demographics
- Customer Data
- Call Records

Secured

Historical Records

Automatic Responses and Publishing
- SMS
- Console Alerts
- EV Grid Management
- Workflow Initiation
- Real-time Dashboards
Ontology-driven Geospatial Workflows - Enable Shared, Actionable Knowledge

- Simple Features
- GeoRaster
- Topology
- Networks
- Gazetteers

- Data Integration
- National Map schemas
- Geographic names
- Temporal
- Naïve Geography
- ...

Application Ontologies

Environmental Monitoring
Famine Relief
Disaster Response

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Oracle: Linked Open Data support: on-premise or in the Cloud

Included in Oracle Database-as-a-Service Cloud Offering

• Highly scalable, secure triple store based on RDF
  – **1 TRILLION TRIPLE BENCHMARK**, leading Triple Store:W3.org
    – 1.13 million triples per second query performance

• SPARQL and SPARQL in SQL support
  – Apache Jena and OpenRDF Sesame pre-integrated
  – SPARQL endpoint enhanced with query control
  – GeoSPARQL support (classes, properties, datatypes, query functions)

• Forward-chaining based inferencing engine in the database
  – Various native rulebases (**RDFS, OWL2 RL, SKOS**, ...), integration with OWL2 reasoners (TrOWL, Pellet)

• RDB to RDF mapping on relational data aligned with RDB2RDF standard
Istat, Italy – Publishing Census Data as Linked Open Data

Recently gone live on Oracle Spatial and Graph

• Domain analysis and ontology definition
  – Territorial ontology
  – Census data ontology

• Triple generation
  – Mapping CSV files using R2RML
  – Using OWLSIF (OWL with IF Semantic)

• Publishing
  – SPARQL endpoint (Joseki)
  – Faceted search, graph browser

Image courtesy of: Monica Scannapieco, Istat
Ordnance Survey Great Britain
Geospatial Data Management System

OVERVIEW
• Centrally managed, authoritative database
• Incorporates 5 corporate national datasets
• Supports national data capture and maintenance
• Contains in excess of 500 million features

CHALLENGES / OPPORTUNITIES
• Need to integrate disparate data sets
• Need to extract 32 million features and submit 313,000 changed features per day
• Need to support multiple users in the same geographic area
• Automated data validation to achieve product ready database

SOLUTIONS
• Oracle Spatial Database, Partitioning, RAC, Dataguard
• Oracle Workspace Manager
• Oracle Application Server & Weblogic
• Oracle BusinessProcessEngineeringLogic (BPEL)
• & Worklist Application, Enterprise Service Bus
• Oracle Identity Management

RESULTS
• Consolidation of raster, vector, network data in 5.3TB sized central repository
• Single source database for product derivation
• Seamless working – removal of tile based restrictions
• Resilient production environment achieving 99.5% availability
Ordnance Survey – GDMS

- **Complete workflow**
  - Planning surveying tasks
  - Data import
  - Data validation, quality assurance
  - Data dissemination

- **Combined technologies**
  - 1Spatial
  - Esri, Intergraph, BAE Systems
  - Safe Software
  - Snowflake Software

Image courtesy of: Ordnance Survey, UK
Workflow & Cloud Supporting Breadth of Enterprise Data

End-user and Developer Environments
- Developers: Data Integration, JDeveloper
- Data Scientists: Discovery, Statistics, Mining
- Business Users: Business Intelligence, Dashboards

Big Data Sources
- Structured Data
- Unstructured Data
- Social Media

Streaming Services
- Event Processing

Data Services
- Statistics
- Text Analytics
- Graph Analytics
- Spatial
- Data Mining
- Natural Lang. Processing
- Sound and Video
- Images

Data Management
- NoSQL
- Hadoop
- Relational
- ODBC
- JDBC
- Compression
- Security & Encryption

Applications
- App Services
  - Web-log Sessionization and Enrichment
  - Sentiment Analysis
  - Reference Architecture
- Vertical Applications
- Horizontal Applications

Enabling Semantic Metadata Layer

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You Enable Order And Efficiency By Using Standards

"We intend to complete development for a new suite of tools for developing the next generation of applications. And there are several interesting things with the next generation of tools, but perhaps the single most interesting thing about them is that for the first time a major application company is going to commit to an absolute standards-based development environment."

– Larry Ellison

- ISO
  - TC 211; TC 204
- Open Geospatial Consortium
  - Simple Features; GML; Web Services
- De-facto Standards
  - SHP, MGE, DXF, KML
- Professional Standards
  - ISPRS, FIG, WMO
- Java, .NET, Flash
- W3C: RDF, OWL, SPARQL, GeoSPARQL
- TAGGED METADATA – agree on tags

SQL3/MM Spatial
Oracle Spatial and Graph

Tens of Thousands of Installations

Web Services (OGC)
SPARQL End Point
Rasters
Network Graphs
Topologies
RDF Semantic Graphs

“Points”
“Lines”
“Polygons”

Geocoding
Routing
Inferencing

3D
Open and interoperable

Oracle 12c Spatial and Graph

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Workflows: **CYBERSECURITY** is Major Challenge Requires Information Security and Privacy

- Monitoring
  - Configuration Management
  - Audit Vault
  - Total Recall

- Access Control
  - Database Vault
  - Label Security

- Encryption & Masking
  - Advanced Security
  - Secure Backup
  - Data Masking

Oracle Database

Encryption & Masking

Access Control

Monitoring

Blocking & Logging
Oracle Geospatial Platform and Cloud Data Platforms
Support any data, any scale, on-premises or in the Cloud
In-Memory / Flash Based / Disk Based – Scale to Many Petabytes

Relational Store
- Relational
- Spatial
- Graph – RDF and Property
- Document
- Real-time Analytics

NoSQL Store
- Key-value
- Graph – RDF
- Graph - Property
- Document

Big Data Store
HADOOP, Spark
- Logs
- Streaming
- Archive
- Spatial
- Graph – RDF and Property
- Web Analytics

Data Integration
Change Capture and Apply, ETL, and Federated SQL
Public Clouds and Private Clouds: Workflow Platforms

- Used by multiple tenants on a shared basis
- Hosted and managed by cloud service provider

Public Clouds

- SaaS
- PaaS
- IaaS

Private Cloud

- Apps
- PaaS
- IaaS

Trade-offs

- Lower *upfront* costs ↔ Lower *total* costs
- Outsourced management ↔ Greater control over security, compliance, QoS
- OpEx ↔ CapEx & OpEx

Oracle Technology Supplies both Public and Private clouds
Oracle Cloud Data Centers in Germany: Frankfort and Munich
Why Automate Your Workflow From Scratch?
UN-GGIM: “train the individuals is at least five years”

Time to Build
Optimizations
Maintenance

Long Term Cost of Ownership rises with custom construction
Enabling Geospatial Workflows: Lowest Cost of Ownership
Best Success Requires Complete Platforms & Cloud Services

**Big & Fast Data**
- Volunteered Geographic Information
- Sensors Streaming Data
- Geo-referenced Video, 3D, LiDAR

**Simplified Spatial IT**
- Support for Open Standards
- Spatial Database, Application Server, BI, tools
- Support by Leading Partner solutions
- Spatially-enabled Engineered Systems

**Deep Analytics**
- Real-time Spatial Event Processing
- Dense Visualization
- Spatial Analysis Graphs

**On Premise, On Cloud, Shared Services**
- Shared GeoSpatial Services
- Location Aware Everything