Enhancing performance of Internet Business Tools using Multi-agent system

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Abstract— **As the complexity of real-world applications increases, particularly with the advent of the Internet, there is a need to incorporate organizational abstractions into computing systems that ease their design, development, and maintenance. The advent of Multi-agent systems has brought together many disciplines in an effort to build distributed, intelligent, and robust applications. They have given us a new way to look at distributed systems and provided a path to more robust intelligent applications.**
In this paper it is presented a preliminary research work that involves the development of the Internet Business tool through Multi-agent system for E-commerce applications taken place online transactions. We focus on the architecture of the multi-agent systems.

Keywords— **Multi-agent system, Business intelligence, E-commence, Online Business Tool, Internet Banking.**

I. Introduction

E-business has been an important and mature Information Technology (IT) application in Internet. The Internet has become the biggest library of information for prospective buyers online. Emerging as the most powerful selling tool, internet business offers cost effective ways for small businesses to market their products or services. Hassle free transactions and vast information available is what keeps the customers coming back for more and more.

Figure 1: E-business

Benefits of internet business are many. Browse through a few of them:

- **Minimum Costs**: Setting user internet business site can be done at minimum costs. Office space, office supplies, job expenses, travel expenses, meals, entertainment, phone etc; expenses are done away with.

- **Low Operating costs**: Once user internet business is set up, operating expenses like hosting fees, merchant accounts, etc are also minimal.

- **Market Selectivity:** One of the advantages of internet business is market selectivity. One can focus on specific interest areas and target market segments.

- **Tracking and Time saving:** The internet businessmen enjoy the luxury of tracking current and potential customers. They get valuable feedback immediately on how users interact with their brands. Valuable time is not lost.

- **Flexibility:** There is complete flexibility in internet business and web communication, twenty - four hours a day seven days a week. This is of great convenience for both the buyer and seller.

- **Advertise for free:** This is another advantage of the internet business. One can write an article and publish it or user can advertise for a really low investment.

- **Tax advantages:** Once can deduct user home, spouse and children if users employ them. Business vacations, cars, business meals, plus, any losses user incur can be tax deductible.

Business intelligence (BI) is essentially all of the data that a business needs to function properly. It is not necessarily something that most business owners think of reviewing, but they do soon a regular basis. There are many BI software products on the market, making it hard for certain owners to determine what they should and should not use. User may find some unique benefits by working online.

Unlike traditional business data management solutions that may have forced user to go to one computer or one program for data, BI applications online will allow user to gain access to the information user need anywhere there is an internet connection. This is perfect for business owners on the go because it allows them to still keep track of their data even while traveling. If user have to go to a lot of meetings out of the office, user can still get in touch with user's business data through a phone, computer, tablet, or even a video game console. As long as the web is available, user information will be available.

When users have the internet backing user business intelligence tools, users know that user can get up to the minute BI reporting all the time. Rather than having to wait for information to sift through other departments, user can see what is going on with user business right when it happens. Real time data is always best because it allows user to make the most accurate decisions user possibly can for the business. If user want to be as close to user business information as user can be, user need to think about using the web to user advantage.

The BI solutions user can find on the web are going to be much more affordable than other solutions out there. Web based companies do not have to pay as much money to produce and run their programs when compared to other business intelligence companies. As a result, they are able to pass the savings onto user. User can get the data user need at a price that actually works within user budget.

Internet marketing has many other strengths and weaknesses, you should not fear about that. Being a good businessman means that businessmen may use their advantages efficiently and making the most out of the disadvantages. Without enough knowledge of internet marketing, there is a big chance that the user may not succeed. Internet Marketing is confusing and takes a lot of time to master. There are lots of people today who are taking advantage of the ignorance of people in the internet; they scam people into buying their fake products. Business like those affects the customers into thinking if user site is legitimate or a scam. Having the site secured may help the customers know that user site is legit.

II. RELATED WORK

MASs are now a research reality and are rapidly having a critical presence in many human-computer environments. Vedran Podobnik et al. (2008) proposed the multi-agent system for automation of Business-to-Consumer (B2C) processes in the environment of the future Internet. The concept of New Generation Network (NGN) defined roles and relationships in the future Internet. The fierce competition among players in the Information and Communication (ICT) industry will just catalyze market redefinition processes, requesting from operators to promptly innovate their business models. The consumer's lifestyle also is change: individual users are interested only in services that are *intelligent* (i.e., personalized and context-aware), *dynamic* (i.e., innovative and fun) and *mobile* (i.e., provisioned anytime and anywhere).

