

A Semantic Web Architecture for Advocate Agents to Determine Preferences and Facilitate Decision Making

Wolf Ketter

Learning Agents Research Group at Erasmus (LARGE)
Rotterdam School of Management, Erasmus University

Monday, June 23th 2008

Work done with: Arun Batchu, Gary Berosik, and Dan McCreary

Overview

- Motivation
- Related Work
- Business Architecture
- Technical Architecture
- Conclusions
- Future Work



Motivation

Research, develop, and use highly personalized agents to complement the cognitive limitations of the human mind to facilitate the decision making process to:

- Reduce information overload (bounded rationality)
- Increase work efficiency, i.e. speed up real-time managerial decisions
- Increase productivity (cost savings and ROI)
- Increase solution (product or service) quality
- There are also *Intangible Benefits*, e.g. greater customer and employee satisfaction!



Motivation

- These agents work in a collaborative manner with users to accomplish their goals.
 - To work effectively and efficiently with a human user, the agents must learn the human user's interests, habits and preferences (as well as those of their communities).
 - In an online retail example, recommendations can be given as to what to buy (product-brokering) and from whom to buy (merchant-brokering), based on customer criteria.



Related Work

- *Adomavicius, G. and A. Tuzhilin, An Architecture of e-Butler: A Consumer-centric Online Personalization System. International Journal of Computational Intelligence and Applications, 2002. 2(3): p. 1-15.*
- *Maes, P., Social interface agents: Acquiring competence by learning from users and other agents. Software Agents—Papers from the 1994 Spring Symposium, Technical Report SS-94-03, Etzioni, O., Ed, 1994a: p. 71-78.*
- *Rhodes, B.J. and P. Maes, Just-in-time information retrieval agents. IBM Systems Journal, 2000. 39(3&4): p. 685-.*
- *Shmueli et. al, Data Mining for Business Intelligence, Wiley, 2007*
- *Shneiderman, B., Direct manipulation: A step beyond programming languages. 1981.*
- *Wayne, E., Performance Dashboards, 2005*
- *Few, S., Information Dashboard Design, 2006*

