

Research Executive Summaries Series

**Intelligent Internet agents for business management and
accounting**

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Executive Summary

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1. Introduction

Intelligent agent technology is considered by many as one of the key solution technologies to the handling of the information overload problem caused by the development of a fully networked business environment.

An intelligent Internet agent (IIA) is a computer 'program' that traverses the Internet (or an intranet) and performs a specific intelligent task as an agent for a human.

The full research paper:

- Fully explains the nature of IIAs.
- Reviews the current uses of IIAs.
- Explores the relevance of existing research work to business management and accounting.
- Identifies future applications of IIAs that will benefit business management and accounting.
- Describes both the advantages and the dangers of IIA technology in this domain.

2. The management accountant and the information management task

As businesses become fully networked, sharing information fully implies the need to rethink the management of the process of collecting, recording, manipulating, storing and making available business information.

Intelligent agent technologies are information management tools and therefore are examined to explore their potential for providing solutions to aspects of this task.

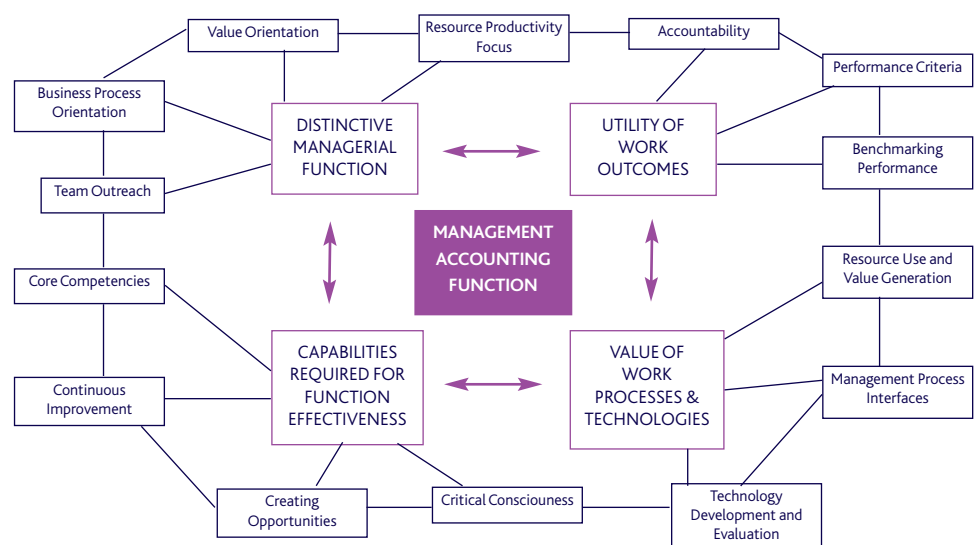
3. Relevance of intelligent Internet agents to management accounting

The modern accountant is described as a 'hybrid', meaning someone who has both accounting knowledge and an in depth understanding of the business.

This need for integrated information in a widely networked business environment suggests that intelligent Internet agents may have a useful role in supporting the modern management accountant.

The diagram below illustrates the range of tasks performed by the modern management accountant and indicates the skill set needed by accountants to perform these tasks.

Diagram 1 - Conceptual framework of the Management Accounting Function
(source IFAC 1998a para. 72)



4. Current roles for intelligent Internet agents in management accounting

Intelligent Internet agents can offer a solution to the problem of how to handle large, complex bodies of information, the need to reduce human time and effort spent in basic information processing, and pressures for more efficient and more effective decision making.

Most authors on this topic take the realistic line that users will not simply blindly follow the decisions or suggestions of intelligent Internet agents, any more than they do the results of any computer software – or even other human agents (such as consultants).

It is expected that intelligent Internet agents, at least in the near future, are more likely to be used in a decision support role than in a truly independent way.

5. Relevant categories of agents

Intelligent Internet agents are very useful for tasks that involve gathering, matching or analysing information. In addition, they can enable co-operation between business systems and individuals and even perform transactions (Scharl et al., 2000). There are therefore three categories of agent technology:

- information
- co-operation
- transaction.