H. Avancini et al. (2000) presented a framework for multi-agent systems (FraMaS) composed by characteristics of Multi-agent systems. FraMaS was used to design agents that have capabilities for perceiving environment, communicating, and deliberating about what to do next. Frameworks allow design and code to be reused. Intelligent agents cover a big amount of application domains but we can detect an important set of common characteristics that can be abstracted for reusing.

Federico Bergenti et al. (2008) provided a structured enumeration of the most notable recent attempts to use multi-agent systems for healthcare. Multiagent systems can be considered a suitable technology for the development of healthcare applications where the use of loosely coupled and heterogeneous components, the dynamic and distributed management of data and the remote collaboration.

Carole Bernon et al. (2006) presented the ADELFE methodology which is devoted to software engineering of adaptive multi-agent systems. Adaptive software is used in situations where either the environment is unpredictable or the system is open. ADELFE guarantees that the software is developed according to the AMAS theory1. He focused the presentation on analysis and design core workflows. In the analysis phase, the engineer is guided to decide to use adaptive multi-agent technology and to identify the agents through the system and the environment models.

Faiz M. Al-Shrouf et al. (2009) developed an approach for extracting agent-based design patterns for B2C e-commerce applications. This approach mainly composes agent design patterns and business patterns to develop application e-commerce patterns for business based systems engineering. Based on this approach, we derived an application pattern namely, the Facilitator design pattern. This design pattern is used to support selling/buying processes in e-commerce domain.

Thorsten Blecker et al. (2003) described role of MAS in Internet based Production Environments - an enabling Infrastructure for Mass Customization. Internet based production concepts provide the necessary interoperability and organizational alignment to support an overall application of multi-agent systems in mass customization. The intended decentralization of organizations in Internet based production concepts conform to the modular structure of multi-agent systems. A coordinated application leads to an enabling of mass customization.

M.H. Jansen-Vullers et al. (1995) discussed a number of simulation tools that are relevant for the BPM field; we evaluate their applicability for BPS and formulate recommendations for further research. Nowadays, many process aware information systems are implemented (e.g., workflow management systems) and business processes are evaluated and redesigned. The discipline related to this field of study is called Business Process Management (BPM). An important part of the evaluation of designed and redesigned business processes is Business Process Simulation (BPS).

Pavlos Delias et al. (2010) shows how an engineer can use Gaia formulas for modeling the dynamic behavior of an agent role and then transform the formulas to a process model compliant to the modern Business Process Modeling Notation (BPMN). The Agent Systems Engineering Methodology (ASEME) employs this text to model (T2M) transformation for being able to simulate the system models even after just the analysis phase. A number of tools allow for simulating process models, even optimizing them. Thus, a number of the system's

(non-functional) requirements can be evaluated before even entering the design phase. This helps an engineer to build a better system capturing its requirements but also a project manager to select the appropriate resources for his project's development based on the performance of the technologies proposed in analysis phase iteration. Our work is demonstrated and evaluated through a real world case study.

Zhongkui Li et al. (2008) introduced to address in a unified way the consensus of multiagent systems and the synchronization of complex networks. Under this framework, the consensus of multiagent systems with a communication topology having a spanning tree can be cast into the stability of a set of matrices of the same low dimension. The notion of consensus region is then introduced and analyzed. It is shown that there exists an observer-type protocol solving the consensus problem and meanwhile yielding an unbounded consensus region if and only if each agent is both stabilizable and detectable. A multistep consensus protocol design procedure is further presented. The consensus with respect to a time-varying state and the robustness of the consensus protocol to external disturbances are finally discussed. The effectiveness of the theoretical results is demonstrated through numerical simulations, with an application to low-Earth-orbit satellite formation flying.

Sara Maalal et al. (2011) presented a practical application of a generic and scalable method of MAS with a component-oriented architecture and agent-based approach that allows MDA to generate source code from a given model. We've designed on AUML the class diagrams as a class meta-model of different agents of MAS. Then we generated the source code of the models developed using an open source tool called AndroMDA. This agent-based and evaluative approach enhances the modularity and genericity developments and promotes their reusability in future developments. This property distinguishes our design methodology of existing methodologies in that it is constrained by any particular agent-based model while providing a library of generic models.

