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INTERNATIONAL PROGRAM COMMITTEE

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Preface

The present Proceedings includes the papers submitted to the 2nd International Workshop "New Models of Business: Managerial Aspects and Enabling Technology" organized by the School of Management in cooperation with the Information Technology Institute at St. Petersburg State University. The purpose of the Workshop is to provide a forum for participants from academia, government, and industry involved in research and practice in the area of business processes transformation based on advanced information technology. Considering an interdisciplinary character of the topic, the Workshop is particularly aimed at bringing together specialists in both management and technology to exchange ideas and present their research results.

The papers included in the Proceedings cover a wide range of topics, which reflect the interplay between emerging information technology and business processes. The Proceedings consists of the following parts: "Management Trends and Market Transformation", "New Models of Business", "Information Technology Management", and "Modeling and Analysis Tools". Both research papers and papers in the case study format are presented.

Members of the Workshop Program Committee have thoroughly reviewed all the papers. I am very grateful to Kamal Bechkoum, Dennis Guster, Margaret Lennox, Mohan Narasipuram, George Rzevski, Arie Segev, Michael Smirnov, and Victor Taratoukhine for their active participation in the reviewing process. I am also most grateful to Michael Chilton and William McHerny contributed so much in the reviewing of the papers.

The papers are published in the form presented by the authors through electronic submission process. In some cases, slight modifications have been made to bring the text into a common format.

I would like to thank all the colleagues who contributed to this volume.

Nikolai Krivulin

NEW MODELS OF BUSINESS

Web Service Providing – Pricing Strategies for Application Service Providers

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Abstract

This paper elaborates on the new business opportunities that Application Service Providers (ASPs) can exploit by entering the market of Web Services. By comparing the value proposition of traditional application software providing and the provision of Web Services, the competitive advantages of ASPs are exposed: ASPs can leverage their expertise in software hosting, partnership management and establishment of Service Level Agreements (SLAs) to expand their business model to Web Service Providing. Three innovative business models for ASPs are presented and analysed with respect to the appropriate pricing strategies: (a) Web Service Packaging, (b) Web Services Brokerage and (c) Web Service Consulting and Management.

Keywords: Web Services, ASP, business model, pricing, outsourcing

1. Introduction

After having been praised as a major revolution in the software industry, application service providers (ASPs) have faced unanticipated obstacles in an attempt to make their business models profitable (Shepard, 2000; Göbbel, 2001b). Nevertheless, many companies still plan to outsource a significant part of their information technology (IT) systems in the future (IT-Outsourcing, 2001), which indicates that ASPs could leverage their expertise once they adapt their value proposition to actual business needs. One opportunity might be Web Services, which promise to enable companies to employ IT functionality offered by external vendors on a modular, customisable basis. A recent study by Gartner Group projects the market for Web Services to reach USD 15 billion by 2003 (Cantara et al., 2001), which reveals that Web Services have the potential to provide sustainable income streams to ASPs.

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For ASPs to position themselves successfully in this new market, it is necessary that they establish a transparent business model, an essential part of which consists of an appropriate pricing strategy (Tamm et al., 2000). In this context, the aim of this paper is to analyse the possibilities for traditional as well as innovative business models for ASPs and to propose a selection of pricing strategies.

2. Web Service Providing

The term 'Web Service Providing' (WSP) has been coined for the purpose of this paper to describe the new business model formed by ASPs offering Web Services.

2.1. Application Service Providers

Commonly, an ASP is defined as a legal entity that deploys, hosts and manages access to a packaged application for multiple parties. ASPs are responsible for directly and indirectly providing all the specific activities and expertise aimed at administering one or various software applications from a centrally operated facility (Günther et al., 2001; Riemer et al., 2001).

The central value proposition of an ASP is the same as for any outsourcing activity: that an external, specialized vendor can provide the same service at lower cost or at a higher quality or efficiency than a firm's own, internal department. The main aspects of the ASP business model are summarized in Fig. 1 and ranked according to the importance managers give them (Göbbel, 2001b).

2.2. Web Services

Web Services are self-contained modular applications that perform a specific business task and conform to a specific technical format. They can be described, published, located and invoked over a network, usually the World Wide Web (WWW). Their modular technical format ensures that they will mix and match easily to create a complete business process.

The modularity and interoperability of Web Services allows managers to outsource business processes step-by-step, instead of outsourcing an entire business function at once, as with an Enterprise Resource Planning (ERP) system. Consequently, the risk involved in the respecttive decision is decreased as the manager can focus on outsourcing only those processes that will deliver immediate efficiency gains, while slowly making the more critical processes and the IT infrastructure more robust and stable (Hagel III et al., 2001). Web Services allow companies to purchase exactly the functionality they need at the time they need it, thereby bypassing the investment in redundant capacity and rarely used functionality (Göbbel, 2001a).

At the same time, Web Services can be combined and scaled to match or exceed the functionality of a traditional application. Existing programmes can be decomposed and rebundled as a Web Service even without having been designed for such a purpose when they were first created (Bettag, 2001). Therefore, every software component performing a specific function might be made available as a service on the Web, and new functions might be invented through the innovative combination of the available components.

However, for all of the component functions to become interoperable and communicate effectively, a complex infrastructure is needed. Hagel III et al. (2001) categorise this infrastructure into three layers: on the bottom layer, the *technical standards* and protocols for communication have to be agreed upon.

Criteria	ASP value proposition	Possible drawbacks
(1) Total cost of ownership (TCO)	TCO reduced through Economies of Scale (EoS). Included: Server hardware and software, data security, admin., maintenance, updates, customer support	Difficulty to estimate alternative in-house development, hard to calculate "net savings". NOT Included: training and customising
(2) Reduction of complexity	Concentration on core competencies through outsourcing of non-core activities	Innovation and business knowledge suffers
(3) Quality and efficiency	Trained personnel, updated software, guaranteed regular hardware maintenance	Loss of quality control, restricted possibility to improve efficiency of processes, data security uncertain
(4) Cost structure	Enhanced transparency of costs, little initial investment, mostly variable cost. Clearer allocation of cost that with in-house development	Variety of pricing methods, lack of clarity in ASP market. Switching costs probable
(5) Time-to-market	No Research & Development (R&D), no local installation, little or no customizing	Fault-prone if implementation too special, time-consuming if too detailed
(6) Flexibility	Scalability of application, supports dynamic growth. Quick customisation to minor strategic changes	Mostly long-terms contracts. Technological lock-in effects. Possible inadequacy to major strategic reorientation

Figure 1: ASP value proposition and possible drawbacks. (Adapted from: Riemer et al., 2001; Günther et al., 2001; Göbbel, 2001b; ASP, 2001.)

On the middle layer, called the *service grid*, all the basic functions are located that then enable the third layer, the *application services*. The basic functions cover everything from electronic transport management utilities (message queuing, routing, etc.) to resource knowledge management utilities (directories, registries, etc.), service management utilities (monitoring, conflict resolution, etc.) and shared utilities (security, auditing, billing and payment). Based on these building blocks, the *application services* can perform the more sophisticated functions. The service grid layer and the application services layer is where ASPs can expand their business, as we will see in section 3.2.

To better understand the value proposition of Web Services, the criteria presented in Fig. 1 are applied (see Fig. 2). Again, they are ranked according to their importance, with the modifications to Fig. 1 being formatted in italics. Overall, the information in Fig. 2 resembles that in Fig. 1, which means that the traditional ASP model and the provision of Web Services share similar success factors. The key difference to Fig. 1 is that flexibility has replaced the total cost of ownership as the most important aspect. The reason is that customers have experienced lock-in to technology and to provider as one of the major disadvantages of the traditional ASP, which contributed to the lack of acceptance of this business model. Recognising this difficulty, Web Services propose an alternative solution with their modular, interoperable nature.

Criteria	WSP value proposition	Possible drawbacks
(1) Flexibility	Scalability of service. Modularity, interoperability, dynamic combination. No lock-in effects.	Might take long until full flexibility of Web Service is supported by infrastructure
(2) Reduction of complexity	Concentration on core competencies through outsourcing of non-core activities. *Innovation and business knowledge unaffected*	Continuous management of outsourcing actions required. Increased competition from more efficiency and shorter production cycles
(3) Total cost of ownership (TCO)	TCO reduced through EoS. Included: Server hardware and software, data security, admin., maintenance, updates, customer support	Difficulty to estimate alternative in-house development, hard to calculate "net savings". NOT Included: training and customising
(4) Quality and efficiency	Trained personnel, updated software, guaranteed regular hardware maintenance, *immediate quality control*	Data security uncertain, interoperability of in-house systems with vendor systems in practice questionable
(5) Cost structure	Enhanced transparency of costs, little initial investment, mostly variable cost. Clearer allocation of cost that with in-house development, *no switching cost*	Not established pricing methods yet
(6) Time-to-market	No (R&D), no local installation. *Dynamic customizing*	Interoperability with in-house systems is a prerequisite

Figure 2: WSP value proposition and possible drawbacks. (Own representation, based on Fig. 1 and adapted from: Bettag, 2001; Shepard, 2000; Hagel III et al., 2001.)

However, this same characteristic represents a source of the recurring preoccupation that, despite the technological innovations and the corresponding marketing initiatives, Web Services will probably not mix seamlessly with existing legacy systems in the near future.

Not only does the interface between in-house and external applications have to conform to the given standards, but also the various legacy systems within a company have to be compatible first in order to derive the maximum benefit from integrating single Web Services into a given process. This argument is attenuated by the fact that the new standards actually cater for a slow, sequential adoption (Moschella, 2002).

3. New Opportunities for Application Service Providers

3.1. Success Factors for Web Service Providing

Sullivan et al. (2002) describe the central idea of this section in a quite intuitive way: ”Web services fit into the original vision of the ASP model in that there are these functions out on the Internet and you can just go out there and rent them”. Still, this statement does not clarify why Web Services are more attractive to rent and why they fit the ASP model. These aspects will be discussed in the following two sub-sections.

3.1.1. The Advantage of Web Services Over Traditional Applications

According to Hagel III et al. (2001), the Web Services architecture provides a platform for companies to offer their core competencies as services to other companies. Using the definition from section 2.1, the core competency of an ASP can be summarized as hosting and maintaining software applications, and delivering them through a network. One disadvantage was that most applications were never designed to be delivered via the Internet, but were meant to be installed within the company (Shepard, 2000; Sullivan et al., 2002). Web Services, in contrast, are ex definitione deliverable through the WWW, and thus represent a much more adequate application to be hosted (Goth, 2000; Bettag, 2001).

By comparing traditional applications with Web Services along the known criteria (Fig. 3), we see that they differ most when it comes to flexibility and time-to-market. In both cases, Web Services are advantageous, because in today’s competitive environment it becomes increasingly important to adapt to new business needs and shorter product cycles as quickly as possible.

On the other hand, what used to be the unique selling proposition of traditional ASPs, i.e. the reduction in TCO and the transparent cost structure, still holds for Web Services. Purchasing a package of Web Services performing the same function as an equivalent rented application should result in a similar TCO, because the production costs and profit margin can be expected to be alike (Günther et al., 2001).

3.1.2. The Competitive Advantage of Application Service Providers

In this section, we analyse why ASPs might be more successful than other firms entering the Web Services market.

Firstly, ASPs already have the necessary infrastructure to host applications, comprising the technological and human hardware, as well as the operational and strategic processes (Sullivan et al., 2002; Shepard, 2000).

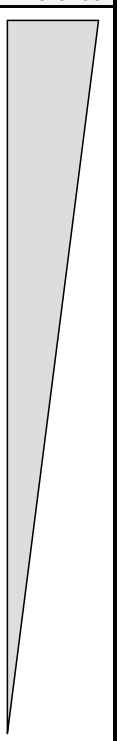
Criteria	Traditional applications	Web services	Difference
(1) Flexibility	Scalability of application, easy customisation to minor strategic changes. Lock-in effects	Scalability, modularity, interoperability, dynamic combination, no lock-in effects. Supporting infrastructure needed	
(2) Time-to-market	No R&D. Little customising. But implementation either fault-prone or time-consuming	Faster implementation, and less fault-prone. Interoperability between legacy systems prerequisite	
(3) Reduction of complexity	Concentration on core competencies through outsourcing. Innovation and business knowledge suffer	More specific outsourcing, more control. Innovation unaffected. Continuous management of Web Services needed. Increased competition	
(4) Quality and efficiency	Qualified and regular maintenance. Loss of quality control. Data security uncertain. Not designed for internet hosting	Same maintenance as ASP. Quality control facilitated. Interoperability questionable/ Specifically designed for delivery through WWW	
(5) Total cost of ownership (TCO)	TCO reduced. NOT Included: training and customising. Difficulty in estimating “net savings”	Reduction in TCO less important. No need for training. Cost of customisation significantly reduced	
(6) Cost structure	Transparency, mostly variable cost. Switching cost probable	Virtually no initial investment, variable cost only. Negligible switching cost	

Figure 3: A qualitative comparison of traditional applications and Web Services.

Secondly, ASPs have developed in-depth knowledge of their own value chain. Basically, this value chain starts with the development of an application, moves on to network infrastructure and hosting, installation of the application and actual service delivery, and ends with distribution, marketing, and customer support (Günther et al., 2001; Riemer et al., 2001). Though on a smaller scale, these steps remain essentially unchanged for Web Service Providing, so that the knowledge that ASPs have accumulated will prove valuable in a field that is mostly unexplored by other companies.

Thirdly, many ASPs have specialized vertically on a certain industry or horizontally on a market. The resulting differentiation represents a strength of ASPs, which is likely to be maintained.

Fourthly, ASPs have partnered with software producers, network administrators, IT and consulting firms in order to cover all steps of the abovementioned value chain (Goth, 2000). They can leverage their existing network as well as their competency in acquiring new partners to position themselves as the coordinating institution in the Web Services market.

Finally, ASPs are experienced in establishing the contracts that specify the exact type, extent, and quality of the services to be delivered (Vizard, 2002; Göbbel, 2001b). In other words, they are familiar with all the peculiarities of SLAs, such as quality of service, degree of maintenance, involvement of other parties, and the respective responsibilities and liabilities of all parties. Also, ASPs have developed the necessary skills in marketing these specific outsourcing contracts.

3.2. New Business Models

3.2.1. Web Service Packaging and Interoperability Services

Corresponding to their core competency, ASPs could alter or expand their business model to hosting, managing and providing Web Services. They could bundle the services offered by other companies to fit the processes of the industry in which they specialize and sell these services as a package. Based on their industry experience, ASPs would add value by selecting the most suitable services, keeping them updated, and replacing obsolete ones with new ones. Furthermore, ASPs could guarantee the seamless interoperability between the individual services as well as between the package and the companies' legacy systems (Hannon, 2001; Scannell, 2002). In this way, the probable emergence of various industry or de-facto standards needed for the technical infrastructure would be transformed into an opportunity.

The packages could comprise a large variety of processes, each composed of several Web Services. The purchasing company could then choose between different packages, which would be priced differently, similar to the classic software versioning. Maintenance and data security options could be added separately. Every employee of a company purchasing a certain package could then select and use only those processes that he individually needs.

3.2.2. Web Services Brokerage

Elaborating on the preceding idea, an ASP could also act as a broker, buying big quantities of Web Services and reselling them. The need for a broker arises, because traditional companies have no experience in buying and selling applications over the Web (Schullan et al., 2001). The ASP will market the services, find a buyer or a seller, respectively, conclude the contract, establish the connection on a technical level and oversee the execution.

The full potential of this business model unfolds, when the three layers of the Web Services infrastructure outlined in section 2.2 are taken into consideration. What traditional

companies will be buying and selling are application services, i.e. the top layer of the infrastructure. However, this layer builds on the underlying service grid, which ensures that the transaction and the execution of the service will work out as expected. Though invisible to the final consumer, there is an immense amount of single functions to be performed, such as routing, monitoring, data transformation, conflict resolution, authentication, billing, and payment (Cutlip, 2002; Hagel et al., 2001). All of them can be carried out by the ASP itself, but it seems likely that these tasks will be distributed among its partners according to their competencies, and whatever might be missing will be purchased. The management, organisation, and provision of these functions correspond to the original capabilities of an ASP.

3.2.3. Web Service Consulting and Management

IT managers of traditional companies and their departments will become responsible for monitoring the Web Services market and for making their firms' systems compatible (Hagel et al., 2001). Thus, they will have to decide which functions to purchase, from whom to purchase them, and which core competencies to offer as Web Services. The resulting need for continuous management of Web Services in order to maintain a competitive advantage was mentioned as a drawback in Figure 2. It introduces new activities, such as business development, strategy formulation and creation of partnerships, into the domain of IT departments.

However, these activities exceed the classical, technical IT-skills and require additional abilities, such as strategy development and marketing, which today's IT managers might be insufficiently trained for. ASPs, on the contrary, often have partnered with consulting firms, who can analyse the strategic and organisational impact of Web Services on the company. The consulting firm would then suggest which processes should be optimised, which Web Services should be integrated, and which ones should be offered for sale. Thereafter, the ASP would assume the continuous management of these Web Services, because it is its core competency to monitor the developments in the Web Services market and manage Web Services. This management would include maintaining an updated service package and replacing obsolete or overpriced Web Services with new ones (Hannon, 2001). A further advantage would be that IT departments could concentrate on supporting the company's in-house IT.

4. Pricing Strategies

The business ideas proposed in the last section have to be complemented with an appropriate pricing strategy, because it is an important part of the value proposition of outsourcing in general and of WSP in particular that the incurred costs are transparent and clearly assignable (compare Figure 3). For that reason, section four first analyses to what extent the traditional pricing strategies of ASPs can be applied to WSP, and subsequently examines some further aspects, which will be of relevance for WSP pricing.

4.1. Traditional Pricing Strategies of Application Service Providers

The cost structure and target profit margin for WSP can be expected to be analogous to that of an ASP (Günther et al., 2001). Although Web Service transactions happen on a significantly smaller scale, this similarity implies that some pricing strategies could be copied. The following analysis is based on the categorization of ASP revenue models proposed by Tamm et al., (2000).