Information agents

Information gathering is the first, and predominant, domain of intelligent Internet agent development at present. These agents are typically referred to as 'bots'. Critical to the difference between static data gatherers and intelligent Internet agents is the fact they will seek not only to get what a user explicitly asks for, but also to learn what the user wanted even though they did not explicitly ask for it.

A second category of information agents are those that focus on information analysis. This would include agent systems designed to pair together related information from multiple sources.

Information monitoring is a third information related task that intelligent Internet agents are well suited to perform. For example, having identified a website from which relevant information to the user's needs can be gathered, an intelligent Internet agent can store the page's location so that it can return to that site at regular intervals, or when the need arises, to automatically check for any changes to the information stored there.

The user can then be notified of this change in whatever way is appropriate to the user's needs and the nature of the information monitored.

Using intelligent Internet agents in this way could be very useful in reducing monitoring costs incurred by managers. Rather than employing human agents, companies can use intelligent Internet agents to scan through an incoming flow of data for information that matches known, or expected, criteria. This type of 'remote monitor and warn' approach has many business/industrial applications in other industries already, for example, production line monitoring or online sales monitoring.

The majority of the few intelligent Internet agents in development or in use in management accounting, and closely related business domains, fall into the 'information agent' category as this is the most developed at the present time.

Co-operation agents

Co-operation agents require information from two or more sources to operate. They are suited to such tasks as collaborative filtering – 'buyers who bought this product also bought product X' such as is found on e-commerce sites like Amazon.com. Such agents are particularly useful for cross selling by content filtering based on customer habits and interests.

In the management accounting domain, transfer pricing negotiations between business entities within a group, or selection of performance evaluation measures would be clear candidates for enhancement through the appropriate use of co-operation agents.

Transaction agents

Transaction agents enable transactions to be performed where parties are represented on one, or both, sides by agent technologies. Examples of such transactions types may include the negotiation of contracts, trading systems and the conclusion of sales and purchases of goods.

In the future, transaction agents may become more widespread in assisting traditional purchasing processes in the electronic medium, and will allow for more agent-to-agent transactions such as the creation of more multi-agent (human-less) auctions.

For a table of current commercial intelligent internet agents and their uses, see the full research report (Chapter 5, table 2).

6. Current business management and accounting roles for intelligent Internet agents

Intelligent Internet agents relevant to management accounting include:

- comparison shopping
- contract negotiation
- data mining (information overload control)
- service evaluation
- information discovery
- business process management
- project management
- simulations of market behaviours
- building information systems
- financial decisions and capital management
- workflow management
- fraud detection
- remote monitoring
- internal audit functions.

Two examples are explored in detail in the full research report. They are:

- The Transport and Logistics Industry – workflow management.
- Information Discovery - Enterprise Intelligent Agents and the area of Monitoring/Auditing.

See Chapter 5.4.1 and 5.4.2

7. Future applications of intelligent Internet agents in business management and accounting

Many claims exist for the potential of these technologies in the domain of business decision making. Many leading technology development companies are pursuing the development of intelligent agents in domains that could be considered to be within the remit of management accounting, including AT&T, Apple, IBM, BT, HP, Lotus, Digital, Microsoft, Boeing, General Motors, Barnes & Noble, Reuters and Deere. The involvement of such leading technology companies in intelligent Internet agent development indicates the common view that value is perceived to exist for business management users of these technologies.

The range of business management and accounting areas currently being explored for future applicability of intelligent Internet agent technologies includes:

- procurement management and purchasing
- interactive personas/characters
- personal agents
- infomediaries
- information filtering
- data mining and analysis
- data warehousing and knowledge management
- organisational processes
- manufacturing processes
- workflow management
- financial tasks
- customer profiling.

Procurement and purchasing

A large number of e-business websites and portals provide personal shopping agents of various sorts to help the user in navigating their website.