III. MULTI-AGENT SYSTM

A Multi-Agent system is a system in which more than one (software) agent operates. With an 'agent' we do not refer to a fysical agent, but to a piece of software that operates on behalf of its 'owner'. The concept is derived from the traditional agent-prinicipal relationship we can find at for instance a insurance-agent and an insurance company. In such a relationship the agent is expected to act on behalf of its principal and along the principal's lines. De principal is the person or organization that is represented by the agent. The agent has a mandate to make a contract and decisions on behalf of the principal. The relationship between an agent and a fysical person or company in a Multi-Agent system is analogous to this traditional agent-principal relationship. Research in MASs is concerned with the study, behavior, and construction of a collection of possibly preexisting autonomous agents that interact with each other and their environments. Study of such systems goes beyond the study

of individual intelligence to consider, in addition, problem solving that has social components. An *MAS* can be defined as a loosely coupled network of problem solvers that interact to solve problems that are beyond the individual capabilities or knowledge of each problem solver. These problem solvers, often ailed *agent,* are autonomous and can be heterogeneous in nature. The characteristic of MASs are that (1) each agent has incomplete information or capabilities for solving the problem and. thus, has a limited viewpoint; (2) there is no system global control; (3) data are decentralized; and (4) computation is asynchronous. The motivations for the increasing interest in MAS research include the ability of MASs to do the following:

- To solve problems that are too large for a centralized agent to solve because of resource limitations or the sheer risk of having one centralized system that could be a performance bottleneck or could fail at critical times.

- To allow for the interconnection and interoperation of multiple existing legacy systems. To keep pace with changing business needs, legacy systems must periodically be updated. Completely rewriting such software tends to be prohibitively expensive and is often simply impossible.

- To provide solutions to problems that can naturally be regarded as a society of autonomous interacting components agents.

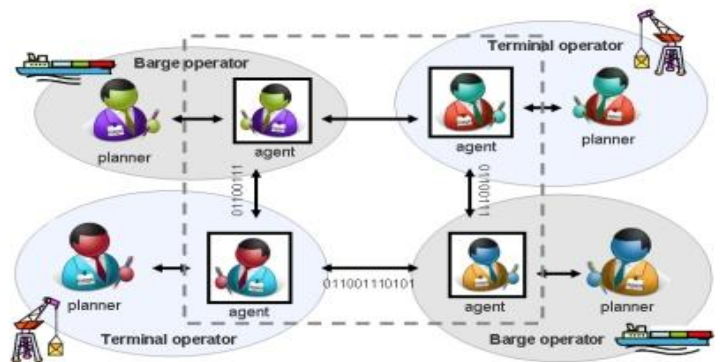For the barge example the Multi-Agent system looks conceptually as follows:

Figure 1: Multi-agent system

Every planner has its own agent. This agent runs on the local server of the company it works for. The agent gets all the relevant information from its planner to make the right decisions. The agent in turn communicates with agents of other companies to make appointments. The agents only exchange only limited information between each other, but enough to make the best decision for their planners. For instance: based on the information the barge operator agent gets from all the terminal operators a barge has to visit, it searches for the best rotation possible and makes agreements with terminal operator agents. The way this is done is similar to the way the planner would have decided otherwise. Terminal operator agents in turn process the information they get such that they make

decisions as their planner would have done otherwise. In case of an exception the planner can be consulted to indicate the decision (s)he thinks is the best.

Although MASs provide many potential advantages, they also present many difficult challenges.

- To formulate, describe, decompose, and allocate problems and synthesize results among a group of intelligent agents.

- To enable agents to communicate and interact.

- To ensure that agents act coherently in making decisions or taking action, accommodating the non-local effects of local decisions and avoiding harmful interactions

- To enable individual agents to represent and reason about the actions, plans, and knowledge of other agents to coordinate with them

The Multiagent System Engineering (MaSE) methodology, takes an initial system specification, and produces a set of formal design documents in a graphically based style. The primary focus of MaSE is to guide a designer through the software lifecycle from a prose specification to an implemented agent system. MaSE is independent of a particular multiagent system architecture, agent architecture, programming language, or message-passing system.

The need of software tools for designing and testing complex distributed multi-agent systems is considerable. Over the past few years a number of theoretical and practical methodologies for designing, implementing and testing multi-agent systems are being developed. As part of this effort an agent-oriented CASE tool, which aims at simplifying the multi-agent system designer's work, and a testing framework, which provides a uniform and automated approach to the testing of multi-agent systems, have been designed and implemented.

IV.   ENHANCING PERFORMANCE OF INTERNET BUISNESS TOOL USING MULTI-AGENT SYSTM

Internet marketing is one of the important E-business researches. It may include lots of marketing activities like advertisement, promotion, making a deal with customers, and so on, through the Internet. In general, Internet marketing applications could be classified into two types, the pull model and the push model. Presently, many researches use software agent technologies to support two models. Software agents have representative and communicative skills. They hope the advertising system can capture the customers' needs and attract the customers to purchase the products/services by using software agents.

