IBA E
EXECUTIVE SUMMARY 2001-2004

2001

The first activities of IBA E were to (i) distribute information on IBA E activities and material such as case studies, presentations and conceptual papers; (ii) formulate common focus areas of interest and (iii) initiate virtual teamwork among key nodes (not much success).

An interactive homepage for IBA E was built in order to make it possible to have a more immediate interaction with the key nodes than through email contacts. The homepage was planned to be used to quickly distribute News material, which will be produced by IAMSR, and links to ongoing research projects and focus groups. The homepage should also be used to distribute and work on material for the EUNITE roadmap. The first version of the homepage was finished and linked to the EUNITE homepage.

The IBA E carried out the following activities done in 2001:

- Active recruiting of key nodes [8]; mailing list of additional nodes [15]
- Starting workshop to define activities at kick-off meeting on March 3, 2001
- Workshop at EUNITE 2001
- Sessions at EUNITE 2001
- Administration: homepage (www.abo.fi/instut/iamsr/eunite), work to activate key nodes, planning of activities for 2002.
- Contributions to roadmap, 4 cases submitted (2 more submitted in 2002)

IBA E worked at getting joint activities started. At the kick-off workshop (March 3, 2001) a number of joint areas of interest were identified and commitments to work towards joint objectives were made. These commitments have been slow to materialise.

IBA E collected a number of papers for the EUNITE 2001 conference and organized a workshop on Mobile Commerce at the conference. The Mobile Commerce area has a good interface to the *Finance*, *Trade and Services* field, with the added dimension of building on the new mobile technology. Planning for the activities in 2002 emphasized a broadening of the scope to other activities than mobile in the *Finance*, *Trade and Services* field and input from the key nodes were promised.

IBA E contributed to the EUNITE roadmap with 4 cases, with an outline of the role of *smart adaptive systems* in its area of activity and with some general material on adaptivity.

The key nodes of IBA E were invited to contribute to virtual task force work in several focus areas of finance, trade and services, which were identified at the kick-off meeting in Aachen:

- Smart adaptive systems in real options modelling [Christer Carlsson]
- Mobile banking and brokerage [Uzay Kaymak]
- Automated messaging in logistics [NN]
- Quality of service. Adaptation through personalisation [NN]
- Financial transaction processing [NN]

- Collaborative filtering in information services [Christer Carlsson initially, the somebody else]
- Insurance companies and value-added smart adaptive products and services [NN]
- Time management [Christer Carlsson initially, then somebody else]

No contributions from key nodes. *Real options* was planned as a workshop in May 6-8, 2002. *Time management* worked out as part of an IAMSR research program. *Collaborative filtering* became the focus of an application of agent technology in an IAMSR research program.

2002

The IBA E consolidated and expanded its activities in 2002:

- The Real Options Workshop in Turku, Finland (May 6-8, 2002) [199]
- Sessions, meeting at EUNITE 2002 in Algarve, Portugal (September 19-21, 2002) [204, 402]
- Intelligent and Soft Computing Workshop in Turku, Finland (September 24, 2002) [200]
- Workshop on Smart Adaptive Systems in Finance in Amsterdam, The Netherlands (November 15, 2002) [203]
- Developed and enhanced interactive homepage [201]
- Compiled and posted a total of 8 cases (6 in 2001, 2 in 2002) [209]
- Worked out contributions to the EUNITE roadmap [332]

The various activities reached a total of almost 200 people (approximate numbers for above activities (some overlapping) 40 + 35 + 100 + 20). The core of active key nodes remained less than 10.

The IBA E members present at the EUNITE 2002 Conference in Albufeira met for a lunch meeting on September 20, 12.30-14.00. There were 5 members present:

- Christer Carlsson
- Uzay Kaymak
- Rüdiger Brause (Frankfurt)
- Menno Israel (SMR Amsterdam)
- Joas M. Sousa (Lisbon)

The IBA E discussed the activities of 2003 and a tentative decision was made to organize a workshop in Frankfurt on SAS in Finance as a follow up to the meeting in Amsterdam organized by Uzay Kaymak. The co-chairmen pushed for contributions to the roadmap, which produced polite answers but no real commitments. The meeting agreed to continue the activities over the IBA E site and commitments were given to contribute to the material being published on the site.

At the EUNITE 2002 Conference the Special Actions for SME were discussed at length among the IBA E participants. It was found that with the special focus the group has on finance, ROV applications for investments and mobile technology applications the focus is more with large multinational corporations than with SME. No immediate Special Actions could be identified, but the IBA E members were charged with formulating potential initiatives. No contributions.

An international workshop on *Real Options* theory and applications was run in Turku, Finland on May 6-8, 2002. The workshop had 43 participants, which included (i) researchers, (ii) corporate managers, experts and planning staff, (iii) consultants, and (iv) system and software developers. The objectives of the workshop were to find both a state-of-the-art and to find promising areas for research and applications as well as to discuss and tackle problems brought by the corporate participants.

The papers submitted were run through a peer review process and will after revisions be published in an edited book by Springer Verlag (Soft Computing series). Two papers were submitted to the EUNITE e-archives.

