Managing real time interactions in industrial environments based on information supply chains: the ESPRIT ATLAS project

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Keywords

Supply chain, Information systems, Information exchange, Logistics

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Introduction

In Walsh and Koumpis (1998), we introduced the concept of information supply chains that was the focus of the European Community ESPRIT Project BUDDY. Information supply chains address the needs of industrial organisations, which continually face challenges to reduce their information processing time, improve added and residual value of information, and reduce processing and distribution costs and "lead-times". Our Buddy project dealt with the information supply chain as an important unitary entity, whose performance and optimisation can very significantly affect the efficiency and performance of industrial enterprises.

There, the foundations for a conceptual modeling and simulation environment were laid, to enable analysis of information supply chain management strategies, policies and decisions. Furthermore, a decomposable, "autonomous agents" approach was adopted to specify information supply chain models. Models were defined in terms of their constituent information supply chain "agents" (e.g. suppliers, buyers, distributors, etc.), including also their structural relationships, interaction "protocols" and coordination policies.

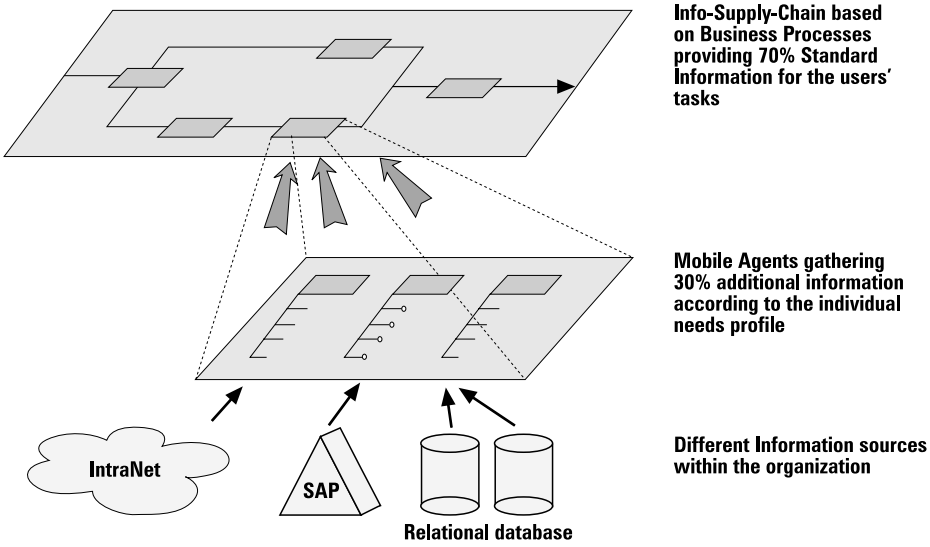
In the present paper, we present new practical results stemming from that original work, as the latter has been elaborated in the meantime and adapted to address emerging opportunities for industrial enterprise.

The target "marketplace" for our new ESPRIT project ATLAS[1] is that of owners/developers of intra- and inter-enterprise information supply chains, especially where indexes or similar data elements are critical. This includes medium- to large-sized enterprises and public sector organisations that provide enterprise-wide data access and reporting services. More specifically, the industrial context in which the ATLAS project operates is that of the global Internet, which in the last couple of years has begun to rapidly develop a huge commercial and business potential. Push technology, and especially real-time data delivery using Push techniques, has emerged as a new dynamic growth area that provides significant opportunities for European companies (i.e. a huge industrial impact is possible) (Szuprowicz, 1998).

In the context of the emerging Information Society and the European Single Market, companies will spend a larger slice of their IS/IT budgets on "extended enterprise applications". These are applications that span company boundaries, thereby including a complex web of relationships between the company and its market, while relying on the acquisition of data and information in real time. In this sense, "the market" includes the company itself, its partners, competitors, customers and suppliers.

Usage of inter-organisational information management systems based on Intranet technology will also grow, because of the need to integrate real time market data and information arriving from disparate organisations or individuals into a unique IT-enabled process, independent of formal

Figure 1 Communication, sharing and provision of information across an information supply chain[2]



boundaries (Haeckel, 1999).

Until now, manufacturing enterprises have travelled their first steps towards the transition to new ways of working by introducing interoperability between various company legacy applications and IT infrastructures, within a distributed (Intranet /Extranet/ Internet) environment (Vitek, 1997). Further demonstration of the applicability, the utility and the cost-efficiencies borne by inter- and intra-enterprise information supply chains can be expected to take place within the context of the European Commission 5th Framework Programme, and more specifically within the information society technologies (IST) programme.