4.1.1. Pricing Methods Dependent of Consumption

The pricing methods that should best correspond to the modularity of Web Services are those dependent of the actual consumption. The most straightforward pricing would be to sum up the cost of a single transaction, add a profit margin, and charge every invocation of the service. A shortcoming to this pricing strategy is that Web Services, as opposed to traditional ASP services, exhibit only minimal lock-in effects and little potential for differentiation in the perception of the consumer. Consequently, the provider has to find other ways of binding the customer for a longer period of time in order to stabilise his own cash flows. Since this so-called pay-per-usage model does not have any substantial binding effect, the customer should be willing to pay a premium over those methods of payment where he enters a longer-lasting contractual obligation. However, many companies will implement Web Services for frequently recurring processes, and will not find the standard pay-per-(single)-usage model appealing. Instead, they might be interested in paying up-front for a greater amount of usages, if they are granted a discount (Kneer et al., 2000). In other words, the more you buy, the less you pay. In this case, usage could be measured in number of invocations, but also in number of logins, units of memory used or bytes transmitted (Müller et al., 2001; Günther et al., 2001).

Payment per seat is normally applied to desktop software, with the 'seats' symbolising the number of workstations or the number of servers on which the application is installed (Tamm et al., 2000). In this strict interpretation, payment per seat is hardly adequate for Web Services. Rather, companies could pay a monthly lump-sum, which is calculated on the basis of the total or average number of employees likely to use the service.

Payment per amount of transaction refers to monetary operations, such as invoicing, payment and settlement. These services are crucial to the service grid. As they are already being conducted in an e-commerce environment comparable to Web Services, they might continue being charged on the basis of a percentage of the transaction volume. Likewise, payment per amount of time seems applicable only to quite specific Web Services, such as a connection service or a service supplying processing power on demand. Both, amount of transaction and amount of time, could be charged either after a single invocation, or by up-front payment for a certain expected volume or time, which then would cost less per unit.

4.1.2. Pricing Methods Independent of Consumption

Fees that are independent of consumption help the provider to build up small, financial lock-in effects. *Non-recurrent fees* could play an important role in Web Service Consulting.

Although consulting services can be charged on a daily or monthly basis, they are not meant to be recurrent over a longer period of time, but are meant to phase out after a determined task has been accomplished. The lock-in effect occurs because a company is likely to turn to the same ASP again when looking for an outsourcing solution, i.e. Web Service Management or Web Services Brokerage, or for further consulting services. Non-recurrent fees can also be raised, if there is a precedent installation or customisation to be carried out. This would be the case for Web Service Packages, which must be checked for interoperability with the buyer's legacy systems. When entering into a Web Services Brokerage relationship, the ASP might ask for an initial payment for administrative reasons.

Recurrent fees are the most attractive form of payment for WSP, because they secure a steady and continuous cash flow. Web Service Packages are likely to be rented for regular use over a longer period of time on the basis of subscriptions or monthly fees. A Web Services Broker should receive a base fee for the responsibility for selling and buying services for a company, so that a steady effort is ensured over a longer time horizon, while a variable component dependent of consumption should be added as an incentive (Müller et al., 2001). Web Service Management lends itself to payment on the basis of monthly fees. The fact that recurrent fees appear to be the most suitable accounting method for the business models introduced in section three supports their viability and validity. In Fig. 4, the first and the second columns summarise which of the traditional pricing strategies should best fit each of the three business models.

4.2. Software Versioning and Software Bundling

Software versioning and software bundling are diffused pricing strategies (Müller et al., 2001). A well-known example is Microsoft Office: at first, Microsoft bundles the various applications such as Word, Excel and PowerPoint, selling them only together, so that the customer has little choice but to buy all of them. Then, different versions are sold to different customer groups according to their purchasing power, whereby revenues are maximized.

Theoretically, every Web Service could be versioned by varying the level of functionality, customisability, and support. A Web Service in its simplest form is called a *core service* and consists of just the basic functionality. *Managed services* add the possibility of enhanced customisation as well as a better quality of service. Finally, *extended services* include comprehensive support and consulting (Riemer et al., 2001). According to Sinn (2001), *core services* are likely to be charged per transaction, *managed services* on a combination of monthly fee and payment per transaction, and *extended services* on a monthly usage fee per user and additional set-up costs paid up-front. An ASP could buy the core service from a traditional company and offer valorised versions as a managed or an extended service by including, for example, better data security, customer support and consulting. The details of the valorised versions are then stipulated in SLAs, which are discussed in the next section.

Discriminating prices according to customer segments is expected to be very useful for Web Services as well, because of the significant Economies of Scale that can be achieved by selling versions with restricted functionality to customers with less purchasing power. For example, a vendor could offer a specific functionality as a *core service* to private

households, as a more expensive *managed service* to small- and medium-sized enterprises, and as a high-value *extended service* to big companies or to the government (Tamm et al., 2000).

Especially Web Service Packaging has the potential to benefit from both, bundling and versioning. The packages consist of several Web Services and can only be purchased as a whole, because the services combine to perform certain tasks. By including additional functionality in the more expensive packages, price discrimination through versioning is achieved.

A Web Services Broker could bundle its services by offering a cheaper price, if it were assigned the responsibility for both buying and selling a company's Web Services. Likewise, Web Service Consulting could be combined with subsequent Web Service Management. In all the above examples, the vendor benefits from selling more, while the customer benefits from a lower total price, or a bundle of services that better suit his needs.

4.3. Service Level Agreements

Product differentiation is a classical reason for premium pricing. As Web Services are quite homogeneous products, the importance of SLAs increases, because they allow adding differentiating features (Kneer et al., 2000). For example, the minimum availability to be guaranteed by the provider could be specified as a percentage of total time (Göbbel, 2001b). A Web Service Provider could then back-up his Web Service with an equivalent Web Service from one or several other brokers, so that the danger of break-downs in availability is minimized. This entails the need to define who is liable, when and for what. As the differentiating features become more intricate, the ASPs' expertise in establishing SLAs will prove valuable (Müller et al., 2001; Günther et al., 2001).

The quality of service and the mutual liability laid down in the SLA are particularly important to the Web Services Broker and to Web Service Consulting and Management. In these models, the ASP acts as an agent for the company and is fully responsible for the activities it undertakes in order to provide the service as defined in the SLA. For Web Service Packaging, on the other hand, the SLA is relevant only to the extent that it helps to add differentiating features, because the company is responsible for what package it buys. The ASP assumes only the responsibility to deliver the package.

The figure below (Fig. 4) sums up the findings of section four, and therefore represents the essence of this paper.

5. Conclusion

Web Service Providing represents an innovative business model based on the emergence of technical formats allowing to purchase IT functionality over the WWW. ASPs have a competitive advantage in the market for Web Services, because their value chain remains basically unchanged. As a consequence, they can greatly benefit from their existing technical and operational infrastructure, from co-operations and alliances, and from their knowledge in establishing and marketing Service Level Agreements.

Nevertheless, it is essential that the ASP specifies a precise value proposition that is complemented by a transparent pricing strategy. The presentation of three business models and the analysis of the respective pricing issues have yielded the following results:

Web Service Packaging resembles the traditional model most, as the ASP constructs and sells packages of Web Services that fit the processes of a certain industry. The pricing can be differentiated through software bundling and versioning of the packages. Recurrent monthly fees are likely to be charged.

Model	**Pricing**			
	Dependent of consumption	**Independent of consumption**	**Price discrimination**	**Impact of SLAs**
Web Service Packaging and Interoperability Services	Pay-per-single-usage (premium pricing), up-front payment (discount), pay-per-seat (total/ average no. of employees)	Non-recurrent: Installation or customisation fee (Interoperability Service). Recurrent: subscription or monthly fees	Software bundling & software versioning (high value added)	medium
Web Service Brokerage	Pay-per-single-usage, amount of transaction, amount of time (depending on service).	Non-recurrent: maybe initial administration fee. Recurrent: base fee (plus variable component)	Software versioning (Valorisation), service bundling (single broker)	high (agency relation)
Web Service Consulting and Management	Possible, depending on service, but unlikely	Non-recurrent: consulting services. Recurrent: monthly fee (Web Service Mgmt.)	Service bundling (Consulting plus Management, limited value)	high (agency relation)

Figure 4: Pricing concepts applied to WSP models.

A Web Services Broker acts as the intermediary between vendors and buyers of Web Services and manages the delivery and execution of the services. By valorising the services, it can ask for a premium. Pay-per-usage or per amount of transaction might be adequate, but a recurrent base fee can be added for a lasting relationship between broker and company.

ASPs can also assume the new responsibilities IT departments will be facing with respect to purchasing, offering and managing Web Services. Non-recurrent fees are applicable for consulting services and recurrent fees for ongoing management services.

Although Web Services promise to change the way business is done, doubt arises as to whether they will find widespread and seamless adoption soon. True interoperability might

be impeded by the emergence of one or a few dominant ontologies (Fonseca, 2001). Companies will observe these developments before making their legacy systems interoperable. Also, managers might be hesitant to outsource quickly, since they have become more cautious and selective after the recent shake-out in the ASP market and the IT world in general. On the other hand, this slower diffusion and more cautious adoption can be inter-preted as a healthier evolution without the exaggerated expectations we have seen in the past.

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Strategic Alignment of e-Commerce Organisations

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Abstract

Over the past decade the Internet has taken off and organizations will soon reap benefits, as they have never seen. e-Commerce will therefore emerge as an efficient yet effective example of new markets although most managers still doubt the impact and profitability it has. Enabled by global telecommunication networks and the convergence of computing, telecom, entertainment, and publishing industries, e-Commerce is supplanting (maybe replacing) traditional commerce. In the process it is creating new opportunities and challenges for today's businesses, creating new market structures, and changing the alignment of the organisation. The study will help managers to understand what e-Commerce is; and how the approach to this concept should be.

Keywords: Business strategies, e-Commerce, Internet, e-Commerce strategies, linkage, strategic alignment, Web-commerce

1. Introduction

During the new millennium users have noted that the Internet has grown a lot and it is possible that organizations will soon reap commercial benefits from using it. e-Commerce, as one of the 'products' of the Internet will emerge as a mode of conducting global commerce although managers still doubt the impact and profitability it has. Enabled by global telecommunication networks and the convergence of computing, telecom, entertainment, and publishing industries, e-Commerce is supplanting (maybe replacing) traditional commerce. In the process it is creating new opportunities and challenges for today's businesses, creating new market structures, and changing the alignment of the organisation. All organizations are challenged by a degree of uncertainty. The question is: How do organizations keep up while delivering business value?

The establishment of linkage between business and e-Commerce objectives has consistently been reported as one of the concerns of managers. It is argued that there is a need to clarify the nature of the linkage construct (socially and intellectually). It is important that all executives are involved during the establishment of the linkage because it creates an

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understanding of each other's long-term visions and their self-reported rating of the linkage and alignment. Based on the data collected, authors such as Reich and Benbasat (1996) argued that understanding of current objectives and shared vision for the utilization of e-Commerce (IT) are proposed as promising potential measures for short- and long-term aspects of the reported social dimension of linkage and alignment.

1.1. Approach to This Study

This article will use the interpretive approach to research as an alternative to the more traditional positivist approach. By using the interpretive approach this article refers to such procedures as those associated with inferential statistics, hermeneutics, and phenomenology. The framework proposed is to formulate a specific goal (the Internet and e-Commerce), subject to certain constraints. Behaviours such as pointlessness, absurdness or confusion can play a role during the alignment of the strategies in the organization. The phenomenological approach will therefore help with the validity of the interpretation that this article will propose.

2. The Strategic Dimension of the Organization

Being competitive in the next decade will depend on the application and development of and e-Commerce. Organizations need to have a perspective that will ensure that investment in e-Commerce is contributing to the organization's business strategy. Increasingly, e-Commerce is therefore being used by innovative organizations to facilitate the alignment of e-Commerce technology strategies now that re-engineering has lost some of its lustre. Strategic alignment could also be defined as the extent to which the e-Commerce strategy supports, and is supported by the business strategy.

Whenever a positive culture exists employees are encouraged to learn and be ready to accept new information or strategies and this could eventually also help with alignment of strategies. Ulrich and Lake (1990) as *cited* by Sohn noted that organizational capabilities have some components, that is shared mindset, management and human resources practices, capacity for change and leadership. These organizational capabilities have the ability to affect alignment and should be kept in mind when alignment is discussed. Sohn argues that IS influence organizational learning and that each process of organizational learning is affected and adjusted by e-Commerce.

Organizations should also utilize a set of measurements that could be used to measure business goals and the results should be used to quantify its performance and emphasize its role in orchestrating alignment with all the strategies. In an age when cost-cutting and adding competitive value lie more squarely on the shoulders of the e-Commerce department it is no longer enough to successfully deploy systems – they should also be part of the alignment of all the strategies. Using metrics enables e-Commerce to highlight its value to get funding for future technology projects and ensure alignment. Nobody had been able to effectively answer these questions. The tricky part of this question is how to align all strategies or measuring the contribution e-Commerce makes to the organization. The use of e-Commerce in organizations is subject to various kinds of risk and this is part of the

alignment of all the strategies (Bandyopadhyay *et al.,* 1999). As spending on e-Commerce rises, organizations become increasingly technology-dependent and consequently become vulnerable to the risks of e-Commerce failure and eventual failure of the organization because there was no alignment of strategies. Risk management of e-Commerce is therefore one of the issues facing executives today. A framework was discussed by Bandyopadhyay *et al.* (1999) concentrating on the sequential linkage of some of the components of risk management that make up the system of e-Commerce (IT) risk management.

According to them, this approach is an improvement because it enables managers to move from one component to another by identifying and understanding the possible courses of action in the different steps. What these managers should keep in mind is that these steps could affect the alignment of e-Commerce although some of the external threats such as disasters are difficult to control. Managers should acknowledge that these could affect alignment of the strategies. Risk-reducing measures must keep in mind that the eventual alignment of e-Commerce should be enforced. The key to understanding strategic risks is dependent on the organizations ability to foresee the long-term benefits from a new system, assess the resources and capabilities of its potential competitors, assess its own financial strength, and align its e-Commerce strategy with its overall business strategy (Bandyopadhyay *et al.,* 1999).

Organizational strategy provides the vision of where any organization needs to go. The problem is that many organizations focus on tactics and operations while the real value of e-Commerce is to open new opportunities to make money and also to enter new markets using Internet marketing to induce potential customers to use the organizations products. Organizations could directly derive the e-Commerce and operational objectives from the overall objectives, ensuring that IS and business strategies are aligned. One of the problems every organization faces is that objectives and strategies can change according to market dynamics (e-Commerce).

At the strategic level, senior managers need a clear vision of the competitive impact of e-Commerce and how it will affect alignment. Most organizations therefore focus on e-Commerce (new revenue opportunities) to help the organization becomes more competitive and enter new markets. It should be possible to ensure that e-Commerce Technology Objectives and Operational Objectives could be derived directly from the organization's corporate objectives ensuring that the business and e-Commerce organizations are focused on the same goals and that alignment exists. Managers must keep in mind that a life cycle will provide a perspective of the formulation of these strategies because each phase of the life cycle has distinct characteristics that affect the operation of the business. Each one of these phases could 'experience' a gap and managers should ensure that leverage does not make these gaps bigger during any of these phases. These performance gaps should be managed and the organization should determine its overall market posture considering its relative position in the industry.

To forecast the incremental leverage effect likely to result from implementing alternative alignment planning, organizations should structure profile measures concentrating on industry market potential, relevant industry sales and real market share. This is where e-

Commerce could ensure that everyone who could reasonably be expected to use the product is using the product as often as possible and to its fullest extent. The problem however is that visitor's numbers as claimed by Internet Service Providers (ISP) cannot be verified and until that can be done, will CEOs surely look at the alignment factor as a thing that cannot be reconciled.

These gaps, as mentioned before, can contribute towards the alignment of the strategy of the organization and it can affect the actual performance of the organization on the e-Commerce strategy of the organization. These gaps are: Product line gap: Introducing improved or new products that should ensure that the organization could compete on the Internet. Distribution gap: This is where e-Commerce and Internet Marketing can help to expand the coverage, intensity, and exposure of distribution. This can help to better align the e-Commerce strategy and that of the organization. Usage gap: The Internet should help to induce current users to try the product and encourage users to increase their usage. Competitive gap: This is where e-Commerce the approach of the organization can make inroads into the market position of competitors as well as product substitutes.

2.1. Implications for e-Commerce Business Value During Alignment of IS and Business Strategy

Tallon and Kraemer (1998) note that organizations' inability to realize sufficient value from their e-Commerce (IT) investment is because of an absence of strategic alignment. They *cited* Child (1992) who argued that the alignment should be a series of intersecting and mutually consistent choices across domains such as business strategy, e-Commerce strategy, organizational infrastructure and processes and e-Commerce infrastructure and processes. Other authors noted that these domains do not allow considerations of strategic alignment as a continuous process nor does it consider the management practices used in moving an organization towards alignment. There are tools available to manage the content and process of alignment.

According to Tallon and Kramer (1998) there are a number of benefits associated with process-level measures of strategic alignment. Process level measures are likely to yield insights into where the organization is misaligned, helping to isolate bottlenecks and other impediments to e-Commerce (IT) business value within the organization. If strategic alignment was measured at the organization level, e-Commerce and business managers might simply know that their organization was misaligned, but would not have sufficient information to isolate the source of the misalignment. It would be somehow different if the organization adopted a process-level perspective and the strategy could be presented as a series of activities within each business process. Strategy can be described as a series of intersecting activities, meaning that it fits neatly with the definition of a process as a sequence or ordered set of activities. This would indicate that the organization should avoid having to force-fit strategy into one of the established generic strategy types and this force-fit strategy could have a similar effect on the strategy that organizations have to adopt. Measuring e-Commerce and business strategy at the process-level allow organizations to take a closer look at key activities within each process configuration and to look at the infrastructure that support those activities.