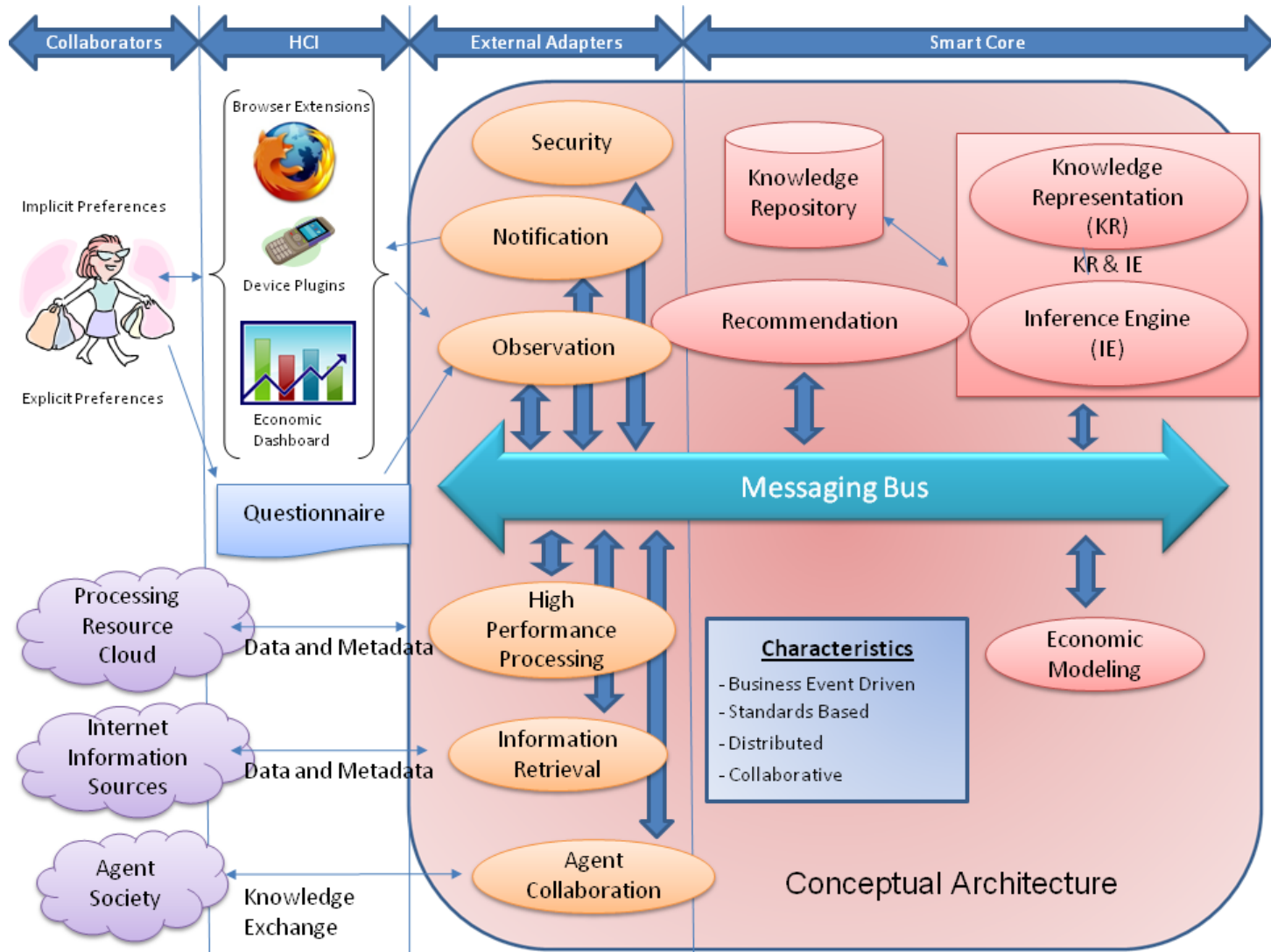


Academic and Industry Partners

- Arun Batchu (Netrii.com)
- Peter Berends (Rotterdam School of Management)
- Gary Berosik (ThomsonReuters R&D)
- Alex Bleasdale (Minnesota Department of Revenue)
- Hans van de Koppel (Capgemini)
- Dan McCreary (Dan McCreary and Associates)



Business Architecture



Economic Dashboard

“You cannot manage what you do not measure”

“What gets watched, gets done.”

→ **“Organizational Magnifying Glass”** –
Focus the work of employees so everyone
is going in the same direction!



Advocate Agents - Slide 8

Economic Dashboard

An Economic Dashboard lets business **people**:

- **Monitor** critical business processes and activities using metrics of business performance.
- **Analyze** critical business problems by exploring relevant and timely information from various sources at different levels of detail.
- **Manage** people and processes to improve decisions, optimize performance, and steer the organization in the right direction.
- **Communicate** with and give **Feedback** to **Advocate Agents**



Economic Dashboard

- Economic dashboards provide a dynamic perspective view of information relating to those different roles and give rapid feedback regarding Advocate Agent performance on specific goal-oriented tasks.
- Non-intrusive user interfaces that facilitate tactical and strategic decision making processes.
- Present summarized views of historical economic and newly gained knowledge, based upon data harvested from the web using information retrieval and drill-down capabilities.
- Users can give explicit feedback to the system to evaluate the goodness of the findings and suggestions.



3 Types of Economic Dashboards relating to Business Intelligence

- Strategic BI: Achieve long-term organizational goals
- Tactical BI: Conduct short-term analysis to achieve strategic goals
- Operational BI: Provide a decision-making environment that reduces the latency between the time a significant business event happens and the business' ability to react to it.



Business Intelligence and Dashboards

Drill-down capabilities →

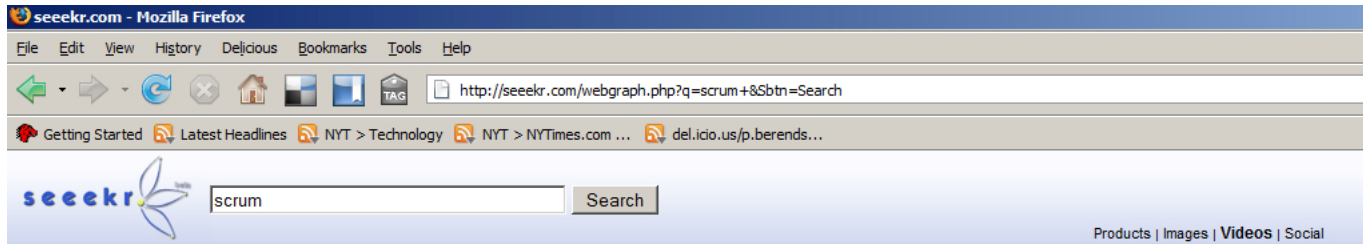
	Strategic BI	Tactical BI	Operational BI
Business Focus	Achieve long-term organizational goals	Conduct short-term analysis to achieve strategic goals	Manage daily operations, integrate BI with operational systems
Primary users	Executives, analysts	Executives, analysts, Line-of-business managers	Line-of-business managers, operational users and systems
Timeframe	Months to years	Day(s) to weeks to months	Intra-day
Data	Historical metrics	Historical metrics	Right-time metrics