An international workshop on *Soft Computing and Intelligent Systems* was run in Turku, Finland on September 24, 2002. The workshop had 97 participants, which included (i) researchers, (ii) corporate managers, experts and planning staff, (iii) consultants and (iv) system and software developers. The objectives of the workshop were to find both a state-of-the-art and to find promising areas for research and applications as well as to discuss and tackle problems brought by the corporate participants.

The workshop was the IAMSR 10th Anniversary celebration with Prof Lotfi Zadeh, UCBerkeley as the keynote speaker and with Prof Mario Fedrizzi (Trento), Prof Stefan Klein (Münster) and Mr Bror Salmelin (European Comission) as invited speakers. Two presentations were submitted to the EUNITE e-archives.

2003

The IBA E members present at the EUNITE 2003 Conference in Oulu met for a discussion meeting on July 11, 13.00-14. The IBA E contributed two sessions for the Oulu meeting.

There were 3 members present in Oulu:

- Christer Carlsson (co-chair)
- Uzay Kaymak (co-chair)
- Rüdiger Brause (Frankfurt)

The IBA E discussed the reasons for the failure of the workshop organized by Rüdiger Brause in Frankfurt, which did not attract a sufficient number of participants. The reasons were found to be (i) that SAS still is regarded as too theoretical and too far from practical applications, (ii) the speakers appeared not to be known in the financial community and (iii) the present economic situation in Germany limits the attendance in external activities which carry a participation fee. The co-chairs thanked Rüdiger Brause for the efforts he put into the activity to make it work.

It was agreed that a new attempt at getting a workshop activated in the Finance area should be attempted. Mario Fedrizzi at University of Trento and also a well-known presence in the financial community of the Trentina region has agreed to help organize a workshop on real options valuation (theory and applications). Co-chair Christer Carlsson had been in contact with Lenos Trigeorgis, the key person in the Real Options Group, and he has agreed to help with the organizing by distributing information through his network. The place will be Trento (or alternatively Brussels) and the workshop was planned for for late 2003, depending on the work schedules of some key persons.

Co-chair Uzay Kaymak was planning a workshop/seminar on risk analysis for January/February 2004. Details were still in the planning phase.

Co-chair Christer Carlsson had revised the IBA E roadmap material, which has been both re-structured and updated. The roadmap working document is available for IBA E members on the IBA E homepage being maintained in the IAMSR server. The homepage is now being enhanced with software agents to simplify the collecting of material on future SAS technologies for Finance, Trade and Services. (The software agent software was made available also for other IBA's upon request to e-mail christer.carlsson@abo.fi; no reactions). The co-chairmen have pushed for contributions to the roadmap through repeated messages and e-mails, which produced polite answers but only one real commitment to write material. The meeting agreed to continue the activities over the IBA E site and commitments were given to contribute to the material being published on the site.

2004

The second EUNITE Workshop on Smart Adaptive Systems in Finance has taken place at the Faculty Club of the Erasmus University Rotterdam in the Netherlands on 19 May 2004. The workshop provided a platform for the professionals in the financial sector to exchange ideas, opinions and experience about the opportunities for smart adaptive systems, including data mining, neural networks, machine learning, fuzzy modelling, soft computing and evolutionary computation within the finance sector. The presentations have shown a cross-section from the state-of the art in this field, recent academic developments and successful applications of the smart adaptive technologies in the finance sector.

The speakers at the workshop were practitioners and experts from large financial institutes, academia and SME's. Hence, representatives of all the parties that EUNITE targets were brought together. Among the topics presented, smart adaptive technologies were applied in the field of mutual funds, asset allocation, operational risk and more. Material from part of these presentations has been used as input for the IBA E contribution to the EUNITE roadmap.

Twenty-nine participants attended the workshop. Therefore, the targeted number of attendants was reached. Contrary to the first EUNITE Workshop on SAS in Finance, there was this time many participants from the academia, including a clear interest from graduate and doctoral students. In this sense, the workshop helped bring the practice from the industry closer to the theory from the academia. The given presentations have shown that financial decision making models can be made more inline with reality by using better predictions, improved explanation and stronger decision support. Furthermore, the potential for smart adaptive systems has been demonstrated in the presentations of the speakers.

To disseminate the conclusions from this EUNITE activity, and to increase the awareness for EUNITE, a brief report of the activity has also been submitted for publication in the newsletter of the Belgian-Dutch Artificial Intelligence Society (BNVKI).

The IBA-E committee organized two special sessions on recent developments in intelligent methods for economics, finance, trade and services during the EUNITE 2004 Symposium held on 10-12 June 2004 at AGIT (Aachener Gesellschaft für Innovation und Technologietransfer mbH Technologiezentrum am Europaplatz) in Aachen, Germany.

The sessions contained seven accepted papers. The contributions covered a wide range of issues regarding adaptive agent-based artificial stock markets, genetic programming for economic modelling, fuzzy clustering in the analysis of financial data, the opportunities for computational intelligence in behavioural finance, fuzzy real option valuation, multi-resolution financial risk management and reinforcement learning agents in micro-economic simulations. All papers appeared in the conference pro-

ceedings, but two could not be presented at the conference as the authors had to excuse themselves from participation.

