Agent-based Systems: Do They Provide a Competitive Advantage?

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Organization Portfolio

• IBM is among the 5 largest companies in the world, yearly income more than 80 Billion USD
• IBM is active in virtually any field of computing – hardware, software, services and research
• ~300,000 employees, ~3000 in research worldwide
• Research division goal: create value to IBM, advance its technologies
• International labs: Tokyo, New Delhi, Haifa, Zurich
• Autonomic computing becomes a prominent field of interest – agents are an enabling technology
• Agent research: at T.J. Watson, Haifa, Tokyo
• Haifa Research Lab (HRL): ~350 staff, the largest outside the US
• Major fields: storage systems, microelectronics, optimization and verification, information retrieval, servers, system management, event management
Outline

• What are agent based systems?
• Where are agents useful?
• Application domain: eCommerce
• Application domain: storage networks
• Is there a competitive advantage?
• Conclusion
What are agent-based systems?

• Agents are autonomous computer systems
• Usually reside in a distributed environment
• Interact with users and perform tasks on their behalf
• Interact with other agents, collaborate and delegate tasks
• Interact with non-agent computer systems
• Exhibit reactive and proactive (intelligent?) behaviors
• Agent-based systems are designed and implemented using the agent metaphor
What are agents good for?

- Although some believe so, agents are not a solution for everything
- They are good for systems
  - that have multiple components;
  - that are distributed over a network;
  - that exhibit dynamic changes;
  - that handle large quantities of information from multiple heterogeneous sources;
  - that require autonomous behavior
Application domain: eCommerce

Infrastructure:
- Security, privacy
- Payments, registry
- Cataloging, trust
- Search, brokering
- Translation, legal
- Site hosting

Cooperation:
- Buyer clubs, coalitions

Middle agents:
- Negotiation, contracting, transaction
- Registry, cataloging, mediation
- Lookup, translation, mediation
eCommerce agents

- Vision – all parties automate trade via agents:
  - Buyer agents, seller agents, middle agents
  - Embedded on servers, desktops, mobile and handheld computers, mobile phones
  - Implementing sophisticated trade, negotiation and collaboration
  - Behaving rationally to maximize gains
  - Expected benefits: more and better deals, reduced transaction costs

- Reality (in industry):
  - Mainly buyer side agents
  - Working mainly on servers, a few on mobile devices
  - Implementing very simple search and trade activity

- What are the reasons for this slow adoption?
eCommerce agent slow adoption

• Are eCommerce agents an inferior technology?
• Unlikely:
  – They promise cost reduction and increased gains
  – They are not too complex to implement or to heavy-weight to run
• So why aren’t they adopted?
  – Slowdown in web-based technologies reflects on eCommerce too
  – B2B: still adopting first generation eCommerce – eMarketplace infrastructure. Agents are second generation eCommerce
  – B2C: consumers will not pay for agents, industry too lean in profits, will not give agents away
  – General: agent manufacturer’s liability issues – e.g., what happens if an agent performs a bad deal on behalf of a buyer?
  – Cultural/psychological: delegation of tasks to an autonomous software entity – an agent – that makes financial decisions on behalf of the user. Would you let an agent do that for you?
Application domain: Storage networks management

NAS - Network Attached Storage:
storage device attached directly to a TCP/IP based network, accessed using specialized file access/file sharing protocols

SAN – Storage Area Network:
high-speed network, connects servers and storage systems

SRM - Storage Resource Management:
A system that monitors storage resources (disks, disk arrays, switches, etc.), analyzes the data and reports to administrator
SRM system

Agents collecting information about devices on the managed storage network

- Agent
- Agent
- Agent
- Agent
- Agent
- Agent
- SAN
- NAS

DB

Application server

Viewing and reporting
Trends/predictions

Administrator
SRM agents

• Vision – an agent attached to storage network components:
  – Monitors activity, reports on it and analyzes it
  – Recognizes problems and automatically manages the components to resolve problems
  – Interacts with other component-attached agents for system-wide coherence

• Reality –
  – Virtually any SRM system includes agents! (EMC, HP, Tivoli,…)
  – However, these only monitor and report
  – Analysis and communication with administrators is done via a separate subsystem
  – Automatic problem resolution as well as interaction with others are not performed

• What are the reasons for this wide adoption?
SRM agents wide adoption

• Are SRM agents a superior technology?
• Not yet, there are some obstacles:
  – They are not too simple to implement
  – They should be tailored to component-specific data models
  – They must be very light-weight to run on devices and very efficient to minimize performance overhead
• But SRM agents are used because SRM systems are an appropriate application domain:
  – Multiple heterogeneous components, distributed over a network, dynamically create large amounts of data
• In the near future, most of the obstacles will be removed:
  – SNIA (Storage Networking Industry Association) will finalized CIM and WBEM standards for storage management, hence interoperability will be supported
  – Template agents for handling CIM data gradually become available
• Autonomic problem resolution and interaction not supported
Comparing domains

**eCommerce**
- Distributed, networked
- Agents attached to users
- Moderate amount of data, dynamically changes
- Open system
- Activity: information gathering, analysis, trade
- Agent may be “fat"
- User centric
- No standard, no tools

**SRM**
- Distributed, networked
- Agents attached to devices
- Large amount of data, changes rapidly
- Close system
- Activity: data collection and possibly analysis
- Agent must be “thin”
- System centric
- Standard and templates under way
Is there a competitive advantage?

• Not all application domains are appropriate for agents
• Distributed, networked application domains with large amounts of heterogeneous data are more suitable [in line with Navi Radjou, Forrester]
• However, as we have seen, suitable application domains do not promise success:
  – eCommerce agents are slowly adopted
  – SRM agents are widely used
• There are some software development barriers
Software engineering aspects

• Software engineering (SE) methodologies, e.g., UML (Unified Modeling Language)
  – Provide means for analyzing, designing, implementing and testing
  – Reduce development time, increase reliability and maintainability

• Agent technology provides some SE methodologies

• Question: do agent-oriented methodologies provide necessary SE properties not available otherwise? If so, to what extent?

• Answer: yes – better support for the combination of autonomy, distribution, collaboration and knowledge management

• Answer: very limited extent
  – There is no industry-grade agent-oriented methodology
  – Existing agent-oriented methodologies have limited tools, if any

• But, Agent oriented methodologies are improving, covering more aspects, will become industrially applicable
Future application domains

• Network/asset management:
  – Monitoring
  – Problem detection, analysis and prediction
  – Autonomous problem resolution
  – Open networks?

• Physically distributed, loosely coupled systems:
  – Transportation: coordination among cars?
  – Robotic environments: mining, manufacturing
  – Autonomous spacecraft and aircraft
    • Traffic control
    • Mission control

• Support for human teams
  – Mixed human/machine teams (military, emergency)
Conclusion

• Agents can provide a competitive advantage, if:
  – Used for a suitable application domain
    Distributed heterogeneous networked environments
  – Designed and implemented using software engineering concepts and tools
    Agent-oriented methodologies get closer to industry
  – Do not face psychological and legal obstacles
    Alternatively, you may need excellent marketing …
Thank You!