The information supply chains concept builds on the paradigm of the "conventional" supply chain, as this is usually denoted in the world of manufacturing (see Figure 1). It provides a scalable working environment encompassing all tasks of data/information management.

The authors' organisations' work in this field addresses the needs of (mainly manufacturing) enterprises to reduce information processing time, improve added and residual value of information, and reduce processing and distribution costs and "lead-times". In other words it deals with enhancement of the information supply chain as an important entity in itself, whose performance and optimisation can have very significant effects on the efficiency and performance of manufacturing enterprises.

It is in this context that ATLAS aims to accelerate the adoption of highly innovative Push technology which, despite some recent setbacks, remains a very important element in the development and usage of WWW.

Internet technology in general and Push technology in particular are areas in which European activity is still seriously lagging. Our companies have identified a leading European product in this domain, Slingshot, and will exploit it, using the support mechanisms of ESPRIT as one step to redress this regional imbalance.

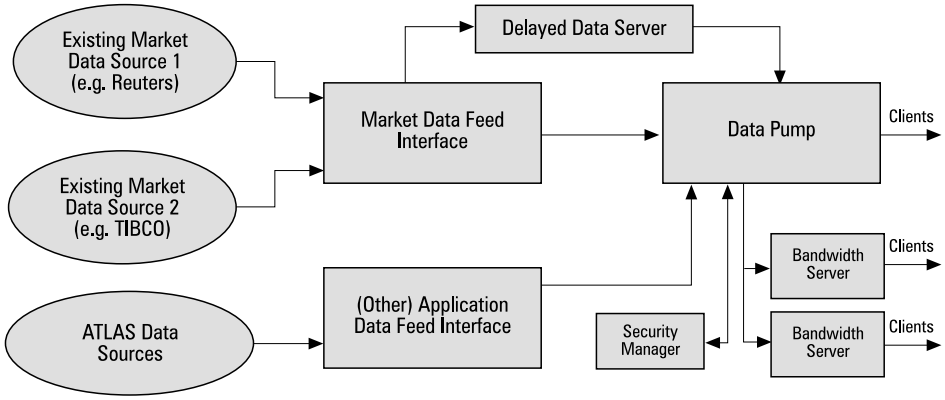
The project consortium consists of four partners, of which two are User partners (Unisoft in Greece, and IDI Eikon in Spain). These two partners aim to increase their ability to use the most innovative real-time software, thus significantly enhancing their business performance. CSK Software of Ireland acts as the Provider partner, whose aim is to accelerate the conversion of its promising Slingshot real-time Push technology product (see www.slingshot.net) into wide adoption and marketplace success. And the fourth partner, Prutech Innovation Services, also of Ireland, acts as the Enabler partner whose role is to close the technology transfer loop between provider and users, by providing necessary technical and business support services.

About the Slingshot technology

Slingshot is already well-known in the financial services sector, for which it was designed, but Slingshot's unique capabilities are also ideal for use in many other sectors. The primary objective of ATLAS is to initiate this extension of Slingshot's use into those other parts of the wider Internet/Extranet/ Intranet world. In this respect, we use Slingshot as the basis for carrying out four pilot demonstrators, two in Greece and two in Spain. Each of these demonstrators (or Slingshot applications) is itself a mini project. At the end of the project these practical business applications will serve as models for future Push technology (and especially Slingshot) applications by new users. Of course the consortium members themselves will be prominent among the ongoing users. The four applications, as described later in this section, cover a wide spectrum of applications where there is a need for immediacy and communication of information in real time.

Extending Slingshot's use into new spheres requires greater effort in a whole range of fields, for which CSK's considerable financial software experience is not optimised. Furthermore, CSK's own priority must be to defend its hard-earned lead within the financial services data world. Now, by bringing in the new User partners, along with the supportive Enabler partner, a true European co-operative effort is achieved to leverage Slingshot's capabilities within the wider business community, to the benefit of all. And it is thus hoped that the example provided by the ATLAS model applications will result in even wider Slingshot exploitation, through emulation by others. Success in that aim will fulfil CSK's main business objective while also satisfying the European Commission's wish for more

Figure 2 Basic Slingshot structure in its native financial applications, with ATLAS added



extensive use of good quality European software.