Intelligent Internet agents can serve as mediators in all areas of buying behaviour: need identification, product brokering, merchant brokering, negotiation, purchase and delivery.

Interactive characters

Software agents can be constructed to function as artificial employees and personal representatives. Mona, developed by iNAGO, is a digital person who greets website visitors, talks with them and guides them through purchasing steps on a website.

The use of interactive intelligent Internet agent characters could offer alternative, efficiency improving, access to corporate information, information retrieval and information manipulation. With such capabilities they could prove useful in supporting business managers and accountants in their tasks.

Personal agents

Intelligent Internet agents have also been created to function as personal agents to both customers and merchants. Personal agents could be created for a specific transaction, and exist only for the duration of that event, or may be able to carry out repeatable functions. An example of the former case would be Anderson's BargainFinder where a personal agent is created to seek a specific purchase for its principal. Once returning its results this agent ceases to exist and a new request requires formulation of a new specifically tasked agent.

Infomediaries and portals

Infomediaries compete on their ability to use information to provide value to their clients, whether these are buyers or sellers.

This group of intelligent Internet agents will have particular value to business managers and accountants in the future as more sophisticated information monitoring and alerting tools.

Information filtering

The development of the web has made all of us more aware of the need to filter information as it is received in order to separate the necessary from the potentially useful to the probably useless.

Data 'sifting' for competitive advantage is a key goal of intelligent Internet agent developers for commercial environments.

The value of such tools to information managers such as management accountants is clear – where improvements can be made possible to their ability to receive, assimilate, filter and disseminate information, their efficiency will be improved with either direct cost or productivity impacts. The area of information filtering will therefore likely be a key area in the future uses of intelligent Internet agents in business management and accounting.

Data warehousing and knowledge management

Intelligent Internet agent tools that can interact with internal data warehouses and external data sources in support of knowledge management have a wide variety of information-based management accounting applications.

Data mining and analysis

Data mining is the process of searching through data sets for useful information, such as links between data elements, which might not easily come to light under normal reporting and reviewing processes predefined in an information system.

Bose and Sugumaran (1999) built a prototype intelligent agent system for managerial data mining and analysis that automatically controls and coordinates tasks for the business user who is seeking to interrogate a data warehouse, or alternative large data set. The prototype allows for more effective use of a data warehouse to support active decision-making processes. Called IDM (Intelligent Data Miner), this system is an operational prototype for a web-based environment that provides the capability of organisation-wide decision support.

Performance monitoring

Intelligent Internet agents may also be used in executive and managerial performance monitoring. IVAANs (Information Variance and Analysis Notices) are intelligent agents similar to those used in computer network management. These agents, however, report on business activity in real-time, comparing executive and managerial performance to corporate plans and key performance indicators. Unlike traditional end-of-period evaluations, IVAANs are timely, unfiltered and objective and operate without direct human intervention.

Customer profiling

One of the most touted uses of intelligent Internet agents is user tracking and preference identification or customer profiling and matching. Placing intelligent Internet agents as part of external facing websites, for example, would help to determine access patterns, support study of 'drop-out' rates during purchases, or help track complex relationships between content provision, content changes and purchase decisions. This is an area of key interest in e-commerce management at present.

Competitor analysis

An intelligent agent could be used to continuously monitor competitors for news, updates or other relevant website changes, either on their own website or via other online sources. They could also be set to watch out for new entrants to a market or other developments in the market place to which you may need to respond.

8. Future of co-operation and transaction agents in business management and accounting information system integration**Negotiation**

Automated negotiators can save time while dealing with complex negotiations. Even with existing levels of use of communications technologies, real time on-line auctions are now possible. They provide an alternative to sequential, single channel, negotiation and even to on-line, but non-real time, auctions, as are currently becoming popular in some industries⁽¹⁾. Using agents, auctions can provide an efficient and effective dynamic pricing method for business transactions without the need for constant human oversight.