Opportunities for strategic alignment will arise if technological resources are directed towards the maintenance, improvement and creation of capabilities that underlie the business strategy. A link should therefore be established between resources and capabilities. It must be stressed that strategic alignment is not an event but a process of continuous adaptation and change and therefore it must be noted that the assignment of e-Commerce resources to capabilities must be continuously re-evaluated to prevent the organization slipping into a state of misalignment. Organizations should also keep in mind that the ever-increasing pace of industrial, social, political and environmental change underscores the importance of strategic alignment. Resources should thus be utilized to the maximum ensuring effective use of it. This is a challenge that managers should keep in mind.

Tallon *et al.* (1999) find a relationship between business value and strategic alignment in a sense that an absence of strategic alignment can lead to reduced payoffs from e-Commerce (IT) investment. Their analysis also noted that the IS department plays a key role in enabling an organization to convert strategic alignment into higher levels of e-Commerce (IT) business value. It can be argued that as organizations focus their efforts on achieving intangible impacts in areas such as innovations (for example e-Commerce) and customer relations (especially on the Internet), evaluating these impacts should therefore become a priority.

3. Organization and e-Commerce Strategic Alignment

Aligning business and e-Commerce strategies continues to be a management issue. The problem is that, according to the Cutter Consortium (1999), 65% of organizations have no e-Commerce strategy while 25% of organizations have not yet developed an e-Commerce strategy. Only 4.2% of the organizations had an e-Commerce strategy. It is obvious from their figures that most organizations do not take e-Commerce seriously and that this, once the affect has hit organizations, would affect their alignment. The Cutter Consortium claimed that many organizations have, however, noted that the role that the Internet can play but they have not taken the steps necessary to fully realize its potential and again this would affect the alignment of their strategies should they try to realize these effects. e-Commerce will affect the alignment of the strategies of the organization and that people do not know what the initial and eventual affect will be. While being an opportunity, e-Commerce can also be a threat to organizations and managers need to recognize the factors that affect e-Commerce and alignment.

There is however, no framework that can be used by organizations to align strategies while conducting e-Commerce. Some of the impediments on this alignment are: download delays, limitations in the interface, inadequate measurements of Internet traffic and successes, security weaknesses and lack of standards on the Internet. On the other hand, the results for the organization could be positive in the fact that the organization experiences improved usage of the effectiveness of the organization's resources and improved return on the investment in data, software applications, technology and e-Commerce staff – in other words, improved quality.

The Internet had been promoted as the essential way of doing business lately but it is still a retail medium (Whiteley, 1999). Organizations that establish successful Internet selling operations will need alignment and logistics on the supply side of their operations. Organizations should remember that e-Commerce is commerce enabled by the Internet-era technologies. These technologies are: Electronic markets; Electronic data interchange; and Internet Commerce and analogous public ICT systems.

In theory, the use of the Internet should give the consumer the opportunity to bypass the intermediary and, with appropriate interfaces directly affect alignment. Any of the e-Commerce operations should affect the alignment of all strategies and should not be resisted by the organization or the people working in the organization. Organizations trading on the Internet, if they are able to build up a substantial business operation and align their strategies, will need to be slick in all aspects of their business. Internet commerce, however, is seen as the leveller as the size of the organization would not affect e-Commerce operations. Therefore, if the organization grows, they have to keep in mind that they need to be backed up by good decision frameworks to ensure alignment of the strategies that should be a long-term investment.

On the other hand, many development teams work hard on projects only to be told by their customers that it isn't enough, priorities are incorrect or the results were wrong and these reactions could affect alignment. Technology changes and developments have been extraordinary in the last couple of years and could also affect alignment. The problem with this is that there seems to be less emphasis on business trends and solutions and more on technology. Highsmith (1999) argues that in the next decade, application development strategies will be among the most important strategy any corporation will make. He also noted that sometime in the 1990s, software made the transition from an enabler of business processes to a driver of business strategies and thus would be helpful with alignment of e-Commerce strategies. According to Highsmith, software is the new economy while the author of this article reckons that e-Commerce should be taken into account when aligning all strategies.

Alignment should be taken with the appropriate decision and framework that suit the organization in the specific environment. As e-Commerce capability evolves, it should enable processes and products and opportunities never considered. To be able to handle this and to ensure that all technology and business matters can handle this should organizations should ensure that they forge better partnerships with their employees and the decisions frameworks they have designed.

In order to achieve the goal of being an organization that achieved alignment and ensures that the organization have aligned properly and WILL stay aligned they need to pay attention to the following key questions: What are the business trends that are driven by or are co-evolving with e-Commerce? What are the key business and e-Commerce strategies that are evolving and how does the organization take advantage of this? What skills and capabilities are critical to make the transition to the new economy? What organization, infrastructure, and management changes are needed to implement e-Commerce, Internet marketing and other strategies and how does the organization ensures that they are aligned

and stay aligned? How does management assemble a decision framework for alignment of all e-Commerce strategies and how do they communicate it to all relevant people? and If the Internet (this includes e-Commerce) is a strategic business driver, how does the organization gives direction to this and what does the organization do to keep the competitive advantage?

Business strategy alignment is about innovative ideas and putting these ideas into action more effectively that the competitors. e-Commerce should take a leadership role depending on the organization, its culture and the types of strategic plans. Business trends such as market fragmentation, information capacity to treat masses of customers on the Internet, shrinking product lifetimes and convergence of physical products and services are important ones and the organization needs to concentrate more on these forces that are co-evolving with the e-Commerce capability and opportunities

There are some strategies that can be used to help with alignment because they are highly involved with business initiatives and e-Commerce is knowledge creation and sharing, collaboration, and agility. These are all overlapping and supportive of each other. Knowledge creation and sharing is the ability to create new knowledge form available information to help with alignment while collaboration is the process of shared creation to draw on the expertise of participants and to be able to create alignment from this collaboration. Agility is the ability of the organization to use new knowledge to adapt to external stimulus and use this to better or ensure total alignment of all strategies. All of these would work better if the staff's motivation were good enough and should be encouraged to ensure that there would be no atrophy.

Alignment is hard to 'see' but managers would know it when they see it. The combination of all the above-mentioned should ensure that alignment exists. Knowledge should help to ensure that there is alignment. The organization should also ensure that all business trends are taken into account when aligning strategies. The question to ask is what skills will be necessary to align e-Commerce and organizational strategies. However, if managers really understand what the organization is trying to deliver, then they should be able to align all strategies. Systems thinking would therefore help with alignment, as these people would ensure that the entire organization is aligned and viewed as a unit. On the other hand, reporting on user statistics on Internet sites is far below the required standards required for any e-Commerce department. These could affect the alignment of strategies because nobody plans anything that is not certain.

Aligning the e-Commerce strategy with organizations goals is appropriate for organizations where there is a vision for e-Commerce. e-Commerce is part of the choice any organization should have to participate. The e-Commerce Department can play a role – the primary responsibility should be to create opportunities of conducting e-Commerce. The role would thus be to ensure that the e-Commerce strategy and the organizational strategy align all of the time while creating new opportunities.

White and Manning (1998) argued that the percentage of individuals on the Internet using the medium for shopping had increased by about 70% between 1995 and 1996. It is important to note that users expect to get something of value for free and this type of

marketing could affect the alignment of e-Commerce strategy with the corporate strategy. Personal opinion should affect the alignment of the strategies. Better use of the Internet could help with alignment.

Gibson *et al.* (1998) note that with the onset of 1990s comes an unstable business environment and businesses started to realise that the strategic vision of the business required a dramatic change in their business environment in order to at least maintain their competitive advantage. This meant that everybody had to realign their strategies to be able to stay in the market. According to them, the companies they investigated exhibited a change in strategic vision but these changes could not be reflected in their IS. It could be noted that this could create a problem because if e-Commerce cannot reflect the changes in the strategic vision, it would affect the alignment of these. It could be because certain business changes could prevent the advent of developments in e-Commerce. As noted before, a gap is created and this gap could create a misalignment between the strategic vision of the organization and the route that is being followed. The gap, in this instance, is created by both business and e-Commerce dimensions and many of the organizations they investigated, acknowledged that their e-Commerce were not a good fit for the organization. These companies that they investigated used a variety of approaches to realign the business model and e-Commerce with their strategic vision. Gibson *et al.* (1998) argued that these approaches have gone beyond technical solutions, which although it would eliminate the technical problems would not address the business issues, so realignment would not occur. Technology such as ERP software, combined with business process requires the need to realign the business model and e-Commerce with their strategic vision.

The aim of management should be to try and provide insights into identifying areas that help or hinder the alignment of the strategy for the organization with the e-Commerce. Alignment focuses on the activities that management performs to achieve cohesive goals across the organization. Certain activities can also assist in the achievement of the alignment while others are clearly barriers. To achieve this alignment is dynamic and can in a certain way be evolutionary. The alignment requires strong support from management at all levels, good relationships within the organization, strong leadership, points must be emphasized that should be paid attention to and communicated well enough so that all people can and should understand the organization's business environment, at the same time ensuring that the alignment is a success. All enablers and inhibitors should be focused on ensuring successful alignment and therefore all inhibitors should be minimized.

3.1. Organizational Information Visualization – The Use of Instruments to Measure Alignment

Historically there have been a number of challenges in aligning corporate strategies and creating an objective measurement of alignment improvement over time. It is important that measurement focuses on business objectives, end-user participation and satisfaction, reaching and sustaining alignment, tracking and measuring factors that affect alignment and communicate on alignment improvement. While remaining focused on these reported items, the alignment team must be able to measure and report on their accomplishments.

They should be able to meet the challenges of being able to objectively measure alignment as performed by the management team and at the same time facilitate a process of continuous improvement of the alignment of the strategies; in other words there should be a process to measure the alignment as performed so far. Managers need to have a metric available that allows them to measure value in terms of business output and the following is required: Good metrics of past and anticipated future Internet strategies; Sound management; Detailed and disciplined tracking; An agreed approach for management; and Good internal communication to all role players.

Measurement should be adaptable to both traditional application support and to enterprise resource planning on alignments. For the alignment team, the measurement approach should provide a focus on the end product – alignment of all strategies (deliverables that provide value to the organization) rather than simply tracking the alignment of strategies. It also ensures management visibility, in that communications show results in terms of accomplishments and milestones met. It should also provide a highly effective measurement capability that should be objective and reflects measurement capacity and alignment tracking.

Kiani (1998) argues that the current decade has witnessed evolution in the media environment and indicated that e- commerce could grow in importance. The opportunities offered by this new environment are still unknown and it is this fact that organizations should keep in mind while aligning all strategies. Kiani suggests new concepts and models for marketers that should be kept in mind while aligning strategies. Organizations should keep in mind that they all compete in two worlds – a physical world that people can see and a virtual world made of information. It is thus clear that information should playa role while alignment of strategies takes place. The two-way communication channel between consumer and corporation, Kiani suggests, should be incorporated during the alignment process. This communication should be more in the way of dialogue.

The methodology could be to create a database of transaction histories and this database should be incorporated during the alignment process by management. This database would be moving all the time and it would mean that the alignment process would be more difficult and moving all the time to keep track of all factors that could affect alignment. The unit of measurement could be the value of each Internet and normal customer to the organization. Marketing strategy will be measured by changes in the asset value of the customer's base over time. Alignment of the strategies should be more flexible as niches too small to be served profitability could become viable as marketing strategies improves.

Opportunities on the WWW are equal for all players – regardless of size and this would be affected by the information available to the consumers. Organizations have earned the right to the digital relationship and they have to shift their alignment all of the time if they continuously enhance the value they offer consumers. All of this should be kept in mind while measuring and aligning all strategies. Alignment of strategies should keep in mind that strategies for e-Commerce would be how to attract users, engage the users' interest and participation, learn about the preferences of consumers and ensure that there is interaction.

With the flood of data produced by today's e-Commerce, organizational decision makers must do something to allow all players to extract the correct knowledge from the available information. Recent advances on the Internet and visualization technologies provide many organizations the capability to start using human visual/spatial capabilities to solve abstract problems found in business and e-Commerce. To achieve this, organizations must use e-Commerce well and increase the value provided to normal and Internet customers. The Internet will force organizations to evaluate how and when they should start to use the Internet to create additional business value to their organization. Some organizations could rely on strategic use of e-Commerce to enhance its competitive position as an established supplier of the goods they are marketing normally and on the Internet.

There are many measurement services that consultants provide. The statement that could be made is that if you cannot measure it you cannot align it. Once the organization establishes some objectives and goals, e-Commerce can facilitate them through a set of technology initiatives and once organizations have that strategic sense, managers can identify criteria as to how this project creates value to the organization and how it can be used to help with alignment.

Many organizations employ the balanced scorecard technique to measure e-Commerce's overall success in an ongoing process. This scorecard gauges things such as internal stakeholders satisfaction, it measures the system, rates the value and quality of that work and can be used in measuring and helping with the alignment of the strategies of the organization. The report card is broken into three categories: responsiveness, value and quality. The users rate things such as deliverables, establishment of timelines, accurately identified timelines and whether the solutions meet the expected ROI. This scorecard gives e-Commerce employees the opportunity for dialogue with business users if results fall short. The balanced scorecard report card can be used to link the alignment of the strategies regardless of the type of investment that was done. Things such as the business outcomes an organization desires, ensuring that key business holders are involved and the issues around change management would affect alignment. It is therefore about setting realistic, tangible and clearly communicated goals, ensuring that the entire team is speaking the same language and this could help with alignment.

To understand the success better organizations can use the balance scorecard to develop a model of organizational performance that could emphasize the contribution of e-Commerce to different dimensions of the performance. Some organizations would be able to prove that e-Commerce, when properly aligned with strategies, can contribute substantially to the organizations overall success and market leadership. Computer Simulation and Human Thought could help a lot because strategic advantage could be obtained through effective utilization of the natural strengths each of these have to offer to improve the quality of the decision making on outcomes such as e-Commerce.

3.2. Instruments That Could Be Used to Determine if the Organization's Strategies Are Aligned

The important thing to remember is always to determine if the organization has aligned their strategies and one of these tools could be a questionnaire. The questionnaire could be scored as follows.

Questions	Agree	Dis-agree	Not Sure
1. Executive management is involved in strategic information decisions and reference the formal business and information strategic plans.			
2. Customers, users and industry are regularly surveyed regarding the information needs and problems related to doing business with the organization.			
3. Technology is invested into only after establishing a business use for the decisions.			
4. The decision-making and operational roles of executives, managers and users are overlapping.			
5. Executives, managers and users understand and practice the concepts of managing data at all levels.			
6. Executives, managers and users understand and practice the concepts of changing information into knowledge at all levels.			
7. Information Services uses graphical, easy to understand methods of explaining how knowledge supports the organization's strategy.			
8. IT can help explain to you how the organization uses frameworks to align all strategies			
9. More than half the IT projects are under budget and on time.			
10. You know exactly how many IT projects are currently being conducted.			
11. You know exactly why and how to use all information and knowledge available			
12. You know how to apply the decision framework (if available) that will be used for strategic alignment.			

Table 1: An example of a questionnaire that can help determine the level of strategic alignment.

Count each category and determine what the people think of the alignment of strategies. If there are more not sure or disagrees than agrees then you might have a problem. The steps to be taken would be to ensure that communication lines are open. Tab. 1 table that represents a questionnaire can help determine this.

The questionnaire available could be used in conjunction with the balanced scorecard approach. The balanced scorecard should keep enterprises such as e-Commerce in mind and could be as follows: There should be different categories, combining it closely with the questionnaire, such as customer perspective, innovation and learning perspective, internal business processes perspective and the financial perspective. All of these categories should be discussed or be part of a decision framework where the different topics could include the goals for each perspective, the measurement of each perspective, the metrics being used, the targets and the actual that could be measured. For customer perspective, organizations need to remember that this could help with better alignment but should not carry as much weight as the internal metrics.

The innovation and learning perspective should be important as this is where new stuff such as e-Commerce and Internet marketing would be added and this would affect the alignment of all strategies. All new innovations and possible innovations should be added here. The internal business perspective should be used, as we need to ensure that employees have kept track of all the perspectives and that they need to know how to work with data, information and knowledge. The financial perspective should concentrate on increased efficiency, effectiveness and transformation and investment. As different measurement issues exist for these, they should be placed into the BCD and used as and where needed.

4. Summary

e-Commerce will develop over the next millennium and it is possible that organizations will reap benefits from using it, as they have never seen. e-Commerce will therefore emerge as an effective mode of conducting global commerce. The problem is, as mentioned in this article, that managers still doubt the impact and profitability it has. In the process it is creating new opportunities and challenges for today's businesses, creating new market structures, and changing the alignment of the organisation. All organizations are challenged by an increasing focus on delivery speed and by an increasing degree of uncertainty. The question: How do organizations keep up while still delivering business value? was answered.

Organisations that survive and thrive in the new economy and use all to ensure that their strategies are aligned are those with better ideas than the rest. These organizations normally produce better products, novel interpretations of the market (e-Commerce in this instance), innovative management strategies and the ability to create a unified strategic alignment where pools of talent, both inside and outside the organization, ensure that all stays on track and as the organization moves, the alignment moves to ensure that everything is in "harmony".

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End-to-end Processing: The Future of Customer-Facing Systems

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Abstract

The paper brings together a number of strands of customer-oriented thinking in both business management and information systems. Concepts of customer service, process-based systems, and 'one-touch' or 'seamless' interaction with the customer underpin the attempts by organisations to provide customers with services which do not require delays or 'hand-offs' to a number of agents within the company. Instead, customers' requests, and company-initiated approaches, will be handled by a single process, whether automatic or manually controlled, which deals with all the company's existing systems, as appropriate. Finally, some considerations are applied as to the effects on organisations and the non-technological issues, raised, such as the effects of the deployment of these systems on corporate culture.

Keywords: CRM, XML, workflow, culture, end to end processing

1. Introduction

This paper takes forward some ideas on technologies and principles commonly found in customer-facing systems. It builds on the work of customer service 'gurus' like Peters, (1982), Davenport, (1993) and Freemantle (1993), and seeks to assess appropriate technologies to enable those principles to be adopted rapidly and easily by organisations.

As an activity, customer service is a mixture of process and information: the percentage content of either will vary according to the nature of the customer interaction. Frequently, organisations maintain extensive customer data but fail to use it, or to communicate it to customers, in a timely and intelligible form.