Approximately 30 people participated in the sessions. Since there was ample time during the sessions, lively discussions have accompanied the presentations. These discussions have led to further contacts amongst the presenters and the participants, and agreements were made for continued research cooperation. In this sense, the sessions have contributed to the aim of EUNITE to improve and enhance research cooperation amongst scientists from different countries in Europe

IBA E Meeting at the EUNITE 2004 Symposium.

Participants:

Person	**Institution**
Uzay Kaymak (UK)	Erasmus University Rotterdam, the Netherlands
Rüdiger Brause (RB)	Goethe University Frankfurt, Germany

Excused:

Christer Carlsson (CC)	Abo Akademi University, Finland
João M. da Costa Sousa (JS)	Technical University of Lisbon, Portugal

Because there were only two people at the committee meeting, it was decided to hold a semi-informal meeting discussing the committee achievements in 2003 and the first half of 2004.

1. Evaluation of past committee activities.

   1.1 Workshop on "Smart Adaptive Systems in Finance" in Rotterdam has been completed successfully. A workshop report and the proceedings are available through EUNITE. There were 29 participants in the workshop with a larger number of Ph.D. and graduate participants, compared to the first workshop.

   1.2 CC and UK have updated the roadmap contribution. The final contribution has been handed over to Eunite Steering Committee. Material from various IBA E workshops have been included in the roadmap contribution.

   1.3 The joint workshop on "Real Option Valuation", planned to be held in Finland, has been cancelled as an Eunite activity, since some of the partners joining the workshop did not want to disclose information to a broad audience.

   1.4 The draft of the survey on intelligent systems in marketing is completed.

2. Finally, a few words were exchanged as an overview of IBA E activities. Generally, it was felt that the IBA E group had been small, but that a number of important contributions had nevertheless been made, especially in terms of organizing workshops and symposia. The interaction with the industry has been good at these workshops, but their participation in the Committee activities have remained at a low level.

IBA E finalized its contribution to the EUNITE roadmap. The document, which finally became quite sizeable, was written by co-chairs Christer Carlsson and Uzay Kaymak.

In the following some documents and reports have been collected to illustrate how the key ideas of *smart adaptive systems* were understood and worked on by IBA E during the tenure of the EUNITE network.

Smart Adaptive Systems in Finance, Trade and Services.

Smart Adaptive Systems in the Customer Interface

The design and implementation of *smart adaptive systems* (SAS) requires different means and different methods and technologies for different types of environments. The standard classification is of support systems developed for (i) a well-structured environment (allows for mathematical modelling and optimisation, typically engineering applications), (ii) semi-structured environment (allows partly for analysis, modelling and optimisation, but will partly be dependent upon heuristic methods), and (iii) ill-structured environments (mainly heuristic methods and the use of qualitative information and knowledge).

Developing SAS applications for the customer interface requires work in an ill-structured environment, for which dynamic change often means radical changes of the prerequisites for building and implementation. The distinction between the three different environments is not complete, there are possibilities to use some selected mathematical modelling tools also for an ill-structured environment (neuro-fuzzy systems, approximate reasoning schemes, etc.). The customer interface is also different in another respect: customers learn how a support system works after a few rounds and change their preferences and their requirements on the support, which should be produced and offered. The EUNITE classification of SAS levels applied below may thus be relative in the minds of the users, a level III SAS may after a while be a level II SAS as the users adapt their behaviour to the support offered in the environment in which they act, solve problems and make decisions.

In the following example we have worked from the assumption of a slightly futuristic view of mobile platforms for fairly advanced mobile support applications. These are technically possible already and full-scale applications will be in the market in 1-2 years depending on the demand. They offer nice challenges for SAS development.

An Example of Smart Adaptive Systems

When working with the customer market technology will have to move into the background, i.e. SAS as a smart technology does not mean anything unless it introduces customer added value in applications.

There are degrees to customer added value (cf. Keen-Mackintosh): (i) *freedom* (significantly changes the ways of everyday life), (ii) *convenience* (may save time, may simplify everyday activities), (iii) *feature* (neat ideas, which may be solutions to problems nobody may care about), or (iv) *no clear target* defined (could be a solution if a problem appears). The highlighted labels refer to alternative results with smart technologies, which may or may not create customer value; the highest value is (i) and the lowest, uncertain value is (iv).

Following this initial classification we have the following example, which is an implementation of mobile technology.