The business objective of Unisoft is to achieve access to Slingshot technology as a new type of building block for its current IT solutions, thus greatly increasing the added value of the resulting IT products and services (see Figure 2). Slingshot will also act as a new stand alone technology pack that may be utilised in novel application domains (as exemplified by the project pilot trials), thus significantly expanding Unisoft's IT products' capabilities.

The more specific project objective from CSK's viewpoint is to identify and prepare the exploitation of business opportunities for Slingshot outside of its traditional financial sector as well as in other European national contexts (commencing with the markets of Greece and Spain). From the two Users' viewpoints, the objective is to facilitate their positioning and exploitation of emerging Internet/Extranet/Intranet opportunities. These opportunities relate to a whole range of Push technology projects with similarities to those of the four ESPRIT pilot trials described later.

The Enabler partner (Prutech) gains from this project by acting as a gateway to the success of this ESPRIT project and to the much wider success of Slingshot in the IT world. As a support and technology-transfer agent in the field of new technologies and of pan-European projects Prutech gains immeasurably from these advances.

Furthermore, an "indirect" objective of ATLAS is to help generate that all-important "snowball effect" for the Slingshot system, which has played such a vital role in the take-off of so many other Internet technologies to date.

More specifically, Slingshot is a relatively new breed of Push product, which is optimised for situations in which large quantities of micro data continuously and rapidly change in value. It is ideally suited for situations in which the validity of data must be known at all times, irrespective of interruptions in the Internet/Intranet transmission path. Slingshot's "home ground" is that of the financial markets (e.g. stocks, shares and similar fluctuating products) in which its capability to monitor the data received and present them in readily accessible formats has already made it a successful product. Data presentation can be page based, spreadsheet based (e.g. individually variable cells embedded into more static general Web pages) or can be in several other formats. It can also be colour-coded to indicate the status of data received.

But Slingshot's capabilities also make it suitable for much wider application and this feature is still very much under-exploited. For example, one could think of applications in industrial monitoring, health care, sport and gambling, in which Slingshot's advantages could lead to real competitive advantage.

The Slingshot approach to data pushing is very innovative in that it minimises bulk data transfer, by only pushing new or changed values across the network. This provides maximum benefit from the available bandwidth. It uses a special protocol as well as other techniques for this purpose. It is also self-checking and can detect loss of communication, thus providing a continuous check of how current the supplied data are. Slingshot is highly scalable, with built-in mechanisms that provide further bandwidth improvements through local caching of data.

More specifically, Slingshot Internet real-time Push technology is implemented using direct connections between the client and the Slingshot Data Pump. The server can push event-driven information directly to the client application – typically, but not restricted to, a Web browser. In this manner, the user is informed of breaking news precisely as it happens. The underlying protocol includes specific features to address the performance and quality issues resulting from the inherent low bandwidth and high latency of the Internet, resulting in the immediate delivery of qualified information to the desktop. Slingshot technology has important advantages over its competitors due to its lightweight nature, which makes it ideally suited to the delivery of real-time, event-driven data to and from the emerging classes of "micro" clients – sensors, Smart Cards, "intelligent" devices, etc.

Real-time management of operations in an industrial enterprise

The first Greek pilot application in the project, called Enterprise Info Supply Chains is directed to inter-enterprise usage (networks of suppliers and providers, clusters of contracting companies, Plug-In Enterprises, etc.). Within the project, these are enabled to exchange business data and information, in terms of exploiting the real-time Push technology inherent in Slingshot and by forming seamless information supply chains. This application leverages Unisoft's existing position as a main business software supplier in Greece and facilitates its entry into the domain of Internet-based Real-Time Business Information Systems, in which each company provides access to a dynamically definable view of its business information system.

The pilot user, Chatzopoulos S.A., has been the major Greek player in the business of producing flexible packaging materials, mainly for food companies. Currently the company has 170 employees, of whom 35 are in administrative operations and in control of the company's supply chain related issues, such as inventory, order processing, financial procedures, etc. It is the biggest company in its sector in Greece, and it is also one of the five largest companies at European level, having a market share of more than 26 per cent. Its clients include, among others: Unilever, Procter & Gamble, PepsiCo Greece, PepsiCo Hungary, PepsiCo Cyprus, Chipita, Nestlé Greece, Nestlé Bulgaria, Bic, Warner Lambert, etc. Big multinational clients of Chatzopoulos have repeatedly evaluated the company and included it in their accredited suppliers' shortlists.