It is the process that dictates the timeliness and intelligibility of the data. It is also the process that sets the context in which the data is used, and it is the process that mediates between the organisation and the customer. Nine years ago, Hammer and Champy were promoting the concept of process. "Task-oriented jobs in today's world of customer,

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competition and change are obsolete. Instead, companies must organize work around process." (Hammer and Champy, 1995).

2. CRM

Customer Relationship Management (CRM) has been promoted over the last few years as the most effective means of customer interaction. Yet definitions of CRM vary. Some, like Peppers and Rogers, identified it closely with Relationship Marketing, or One to One marketing. "Customer Relationship Management (CRM): CRM is the same as one-to-one marketing. This customer-focused business model also goes by the names relationship marketing, real-time marketing, customer intimacy, and a variety of other terms. But the idea is the same: establish relationships with customers on an individual basis, and then use the information you gather to treat different customers differently. The exchange between a customer and a company becomes mutually beneficial, as customers give information in return for personalised service that meets their individual needs." (Pepper and Rogers, 2001). Buttle was amongst the early CRM writers who perceived that CRM was not just another marketing initiative. "CRM acknowledges that talents other than those of the marketer are necessary to create and deliver value to customers. Operations, customer service, sales, human resources, credit control are essential ingredients in the customer satisfaction blender." (Buttle, 2002).

I would argue that CRM is a process, or matrix of processes, by which the organisation seeks to know what the customer wants, and be in a position to fulfil those wants, before the customer has fully articulated them. In other words, a CRM system should be able not only to identify the customer who is contacting the organisation, but should also be able to access many sources of data, possibly including predictive systems. Therefore, as the customer conducts their business, the agent, or indeed the system, is building up a picture of what that customer is likely to be interested in, and what cross-selling or up-selling might be appropriate.

Some transactions will be simple ones – recording deposits, withdrawals and so on. However, many processes are complex: Individual Savings Accounts with tax free implications and complicated rules; mortgage applications, with multiple criteria and documents of proof: in order to enact the complex processes on which successful CRM depends, it is necessary to have some kind of technology which will assemble items of work ready for processing, prioritise them, route them to workers as required, and monitor progress. Whether specifically designated as such by the system designer or CRM software vendor, such technology is normally defined as a workflow engine, or workflow management system (WFMS).

WFMS is a technology that has been extensively taken up within process-driven organisations, particularly the former 'paper factories' like banks and insurance companies, with massive clerical workloads. WFMSs are qualitatively different from the majority of traditional information systems in that they typically focus on processes, not the data that supports those processes. As a result, they are in a position to alter the way in which people work, and consequently, the way people relate to each other in the workplace. They are

characterised also by the improvements in productivity (30-60%), improved customer service, and flexibility of working patterns that they enable (Doherty and Perry, 1999).

This is not to argue that CRM is delivered only by workflow technology; depending on the specific processes being implemented, customer database systems, demographic databases, data mining techniques, automated call distribution, computer telephony integration, image management systems, and a number of other application and infrastructure systems all have to be integrated. However, it is my contention that a workflow engine is at the heart of any well-developed, complex customer service system.

Using these technologies, then, it is possible for a company to cross sell, or up sell to any customer at any point of contact, whether it is a service enquiry, sales enquiry or even a complaint. The workflow element will initiate automatic searches across multiple databases within the company, and prompt the agent to not only address the customer's immediate requirement, but also to discuss other offers, based on criteria which the workflow system has discovered, such as propensity to buy, status, current situation and so on.

3. e-CRM

When CRM is deployed across the web, both the possibilities and the technical difficulties expand. The possibilities of interacting with customers on a global basis, unrestricted by location or time of day, are well understood (Turban et al., 2002). Less well understood are the possibilities for using the process technology itself to increase productivity gains, and to develop further the customer relationship. Using workflow technology, the customer now initiates his own workflows, and to some extent controls them; as an example, he/she enquires about a home loan, and begins the application process. This will be fed into the workflow, which will require him / her to provide the necessary data, and documents, on which to agree and process the application; the system will provide feedback and prompt the customer and interested parties (estate agents, lawyers, brokers etc) as defined by the customer and the home loans company. Most of the initiation of work will be done by the customer, and most of the routine decisions will be done by the workflow element within the CRM system. Technical or 'borderline' questions will be automatically routed to skilled people within the company, and their decisions will be fed back into the process.

The technology for achieving this is increasingly better understood, and is to some extent addressed later. Less well understood is the design process. Does the organisation begin by accepting its present ways of working, and design outwards, so that the web-based customer interface reflects them? Or should the design start from the premise that the process should be tailored to the customer, and that the organisation's processes should then be re-engineered as necessary, to fit?

4. Content and Data

When conducting business processes across the web, there will however be problems in managing the content of the process. The prospect of handling large databases distributed across a three- or four-tier architecture, even if theoretically feasible, fills most practitioners

with horror. The workflow queues themselves – consisting largely of pointers to where the actual data resides – can adequately be handled. It is the electronic documentation – forms, letters, images and so on – that pose the largest problems in terms of management. Currently, the most popular answer to content management seems to be the use of eXtensible Mark up Language – (XML).

XML was based on Standard Generalised Markup Language – (SGML), an international standard (ISO 8879 agreed in 1986). SGML is a syntax, which allows the description and machine manipulation of the logical structure of documents; it simply allows software to manipulate document content in a way that respects the meaning of the elements that form the document.

It should not, therefore, be confused with Hypertext Markup Language (HTML), which uses markup to define the appearance of documents viewed over the Internet. Since HTML is designed to handle appearance, not content, it had limitations in a rapidly expanding Internet environment, in which organisations were concerned to provide more than just static information. Anghern's ICDT model, for example, clearly demonstrates how e-commerce evolves in complexity from simply providing information, through to managing transactions in real time (Anghern, 2002).

In 1997, the World Wide Web Consortium (W3C) produced a new syntax that offered most of the functionality of SGML in a simplified form; it was to become XML.

XML is therefore a subset of SGML; the reason for its popularity however, lies in its structure. Since it is more compact than SGML, it has enabled developers to produce simpler, more portable, and cheaper software products. Further, the portability and low cost have enabled developers to offer users a much greater range of interfaces and access points for data. For example, a U.K. consultancy, working in the healthcare sector, surveyed the data requirements of 300 doctors and surgeons. Half said they wanted summary patient information only, and half said they wanted detailed information on their patients. Six months later, Graphnet carried out the survey again; the split between summary and detailed information was roughly the same, but the respondents who had previously wanted summary information were now those who wanted detailed information, and vice versa (Graphnet, 2002). It proved much easier to offer them a variety of views of the records by creating both the patient records and the 'information forms' in XML, than to create a database with customised views. Further, the company found that it was also much easier to import data from other sources, including images and vector graphics, than to use a series of integration tools to provide access to these additional sources of data.

5. The End-To-End Concept

For some time, CRM analysts have been seeking to demonstrate that 'front office' and back office' systems need to be seamlessly integrated if the goals of CRM are to be achieved (Karpinski, 1999; Staffware 2002; McAvoy, 2000). 'Front office' systems are normally defined as the customer-facing systems such as sales, customer service, and helpdesk, while

‘Back office’ normally encompasses applications supporting the finance, manufacturing, operations and logistics functions.

The reasons for this are straightforward, and are rooted in the fundamental principles of CRM. In order to understand, and more importantly to respond to, any customer question, it is important that the organisation should have a ‘single view’ of its customer. In other words, the agent (human or software) must have access to all the information the organisation holds in relation to this customer. This will extend far beyond the ostensible matter in hand: for example, if a bank’s customer calls the credit card customer service centre, a ‘full’ CRM system would immediately search, not only the credit card database, but also all the other product databases – banking, insurance, mortgages and so on – which may physically reside in widely dispersed locations. Further, such a system would probably use data mining techniques to assess that customer’s pattern of buying and methods of interaction – telephone, internet, branch, etc. Not only that, but the system should also check on family members, as their financial standing with the bank may well affect the outcome of the interaction. For example, someone applying for a loan may well be treated more favourably if it were evident that several family members, each using many bank products, were also good customers. Indeed, this ability to ‘price for risk’ is one of the attractions of CRM to many companies.

Such a ‘single view’ can be obtained by establishing a dedicated customer database (which may be very complex and expensive to achieve) or by providing a ‘loose coupling’ with existing databases and applications to achieve a ‘virtual single view’.

On the other hand, most CRM software vendors will accentuate the benefits of the applications in which their software is strongest; Siebel (2002), for example stresses sales and marketing functions, while Chordiant (2002) promotes call-centre based applications.

The ERP vendors, like Oracle, SAP and so on, claim they are in a position, because of their existing software suites, to offer end to end processing. However, industry analysts (not to mention other vendors) stress the importance of selecting ‘best of breed’ for both front and back office applications, and for the integration software that makes the CRM approach possible. Moreover, in practice, most companies will have already invested heavily in a range of both front and back office systems, and will be unwilling to replace all of them in the near future.

It is in this context – the need to integrate complex processes, and to do so across the world-wide-web – that XML is currently being widely adopted as an essential part of the middleware architecture. Its significance lies in the ability of an XML server to handle documents and data objects. Unlike a web server, which is designed to deliver HTML documents to a client under HTTP control, an XML server is suited to server-to-server communications. Most XML servers provide two services that are critical:

“Data Object Access: The document handler calls the appropriate back-end data object and passes the appropriate input fields based on the method processing. For example, it may invoke a SQL statement that inserts a new customer into the database…. Document Handlers: The key functional unit in an XML server is called a document handler. A

document handler is a particular piece of business logic that can operate on a certain class of documents. Each document handler will usually have multiple methods – functions that can be performed on a particular type of document. A purchase-order document handler might have submit, acknowledge, and cancel methods, for example. Each of these methods would incorporate application-specific logic and they might call different back-end data objects such as a database." (Bickel, 1999). Because it is designed to be able to communicate with other applications (including non-XML applications) and with other servers, it becomes a powerful, and flexible, point of integration with multiple applications.

Some of these applications may well be user applications; the client side of workflow applications, or XML style sheets to display information, for example. Using XML and its derivatives for mobile technology, users can not only access data, but can initiate and control processes on thin or thick client PCs, on hand held devices, interactive TV, and mobile phones.

Now we see a technology matrix: web-based applications, accessing CRM systems, including a workflow engine, using XML as an integral part of the middleware to link the content of legacy databases and transaction systems. In this way organisations will be able to bring back and front office systems together to achieve 'seamless' processing of customer requests, and to create customer interest and demand.

Thus the technology now exists to conduct end-to-end processing of customer requirements. Issues of security and scalability continue, but it would seem that these are diminishing in importance as the technology develops. The potential benefits to companies appear enormous; to be able to directly harness the projections of a customer demographics database with a customer profiling system, to then link them dynamically with a data mining system to identify background preferences and family connections of customers – these are just some of the opportunities open to 'analytic' CRM. 'Operational' CRM can execute business processes at far grater levels of complexity and depth of relationships than formerly possible, so that customers can genuinely be treated as customers of the whole organisation, not just of one division or product group. Further, customers themselves can, via the internet, begin and control their own business processes. These may be something relatively straightforward like applying for a loan, or may be as complex as setting up a customised package (with appropriate discounts) to take out a mortgage, with indemnity insurance, buildings insurance, and contents insurance. Potentially, this would give the successful company an enormous competitive advantage in the following areas:

- Reduced cost of customer acquisition, through better analytical systems and better acceptance processes, including pricing-for-risk
- Better customer retention, through fewer errors and more proactive processes.
- Fewer staff involved in the customer-facing processes, as a result of technology deployments
- Increased ability to integrate with partners (e.g. banks working with insurance companies to provide complete financial services)

- Increased ability to take over competitors' systems (given the improved integration methods referred to above).

This is not intended to be an exhaustive list of competitive advantages, simply an indication of what might be achieved. At first sight, it would appear that the benefits represent an unanswerable case for the implementation of CRM, incorporating end-to-end processing.

If this were indeed the case, then why has enterprise-wide CRM not been adopted by all major companies?

6. The Barriers to Take-Up of End-To-End Processing and Full CRM

In an article dated October 2001, Harvey (Harvey, 2001) discusses some of the reasons why CRM has failed to have the transformational impact widely predicted by the software suppliers and expected by the early adopters. He found that firstly there was a high failure rate of CRM projects as researched by Gartner Group who had identified a failure rate of 65% of CRM projects, rising to 80% in 2002.

Secondly, Harvey criticises CRM projects for not being part of an integrated programme of change; he quotes research by Hewson Consulting, which concluded that out of 500 case studies, only 18% could show evidence of reorganising business processes.

Thirdly, he criticises vendors for not spelling out the difficulties, again citing Hewson Consulting's opinion that vendors do not invest in the 'process and strategy know-how that support CRM sales'.

Finally, he believes that there are conflicting demands between the short term and long term benefits anticipated for CRM. This is perhaps the obverse of the point about understanding the significance of organisational change; in other words, organisations which do not build the new technologies into a significant change programme are likely to focus on the short term goals presented by improving the efficiency of just the front office, or by integrating front and back office across just one product line.

There is, then a suggestion that companies are looking for more efficient ways of working in the same ways as before, and paying 'lip service' to the idea of CRM and end to end processing as a 'transformational philosophy' of business activity.

This is not surprising; a study of workflow systems by Doherty and Perry (2001) showed that the implementation of these systems (an integral part, as I have described earlier, of the functionality of CRM systems) *was rarely accompanied by any attempt to alter the organisational culture*. This study surveyed 30 major UK financial services companies that had installed workflow management systems. It also interviewed managers from 12 of those companies. All interviewees, and a high percentage of the total survey, agreed that corporate culture had been changed in the areas affected by those systems. Again, all interviewees agreed that the impact of the cultural change had been positive. Yet only 4 of the 12 reported any accompanying cultural change programme. In fact, only 2 of the 12 reported an explicit attempt to change company culture.

In this context, it is perhaps worthwhile to look back at other innovations in the information systems arena that have been linked to culture. Business Process Reengineering (BPR) was linked, by Michael Hammer, to cultural change. It was also widely attacked as having failed in the vast majority of cases. Hammer's defence was that where it failed, it had not been implemented extensively enough to change the culture of the organisation. The evidence produced by Perry and Doherty (2001) was that certain processed-based systems were per se cultural change agents, because they changed the way people worked and related to each other in the workplace.

Against this background, the market place itself has been changing. Customer expectations are probably rising. Anecdotally, most of us can remember that we were used to queuing for several minutes at least at our local bank: waiting for a minute on a telephone bank transaction is irritating, while waiting thirty seconds for a response from a web base query is enough to make many customers abandon the enquiry.

Perhaps as a result of this change in customer perception, business thinkers are also shifting their approach. In a 2001 interview, Tom Peters said "I'm no longer interested in excellence… I'm interested in what's different. So are customers. They take quality for granted." (Dourado, 2001).

Similarly, earlier this year Michael Porter advised, " Be different, instead of better. You can more highly differentiate yourself, so you claim back some of the power in the relationship because the customer really wants to do business with you." (Dourado, 2002).

These are areas where the technology itself does not provide direction. Strategic issues like these can only be concluded by strong management thinking, and action.

However, there does not seem to be any evidence that the management community has taken seriously the culture and behavioural changes created by the new technologies. The hypothesis is that more sophisticated interactions along the CRM/XML/workflow enabled models will change the way customers respond and behave every bit as much as the advent of telephone and Internet purchasing has changed customer expectations in those areas. Certainly, there is evidence that this type of technology alters behaviour, and organisational culture, within the user company; Doherty and Perry's study of the cultural effects of workflow systems (Doherty and Perry, 2001) demonstrated that, whether organisations anticipated change or not, whether they used the introduction of workflow systems to facilitate change or not, nevertheless cultural change would occur as the result of the inevitable changes in process, and in particular through the 'empowering' effect or increased span of control which these systems give to people at 'lower' levels of the organisation.

7. Conclusion

The technology, though still evolving, appears to be in place to achieve a paradigm shift in the way (particularly large and complex) businesses can relate to their customers. At the same time, there is evidence that the technology will, almost indiscriminately, change the behaviour and the work culture or culture of interaction, of those who use it.

Fox and Brown (2001) among others, have argued that organisational culture change is necessary to enable, and underpin, a successful CRM programme. However, the evidence seems to be that businesses are not doing that, whether through short termism, fear, or uncertainty how to proceed. Perhaps businesses feel that they do not understand how to measure, or predict, cultural change.

Yet, with the availability and the culture-changing propensities of the technology, perhaps it is time to consider implementing conscious culture change as an integral part of customer relationship management, and customer facing technology.

As more and more businesses derive some kind of benefit by implementing departmental, or partial, CRM systems, the need will increase to maintain competitive advantage by fully extending the processes 'end to end'. By building cultural change into both the process and into the technology, it may be possible to achieve a new paradigm shift in competitive positioning.

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Group Mediation – A Business Model for Mobilised Internet[1]

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Abstract

Telecommunication services in coming decade will become a product of mutual effort of several stakeholders, namely and firstly, users themselves, service providers, network providers and mediating entities, facilitating dynamic creation of both services and of service customisation. Mediation function is not necessary in steady condition, however it is becoming increasingly important when status quo is changing, it helps to achieve smooth transition. The change is understood here as a change in the business layer, thus requiring re-engineering of provider network.

Keywords: mediation, policy, service creation, group communication, evolvability.

1. Introduction

The first decade of the 21st century is a turning point for telecommunication services business. High licensing fees that PNOs have paid for the right to offer what is expected to be a major source of revenue for telecommunication service provides in the next decades urges them to introduce these services, though the technology is not ready yet. At the same time high expectations associated with the success of the Internet and its penetration into traditional business sectors to support virtually all types of activities in both business and everyday life make everybody sure that these service will be "all IP" based. TCP/IP technology was accounting in 2001 for 110 millions of IP hosts interconnected worldwide – a tremendous success, however this is merely 14% of telephone devices and less than 0.9% of micro-controllers installed and being in operation currently (Zeletin, 2002). Already today a broad range of design efforts has been started for new telecommunication services spanning the complete range of networks – from Personal Area Networks (PAN) – networks of wearable computing devices capable of a Bluetooth communication, to Home and Office Technology (HOT) networks, interconnecting chips controlling power, facilities, security, etc. in the office, home, car, to traditional – local, metropolitan and wide – area networks.