Using an advanced web-enabled mobile phone in the GPRS network you are able to access services in the travel and hospitality industry (already now in some countries, in the near future in other countries), which represent significant customer added value. You can check for availability and book your flight through your mobile phone, and pay through an integrated secure mobile payment service, either drawing upon your bank account, your credit card or on a company line of credit. When travelling to the airport you get personalised and localised information on traffic conditions, and updated and personalised information on delays and/or cancellations for your flight and connecting flights. Arriving to your destination the mobile phone connects you with the local ground transportation, which may have been reserved in advance or en-route, by showing a code or identification number, which matches with the taxi or limousine serviced. Getting near to your hotel, the hotel will "sense" your arrival and check you into the hotel, tell you your room number on the mobile phone and download an entry code to the phone. You can go straight to your room without collecting a key, you point your mobile phone on the door, tap in or send the entry code and open the door. Part of the service offered by the hotel may be restaurant and entertainment services, for which access codes can be downloaded to your mobile phone. If the hotel has access to your preference profile for meals and entertainment, the selection can be personalised. The access codes will offer you the possibility to make reservations and to get directions to the restaurant (or a message in the local language for a taxi driver). The same code offers the restaurant the possibility to "sense" that you are close and to start preparations for your personalised meal. The bill is built up as you eat and drink, and you can follow the total on your mobile phone. When you are finished, you simply send a message to the restaurant server, which will charge your payment system (and discretely let the waiter know that you actually paid). Then you can reverse the routine with the taxi, and show the driver the directions to your hotel in the local language. When you are ready to check out of the hotel, send the entry code again as part of an MMS message to the hotel intranet server and your bank account, your credit card or a company line of credit gets charged.

The type of services described here are of the *freedom* variety, they will significantly change the everyday routines of travel and will take away a number of activities people have to worry about and spend time on when travelling, not to mention that they may cause serious problems for people with tight schedules and many obligations.

There are different varieties of freedom (cf. Keen- Macintosh), besides the customer freedom we have shown in the above example. The "travelling SAS" will probably not be a reality unless it adds value to the business of the producers of the products and services it gives access to. The producer side of the technology can basically use the same SAS technology as the customers to work out at least three different types of freedom, i.e. business models, which will change their daily mode of operations in significant ways. *Relationship freedom*, which add value to customer relationships by exploiting mobility, personalisation and the combination of mobile phones and the Internet. *Process freedom*, which add value along a supply chain, logistical operations and business partner relationships by adding mobility to as many steps as possible. *Knowledge freedom*, which add value to the organisation and its workers through knowledge mobilisation throughout the organisation.

In terms of the EUNITE three levels of adaptation the "travelling SAS" can be built in layers and be personalised (or customised) to offer the traveller different levels of smart support (with customised pricing):

Level I. The "travelling SAS" uses localisation data and "senses" closeness to an airport, a hotel, or a restaurant and activates relevant, personalised information and services.[Adaptation to a changing environment].

Level II. The "travelling SAS" changes payment system depending on circumstances: company credit card for the hotel, private credit card for the restaurant and cash payment for shopping if less than 20 €. [Adaptation to a similar setting without being explicitly ported to it].

Level III. The "travelling SAS" may be designed with personalised security routines to follow the pattern of use and transactions. If the regular pattern (which can be calibrated) changes the new pattern needs to be confirmed with a personalised code; if the response is irregular (or an emergency code is given) the payment system gets alerted and will be closed unless a confirmation code is given and emergency services get alerted to the location of the "travelling SAS".[Adaptation to a new/unknown application].

References

Keen, Peter G.W. and Ron Mackintosh, *The Freedom Economy*, Osborne-McGrawHill, Berkeley 2001.

SMART ADAPTIVE SYSTEMS

Christer Carlsson
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Sommerhoff (1950, pp 282-288) gave one of the early descriptions of *adaptation*: "Speaking generally, it may be said that the notion of adaptation when applied to living nature refers to the widespread and striking *appropriateness*, which organic activities show in relation to the needs of the organism, and to the *effectiveness* with which organisms meet the demands made upon them by their environment. In the first place, the response must be to something, it must be evoked or called into being by some antecedent environmental event or state of affairs … Secondly, the response can be called *appropriate* only in relation to the subsequent occurrence of some event or state of affairs towards the actual or probable occurrence of which we believe it to contribute effectively. This event or state of affairs is what is commonly regarded as the *goal* or *aim* of the response… In the third place, whether or not a given response is appropriate depends on the environmental circumstances which it meets and with which it comes to interact."

This early formulation still contains most of the key aspects of adaptation and of what we understand as adaptive behaviour.

Ashby's contribution is more distinct (1972, p 72): "… *adaptive behaviour* is equivalent to the behaviour of a stable system, the region of stability being the region of the phase-space in which all the essential variables lie within their normal limits."

Sagasti (1970, p 153) builds on Ashby: "*Adaptation* – A system whose function it is to produce a class of entities Y is said to be *adaptive* if either of the two following conditions are satisfied:

- One or more modifications of the system's defining elements E and/or relations R, which affect the system's potential production of Y, generate one or more changes in E and/or R, such that the Y producing property of the system is preserved with at least the same level of efficiency. The initial structural modification(s) is (are) called *stimulus* and the subsequent ones *response* [structural adaptation].
- One or more modifications of the system's defining elements E and/or relations R generate a change in the function of the system, so that it will produce a different class of entities Y_1; these are more compatible with the new structure of the system in the sense that, after the initial modification of structure, the number of states of the system producing Y_1 becomes greater than the number of states producing Y. Therefore, after the stimulus, the efficiency of the system as a potential producer of Y_1 is greater than its efficiency as a potential producer of Y [functional adaptation].