In recent years, the company has opened operations in transnational markets, and now about a quarter of its turnover comes from foreign sales. It exports mainly to Central and Eastern European countries such as Poland, Ukraine, Bulgaria, Romania, Hungary, Germany, Latvia, FYROM[3], Yugoslavia, Israel and Cyprus.

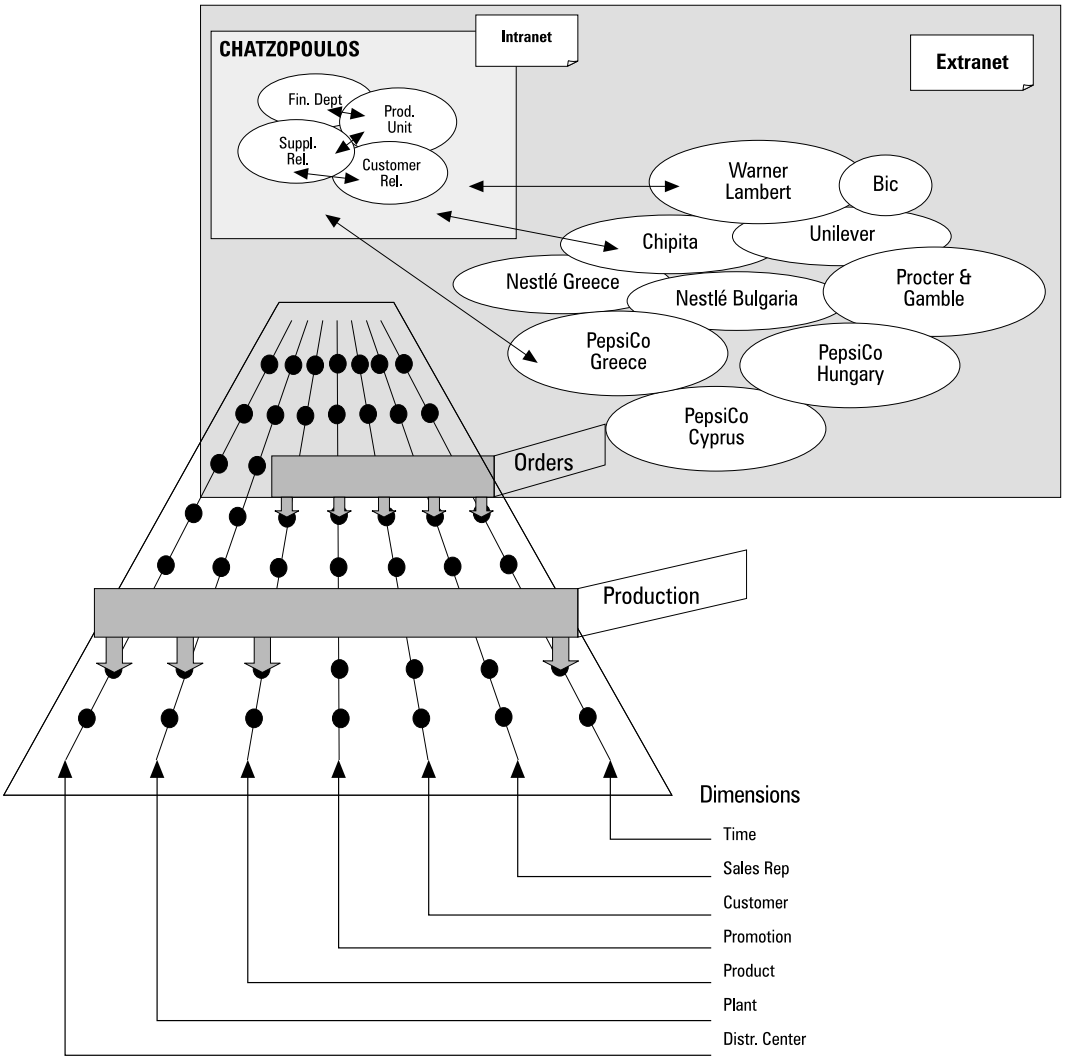
The size of the company's clients, as well as the intensity and volume of their orders, necessitates the existence of a flexible extended information supply environment, which allows the clients to have full information access regarding their orders.