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The user-oriented, so called "i-centric" vision of the Wireless World Research Forum (Visions, 2002) suggests that as soon as in 2-5 years from now nearly half of the Internet population will consist of users capable to communicate by devices capable of smoothly changing radio frequencies (software defined radio), providers (user defined multi-homing), technologies, partially due to the potential of software defined radio and its integration with ubiquitous all IP infrastructure, partially due to the ability to build peer-to-peer (P2P) networks and services. In this vision, the following principles will hold:

- All nodes will be equal – there will be no distinction between client and server roles, each user can become a connectivity provider and/or a content provider;
- There will be no central element of control, and, thus no central authority, therefore principles developed in the area of distributed systems will be highly demanded;
- Each node will have a strong sense of "community" in which it operates, thus group communication mechanisms will be widely used to build and to maintain communities and federations.

This bright new world of ambient intelligence and communication is impossible without legacy telecommunication networks, including both traditional wired and wireless network operators, and Internet service providers (ISP) with and without their own networks. We aim to propose a strategy that helps to identify the need to act (i.e. to re-engineer and/or to re-dimension the network) by monitoring the business process of a network provider, which monitoring being seamlessly built into the telecom service delivery process as a part of it automation, including e-services (Bunjie, 2001) as a tool.

The rest of the paper is structured as follows. As a result of case studies (Smirnov, 2002) we propose recommendations for a new business model centred around mediation, rather than on direct access control to services and resources. This conforms to an earlier proclaimed value in the networked world (Sawhney, 2001). Mediation is an enabling technology behind dynamic service creation in premium IP networks, which is addressed in the next section, first as a comparison with traditional IN like approach for service creation, then as policy enabled, true connectionless approach. This approach allows us to distinguish between components – service creation products – which are traded between different parties in order to create a service. We dedicate the next section of the paper to this trading, while we see it as the very essence of the mediation, and demonstrate that group mediation is the technology that meets all important requirements. Finally, we conclude the paper with a short discussion of the approach.

2. Service Creation Business Model

We distinguish between the following two business models: traditional model and service creation based model. In traditional business model created service is offered to customers of a network domain. Created services may belong to a network provider itself, or to a service provider. Usually network and service providers arrange for a number of agreements governing the process of a service offer by a network provider on behalf of a service provider.

In a service creation based business model a network provider not only offers created services to its customers but also offers service creations tools and platform for service providers. A service creation tools and service creation platform are owned by a network provider, however they have to be open enough to allow service components (service creation products) to be injected into it from foreign network domains.

Even the key question of a service creation business model, *Who is selling What to Whom*, is hard to answer in a generic manner, partially, because the service creation is not yet an established area in connectionless world. We make an attempt here to define service creation products and service creation roles helping us to sketch an emerging business model.

2.1. IN vs IP Service Creation

Before, we go into details of our model we need to make certain remarks on service creation technology as such. Service creation, as known from Intelligent Networks (IN) is the process of interrupting the basic call chain and consulting with additional intelligence, remote to a switch – the point of interrupt. Additional intelligence processes the signalling request in question and returns to the switch a routable entry, thus completing the call chain. The only way in IN to invoke a service, and service creation, if needed is to dial a service number.

There is no straightforward mapping of IN like service creation to IP networks: the basic call chain does not exist in connectionless networks. Additional intelligence in IP networks is normally distributed per protocol. In some sense, service creation in Internet does already exist in a form of numerous client server protocols between intermediate devices controlling different aspects and phases of an end-to-end session. These intermediate devices – generically called middle boxes (Huitema, 2001) – are: firewalls, network address and protocol translators, realm specific IP gateways, QoS enforcement devices, policy enforcement and policy decision points, tunnel terminators, proxy servers, bandwidth brokers, signature management agents, authentication, authorisation and accounting servers, multimedia buffer management, application-aware caches, load balancers, third-party secure associations, SMTP relays, routers with different additional (to essential forwarding) functions, etc. While middle boxes do their own job well – they are needed for obvious reasons (lack of IPv4 addresses, security or QoS concerns, etc.) – they do harm the grounding principle and the major driving force of the Internet – the end-to-end principle. Examples are numerous; their taxonomy is well defined in (Huitema, 2001, Kuthan, 2001).

We attempt at some generalisation of middle boxe. A Middle Box (MB) is a network element processing IP datagrams based on its Rule Base (RB). An RB may be concurrent (each datagram passes through all rules simultaneously as if each datagram is replicated); linear (each datagram passes through a pre-defined sequence of rules); tree-like (there is always a first rule to be applied, and the next rule is a result of previous, etc).

As usual for rule based systems, we distinguish two parts of a rule base: a state (all filter conditions), and actions (e.g. drop a packet, cache a packet, modify a packet, establish internal state, or establish external state, by e.g. sending a message). A filter condition is

normally a Pattern Matching Expression (PME) applied to IP header or to transport header fields. A filter condition may also take a form of a predicate based on PME.

This division is crucial, because a number of possible actions is limited by an implementation of a network element, while a number of possible combinations of state data (conditions triggering actions) is theoretically unlimited. This, in principle, allows changing MB's behaviour by changing its state data in a desired way. Is this feasible in reality? This question was one of the most challenging questions in networking research of the last decade. The answer, thanks to advances in active networking, agent technology, Java, etc., is positive, though rather discouraging in terms of simplicity, security, performance, and other aspects of successful deployment.

Our solution for simplicity and evolvability is to distribute required complexity between processing and communication in a novel way.

Traditionally, Internet engineers try to keep all communications as simple as possible (assuming stupid and unreliable network) with all needed logic being hardwired into client/server state diagrams. We suggest – at the price of more sophisticated communication, and more complex design – to achieve simplicity in Internet system evolution. More details on dynamic IP service creation are provided in (Smirnov, Security, 2001, Smirnov, Programming, 2002).

Conclusion. In a connection-oriented IN a service request is bundled with the call setup; in connectionless IP a service request can be triggered by data (e.g. by a service specific protocol, e.g. HTTP, Telnet, etc.); or by signalling (e.g. by SIP, RSVP, etc., or by combinations of these protocols). Depending on implementation of a service, a service creation at IP level can be also data triggered or signalling triggered. In any case, a service creation at IP layer is always achieved by dynamic modifications of filters associated with needed pipes (see the next section for pipes and filters architecture).

2.2. Network Model

Dominating transport communication pattern in the Internet is changing from a traditional „machine to machine", to a more end-user oriented „person to person" communication. To fulfil many, sometimes complicated, requirements of a personal communication service there is a need to deploy plenty of client-server ("machine-to-machine") *control* communications, happening in the Internet. Examples are multiple, from routine DNS lookup for name to address resolution, to a run-time bundling of security, QoS, AAA, network address and protocol translation. The latter, known as middle boxes, are not only patches (FW, NAT/PT), but often – inevitable and increasingly widely deployed service components (SIP, RTSP, AAA, MEGACO, etc.). The majority of these control communications happens transparently to end-user, thus being conformant to end-to-end principle of the Internet, however, even if middle boxes are explicitly exposed to an end-user session they are not considered harmful from the traditional architectural viewpoint, provided that a corresponding transport connection is terminated properly (Bradner, 2002).

We claim, that the E2E transparency of the early Internet is no longer either a religion or an axiom, but at Layer 3. In early days of the Internet it started at IP and finished at IP – it was important to connect computers, to make them talk, thus a simplified view of a network and addressing were important and essential assumptions/constraints. We argue, that the E2E transparency is needed, it is an axiom, it will be preserved and favoured, but above layer 3. We see already now that http, e2e signalling, active networking, agents, proxies, etc., etc., generally speaking – *the web* does now the job IP protocol was doing in the early days of Internet.

To demonstrate the generality of our approach we need to generalise the network model.

One extreme viewpoint at telecommunication network is a "pipes and filters" model (Zave, 2001). Really, whatever a complexity of a network element is, it can always be considered as a routing function (which routes datagrams to queues for QoS, to outports for forwarding, to trash for drop function, etc). Routing, in turn consists of classification (based usually on a packet header fields), followed by certain treatment (see above), thus can be represented as a rule "*IF <condition> THEN <action>*", these rules are nothing else, but filters.

On the other hand, these rule based model comes very close to the notion of policy. Current IETF work on policy is concentrated on static approaches, suitable mainly for device configuration, therefore supporting monolithic information modelling based on CIM adopted from DTMF. However, policy as an instrument has much higher potential, if understood as a "a rule defining a choice in the behaviour of a system" (Damianou, 2001). Thus, e.g. in mobilized Internet, behaviours of service components and network elements to a large extent will be defined by policies, which will no longer remain a static rule set. Rather, a network will compute policies (=behaviours of its elements) based on behaviour components (user- , service-, and resource-rules), and on composition (computation) rules.

As a **conclusion** to this section we summarise our network model: transport network consists of pipes and filters, filter behaviours and pipe properties being defined by policies. Policies are computed by a network out of components, originated by user, service and by a network provider.

2.3. Service Creation Products

2.3.1. Components

To change network behaviour by policies means practically to define network behaviour based on Who, What, and When conditions. *Who*, means identifying who is accessing network services (user or corporate, profile, SLA, other preferences, etc.); *What*, means identifying what network services are requested, i.e. What is the desired network behaviour; and *When*, means that all the above is provided taking into account network state, i.e. Resources available at current load, etc., which often can be already integrated in provider's policies.

In other words, all the above is defining three types of components of a finally computed policy, or, in IETF terms, policy ready to be enforced in network elements. We shall call

this a behavioural policy to distinguish it from a role-based policy, or device configuration policy. Figure 2.3.1 demonstrates how these three policy components differ and how they contribute to overall behaviour.

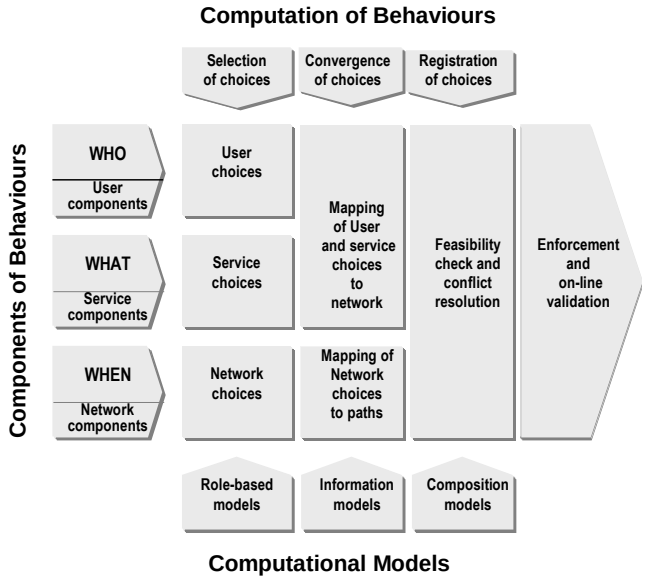

Figure 1: Computation of network behaviours.

We define service creation products along the roles and components specified above.

The *Who* component is that part of service level specification which is offered to and filled in by an end-user – it has few technical details, however rich capabilities of expressing user preferences, both – generic and service specific. We shall traditionally call this component a user *profile*. Important is to note, that part of a user profile might be a zero-knowledge requirement.

The *What* component is that part of a service level specification which depends on a network, i.e. requires specific network capabilities to assure the QoS, like "*requires DiffServ EF service class*", or similar. It may contain even proprietary service specific requirements, like "*Best viewed with XYZ media player*", or may reflect business agreements a service provider wishes to be preserved, like "*requires copyright protection scheme from content provider ABC to be enforced*".

The *When* component is a traditional provider's policy specification, such as rules enforcing QoS marking for particular flows of datagrams, rules opening pinholes in firewalls, or in routing aggregates, etc. Those rules, however, are not yet ready to be enforced in the network, while they are not yet instantiated for particular flows, that is, they do not have yet network topology information.

While all three components above might be already sufficient to invoke a service in a way satisfying all the requirements, they are not ready for immediate enforcement mainly for scalability reasons – network elements need not to know details of micro-flows. Only, when all the requirements are met in a feasible and conflict-free manner, and mapped to generic network policies (rather per flow aggregates than per micro-flows) for needed set of network elements, the policy is ready for enforcement. Thus, policy computation is achieved by two seemingly contradicting actions – *anonymising* of user and service specific features, and *concretisation* of network specific features. (Note: in a very general sense this reminds the work of a scheduler, however network side service creation needs to be achieved dynamically, at run-time).

2.3.2. Mediation

The above components are easily mapped to service creation architecture, developed by Cadenus consortium, and consisting of three types of mediators – Access mediator, Service mediator, and Resource Mediator (Cadenus, 2001). In fact, the three mediators provide all functionalities of a *market place*. More on the high level part of the Cadenus mediation architecture is available e.g. in (Cortese, 2001, Antonio, 2002)

For our purposes we should abstract from the above architecture, keeping however the notion of mediation as a useful tool for the definition of a service creation business model and of related products.

Fig. 2 classifies possible BMs for service creation based on the position of mediation in the chain. Circular nodes in this diagram represent roles in the business model, square boxes – types of relation between roles (usually directly mapped to a document/information being exchanged between the role-holders in conformance with the type of relation), links represent the direction of the flow of information between role holders.

Accordingly, based on the type of mediation we can classify service creation products, and discuss associated risks. Risks are due to the fact that each of the players in the diagram in order to participate in a service creation has to open certain part of proprietary information.

It is possible to minimize the risk to nearly zero level by a separation of concerns. That roughly means: first, to disclose only necessary part of proprietary information and only to the party which really is going to be involved in critical usage of this information, and, second, to disclose this information as a *metadata*, that is in network- device- and vendor-independent manner. Thus, for example, for QoS enforcement, only an access provider has to know the microflow information on which a QoS marking is to be enforced, while the egress routers of the access provider domain will need to know only the flow aggregate parameters. As an example of meta-data let us consider and XML based data structure

defining which parts of policies to be deployed in a service creation can be modified and under which conditions.

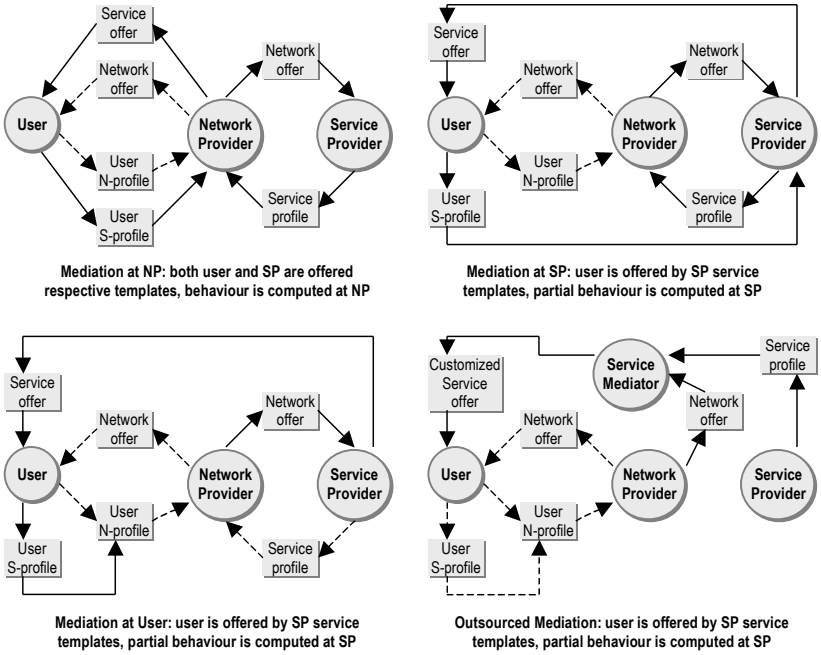

Figure 2: Possible service creation business models.

2.3.3. Bilateral Mediation

Traditionally all negotiations are happening on a bilateral basis, for example according to the following scenarios.

Scenario 1. A large content provider (CP) willing to get a direct access to customers of a large ISP establishes a virtual peering agreement with an ISP. From the networking viewpoint CP and ISP are not peers – their networks are incompatible in size and connectivity, however with regard to traffic volumes originated in CP's content servers and requested by ISP's receivers they might be equal enough to establish a BGP peering between them. ISP can initiate peering as well, wishing to enlarge its service portfolio by

premium access to CP's content. In any case, after such a peering agreement is done a network is to be engineered (which means dimensioning, routing, traffic engineering, etc.) accordingly to be able to guarantee substantial QoS for content flows, even without special QoS mechanisms (IntServ, DiffServ, and the like).

Scenario 2. An ISP, wishing to offer service differentiation in its network introduces user profiling service, allowing its customers to specify (select by filling in a template) for example types of service they wish to use, service scope (e.g. MAN, WAN, world wide), possibility to specify service schedule, and payment options. Profiling is an essential tool, equally useful for customers and for providers and implies automation of service level agreements. As soon as profiling service is offered to users and accepted by them, a network provider shall use obtained information to engineer its network accordingly (as in scenario 1) in order to satisfy user requirements and at the same time to increase resource utilization.

Scenario 3. A first-tier service provider, already having peering agreements with a number of NP can extend its offer by utilizing its possibility to offer premium (e.g. guaranteed by engineering) connectivity to a large customer base residing in several networks. A service provider thus can establish a second-tier peering agreements with CPs seeking to reach larger customer base as in scenario 1, however being not yet able to generate as large traffic volumes as first-tier content providers. In this case, a first-tier service provider has to extend its peering agreements with NP if needed, but also has to take care of network engineering – connecting second-tier providers to a first-tier provider.

Scenario 4. When scenario 3 above evolves, it becomes difficult for a service provider to continuously care about second-tier network engineering, and after reaching certain threshold, the task can be outsourced either to one or to several NPs being able to do this engineering work on behalf of tier-one SP. The situation now can be described either as a peering of distributed SP with a set of NPs, or, more complicated, as a multi-tier relation.