There are four different forms of adaptation in Sagasti's classification:

- *External adaptation*, adaptive behaviour in the presence of a stimulus originated in its environment.
- *Internal adaptation*, adaptive behaviour in the presence of a disturbance located in the *object* of the system.
- *Darwinian adaptation*, adaptive behaviour when the response is directed towards modifying its *object*.
- *Singerian adaptation*, adaptive behaviour when the response is directed towards modifying its *environment*.

Even if the early definitions of adaptation are from the 1950'es and 60'es they are still adequate today as can be seen from the description of the same phenomenon in the IIASA Adaptive Dynamics Network (ADN) program, which now is active. In this program, the adaptation of an ecological system is described in the following way: *the system is affecting its environment in order to induce desirable changes and then modifies its adaptive behaviour as a function of the input from environmental feedback loops*.

The way the ADN is structured and carried out is instructive for how large-scale research programs focused on adaptive systems could be carried out. The IIASA ADN program is built around a blend of analytical and numerical approaches, which have been selected to find a viable compromise between oversimplification and intractability. The ADN started with available mainstream methods and expanded with interdisciplinary methodological innovations to cope with problems of increasing complexity. Within the ADN program many studies have been designed to explicitly bridge the gap between abstract analysis and practical applications, as it appears that this is not part of any mainstream methodology. Finally, in the ADN program it became apparent that most ecosystems are so complex that the learning processes to begin to understand them will take a long time. The ADN strategy has been to focus on those re-

search tasks, which have become tractable with the new methods and to not attempt any of the wide-open "missions impossible".

Using all this material as a basis, *adaptive systems* would thus have the following properties or characteristics: they (i) work to find regions of stable behaviour (where all essential variables lie within wanted or predefined intervals), (ii) adapt to changing environments with algorithms, methods, models, instruments and technologies, which are appropriate and effective to find a stable behaviour, and they (iii) use different strategies to build the adaptation programs: adaptation to (iii.1) the environment or (iii.2) the object, and adaptation of (iii.3.) the environment or (iii.4) the object.

Adaptive systems could be built around all the COIL technologies: fuzzy logic and fuzzy control theory, artificial neural nets and self-organizing maps, genetic algorithms and machine learning.

Smart adaptive systems are ultra-stable in the Ashby sense, i.e. their adaptive behaviour will converge faster, more effectively and in a more appropriate way than standard adaptive systems. This is due to either learning and/or reasoning capabilities or to the intervention of and/or interaction with smart human controllers or decision makers.

Smart systems are designed to work (i) efficiently in relation to predefined objectives, (ii) effectively in relation to predefined goals, or (iii) in an appropriate way in relation to formulated visions or intentions. Smart systems have learning and/or reasoning capabilities in relation to (i)-(iii) or are working interactively with human controllers or decision makers. In all cases smart systems are built around effective algorithms, efficient models and/or effective reasoning schemes, etc.

References

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Mobile Commerce: Core Issues, Products and Services

Summary

Although m-commerce is an emerging field in its early stages there are a number of ideas of what is going to constitute the key success factors for the actors in the global m-commerce arena.

We will attempt to form an embryo of a conceptual framework for m-commerce products and services from three perspectives[1]: *the customer*, *the producer* and *the management*.

Seen from the perspective of the *customer* the necessary distinguishing elements are

1. flexibility, m-commerce products and services should be available anywhere, at any time and anyhow.
2. value-adding, m-commerce products and services should improve productivity, they should be adaptive to localisation and they should be sensitive to customer personalisation.
3. a mobile technology basis, m-commerce products and services should use innovative and distinguishing features of mobile technology to enhance the quality of life (e.g. messaging, entertainment, education, information, privacy, etc.).

Seen from the perspective of the *producer* the necessary distinguishing elements are

4. modularity, m-commerce products and services could be built from a core of generic product and service modules, which can be combined to form context adapted products and services; this should support the *flexibility* element.
5. layers, m-commerce products and services could be built in layers to add attributes and characteristics, which are adapted to (i) customer personalisation, (ii) localisation, (iii) brand profiles, (iv) privacy, etc.; this should support the *value-adding* element.
6. bundling, m-commerce products and services could be built through a bundling of modular products and services, which would be a way to make use of the mobile technology basis (cf. also 4 and 5).

Seen from the perspective of the *management* the necessary distinguishing elements are

7. value/cost ratios, m-commerce products and services should show good or very good value for cost in comparison with similar products and services; this should form the basis for pricing strategies, and cost and revenue models.
8. production, logistics, marketing and advertising, m-commerce products and services should have innovative features in comparison with similar products and services; this may be a function of the possibilities offered by the mobile technology.
9. business model, m-commerce products and services should use innovative and distinguishing features of mobile technology to support new business models.

As the distinction between products and services may become blurred as they are produced with digital mobile technology we need to introduce the following distinctive elements:

- services: intangible, no ownership is defined;
- products: tangible, ownership is defined;
- digital products: intangible, ownership is defined
- digital services: intangible, no ownership is defined;
- digital product & service: intangible, ownership is defined;

[1] This material was first generated in a brainstorming session on December 16, 2000 in which Christer Carlsson, Tawfik Jelassi, Pirkko Walden, Myra Spiliopoulou, Thomas Hutzschenreuter and Alexander Lorbeer participated.