Both Agent and Internet Technologies are considered as key factors of a mass customizing production system. Internet-Technologies offer a high connectivity, which is needed for fast and seamless transport of data. The high number of variants and processes leads to higher complexity, especially in information logistics. Thus, we show the benefits and

implications here of such an infrastructure for mass customizes. Mainly it enables the following features:

- Enhanced planning and control of the production environment.

- Reconfigurability of production systems that enables fast integration of new variants.

- Seamless information flow from customer to the shop floor that enhances delivery times, reduces costs and enables process transparency for internal purposes, as well as for customers.

We assume that the new key Technologies in business are Internet Technology based agent, information and production systems. Therefore, we analyze the effects of the emerging infrastructure for business activities management.

MAS are more precise in planning, scheduling and reconfiguring production processes, respectively the dependent information systems, such as production planning and control. The application of Internet based concepts in general supports a distribution of decision rights directly from various levels. Compromising the application of multi-agent systems (MAS) in an Internet based environment has several positive effects that lead to an enabling of mass customization. The necessity reaching conformity between information systems and the organization structure are indispensable for mass customization companies. Especially information systems are often not aligned with the organization structure. MAS are a promising concept that provides the necessary flexibility and changeability in decentralized environments.

Actual MAS-approaches in mass customization neglect implementation considerations such as the integration within the information infrastructure and the uniformity to the organization
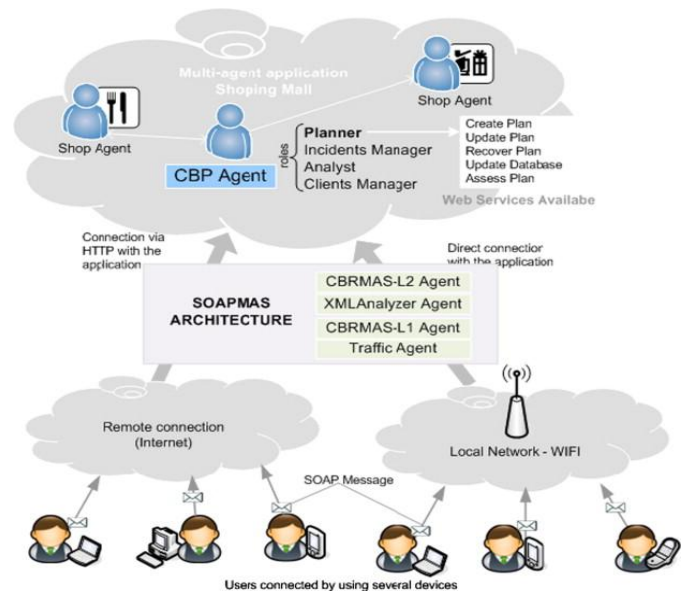

Figure 3: Internet business tool

In many E-Business cases, business intelligence plays very important role in the process of building the business tool. The multi-agent system is best option to implement the business intelligence. The multi-agent can be designed routinely collect

customer's basic data, such as customer's name, and data regarding to job, education, interests, address, ZIP code, and so on. A customer might be forced to type in these data before he could really interact with this agent about real business tasks every time a representative agent from an enterprise arrives. It would be a boring and time-consuming work for a customer to repeat these key-in activities again and again. In other cases, an agent might be popped out to request for doing some product promotion to a customer although he may be currently on duty and hope not to be bothered at that time Therefore, it will be useful and convenient to customers to have a software secretary who will do agent authentication in behalf of a customer so that the proper and permitted representative mobile agents from enterprises could talk to the customer.

Hence in this way, Internet business tools can be implemented with high performance due to features of availability of business intelligence, mobility, atomicity of the multi-agent system.

V. CONCLUSIONS

Although agent technology has been an important solution for large complex applications in the Internet, there is no sound methodology available for software engineers to develop their agent-based systems. The advantage of MAS is the possibility to solve partial problems without having to consider the general problem. Intelligent agents know about their specific domain and try to obtain the necessary information or resources to solve the actual problem. The agents have to cooperate with other agents, which can be organized in terms of negotiation, bidding or opportunistic behavior. In several research projects the usefulness of MAS in realistic commercial application scenarios has been investigated. Production is one important domain for MAS. Several MAS-based solutions have been developed for complex problems in manufacturing. MAS are analyzed for controlling machines and manufacturing lines to reach a more fault tolerant and more flexible control.

This approach allows a conceptual integration of MAS into the production system by considering agents as actors that act on behalf of other actors. The actor approach permits the adoption of the theoretical benefits of MAS into the mass customizing manufacturing system. The application of Internet based production concepts provide the necessary

decentralized organization structure, as well as technical prerequisites

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