Major commonality in all of the above scenarios is that there are three phases which are continuously repeating themselves: service offer, service contract, service provisioning (e.g. by network engineering). The triggering of phase 1 can happen inside any role-domain: customer base with a certain profile preferences growth, or NP wishing to increase service offering, or SP wishing to establish/increase network connectivity.

This commonality requires that all three role-holders are constantly monitoring respective thresholds in order to be able to satisfy their business growth goals. Such monitoring is a hard task, because each role holder has to understand the process, to be aware of quantitative metrics for respective thresholds, and be able technically to monitor the situation (network instrumentation). Additionally, there is to be a communication channel established to respective NPs allowing advising them on situation change.

2.3.4. Group Mediation

In all the above scenarios we can always identify a group of role-holders involved in decision-making. We are mostly concerned with the decision on service provisioning – when it comes about the right time to [re-]engineer the network. We argue that tools and mechanisms required to properly monitor the situation are best implemented with group communication principles in mind. Obvious advantages are scalability, independence of group sizes, while the number of groups, as we saw in scenarios above is small and permanent.

While our main goal is to automate the network engineering decisions, we see the need to design these mechanisms in a manner friendly to network provisioning. Ideally, the network provisioning tools should have these mechanisms embedded, in such a way that, for example, QoS violation events can be correlated to properly trigger the engineering machinery.

One of the main tools for NP to engineer a network is to use policies. Policy is a flexible mechanism to configure network devices, because policy is "a rule defining choices in system's behaviour". The use of policies in current Internet is limited to a device configuration option only, thus design of policies is a highly sophisticated job, requiring knowledge in many fields including proprietary network specific knowledge. Our goal will be achieved if a policy design could be automated and composed at run time.

Historically, policy work was progressing towards role-based modelling after the organisational roles for security management. Later, a DTMF has started working towards policy based device configuration and management, which work resulted in CIM, guiding device information modelling. At a later stage IETF has adopted DTMF information modelling approach and has developed its own policy management framework with the following three core elements: policy repository (notoriously considered to be similar to LDAP), policy decision point and policy enforcement point.

Every time a new policy is to be designed a new network behaviour is assumed. Changing network behaviour by policies means practically to define network behaviour based on Who, What, When conditions. We have proposed a novel policy architecture with no fixed policy decision point and without policy repositories, instead we use group communication mechanism to facilitate early awareness among potential group members on situation change.

3. Discussion

The mediation architecture is in fact a market place where parties willing to co-operate via service creation process are trading their goods. The business model behind providing mediation as a service is a marketplace business model, with minimal functionality, policy driven and soft.

The ambient intelligence that is predicted to be the way of life in the 21st century, requires more sophisticated behaviours from traditionally dumb networks. This, however, does not

necessarily mean that networks (especially backbone, or core networks) should become stateful. There is another paradigm, being developed by distributed systems research community for several decades – radically distributed, self-organising and evolving systems. Algorithms are largely available for engineering internetworks based on these principles, which will demonstrate high levels of scalability, robustness, versatility and cost-efficiency.

What will be the price for these nice features? The answer is: more complex design of a simple and yet dumb network capable of run-time service creation, of self organization, of self validation and reporting meaningful events through carefully designed validation processes. This is largely future research work and research in progress.

As a main facilitator of this new paradigm, and as a result new business landscape in the IP based telecommunication, we see the adoption of a new business model by network providers – a group mediation.

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The Strategic Implementation of the Adoption and Implementation of e-Business by UK SMEs in Light of EU Policy Initiatives

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Abstract

This paper details doctoral research currently underway which analyses the strategic implications of the adoption and implementation of e-business by small-and-medium-sized enterprises (SMEs) in the UK in light of (European) EU policy initiatives to that end. SMEs find themselves having to operate without role models and tested business plans within an increasingly complex and competitive environment. Through in-depth, qualitative case studies, this research seeks to answer the following questions: How do SMEs cope with the introduction of e-business, most specifically the Internet and mobile technologies, and how does it influence and shape their agendas and how they operate? How is e-business, with a particular focus on Internet and mobile technologies, redefining business processes and functions in SMEs in the UK in the light of EU policy initiatives? And how relevant, accessible and coherent are these initiatives to SMEs? The paper presents a distinctive use of theory as a means for addressing this research agenda and presents expected contributions to theory and practice. Soft Systems Methodology (SSM) is proposed as a guiding framework, enabling discussion to take place about the requirements of SMEs within the context of their organisational setting. Using the rigour of systemic thinking as a basis, criteria for the assessment of IS quality. A modified form of SSM and an emphasis on the cultural aspects of SMEs is proposed for the definition of relevant (in-context) notions of the strategic implications of e-business on SMEs.

Keywords: SMEs, e-business, EU Policy Initiatives, Soft Systems Methodology, Action Case Research

1. Introduction

A significant number of European Union (EU) projects and policy initiatives have been introduced in recent years to aid and manage the impact of e-business on small and medium

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enterprises (SMEs). But have these policies and initiatives focussed on the real needs of the majority of adopters of the technology? And how much practical guidance do they in fact offer?

This doctoral research examines the practical impact of EU policy initiatives on SMEs who have adopted and implemented e-business in the United Kingdom (UK), with a view to instruct feasible changes. Focussing on six UK case studies, the research examines the impact of EU policy initiatives, and is designed to investigate the way in which SMEs traverse unfamiliar landscape and manage. Through a narrative research approach informed by concepts from soft systems methodology (SSM) in combination with action case research, this research develops our understanding of SME policy initiatives in the UK and the EU which has implications for future policy initiatives, that they become more relevant and coherent to SMEs.

2. Background and Objectives

The motivation for this research arises from a practical problem. SMEs need to have suitable opportunities to assist them adopt and implement e-business, not least because of the way that e-business has enabled new companies to compete with and out-manoeuvre market-dominants. However, the use of information technology, especially Internet and mobile technologies, is having an impact not only on the way companies sell their products but on the very way they conduct business (Kalakota, Robinson and Tapscott, 1999). E-business offers many possibilities and threats, which SMEs need to be aware of and deal with.

To better understand recent developments, the study will begin with an examination of relevant examples of attempts undertaken by SMEs to recognise and address the strategic implications of e-businesses on their operations, and will survey the strategic consequences of forging new practices, partnerships and alliances. The research will show to what extent these factors reflect significant changes in wider social, cultural, theoretical or historical perspectives, and an account will be made of the wider frameworks in which these operate.

It is in this context that we are interested in the potential role of SMEs, and more particularly in the way in which it may be influenced by appropriate public policies to create new opportunities for SMEs resulting from e-business developments. The research will also examine the effects e-business has had in recent years on the relationships between SMEs and their customers, in order to ascertain to what extent e-business has affected the nature of the relationship within and between a company and its customers, and the way in which companies see themselves, set their agendas, and operate. The research will seek to determine the ability of mobile and Internet technologies to transform traditional business models to enable collaboration, and to what extent this transformation, if it has occurred, has provided new opportunities for SMEs.

It would benefit SMEs to understand the relevance of e-business in relation to their operations, but how to employ strategies in order to harness the opportunities for growth.

Many SMEs in the EU are unsure as to how e-business can benefit their business, as they lack knowledge of good e-business models.

SMEs cannot compete with large companies head on, as their advantages stem from different business characteristics. For example, a large company can take advantage of economies of scale, spreading out fixed costs throughout the product line using its sheer size. SMEs, while unable to do this, are usually more flexible and controllable, and able to react faster than large companies to the business environment (Nunes and Cunha, 2000). They are thus able to take advantage of various niche markets that may be profitable. However, experiences from SMEs' adoption of e-business, primarily the Internet and mobile technologies, show that small business are reactive rather than proactive, usually doing just enough to meet their customers' requirements (Chen and Williams, 1998). Studies also show that e-business cannot promise growth for SMEs – access is dependent on the way it is used. Appropriate government policy initiatives operating alongside education initiatives would facilitate the successful adoption and implementation of e-business by SMEs.

This research will examine the impact of EU policy initiatives on UK case studies, throughout concentrating on specific and detailed case studies, and focussing analysis on the strategies employed to investigate the way in which SMEs traverse unfamiliar landscape and manage. Emphasis will be placed on hard data and substantive analysis. Detailed tables and charts will be provided for each critical area, along with an overview of national data, data produced by international organisations, unclassified government data and the results of original research. Through a narrative research approach informed by concepts from SSM, in combination with action case research, this doctoral research project develops understanding of SME policy initiatives in the UK and the EU. This has implications for future policy initiatives, that they become more directly relevant and coherent to SMEs.

3. SMEs

According to the UK's Small Business Service statistics, there were an estimated 3.7 million businesses registered in the UK at the start of 2000. They provided 45% of the UK non-government employment and 38% of the economy's turnover. The SME sector plays a leading role in the development of new technologies and the creation of innovative products (Troye-Walker, 1998).

3.1. EU Projects and Policy Initiatives for SMEs

The EU has oriented a significant number of actions relating to e-business towards SMEs in order to build on the potential advantages that it can generate, with the primary emphasis on creating a favourable competitive business environment in which SMEs can flourish.

It is intended that an outcome of the research will be to formulate a framework to enable translation of an SMEs' vision and strategy into a coherent set of performance measures, or tools, to channel the energies, abilities, and specific knowledge held by employees towards achieving long-term goals. To this end, the research will examine a set of case studies from

which ideas and organising frameworks can be discussed for thinking about the strategic posture of SMEs.

4. Research Questions

This research project seeks to answer the following research questions: How do SMEs cope with the introduction of e-business, with a particular focus on Internet and mobile technologies? How does e-business influence and shape their agendas and how they operate? How is e-business redefining business processes and functions in SMEs in the UK in the light of EU policy initiatives? And how relevant, accessible and coherent are these initiatives to SMEs?

Through a combination of the use of SSM and action case research, focussing first on the analysis of EU policy initiatives, then on SME case studies based in the UK, this research aims to ascertain the level of legitimacy of these initiatives to the "real" experiences of SMEs. The next section outlines the theoretical grounding of this research in order to provide the reader with a basis for understanding the way the data is being collected, handled and analysed.

5. Theoretical Framework

This research is an interventionist rather than observational study. SSM provides the guiding framework, enabling discussion to take place about the requirements of SMEs within the context of their organisational setting. Using the rigour of systemic thinking as a basis, criteria for the assessment of IS quality have been introduced as a way of identifying the aspects that are of concern. A modified form of SSM and an emphasis on the cultural aspects of SMEs provides the definition of relevant (in-context) notions of the strategic implications of e-business on SMEs.

SSM was developed through practical application and experience in a wide variety of complex managerial systems. The methodology articulates a process of enquiry that leads to action. It is a learning system concentrating on complex, problematical human situations that leads to taking purposeful action that is aimed at improvement. The outcome should seem sensible to all concerned in a given situation, also provide an effective and efficient way to carry out a systems analysis of situations in which technological processes and human activities are interdependent.

5.1. Soft Systems Thinking

The aspect of SSM that seems particularly significant with respect to defining the strategic implications of e-business on SMEs is the recognition of logic-based and cultural streams of analysis. The logic-based analysis may result in changes that are systemically desirable, but those changes must be perceived as being culturally feasible.

SSM involves systems thinking, where systems are characterised by communication, control and emergent properties relating to the system as a whole. The system is seen as an adaptive whole that has the potential for survival in a changing environment. In SSM systems ideas

are not used in an ontological sense; the models created through systems thinking are systemic, but the problem situation ('real world') is considered to be problematical. The systemic models of purposeful activity are based upon an explicit recognition of the Weltanschauung, or worldview, of the interested party, that makes the transformation performed by the system meaningful. The logic-based stream of analysis, which is concerned with the building of relevant models of human activity systems, is complemented by a cultural stream that allows social and political factors to be investigated. There is also a strong emphasis on a continuous cycle of purposeful action and learning.

6. Research Approach

SSM is, in essence, a form of action research, a form of inquiry which addresses complex real-life problems and the immediate concerns of practitioners (Avison et al., 1999). Action research begins from the interventionist viewpoint that if a researcher wants to understand a situation well they should try to change it (Easterby-Smith et al., 1991). According to Galliers (1992), action research is "applied research where there is an attempt to obtain results of practical value to groups with whom the researcher is allied while at the same time adding to theoretical knowledge".

Action research encourages researchers to experiment through intervention and to reflect on the effects of their intervention and the implications of their theories (Avison et al., 1999). Action research also has the goal of gaining knowledge through making deliberate interventions in order to achieve positive and desirable change in the organisational setting (Braa and Vidgen, 1997). In action research, the researcher will try out a theory with practitioners in real situations, gain feedback from this experience, modify the theory as a result of this feedback, and try it again (Avison et al., 1999). One or more cycles of research can be completed before the goals are achieved.

Although an increasing body of literature exists in hard copy and online, there is no single comprehensive work that examines the historical and sociological context of the strategic implications of e-business on SMEs, considers recent EU projects, and draws together the issues involved.

6.1. Case Study Research

With the intent of understanding "how" and "why" SMEs change their structure and nature of work from the introduction and implementation of e-business, Yin (1994) recommends the usage of case study as a methodology. There are particular advantages for conducting a case study when seeking to understand a contemporary complex social phenomenon, as the method enables "an investigation to retain the holistic and meaningful characteristics of real-life events – such as organisational and managerial processes" (Yin, 1994). Thus, case study research can be considered in terms of an approach to a situation with a particular focus on what is unique and what is common about a particular case.

Galliers (1992), further, identifies the major strengths of the case study approach as being that it captures "reality" in a greater detail and that it is possible to analyse a greater number of variables than other approaches, but acknowledges the major weaknesses as being the

difficulty of generalising and acquiring similar data from different cases, as well as the lack of control of different variables.

The concept of choosing strategic, or critical, cases was raised by Stake (1994), who suggests that they should be cases of particular interest and with strategic content in relation to the research questions investigated in order to highlight the different aspects of a particular problem situation. Stake also stresses that extreme and atypical cases tend to give more information and illuminate more aspects of the situation under review.

This research focuses on conducting research among a selection of very different chosen case studies, to highlight contradictory and paradoxical issues in order to contribute to existing theory and illustrate the inadequacies of the relevant EU policies and initiatives for the purpose of constructing more appropriate initiatives in the future.

6.2. Action Case Research

Building understanding of how SME-targeted e-business policies are developed and used in social, business and government environments involves research into SME cases in their everyday contexts in order to learn about their practices, problems and concerns, and in order to generate useful and usable research and theory. A greater understanding and analysis of professional practice will inform theory as well as practice. Indeed, Braa and Vidgen (1997) argue that "the primary laboratory for IS research is the organization". Researchers have also stressed the importance of a theoretical or purposive strategy for choosing cases to review (Pettigrew, 1990), the rationale being that given the small number of organisations that can realistically be included, a selection strategy is needed to serve as a lens to magnify the research topic. Thus, Pettigrew (1990) argues for the inclusion of polar opposite cases in order to contrast the topic of interest.

This proposed research will not only attempt to observe, interpret, and understand, but also to intervene in and change, the practice under study, a process which has been labelled action case research (Braa and Vidgen, 1997). Braa and Vigden advocate a means of adapting SSM's action research so that it can become useful as a realistic research strategy, and they advocate clear guidelines for well-delineated research practices. They also acknowledge the dilemma of a single researcher with limited resources attempting full-scale action research projects, and suggest that small-scale interventions based on deep conceptual understanding provide a pragmatic and feasible approach.

6.3. Empirical Design

Triangulation of various sources of data will be applied to the case studies, in accordance with standard qualitative research design to tackle the validity and reliability of case studies (Marshall and Rossman 1995; Yin 1994). Six case studies have been chosen and researched, and a pilot is currently underway on one. The researcher will obtain information through semi-structured interviews with the accelerators of the case studies and their associated stakeholders. Walsham (1995) argues that interviews are the main source of data for interpretative case studies because they can grasp the interviewees' interpretations of their action and events, as well as their beliefs and aspirations. In semi-structured interviews, the

researcher has pre-established a set of categories and questions that direct the interview, as opposed to an unstructured format, in which the interviewee is allowed to express any and all views held of the phenomena under study. For this research, there will be a pre-established set of categories corresponding to the theoretical framework and sub-units of analysis. Despite this, all interviewees are able to express their views on any and all aspects they consider to be important and/or relevant.

These interviews will be supplemented with interpretations of internal material and documents, external reports, industry reports, popular press, and observation. Qualitative observation is naturalistic in that it records events of the quotidian life of the phenomenon under study in its real context. Observations open the phenomenological complexity of the world and allow the researcher to witness connections and relationships (Silva, 1997).

7. Expected Contributions

It is anticipated that this research project will contribute to the literature in several ways. Firstly, through the documentation and reflection of the impact of EU policies and initiatives on a selection of differing UK SME case studies. This may help practitioners to better identify and manage the issues contributing to the breakdown or legitimisation of a project initiative, and to encourage timely and informed new initiatives.

Secondly, research focussing on the SME experience of adopting and implementing e-business, specifically Internet and mobile technologies, can only serve to provide much-needed visible role models for the many SMEs that remain isolated.

Thirdly, this practice-oriented research project will develop notion of applying action case research to SSM (a combination which has been under-theorised in the literature).

8. Conclusion

The most desirable outcomes for SMEs successfully adopting and implementing e-business will be achieved only if suitable public policies are designed, implemented and evolved. It is the design, implementation and evolution of these policies which is the real challenge facing SMEs, policy-makers and researchers. Insofar as deployment of new technologies may hinder the creation of production networks, policies may be sought to offset any negative effects; insofar as deployment of new technologies may be insufficient, policies may be sought to supplement their role; and insofar as deployment of the new technologies may facilitate the creation of production networks, policies may be sought to stimulate their advantages.

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IBM – Strategy to Success

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Abstract

The need of the strategic response to the today's challenges of the emerging IT markets is considered in the article. To demonstrate the practical aspect of transforming the business strategy the authors consider the case of the industry leader IBM as an example of successful business revitalizing.