- digital service & product: intangible, ownership is not defined;

The last two cases point to the possibility that we have proprietary services as part of digital products or that services may have products incorporated, for which no ownership can be claimed. It appears that ownership is a key feature for products – a key feature for services is that the client's presence is needed. This may then serve as a guideline for building m-commerce products and services.

The quest for *killer applications*, which is a common feature in most of the business seminars sold by the key consulting companies, may be a quest in vain. Already from the elements we have introduced above it appear evident that single, outstanding killer applications may be rare and far between. This has also been visible in discussion of m-commerce products and services, in which we have various types of combinations:

- *Killer Cocktail*, a mix in which the components cannot be distinguished [Nokia];
- *Killer Pizza*, a mix in which the components can be distinguished;
- *Killer Bouquet*, a set of components for which the aggregate is more than the sum of its parts [The Mobile Commerce Research Centre];
- *Killer Soup*, the more ingredients you put in, the better it gets – an operator will be needed for stirring;
- *Killer Fondue*, as for the soup, but no operator is needed for stirring;

Using these, no doubt rather stirring metaphors, the "killer bouquet" can be given the following schematic representation (cf. fig. 1).

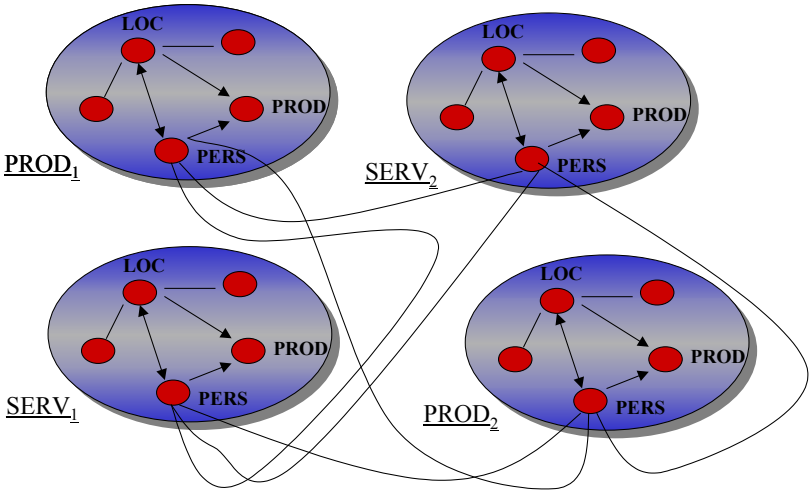

Figure 1. The *Killer Bouquet* of m-commerce products & services.

The interrelations between the various products and services can be in terms of (i) technology, (ii) content, (iii) information, (iv) design, (v) co-production, etc. The *bouquet* can easily be extended to n products & m services.

With an understanding of the key features and success factors it appears that the issues at the core of the m-commerce business logic are, *to develop value-added content, business models and technologies, which can create the key features and serve as drivers of the success factors*.

SAS IN FINANCE, TRADE AND SERVICES – A SUMMARY

Introduction

Finance, trade and services area has largely been influenced by the developments in the information and communication technologies (ICT), in the recent years. This has also been the case during the three years during which EUNITE has been active. The trend of ever increasing computation power, ubiquitous computing and large-scale mobile communication is transforming the trade and services in fundamental ways. As in other industries, more interaction, adaptivity and ultimately, intelligence is required from the finance, trade and services systems. Smart adaptive systems contribute towards this goal. This report gives an overview of the most salient developments in the field of intelligent technologies and smart adaptive systems (SAS) applied to finance, trade and services, as well as the contribution of the EUNITE IBA E nodes to the developments in this field.

Recent research in SAS for finance, trade and services

A large portion of the research for applications of SAS in finance, trade and services is driven by the following considerations.

- The need to deal with the large amounts of data being produced and stored in various business processes. Efficient and effective data mining techniques for large business databases are required to develop improved models and to unleash the power of hidden information in the data.
- The need to offer online services that are location and time independent, and adapted to the specific needs of the customer. The customer should be served at the right time, right location and in the right manner.
- The need to provide increased robustness and adaptivity to business processes, enabling the organizations to survive in the fast-changing and highly dynamic environment that they find themselves in.

As a consequence of the above points, the following have emerged as hot research topics.

- Personalization and personalized solutions.
- Real-time response for online services.
- Improved decision support systems that can adapt to the needs and the goals of the users.
- Advanced modelling and data mining techniques, including conditional analysis (adaptation to different circumstances) and methods for mining in very large data bases.
- Delegation of tasks to software agents and the design of such agents.
- Collaborative and cooperative problem-solving systems.
- Methods to deal with multiple forms of uncertainty in a unified manner.

EUNITE IBA E has undertaken activities to promote and foster research into the theory and applications of SAS for finance, trade and services. In particular, workshops and special sessions have been organized at EUNITE Conferences where researchers presented their most recent results and had a chance to exchange ideas with other members of the scientific community focused on SAS for finance, trade and services. Furthermore, symposia and targeted workshops have been organized to bring together the researchers from academia and practitioners from the industry, disseminating knowledge about SAS from universities to the industry. Conversely, practitioners from the industry had a chance to present the most pressing needs and problems of the industry as promising or relevant research topics. As a result of these activities, the research efforts of EUNITE IBA E members have also been more focused towards the applications of SAS in finance, trade and services. Last, but not least, infrastructure has been developed and made available to the SAS community, so that those interested in SAS for finance, trade and services can function as virtual working groups. Below, we give a list of the highlights of the IBA E achievements.