Chatzopoulos has a fully operational Information System, based on Unisoft's AXES® product family, which has been extended by production planning application modules from an independent software vendor and from Unisoft. Following a two-year modernisation programme, the company "runs" its business applications on an IBM RISC RS6000 F40 (AIX OS), apart from the production scheduling and management application, which runs on a WindowsNT server. The company's Intranet consists of 35 workstations running Windows 9x. Furthermore, the new production unit is linked with the company's headquarters via optical fibre, and production is monitored continuously. The Web server and a back up server are located in this second unit.

Using the production scheduling and management application, the responsible company employees provide the application with parametric data on each order that arrives from a client, as well as any necessary technical specification (this is of utmost importance for the first time an item is ordered). The system responds with a first-pass scheduling, which the user may change. Finally, the application concludes by delivering an optimised production schedule.

Though the company's IT infrastructure enables cost-efficient and highly competitive "under-order" operation, Chatzopoulos has not previously exploited the advent of Internet-based technologies to integrate

Figure 3 Information layers of the Chatzopoulos management system



communications with its clients into its business processes. Transactions with clients still take place using paper, or by face-to-face meetings, or via phone calls or facsimile messages.

However, the goal of this pilot goes far beyond the provision of access to company-related information, as it enables the company's clients to actively monitor relevant Chatzopoulos business processes. Indeed the pilot application, being more than a static business data repository, empowers the company's clients to dynamically monitor workflow or production procedures related to their orders.

This eliminates the need to know whom to call and the frustrating wait for the arrival of information via facsimile. As a consequence, the disconnections that often anger customers and which can all too easily compromise business deals are greatly reduced. Last but not least, as clients may continuously view the states of their orders, they are thereby better able to (re)organise their own internal business activities, which in turn contributes to harmonisation of an even greater section of the supply chain.

Within a typical usage scenario to be demonstrated in ATLAS, one client of the company (e.g. Nestlé Greece), that placed four consecutive orders on 5th, 6th, 7th and 8th of March, was able to continuously check their status and to monitor all progress made. It also received immediate feedback on any alterations in their preparation.

Those modules of Chatzopoulos's business information system relevant to the pilot are connected to the Slingshot Feeder and, through its Data Pump Server, the real time event information is passed to clients.

Chatzopoulos' clients gain access to the system and are able to view their own orders, the order status and a great amount of related relevant information.

The pilot is designed to work correctly throughout The Internet, within the "virtual network" (Extranet) of main clients and also within the intranet of Chatzopoulos (see Figure 3).

As stated above, the application leverages Unisoft's existing position as a main business software supplier in Greece and enables its entry into the domain of Internet-based Real-Time Business Information Systems, where each company provides access to a dynamically definable view of its business information system.

Unisoft has a penetration of more than 45 per cent of industrial enterprises in Northern Greece, where this pilot application is installed and successfully applied. It is in the direct business interests of Unisoft that many similar applications should derive from this pilot, each being customised to the needs of a particular company, thus allowing differentiated usage patterns.

Having in mind Unisoft's dominance in the area of business information systems, and the current trend for companies to open their information infrastructures to suppliers, clients and collaborators, by means of Extranets, Unisoft will seek to capitalise on this pilot by adding value to its existing product families.

There are two principal objectives of our work in the area of smart industrial environments using Slingshot as a base technology for building enterprise-wide information supply chains. The first objective is to explore and enable time and cost-efficient collaboration of the three key participants in the manufacturing process, namely:

(1) *Software*, which administers and assists the process of manufacturing. It is typically in the form of an integrated software system such as a conventional business information system (or a part thereof), knowledge based system, Web based application providing/pushing information, a specific Internet search engine, etc.
(2) *Hardware*, which plays an essential role in implementation (e.g. of a production plan). It is typically an IP-addressable PLC machine, CNC machine, sensor etc.
(3) *Human*, who is usually an expert, a user, a decision-maker or any multi-skilled highly motivated person involved in an industrial activity.

The second objective relates to the "opening" up of industrial activities on to the Internet, by means of exploiting the global information infrastructure. In the Chatzopoulos example, this means opening production planning, from being a restricted internal activity, to becoming a more transparent intra-enterprise activity. In a more general sense, the aim is to include all involved parties in the production planning activities (contractors, suppliers, customers), so that all become part of the distributed (Intranet/Extranet/Internet) working environment.