Keywords: business strategy, emerging market, IBM

1. Introduction

The competitive strength of multinational corporations is determined by a number of economic factors and strategic priorities. Economic growth can be generated either by increased inputs of capital and labor or by more efficient use of those inputs – as a result of new technology and better management. In the United States and other developed economies, where the capital stock is already large, such priorities are labor – cost oriented, therefore, technological advances and efficiency gains are the keys. In Europe, the economies are much less capital – intensive and natural resources cost awareness prevail. Japan is known to uniquely combine both factors, contrary to the South Asian markets where the production process is comparably more labor – intensive and capital investments are scarce, therefore, innovation is less important**.** The shortfalls of the labor growth slowdown in Asia are being offset by improving the quality of workforce through education.

Even if growth in developed economies is spurred by the IT revolution, emerging economies could outpace them if they pursue sensible economic policies. Depending on development planning and chosen strategies set by today's trends in international cooperation, multinational corporations are facing the challenges of production cost reduction, employment market fluctuations, scarce natural resources, environmental issues

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i.e. The Old and New World economies are dealing yet with another set of newly emerged priorities imposed upon by the expansion of technological progress:

- to develop friendly policies and favorable economic environment to ensure small and medium size innovative business development and growth;
- to legally secure expansion of new technology market wide through worldwide cooperation and partnership;
- to provide open standard industry wide solutions;
- to research and develop new patterns in customer's behavior and employee's corporate code of conduct.

Though, prudent market and fiscal policies, economies that are open to trade and foreign investment and efficient banking system are all essential in allowing technology to be diffused more speedily.

2. IBM Strategic Responses to the IT Challenges

The emergence of IBM as the industry's leader in the world of information technology is the perfect example of such a winning strategic business orientation.

IBM's problems are related with the fail to focus on emerging technologies. Owing once 80% of the US market, the company focused too long on a maturing mainframe business, allowing smaller firms to lead in emerging markets for PCs, software, etc. (Stauble, 2000).

The explosion in computer networking and the Internet drove the computing world back to IBM. The company, which only yesterday appeared incapable of adapting to a world of open standards, specialization and change, is not only back in the game, but it ended up winning it. The corporation reemerged with the mindset of a customer.

The answer to problems of promoting its own products and coordinating the different parts of IBM into providing the kind of solution customers were looking for lays on what become the company's key strategy: the customer comes first, IBM comes second, business unit comes third. The solution approach has been pursued by numerous companies; many large firms in the IT industry, including IBM (the critical part of the turn-around of the company in the late 1990s was when IBM decided to sell product from other suppliers, as well as its own) remain competitive when they changed from a product to a solution approach (Tvede et al., 2001). Customers are always entitled to best solutions, if IBM doesn't have the right product it will offer a third-party alternatives.

2.1. Partnerships Strategic Orientation

In most markets, contrary to common practice, instead of opening a new branch, IBM starts with exploring possibilities for creating new partnership with already established market players using such cooperation as a platform for further market integration. Lower startup costs and less strict small business worker protection laws make it easier for innovative small business to enter the market and experiment on small scale to test the markets and to

expand. In a period of rapid technological change, greater experimentation allows new idea to be tried out more swiftly. To choose new partners among most successful is the IBM's main strategic objective.

Teaming up with multiple affiliates allows IBM to be closer to their markets and to escape the overhead of opening a branch in the new market. It's a known fact that 30-35% of total productivity growth is driven by what happens within existing companies. Shifts in market share play only a small role. In high-tech industries, new firms are found to make a far bigger contribution to productivity growth .The key insight's was that technology was now more than just a productivity tool, it has become fundamental to how a company operated and thus a central source of the company's competitive advantage.

If there is a need to open a branch, the following market requirements must be satisfied: the presence of a great production and distribution potential, most favorable economic conditions for company's growth and a set of implemented laws of physical and intellectual property protection, and at last, political stability as the main factor of company's longevity in a given economy. Analyzing the impact of regulation and labor markets on productivity, and particularly the ways in which regulation might deter a new company from setting up a branch (entering the market) influences the company's decision to advance.

2.2. Market and Customer Definition

IBM's transformation to success began years before the concept of e-business was introduced to the market. E-business defines a marketplace where business capitalize on Internet technologies and network computing to transform their internal processes, strengthen their relationship with customers, suppliers and business partners; buy and sell products and services; and leverage information for competitive advantage. While IBM has been promoting the vision of e-business, the company has been hard at work becoming an e-business themselves.

In 1993 IBM confronted a critical, company-wide situation when its existing business practices and initiatives were not delivering desired business and product results (Ruddle et al., 1999). The company was operating as a confederation of 20, near-autonomous business units with independent processes, systems and IT structure. The business was highly complex with more than 5,000 hardware products and 20,000 software offerings. This complexity was not only difficult to manage, it also made it difficult for customers to deal with. The customer delivery and development cycle times were unacceptable because of skills imbalances, poor teamwork and an internally focused culture.

3. Creation of New Business Model

3.1. IBM Strategic Change Directions

Changing the business model would involve facing critical business demands (internal customer focus, a highly responsive supplier, operations that could deliver quickly to the market, timely and reliable information, integrated processes, one face to customer) and improving the complexities in three crucial areas:

- Technical and administrative operations – eliminate redundancies and unnecessary business complexities that caused errors and poor cycle times; decrease unreasonable expense levels related to excessive application development and maintenance.
- Finance – eliminate multiple general ledgers and payroll systems (from 282 financial systems to 30; implemented one global general ledger and a single payroll system in the US)
- Information systems – change IT architecture according to business needs eliminating redundancy and ineffective development.

3.2. Transformation Program Elements

IBM responded to the financial and business crisis by initiating *major transformation programs* that consisted of multiple interrelated efforts:

Restructuring the workforce **–** involved establishing cost and expense reduction task forces and implementing a new performance assessment and compensation process

Reengineering IBM – radically changing the way of doing business, involved redesigning major processes and the product portfolio, as well as changing company's culture and behavior, The goals were to reduce expenses and to restore profitability.

Reducing complexity of business operations to improve customer responsiveness and to renew IBM's customer and competitive focus.

Reinventing for growth **–** converting company's business systems from segregated to integrated, from locally dependent databases to worldwide in nature capable of supporting an e-business environment.

3.3. Business Objectives

To implement the transformation efforts the aggressive overall business objectives were established:

Increasing speed of execution. IBM wanted to improve its market-to-market performance and responsiveness to customers, as well as improve delivery time for products (PCs within hours, servers within two weeks, to develop hardware platforms and integrated solutions in less than a year)

Establishing efficient operations. Redesigning the processes with a focus on integration, standards and learning included bringing sales, general and administrative finances in line with the industry and consolidating worldwide procurement.

Meeting customer needs and values: providing a consistence interface to customers worldwide, as well as establishing partnerships with the best outside companies.

Leveraging teamwork across organizational and functional boundaries involved sharing customer information and best practices, using consistent approaches and processes worldwide

4. New Strategy Implementation

4.1. IBM 3-Phase Strategy

The transformation to success involved a *three-phase strategy*:

Phase 1: Assessment and Strategy – identifying opportunity priorities and target objectives which included:

- identification of customer satisfaction requirements;
- benchmarking and competitive analysis;
- assessment of current business issues, such as financial, organizational, process and IT (information technology);
- tactical decision making, such as how to achieve cost and expense reduction.

Phase 2: Design – creating process redesign and deployment plans that produced:

- measured results;
- incremental improvements;
- enablers, such as measurements;

Phase 3: Launch – to produce measured results through:

- conducting pilots;
- implementing reengineering processes;
- managing sustained change;

The program has been managed within a transition management framework illustrated in Fig 1.

As part of an overall drive to transform the company and regain its leading role in information and technology management, IBM launched several reengineering efforts.

To accomplish this transformation IBM needed a clear roadmap that could help maintain tight linkage between business strategy, organization capabilities and technology.

4.2. New IT Model Implementation

To support the company's strategic vision, IBM needed a new framework of managing, developing, deploying and operating information systems within IBM – *IT (information technology) process* to improve the effectiveness of information resources, generate a higher return on the global IT investment and enable employees to become more productive and to better serve customers. The implementation of the new IT model has allowed IBM to:

- aggressively reduce costs and optimize investments in IT resources on a worldwide basis, including people, hardware, software and applications;

- lead and facilitate use of technology and information management to gain competitive advantage;
- clarify the lines of authority and accountability for IT investment, decisions, executions, deployment and results;
- improve ease-of-use, data integration and support so employees could be more productive and responsive to customers;
- accelerate IT response to changing business requirements, technology, application development, common systems deployment, education and so on.

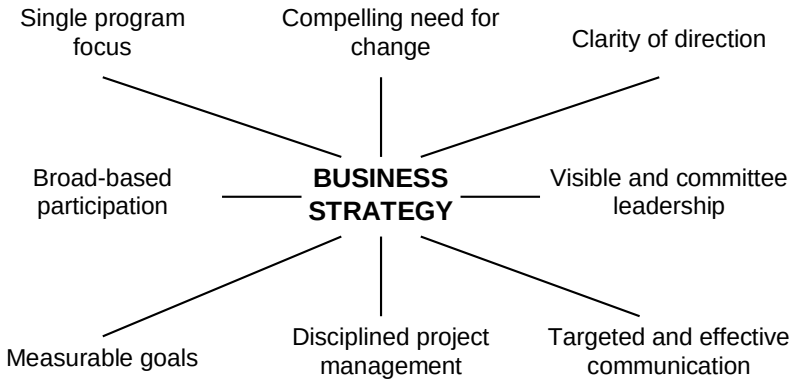

Figure 1: A transition management framework.

4.3. Customer Relationship Management

Customer Relationship Management (CRM) is another process deployed as one of the reengineering initiatives. CRM is a set of common, worldwide processes that govern the relationships and sales transactions between IBM and its customers. These processes (Campaign Execution, Relationship Management, Sales Execution and Sales Management) focus on satisfying the customer's needs and on helping the sales force realize revenue objectives. The successful implementation of the CRM strategy is enabling IBM to:

- provide global access for any customer to a single IBM Company;
- deliver the right skilled resource, at the right time and at the right cost anywhere in the world;
- focus the sales channels on the right markets worldwide and equip them to win;

- execute in the right transaction cycle time;
- share resources and information worldwide.

4.4. Integrated Product Development

One of the most important efforts was the introduction of a new process known as *Integrated Product Development (IPD).* It was initially adopted in hardware and then adapted to support software and service offerings.

This process provides an industry best mechanism for effectively developing, in a timely manner, competitive high quality offerings, it redesigns the way IBM manages individual investments in development projects allowing to reduce product development expense while decreasing time to market, from concept to delivery, to less than a year, and to increase customer and shareholder value.

4.5. The Integrated Supply Chain

The integrated supply chain (ISC) was identified as one of IBM's major business transformation initiatives. Along with optimizing the company's inventory investment, the main goal of establishing a new supply chain was to improve customer satisfaction, shareholder value and IBM competitiveness by increasing the speed, reliability and efficiency with which IBM products were delivered to the marketplace. By accomplishing this mission IBM has accomplished highly reliable deliveries, high level of customer and business partner satisfaction, delivery simplicity and efficiency, improved supplier ability to respond, reduced inventory requirement, responsiveness to market, lower commodity cost, cash generation.

4.6. Customer Fulfillment Initiative

To reverse the negative trend in customer satisfaction, IBM identified the following overall objectives introduces as *Customer Fulfillment Initiative*:

- accurate, timely and complete access to information;
- delivery based on committed date;
- easy access to IBM and knowledgeable sources;
- flexible, consistent and simple terms and conditions;
- international solution design and delivery support;
- simple, responsive, customer-selected ordering vehicles;

By implementing this strategy IBM has established a single worldwide customer fulfillment process; replaced more that 200 independent systems with a single comprehensive worldwide system; increase overall customer satisfaction with customer support; improved the commitment-to-request date; improved on-time delivery; reduced time from order to install; improved billing and invoicing accuracy.

The evidence is that the accross-the-enterprise decision to move to a single global process offered a significant opportunity to be more efficient and to reduce costs, thereby, increasing competitiveness.

5. Business Strategy Challenges

5.1. New Information Economy

To attain a more advantageous stance on the market, IBM widens its business vision to encompass more than the WEB opportunities, it embraces the fact that business is conducted in an increasingly information-centric environment driven by rising customer and stockholder expectations and dependent upon a host of technologies that help fulfill them. To remain effective the company recognizes the challenges the new information economy and adjusts its strategy to face new realities:

Globalization – today's marketplace, free from traditional boundaries, invites new competitors and customers worldwide.

The customer experience becomes more personal, clients want more attention and customized products and services, they expect real time answers and superior usability.

Immediate gratification: capitalizing on an "always open" environment, the pervasiveness of wireless technologies is turning online activities into a 24x7 proposition.

Business is both simpler and more complex: personalized technologies have made thing simpler, but these new tools have also resulted in enormous volumes of data, additional processing requirements and more complicated transactions.

The enterprise is more connected and accessible: internal processes are now outwardly visible, data can be shared with vendors and customers through extranets.

The world is more intelligent and integrated: exchange of data and automation of processes

Decline in the cost of producing: what was traditionally sold is now given away in the name of branding or market share.

5.2. IBM Approach to the Marketplace

The key challenge now is addressing today's pressing needs, while still building the capabilities needed to compete successfully in the future. Dealing with these issues necessitated that IBM altered its approach to the marketplace and developed the new strategies for success:

Operational excellence. How a company relates to consumers and interacts with suppliers, distributors and retailers will distinguish industry leaders.

Customer insights: IBM collaborates with partners and customers to collect pertinent consumer data that lead to selling opportunities, better product designs and increased brand loyalty.

Effective partnering: establishing strong partnership with suppliers, access providers and content creators.

Recurring revenue: creating revenue streams from innovations, bundling hardware with service, content or other solution to address unique consumer requirements; earning royalty payments from licensing a design or software used industry wide.

Regulatory and legislative monitoring: to built legislative support IBM stays politically informed and involved willing to ally with other industry players, even competitors, to help shape relevant political and regulatory outcomes.

Standard setting engagement: company attained a leadership position in the worldwide industry standard-setting process; the openness of the standards in emerging industries helped IBM to benefit from its proprietary standard (Prahalad, 2001).

Flexible game plans: competition is based not just on price but on speed-to-market, creative alliances or an innovative combination of products and services. IBM simultaneously nurtures, coordinates and controls all domestic and international business initiatives.

To compete successfully in the digitized world, IBM e-business strategy encompasses the full spectrum of the networked economy: a host of electronic relationships, an unlimited amount of information and an expanding set of intelligent devices, all fulfilling a role in the dynamic new business model. Once the intelligent infrastructure of an automated economy emerged, the current set of challenges was replaced by new ones and addressing them timely helped IBM produce immediate benefits and build flexibility for the future.

6. Global Strategy for the Russian Market

Few would dispute the fact that the Russia's market of technological innovations is the biggest in Eastern Europe and it has always been of great interest to IBM. 1997 was marked as the IT industry's most successful year in post reform Russia. The abundance of investment capital seemed to last eternally, but these hopes were shattered by the economic crisis in 1998. Analyzing the consequences of the default and witnessing the ability of Russian small and medium businesses to quickly adjust to the harsh economic downturn and maintain their profitability, IBM has changed its strategy in favor of cooperation with such flexible and innovative market players.

The core of the developed economies lies in small and medium size company production. Each of the America's biggest corporations today has established business relationships with over 200,000 partners and suppliers. Most of the IBM's partners are e-business systems innovators, rather than consultancies (because they do more than just giving strategic advise) or system integrators (they not just build off-the shelf solutions that can also be bought by competitors). IBM can provide hardware, software, training, security, networking and services to pull everything together, and meanwhile, allows the companies to be themselves. What has changed is that they now have IBM money, distribution and R&D (Research & Development) resources behind them.

The attraction of going to IBM is that it indisputably has a variety of products as well as an army of consultants with knowledge of event industry and huge system integration experience. Customers are getting more demanding looking for a customized solution delivered within days. At the same time, most firm's manufacturing processes are becoming increasingly dispersed and global, and they are turning to IBM to implement technology to speed up the information exchange with their partners and collaborate on planning.

To its own advantage, IBM doesn't have to deal with constraints and overhead of establishing and managing multiple branches everywhere in the world and still being able effectively reach millions of new customers and capture new markets. In 1974 IBM was the first multinational technology corporation that entered the Russian market by starting operations out of its branch office in Moscow. In 1991 IBM founded its subsidiary IBM USSR, which, after the Soviet Union was dissolved, transformed into its current entity IBM Eastern Europe/Asia and conducted business as a Russian firm ever since. The company started with the distribution of infamous IBM PCs, the range of products and services offered today runs from operating a number of education and service centers to developing a variety of integrated software solutions for Russian companies.

The whole of IBM is worth more than its products its services and this lays in the foundation of the company's code of conduct. Employee's own commitment to make IBM work, respect to each other, teamwork, better solutions and best service to customers is the only definition of leadership that matters. "Our customers will tell us if we've achieved it," has become the company's strategy to success.

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MANAGEMENT TRENDS
AND
MARKET TRANSFORMATION

Perspective of the Market and the Control Over the Firm: Thoughts in View of the Informational Revolution

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Abstract

In the article the question is put about the macroeconomic control over the economy during its development since the agricultural model until the postindustrial one. Three main types control are distinguished. The latter, the informational one means the elimination of the market as the economy's regulator. Between the market and the informational types the transition one appears.

Keyword: macroeconomic informational space

1. Introduction: Putting the Question

At the beginning let us note the most important features of the market that are interesting for us. Firstly, it is a set of transactions, an exchange space. Secondly, market is a mechanism that is running the economy, the synonym of the Invisible hand by A. Smith or of the Auctioneer by L. Valras. The instrument of control over each system is information. Consequently, market is an informational space, the space of information flow.

It is not enough clear why the market emerges, why the economy is in need of the Auctioneer. Under some circumstances the economy exists without it, subsistence economy par example. Even under division of labor and exchange (the small medieval town economy) market is not powerful, does not run this economy. This was noted be K. Polanyi (Polanyi et al., 1957).