- Workshop "Mobile Decision Support Systems as Smart Adaptive Systems" at EUNITE 2001 (December 2001, Tenerife, Spain). This workshop consisted of a number of presentations from IBA E members regarding this emerging field. State-of-the-art developments touching on finance, trade and services in several of its core areas have been disseminated. The workshop provided an opportunity to other IBA E nodes and EUNITE participants to exchange ideas with the experts in the field.
- Real Options Workshop (May 2002, Turku, Finland). This has been an international workshop supported by EUNITE. The workshop was attended by a large number of researchers, corporate managers, consultants and software and systems developers. Papers have been presented about the applications of real options and the extension of the real option theory by fuzzy sets in order to adapt to types of uncertainty other than probabilistic uncertainty. Promising areas for further research have been identified. Papers presented at the workshop are being reviewed to be published in an edited volume. Research in the areas identified as promising has led to a follow-up workshop in real option valuation to be help in 2004.
- Workshop on Smart Adaptive Systems in Finance (November 2002, Amsterdam, the Netherlands). The workshop aimed to provide a platform for the professionals in the financial sector to exchange ideas, opinions and experience about the opportunities for SAS, including data mining, neural networks, machine learning, fuzzy modelling, soft computing and evolutionary computation within the finance sector. The presentations showed a cross-section from the state-of the art in this field, recent academic developments and successful applications of the smart adaptive technologies in the finance sector. The workshop closed with a forum discussion in which the expectations from the SAS in the financial sector and the potential questions regarding their application in the finance sector were discussed. Promising areas for future applications of SAS in the finance sector have been discussed. This discussion has led to a follow-up workshop on SAS in finance, which will focus on SAS for risk analysis and risk management. This workshop will take place in 2004.
- Workshop on Soft Computing and Intelligent Systems (September 2002, Turku, Finland). This workshop has been organized together with IAMSR Research Laboratory. The workshop has brought many leading researchers from

the fields of soft computing, intelligent systems, SAS and decision making together, highlighting these fields within the Finnish scientific community.

- Special sessions during EUNITE 2002 and EUNITE 2003 Conferences. Multiple special sessions at various EUNITE conferences have been organized. The topics covered included business and management applications of SAS in finance, trade and services, SAS in finance and marketing, and SAS for mobile services. The sessions have provided a means for the researches to share their latest results with the scientific community. Some papers from these sessions have been published in special issues of journals, which have been initiated by other EUNITE groups. The have also helped direct the research of IBA E nodes towards SAS in finance, trade and services area.
- Interactive homepage and infrastructure for virtual working groups. IBA E has created an interactive homepage and infrastructure for enabling cooperation at a distance through virtual working groups. The scientific community can access the results of various monitoring and authoring activities, such as the monitoring of SAS in use (case studies) and IBA E contribution to the Eunite roadmap through this homepage.

IBA E has also functioned as an additional focus mechanism for the research of the active nodes, stimulating them for research in SAS in finance, trade and services. The research of the IBA E nodes for SAS has been concentrated on SAS for mobile services, personalization, fuzzy real option valuation, agent-based SAS design for providing services, and probabilistic fuzzy modelling in finance and marketing. Surveys have been made regarding SAS for mobile decision support systems and SAS in marketing, which have provided input to the roadmap contribution.

In addition to the activities described above, it appears that the efforts of EUNITE IBA E Committee has also induced interest in a group of young researchers for further research in the domain of SAS for finance, trade and services, as witnessed by the proliferation of the student papers being submitted to IBA E sessions at EUNITE 2004.

Status of SAS in finance, trade and services

Considering the EUNITE definition of an SAS as a system that shows some kind of adaptivity and utilizes one of the computational intelligence methods, it can be said that multiple examples of SAS have been reported in the finance, trade and services area.

In electronic commerce and mobile services area, personalization and localization is an important issue, requiring the services, interfaces and procedures to be adapted to the needs and characteristics of specific users. Systems have been reported that personalize information for users (e.g. personalized information agents from BT Exact) and support personal decision support (IAMSR's decision organizer showcase). There is a clear tendency to combine this line of developments with agent research, leading to agent-based solutions. This is a natural development because of the advantage agent-based solutions provide for massively distributed systems. There are also systems being developed whereby a user can delegate some specific tasks to an agent, which then operates autonomously to perform these tasks, usually in negotiation with other agents with similar tasks. Some of these solutions use truly SAS technology.

The interest of the scientific community in these systems is indicated e.g. by the regular competitions that take place amongst (recommender) agents that have to compile an optimal holiday package for their user. At the moment, the best performing agent uses a fuzzy set based approach (from the group of N. Jennings).