At the technological level, the principal motivation of our work is to replace the traditional approach for carrying out industrial activities with a more dynamic and adaptive one, so that it proactively reconfigures itself with respect to changing market demand and availability of best possible collaborators. This means addressing the process from the early planning phase through to actual implementation, which is currently based on database manipulation and fixed product and process data (order) exchange among members of the supply chain. The improved system integrates the process of communication, bidding, negotiation, data/information manipulation and requirements delegation within a single community of actors involved in the entire information supply chain. Such a unified industrial activity can be viewed at the intra-enterprise level, where interaction, data/information sharing and responsibility allocation within the company departments is considered, and at the inter-enterprise level, where all parties involved in a process are considered.

The current information technology (IT) support for industrial activities, which follows the traditional centralised approach, does not fully utilise all possible potential for efficient collaboration among the complex and expensive software, hardware and personnel involved in the production process. Implementation of the information supply chains concept using real-time Slingshot technology helps improve time and cost-efficiencies, while optimising utilisation of the various resources (human, technology, monetary) along the entire supply chain. These latter parameters constitute the principal measurable and verifiable generic targets of our project.

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The ATLAS opportunity

Real-time Slingshot technology is already on a fast-forward path in the financial markets area but there are innumerable other opportunities outside this field, which is where the ATLAS project comes into play. Real industrial applications (i.e. the pilot applications) are being "fielded" by the partners, one of which is described herein. But these should be seen as only demonstrators (albeit very real ones) for the myriad other possibilities that exist, and many of which no doubt still remain to be discovered (McKenna, 1997).

ATLAS is a project within the European ESPRIT programme, which provides a framework within which other European organisations can ally themselves with the Slingshot developer to extend the range of market options open to Slingshot. This co-operative effort provides extra resources, applications and geographical reach to Slingshot's potential, to the benefit of all project partners. Furthermore, the concept of information supply chains provides an interesting new paradigm for the Information Society and also forms a basis within which one of the ATLAS pilot demonstrators will operate.

Notwithstanding the risks posed by competing technologies and by the manoeuvrings of the major vendors in unrelated technologies, there remains a tremendous opportunity for all of the ATLAS partners and for the European Commission which funded our project. In recognising that opportunity, it is still possible to leverage Slingshot to our advantage, regardless of the outcome of the technology battle.

Slingshot is the first production quality product of its type, which is being presented as a ubiquitous platform for the implementation of the emerging immediacy applications. It is being made available today to the other ATLAS partners by CSK – together with a wealth of insight into the nature of those applications – and offers those partners the opportunity to participate in the development of leading edge, visionary applications.

The understanding thus gained of the technological implications of real-time Push technology will be applicable to any appropriate delivery mechanism – in much the same way as an understanding of C/C++ facilitates the development of applications in Java or CORBA.

As technology becomes easier to implement and as development tools become more powerful, the understanding of the applicability of technology is what matters. Through the ATLAS project, the partners will gain tremendous insights into the competitive advantages that can be gained through the delivery of better information, faster.

It is this understanding – which can only be gained by being involved as an "early adopter" of emerging technology – that creates the competitive advantage that European small and medium-sized enterprises (SMEs) require.

Furthermore, the promise of immediacy – of delivering the best quality information in the shortest possible time to any location at any time – has far reaching consequences on the way we interact with information in Europe and elsewhere.

We will see immediacy applications not only driving business but also permeating many aspects of home and family life. Those that understand both the technology and its sensible and useful applications are uniquely positioned to take a leading role in the formation of the Information Society.

And that is surely the aim of ATLAS – to leverage the underlying technology of Slingshot so as to provide the partners with an understanding of the business applicability of real-time Push and to position them – European SMEs – as experts in the implementation of viable immediacy solutions.

Notes

1 Work reported in this paper is carried out in the context of the ESPRIT Project 29524 ATLAS, "A Push Technology Leveraging Action for 'Slingshot'". ATLAS, which began on 20 December 1998, is wholly funded by the European Community ESPRIT Programme, operated by DGXIII of the European Commission. The authors' work for Information Supply Chains was partially funded by the ESPRIT Project 2663 BUDDY, "Building information supply chains with a high degree of adaptivity", of the same Programme.

2 In terms of ATLAS, such communication could employ Push technology for forwarding information and providing interoperability with the company's legacy

systems (e.g. SAP/R3). It would also integrate use of the various product and marketing/sales databases and data-warehouses, the corporate intranet and other information Systems of Special Scope (e.g. for Production Control).

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