Example Dashboard - 1

The screenshot shows a search engine interface for 'seeekr.com' in Mozilla Firefox. The search term 'scrum' is entered in the search bar. Below the search bar, there are sponsored links for 'Scrum Master classes', 'Cheap Internet Hosting', and 'Project Management Professionals'. To the right, a list of video results for 'scrum' is displayed, including 'Scrum et al.', 'Scrum Masters 2', 'Amazing Grace - Scrum', 'Scrum Tuning: Lessons learned', 'NZ AllBlacks Scrum Practice', 'NZ AllBlacks Scrum Drills', 'High Moon Studios: A Portrait', 'Buffalo/ Ottawa scrum', and 'Scrum - Drunk Again'. Below the sponsored links, a network diagram shows the relationships between various terms: 'project management' (with a green plus icon), 'software', 'photos', 'training', 'rugby', and 'scrum'. The 'scrum' node is central, with arrows pointing to 'project management', 'software', 'photos', and 'training'. There are also arrows between 'project management' and 'software', and 'photos' and 'training'.

Example Dashboard - 2



Sponsored links:

Scrum Master classes
 ScrumMaster Certification Training
[ScrumMasterClassesRotterdam.nl](#)

Cheap Internet Hosting
 5 year hosting for only \$1. Order now
[Cheapskates.com](#)

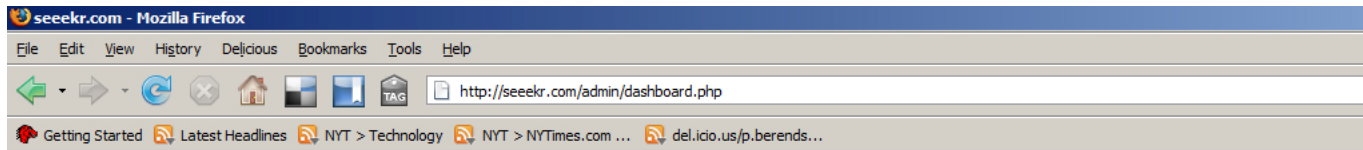
Project Management Professionals
 Temp agency in Project Management
[ProjectsDoneRightVeryCheap.com](#)

Video results for:
scrum project management

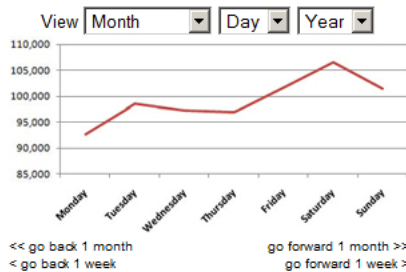


- Real life project management u
 - Certified Scrum Master Trainin
 - The Road from Project Manager
 - The Road from Project Manager
 - metoCube procedure documentati
 - Radical Thoughts from a Projec
 - The role of leadership in soft
- More results