In finance and trade, systems have been developed for foresight and scenario prediction, advanced vendor evaluation, fuzzy real option valuation, credit rating prediction, fraud detection, hedge fund style classification and automated underwriting and insurance. Most of the studies from the academia apply one computational intelligence methodology for modelling and reasoning. Industry applications, however, emphasize strongly the synergetic relations between different methodologies, and they often pursue a hybrid approach, combining various methods in order to boost system performance and smartness (e.g. the automated underwriting system from GE Finance). Systems in the finance industry are mostly in the prototype and experimental stage, but they do demonstrate the potential for the SAS in this industry. In particular, SAS provides advantages in an environment where the financial products are becoming more complex, requiring expertise to deal with them. The number of experts available, however, is below sufficient levels, and so SAS can decrease the critical dependence on the small number of experts. Furthermore, many services are now provided online, which require SAS in order to deal real-time with the clients' questions.

In marketing, the focus up to now has mainly been on developing marketing models and mining marketing data. A survey has shown that adaptive powers of these models are very limited. Most of the literature has been on applying computational intelligence methods to develop marketing models and to compare their performance to the more traditional modelling methods. However, the potential for SAS is significant with the increasing importance of data-intensive marketing management, such as customer relationship management. Customer behaviour modelling (Credit Suisse), dynamic client segmentation and tracking (MIT Gmbh) and adaptive customer management systems (SMR) have already been reported. Furthermore, SAS technology is also being put to use for commercial web pages and web advertising.

Additionally, there is an increased interest in the research community to investigate synergetic combinations of different modelling paradigms, such as probabilistic fuzzy modelling in financial and marketing models. The interest in such systems that can deal simultaneously with multiple types of uncertainty is expected to increase in the future.

Concluding, one can say that SAS are available for finance, trade and services. However, their numbers are still small, and most are in experimental stage. There is a large potential for SAS, but time is needed before the applications become large-spread. One also notices that most SAS applications so far have been used in large-scale organizations and corporations. There are very few (if any) SMEs that use SAS in their daily operations. At the moment, SAS appear to be beyond the reach of SMEs, and this will be an issue that the developers of SAS technology will have to deal with.

How adaptive are SAS?

Most of the SAS currently available in finance, trade and services area is "situated" in the sense that the systems can recognize a particular set of conditions (a situation),

and they can adapt their output to this situation. In this sense, the output of such systems is conditional upon a situation that they recognize. However, most systems cannot adapt the situations that they recognize to accommodate new situations or new information. This corresponds to a very basic form of adaptation (at most semi-weak adaptation according to the classification of the EUNITE Taxonomy Task Force). Some systems can learn the relevant situations, but in many the relevant situations are still determined and defined by the designer. Automated portability of these SAS to similar new situations is virtually non-existent, while all the systems require specific domain input from the designer to operate successfully. In other words, the systems are not able to adapt to a totally new situation from scratch. As such, it can be concluded that SAS technology is still in its early periods. The following reasons could be given for this.

- Most of the existing systems are not adaptive at all. They are not even situation-aware. Hence, much can be gained by introducing situation awareness and conditional operation to the existing systems. This delays the more advanced usage of the technology.
- Most system designers have been trained to produce solutions with methods other than SAS, or they are only familiar with a single component of the intelligent technologies. The IT industry is also organized around providing solutions with traditional methods, for very specific problems. SAS implies dealing with a broader range of situations. Hence, there is little incentive to innovate in this sense.
- Achieving a general adaptation task as SAS aspire is difficult, and much research is still needed to answer many open questions.
- Adaptation and especially distributed adaptation as in agent-based systems creates a complexity that orders higher than the complexity of more traditional systems. A paradigm to deal with this huge complexity is missing. Consequently, many of the important questions from the industry, such as performance comparison, correctness, robustness and reliability cannot be answered in a satisfactory way.
- Targeted technology transfer is needed to disseminate knowledge and awareness with the technology. Possible technology transfer cases reported in finance, trade and service include
    - Solutions developed top-down by a central research team and development department.
    - Solutions developed by a third party in consultation with the practitioners.
    - A pilot project run by a small group, later to be extended to a full solution.

Events on SAS related to Finance, Trade and Services

There is not a predominant regular (periodic) event that focuses on SAS for finance, trade and services. The most focused sessions and tracks can be found at the EUNITE Conference and at the CIFEr conference (as far as financial engineering is concerned). However, many other AI related conferences contain presentations and sessions that are related to SAS in finance, trade and services. The following is a list of some of the prominent periodic events in this field.

- European Symposium on Intelligent Technologies and their implementation on Smart Adaptive Systems (EUNITE)

- International Conference on Computational Intelligence for Financial Engineering (CIFEr)
- European Conference on Information Systems (ECIS)
- International Conference on Autonoumous Agents and Multiagent Systems (AAMAS)
- Hawaii International Conference on System Sciences (HICSS)
- European Conference on Operational Research (EURO)
- International Association for Fuzzy Set Management and Economy Congress (SIGEF)
- IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)
- International Joint Conference on Neural Networks (IJCNN)
- Congress on Evolutionary Computation (CEC)
- International Conference on Soft Methods in Probability and Statistics (SMPS)
- European Conference on Machine Learning (ECML)
- European Conference on Principles and Practice of Knowledge Discovery in Databases (PKDD)