AuctionBot, Kasbah and Tete-a-Tete are all prototype intelligent Internet agents that are designed to help the user negotiate the terms of a transaction. These technologies could prove useful in inter-firm and intra-firm (e.g. transfer pricing) negotiations.

(1) An example of an industry that is making use of this kind of process is the car industry. Sourcing of selected parts in the build process is arranged by some major suppliers via a reverse auction where potential suppliers bid to fulfil stated order requirements placed on the auction for specific parts.

Co-operative personal agents

The progression towards co-operation agents has been clear in the financial services sector over the last few years from the introduction and subsequent rapid growth of online brokers to account aggregation services that offer portfolio support services from multiple sources (e.g. www.moneyextra.co.uk).

Organisational processes

Intelligent Internet agents may provide support for the development and facilitation of collaborative organisational processes and inter-organisational communication. Business developments over the last decade or more have suggested that interoperable and co-operative business units can, under certain circumstances, be more profitable organisational designs than those that compete directly with each other. For example, a number of co-operative agreements between traditional rivals have produced market gains for all in the areas of products innovation (e.g Bradford and Bingley Building Society's mortgage recommendation system - www.marketplace.co.uk) and costs savings (e.g ITEX Business Exchange - www.ubarter.com). Co-operative intelligent Internet agents could be a useful part of the technical framework enabling such units to operate together by supporting efficient integration of diverse organisational systems.

Manufacturing process support

Carey (2000) suggests that intelligent Internet Agents can provide useful support to plant managers co-ordinating selected tasks between systems such as automatically dealing with routine, or pre-determined production problems, or ordering or calling off of parts and raw materials in a timely fashion from stores or other stages of a production process.

Workflow management

Fakas and Karakostas (1999) created a workflow management system architecture, called WIBOs (Workflow Intelligent Business Objects) that designs workflow systems to assist in improving process automation and dynamic management of business environments. Similar systems, such as the METEOR project, have been developed using CORBA - Common Object Request Broker Architecture (Miller et al. 1997), whereas WIBOs are developed using Java making them Internet/intranet capable and platform independent.

Financial tasks

Intelligent agents have been used in the development of prototype financial investment decision support systems. StockBot, for example, was created to monitor an electronic stock market and then to execute purchase and sale orders.

9. Impacts of intelligent Internet agents

Whilst successful implementations of intelligent Internet agents offer the possibility of efficiency gains, potential problems also exist linked to their development and commercial exploitation.

These include concern that current technologies are not yet competent enough to dealing with all the complexities of real world environments and will therefore fail to perform as expected resulting in untrustworthy systems of limited usefulness.

Another potential problem is the unpredictability of agents (particularly co-operative or transactional agents) interacting in a complex environment.

The full research report explores the possible impacts of intelligent agents and the barriers to widespread use of intelligent agents. (See chapter 7). Topics covered include:

- general feasibility and application issues
- development issues
- legal issues
- privacy issues
- productivity issues
- security issues
- market and competition issues.

Conclusion

The potential for intelligent Internet agents used in business applications, and particularly of management accounting tasks, is interesting. A number of intelligent agents, embodying varying degrees of intelligence and mobility, are under development and a few are already in use.

Intelligent Internet agents are still in the early stages of development.

The question of whether or not these technologies are 'a solution in search of a problem' is an important one to consider in conclusion to this study.

Literature research and interviews undertaken as part of this study appears to indicate this technology is being developed in a business domain with little evidence of strong, wide spread, demand for such use being demonstrated.

What is clear however, from both trends in the market and the interviews conducted, are the specific needs for more efficient information management in modern businesses.

It is also clear that for wide spread development of these technologies, fulfilling some of the extravagant promises made of them, that a mind-set shift will need to occur in both developers and potential users of these tools that has not yet been noticed in respect of commercial application of other intelligent computing solutions.

The most likely scenario for the future of intelligent agent and intelligent Internet agent technologies is that, like expert systems and neural network technologies and methodologies before them, they will continue to be developed and integrated into business packages and services to the extent that their separable presence becomes impossible to spot.

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