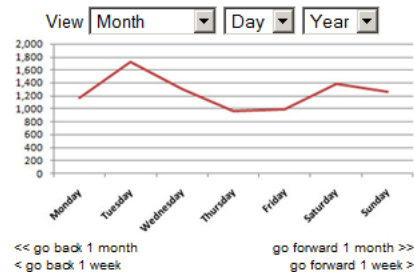
Example Dashboard - 3



Search Queries per day



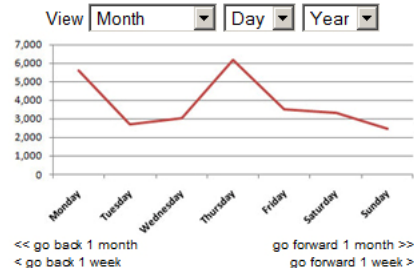
New Users per day



Search Queries by Registered Users per day



Imported Contacts per day



Clusty



Google



Amazon



Youtube

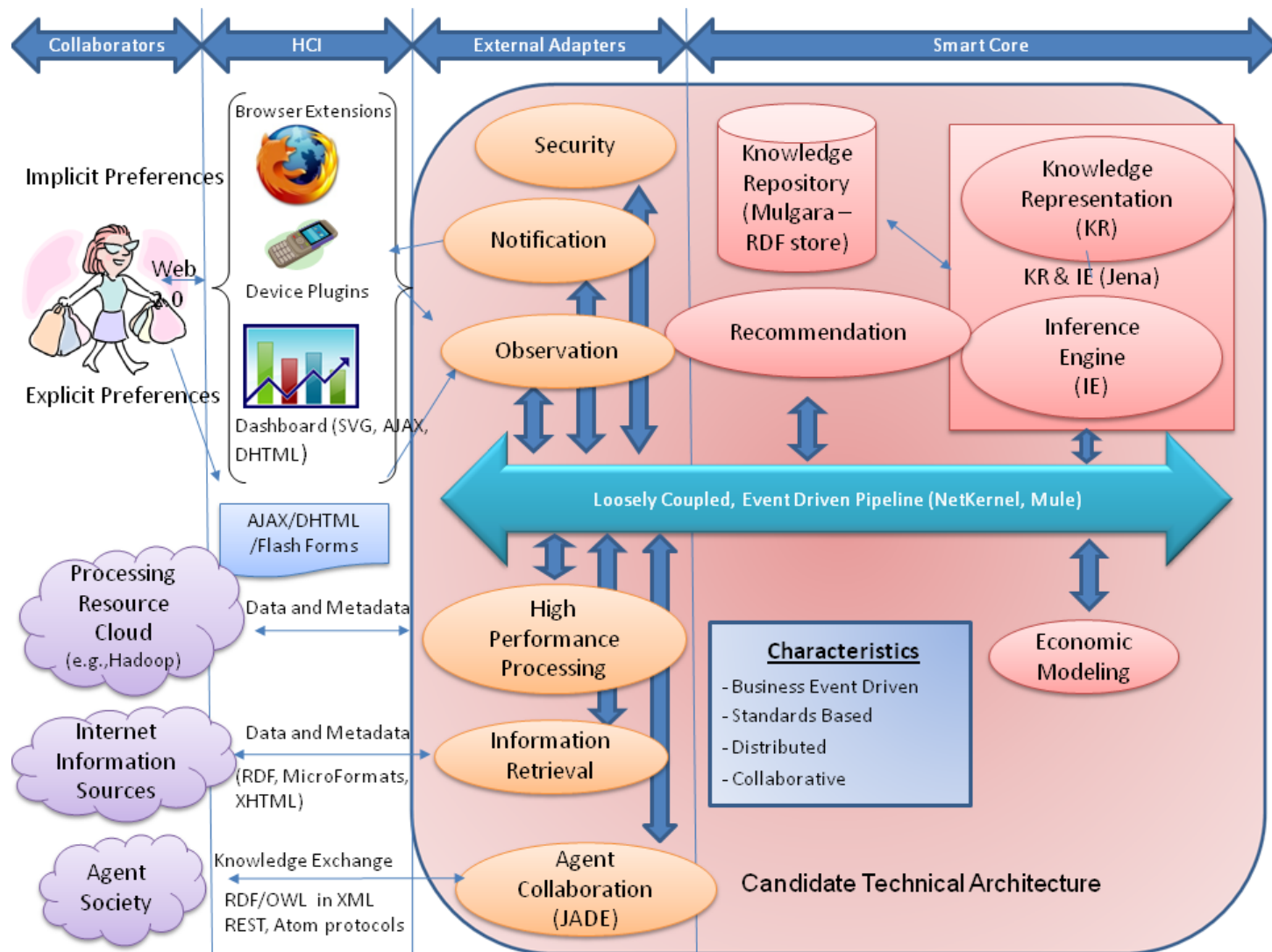


Flickr



Social Networks

Technical Architecture



Preferences

- Central concept of decision making and are fundamental for the analysis of human choice behavior!
- People have different preferences for different **roles**.
- Inherently a multi-disciplinary topic, of interest to economists, computer scientists, operations researchers, mathematicians, etc.



Preference Elicitation

- Questionnaire
 - Define roles, areas, objectives, and tasks
- Implicit
 - User observation through browser extension (Piggy Bank, etc.)
- Explicit
 - User feedback through economic dashboard, and none intrusive sidebar in browser window
- Business and Social Networks
 - Professional (intra company e.g. IBM, LinkedIn, Plaxo, etc.)
 - Personal (Facebook, Hi5, Hyves, etc.)



Document, Web, and Semantic Web

Highest level of automation –
designed for intelligent agents



	Relational	Web	Semantic Web
Designed for	Storing and Joining Tabular Data	Linking Documents	Inference of Distributed Assertions
Metaphor	Tables	Hypertext	Graphs
Search	SQL	Keywords, meta data	SPARQL
Search Engine	RBDMS vendors	Google, Yahoo, Microsoft	Triple Store



Microformats and RDFa

```
<div class="vcard">
  
  <a class="url fn"
    href="www.ketter.ws">Wolf Ketter</a>
  <div class="org">RSM Erasmus University</div>
  <div class="adr">
    <div class="street-address">
      Burgemeester Oudlaan 50</div>
    <span class="locality">Rotterdam, The
      Netherlands</span>
    <span class="postal-code">3062 PA </span>
  </div>
  <div class="tel">+31-10-4082624</div>
</div>
```



Knowledge of User Preferences

User preferences will be stored as triples. For example the following statements might be stored in a user preference triple store:

- [Wolf] [prefers Rating above] [3]
- [Wolf] [prefers Vendor] [Amazon]



Knowledge of User Needs

- An Advocate Agent learns of its master's needs via observations or direct questions. For example, after a user does several searches for computer hard drives, an agent might store the following assertion in its objectives triple store:
 - [Wolf] [needs Product] [Hard drive]



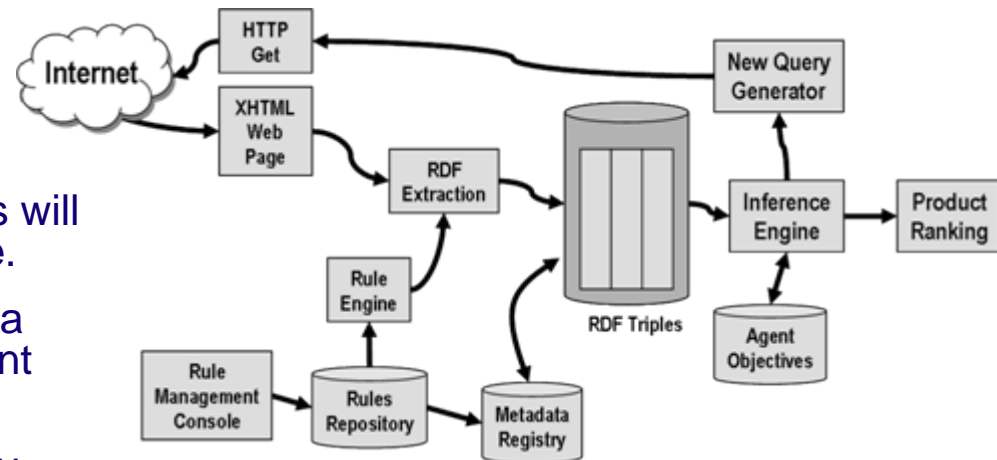
Knowledge of Available Products

- The agent must then combine knowledge of the user and user needs with data about where these products might be purchased, and about how keywords related to user needs also relate to product taxonomies. The following is a sample list of these assertions:
- [Amazon] [has product] [Samsung Solid State Drive]
- [Best Buy] [has product] [Samsung Solid State Drive]
- [Samsung Solid State Drive] [has Rating above] [4]
- [Samsung Solid State Drive] [is an instance of the class of products] [hard drive]



Knowledge and Inference Architecture

1. A user creates objectives and saves them in **Agent Objectives** DB.
2. The **Inference Engine** takes objectives to search its **RDF triple store** and construct new queries. It passes queries to **New Query Generator** which converts to **HTTP Get** queries on the Web, to look for product info, recommendations and other metadata.
3. **HTTP Get** requests return well-formed **XHTML Web Pages** that run through **RDF Extraction** and harvesting process.
4. The RDF extraction process is governed by a **Rule Engine** that determines what RDF statements will be added to the **RDF triple store**.
5. The executed rules are stored in a **Rule Repository** that is consistent with the semantic bus.
6. Changes to **RDF triple store** may trigger new queries or may change the **Product Rankings** of products.
7. Users may change the rules at any time using a **Rules Management Console**. This is a set of **Rule Templates** generated by the Advocate Agent system.



Security

- *Social Trust and Verification*
- Private and Public Firewalls
- *Behavioral Inferences*
- *Central Authorities and Open Identifications*



Conclusions

- Demonstrating the feasibility of Advocate Agents by presenting an architecture that integrates current technologies, such as Enterprise Service bus, XML, RDF, and machine learning techniques into a unique system and demonstrating that all the components of Advocate Agents can be built from already existing methods and elements.



Future Work

- First application areas:
 - Capgemini Financial Services
 - Dutch Flower Auctions
- Setup the architecture framework
- Setup RDF inference engine and knowledge repository
- Implement the browser extension
- Implement the Economic Dashboard
- Perform data and text mining, machine learning and personalization



Discussion

- Suggestions?



More info and contact

- <http://advocate-agents.blogspot.com/>
- Lots to do... interested in participation?
- Email: wketter@rsm.nl