The economy, each economic system is composed of two sections (consumption and production) that are mutually subordinated and closely interlinked, informationally too. Production delivers to consumption information packed into goods. This is consumption's feedback information. Consumption communicates orders for goods that forms production's feedback. Thus in the economy as a whole the control over both production and consumption intersects. The direct communications circuit of one controlling mechanism

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forms a feedback circuit of another. This is the general macroeconomic picture that aggregates informational flows of a number of isolated systems of control over each economic actor. The character of the control over the whole economic system depends on the quantity and relationships of these microsystems. It is possible to distinguish two main types of the economy's regulation and running: 1) the "direct" one and 2) the market, the Auctioneer. The content of producer feedback circuit and its place in the information's flow form the difference between these types.

2. Non-Market Economy's Regulation

In the subsistence and small medieval town economy producers' feedback information (consumers' orders) is input directly into producers mechanism of control. In the subsistence economy, where the number of economic actors equals 1, where firm and household, producer and consumer coincide fully, the subject and the set of control over both production and consumption, the information's processing appliance coincide too. The control over this sole actor (firm-household) coincides with that over the whole economy as well.

In a small medieval town economy, where the economic actors' number is more than 1 though not great, there is not such coincidence. Firstly, the control over the firm is separated from that over the household. Secondly, control over economic actors becomes both isolated within the whole economy's control and simultaneously woven together with it. The firm's direct communications circuit is situated inside the firm, as it is formed by decisions concerning production. These decisions predetermine goods' output that gives the feedback information to households. Decisions about the income are taken inside the household, then communicated to the firm in the form of consumer's orders. The latter represents the firm's feedback information.

Thus the direct communication circuits are incorporated into the firm and the household. The feedback information circuits are situated outside, beyond the economic actors and form the common overall informational space in contrast to individual ones inside firms and households. It is important to pay attention to this old economy's analysis as this dichotomy characterizes the market economy as well.

In a small town economy information flows directly from consumer to producer and back since all producers and consumers are acquainted with each other as their number is limited (Goubert, 1958). There can emerge a kind of consumers' network around producers if this number increases. Under these conditions the control over both production and consumption is united and indivisible, control mechanisms intersect and feedback circuits form their intersection. It means that the control over each economic actor corresponds fully to the above described rules of general control over the whole economic system, reproduces it on a small scale. There is no contradiction between macro- and micromechanisms of the control over the economy.

It is extremely important to point out that in the subsistence and small medieval town economy the feedback information is perfect and complete as it comes to producers directly

from consumers. This feedback information is processed inside the firm by the same processing appliance – producer's brain, by which decision-making is done. Therefore producer's decision-making in the small town economy is determined as well as in the subsistence one. The economy is controlled by this simple mechanism. There is no need in something additional. This is a direct, determined type of the firm's control.

3. Market as Economy's Regulator and Its Paradox

Market changes the situation. In a market economy with a good deal of actors (perfect competition) producers networks are destroyed, the direct information's exchange between producers and consumers is physically impossible. Consumers' orders enter the common overall informational space without concrete addresses and producers do not receive the feedback information from concrete consumers. That's why this information is indefinite, imperfect. Goods are output into the market without addresses as well. Firms and households have no direct communications. In this sense economic actors are informationally isolated.

If so, the economy does not exist. The blockade of information flow between production and consumption deprives the economy of its essence, contradicts the general rule of production-consumption suitability. Since the economy continues to exist and even to develop one must conclude that economic actors are informationally tied. There is a sole way for their connection – the common overall space of feedback information. This space where feedback information enters without concrete addresses is market. Thus the relationship between economic actors passes through the market informational space.

As it was mentioned, the information from both sides is sent without addresses. Therefore it is wandering in the informational space and is inaccessible to economic actors who are standing beyond the market walls. Their situation is similar to that of the explorer who observes the gas in the closed container. He cannot watch the movement of each gas molecule directly. He can apprehend the picture only by means of macroscopic indicators: temperature, pressure etc. In a similar way producers have no information about concrete consumers' orders. Market gives them only aggregated information about prices – the core of market's informational output. This means that the market processes the initial data and takes one function of producer's brain, that of feedback information analysis. It is doubtful however whether the market can fulfil this function better. This circumstance can strengthen the imperfectness of the market informational output.

Thus in the market economy (perfect competition) producer's control over production is limited to one circuit, that of direct communication like in a small town economy. In contrast to it the producer's brain is deprived of the function of the feedback information analysis and is limited to the elaboration of decisions on the base of market information. Similarly is limited consumer's control. The very important part of the control over both the firm and the household (the processing of the feedback information) is transferred to the market.

The peculiarity of market informational space is its coincidence with exchange one. In the small town economy producer feedback information's flow is independent on that of goods as it comes to producer directly from consumer in its own informational form. K. Polanyi distinguishes trade and market (Polanyi et al., 1957). In the market economy the feedback information is price. It means that it is indivisible from goods, is objectified, packed into goods. Therefore the sole communication way from consumers to producers passes through goods exchange. The informational space and the exchange one are stuck together.

Let us back to the analogy with gas. The gas explorer is in a better position, than producers around the market walls. The macroscopic information, that the explorer receives, is relatively precise, as temperature, pressure etc. are measured by relatively accurate apparatus. Producers do not have such apparatus. They must be satisfied with the information that the market them gives. They do not know how it is processed and prepared. The market is similar to black box. Consumers input into it their communications and the market outputs the information to producers.

As they do not know, what occurs inside this black box, the economic theory was appealed for help. Research of the market black box was its main task during more than two centuries. The result cannot inspire. It is recognized that the market information is imperfect and incomplete. We can find this statement in textbooks (e.g., Baumoll and Blinder, 1985; Barro, 1990).

Really, each event in the market informational space occurs at random as the information is wandering like molecules of gas in the container. Information, that producers receive, represents random variables. Consequently producers make decisions under the uncertainty. This situation attracted economists' attention. One of the first was, may be, F. Knight (Knight, 1921). In contrast to the small town economy the firm's decision-making becomes a stochastic, not determined process. This is the subject of information economics that can intersect with marketing.

The important step to the solution of the problem is the rational expectations theory and the new classical macroeconomics (Sargent and Wallace, 1976; Lucas, 1981; Begg, 1983; Dornbusch and Fischer, 1987). However there is a lot of critiques of it on the ground that economic actors do not know probabilities of events in the market and cannot make decisions in accordance with the initial consumers' information. Really, if producer does not know the probabilities of two events that stimulate price increase (1 – the rise of the aggregate price level and 2 – a relative shock in the market of a good) he does not know how to react: to produce more or not. Thus he cannot make correct decision.

May be, it is possible to solve this problem using Bayes criterion (e.g., Hovanov, 1998). However the mathematical instrument and procedure are so sophisticated, that the usual economic actor cannot use it. Mathematicians, statisticians and psychologists (e.g., Albert and Sponsler, 1989; Hogarth, 1975; Johnson et al., 1993) estimate rather negatively the human ability to get the probabilities information and to process it. Empirical researches (Lovell, 1986) demonstrate as well, that economic actors make systematic mistakes in their expectations. There are doubts about the new classical equilibrium approach too (Mishkin,

1982; Gordon, 1982). Thus the conclusion about information's imperfectness, more precisely about unmeasurable uncertainty (Knight, 1921) remains valid.

This conclusion contradicts the central idea of modern mainstream economics, that about the power of the market to run the economy. Rational expectations is an attempt to solve this problem. However if we refuse rational expectations conception, then the above mentioned contradiction remains. Thus, we are standing before two contradictory statements:

1. The market runs the economy as the market information is perfect or can be corrected.
2. The market information is imperfect and cannot be corrected what impedes the regulation of the economy by the market.

In order to try to solve this problem it is helpful to put a question whether one statement really is in contradiction with another. Let us consider this question.

4. Hypothesis of the Paradox Solution

What is estimated in the economic theory as a best and desired position of the economy, what is the goal, to which the market leads it? It is production-consumption equilibrium that is automatically achieved under the influence of the market without any intervention from outside it. In contrast, the thesis about information's imperfectness argues against the equilibrium attainability. However it is not doubtless that the market can not aim at the equilibrium even under the condition of imperfect and incomplete information. This hypothesis can not be explained and argued with the help of traditional economic theory. We have to appeal to physics and to the theory of information.

We can consider the economy as a physical and informational system that is run by natural and informational principles, in particular by those of thermodynamics. Each close system transits automatically to the more and ultimately to the most stable (most probable) position, that of its thermodynamic equilibrium, that is to say of its maximum entropy. Information is mostly unarranged, disorderly and erratic in this position. This thesis correlates well with the above-mentioned description of market informational space: information is wandering at random. This space draws entropy in, what is necessary for the very existence of the economy, as each system must have a kind of entropy's pull. The market is a pull of economic entropy. In this way it plays a very important role in the economy.

In the physical systems the state of thermodynamic equilibrium is achieved under the temperature of absolute zero. There is no changes, no movement inside the system in this position. If production-consumption equilibrium is the most desired position of the economy, the latter risks to stay for ever in this position. Perfectly competitive firms at the equilibrium point (the intersection of average and marginal cost curves where the price line is tangent to the average cost curve) are not stimulated to change their path. Thus the market's mission is to assure equilibrium, quietness and unchangebility, that is to say stagnation. This is the fully negative estimation of equilibrium and of the market' mission in the economy.

However, the absolute zero is unattainable (the third principle of thermodynamics) and the economic equilibrium as well. It exists only on the pages of textbooks, is an abstraction. Otherwise the economy would remain on the stage of traditional society, but in reality it has achieved much higher one. This means that the economy grows and develops contrary to the market that leads it to stagnation. Why is the economy growing? What is the source of this growth and development? It is the openness of the economy (not in the sense used to being interpreted in the economic theory), that guarantees the entrance of the new additional information, that increases negentropy and stimulates informational structurization and changes. Negentropy's increase counteracts the movement to equilibrium.

As to this tendency to equilibrium, whether it is really purely negative? Since economic equilibrium is born by general principles of the Nature, as we have decided earlier, then this tendency is inevitable and justified. Economic equilibrium expresses the production--consumption suitability that is the core and the essence of the economy itself. If this suitability is distorted the economy does not exist at all since production is created by the Humanity in order to consume. That is why the tendency to equilibrium is the immanent feature of the economy. Thus, the market's mission can be estimated not only negatively but positively as well. Two sides of the market medal is the basis for development of market apologetics on one hand (modern mainstream economics) and of its critique on the other (Marxism is the most striking example).

In the real market economy both tendencies are present and active. If they are interlaced rather proportionally (it is a pity that the science does not know this proportion) the so called balanced growth takes place. If the negentropy's tendency prevails the unbalanced growth develops. If on the contrary the latter is suppressed the stagnation can threaten the economy. Anyway the market plays an important role in the economy's running and regulation.

5. Informational Revolution – The New Stage of the Control Over the Economy

Now we return to the informational revolution and its influence on the economy's regulation and on the market. What is the informational revolution's content? From the informational point of view economy is a complicated hierarchic system of control that is composed of a great number of controlling microsystems. A digger with its shovel is such system and this is his difference from animals. The digger's mechanism of control over the shovel includes both direct communication and feedback circuits. Really, if the shovel runs against the rock, the digger comprehends this as feedback information, processes it in his brain and changes the direct order to the shovel, par example changes its inclination. Each worker controls its machine tool in same way. Thus information plays the leading role in the control over each economic system. However we do not speak about informatization of peasant farm in the XYIII century.

Informatization means the transfer of control functions from the human brain to artificial intelligence. Artificial intelligence interpretation by specialists is multivarious. From the economic point of view even the calculator is an artificial intelligence. Remember that the

famous mathematician of the XYIII century L. Euler could multiply two six-figures in his brain in two-three minutes. The calculator substitutes for this function of L. Euler brain though modern specialists will laugh at the idea of giving to calculator the status of artificial intelligence.

The logic of calculator consideration permits to conclude that machine tools include some elements of the artificial intelligence, those of direct orders. Surely the spinning-machine substitutes mainly for human hand and muscular power but the direct communication circuit of the control over spindles and their spinning is partly transferred to the machine.

According to this interpretation of the artificial intelligence, it is possible to distinguish the stages of its development in the industrial epoch. The agricultural one and the traditional society did not know the artificial intelligence at least in production. Industrial model of the economy introduces it into production and develops it till now. The industrial machine takes the simplest operations of the direct communication circuit of the control over the object of treatment. The feedback remains in the worker's brain as well as more complicated operations of the direct circuit. Mechanization is the gradual progressive substitution mainly but not exclusively for human and animal's muscular power. Machine takes some, though very simple human brain functions as well.

Automation is the new stage in the industrial artificial intelligence development. The feedback circuit is partly transferred to machine. Automation can be and is realized on the basis of microprocessors and so called microelectronic revolution, the peak of which is the construction of fully automated works that are run from the central control panel. Automation and microelectronic revolution is limited to works, to relatively small parts of production.

Surely the fully automated production in the scale of the whole economy can be imagined. Even the real attempt was undertaken in the soviet economy in 70-80th. The conversation is about automated control systems (in Russian ACУ). They were ineffective, less effective than the old mechanization (Goskomstat SSSR, 1990). In western countries such gigantic projects were not popular. May be the reason of their ineffectiveness was their too early appearance. May be the complete automation and computerization of production solely without its relationship with consumption is useless as it transfers to united on the scale of the whole economy artificial intelligence the control only over production, that is to say only over the direct communication circuit. The feedback is not taken into account, though it is not less important.

The informational revolution can unite in the artificial intelligence both control's circuits on the basis of new informational technologies and achievements in cybernetics. The informational revolution embraces the whole economy, the control over production, consumption and their relationship. The informational revolution mission is to transform all principles of information's flow in the economy. The informational space can become an overall web where all economic actors are represented and interconnected directly and in real time. This hypothesis is grounded on the experience of some firms and networks that are controlled in this way. In the web each economic actor, each producer can receive

precise information from concrete consumers like in the small town economy. This information is perfect and complete.

6. Market Elimination

Modern economy differs from the small town one in the economic actors' quantity. Their great number can give the abundance of information that cannot be processed by human brain especially in real time. The artificial intelligence will be in need that can first of all process the initial data (consumers' orders) and to prepare them to use in decision-making, where human brain continue to play an important role.

In this mechanism of control over the firm the direct communication circuit and the feedback information processing are incorporated into the artificial intelligence that substitutes for some human brain functions and multiplies its abilities in these functions. The black box of the market will be eliminated from the economy's regulation. Market will lose its control over the economy and its power. The web of artificial intelligence appliances will substitute for it. Market in its present state and role will disappear. The informational space will divide from the exchange one. Only relatively small part of information destined for consumers remains packed into goods and will pass through the exchange space.

Divided from the exchange space, arranged by artificial intelligence the informational space will transform into the source of negentropy whereas it was the pull of entropy inside the market. Market disappearance deprives the economy of its former entropy's pull. The new one has to be constructed. What it will be? This is a very important problem.

The above designed picture is extremely remote. It can be achieved only step-by-step. First of all, there is a good deal of technical problems to be solved. Those in economic theory are not less. At the beginning of this transformation its costs will be enormous in terms both of negentropy and money. One can foresee that these costs increase is not justified economically, is very risky and may be not profitable. Producers do not want and/or are not able to support them.

This problem can be solved in two ways. The first is the construction of the unique public artificial intelligence appliance connected with and open to all economic actors who will buy the information they are in need. This is the way passed by some infrastructural branches in the XX century in Europe. The result is the reinforcement of the economic power of the state. The "American way" is different. Great corporations create a few overall artificial intelligence appliances and sell the information as well.

In both cases the informational space divides from the exchange one since information's flow is following its own path. Information is not packed into goods or services. Simultaneously informational space stays within the usual market rules since information is considered and estimated as the usual service or good. The market of information with all above described peculiarities of the market becomes the master of the economy in place of goods and resources markets. Consequently the information's market becomes the pull of entropy as well.

Whether the economy will gain any advantage? Doubtless. The information becomes perfect and decision-making can be transformed into determined process. Transaction costs will be reduced to informational one though the latter can be great enough especially at the beginning of this transformation. May be the developed economy enters now into this way to the informational market that substitutes for those of goods and resources in the role of the Auctioneer. Out of two mentioned theoretically possible ways of the informational market creation the "American" one seems more realistic to all appearances of the contemporary economic development.

However under this condition the situation is not absolutely perfect from the point of view of uncertainty and transaction-informational costs. If the information's market is functioning under perfect competition, the uncertainty and the lack of information about probabilities remain the obstacle to the determined decision-making. If the oligopoly situation prevails, the danger of transaction-informational costs increase appears. The improvement is connected with the advances of informational technology and cybernetics.

Communication and artificial intelligence appliances will become cheaper and cheaper and will be within reach of every economic actor like personal computer now. Under this condition the designed overall web of direct real time communication can develop. The information's market will disappear like that of goods and services. There will be no obstacle to determined decision-making. The transaction costs will disappear together with the market. Informational cost can be included into production one. The situation is similar to that of the small town economy. But where is the pull of economic entropy?

Besides the technological difficulties on this way, there are those connected to the economic sciences. The artificial intelligence demands programs with the help of which it can process information. Software is based on mathematical models. Since the artificial intelligence has to substitute for the Auctioneer, to take its functions, we are in need of the Auctioneer functions models in order to provide software for the artificial intelligence

There is a lot of formalized macro- and microeconomic ones. But they include variables that are already aggregated, not the initial ones. These models are beautiful but not enough helpful for the practical purposes of economic artificial intelligence construction. Marketing researches are much nearer to the real life and consider initial signals from consumers. But they take into account rather limited and isolated groups of these signals. There is insufficiency of aggregation in marketing researches. To construct mathematical models of the Auctioneer both marketing approach and that of economic theory are necessary.

Let us continue the analogy with gas once more and remember that the relationship between the features of microscopic corpuscles (gas molecules – isolated economic actors) and the values of macroscopic structural dimensions (temperature, pressure etc. – prices, quantity sold and demanded) is not enough clear. Its full and precise determination demands the integration of all economic sciences mostly disintegrated now. The situation is in some sense similar to business reengineering. Instead of division of labor reintegration is an acute need in economic researches.

Thus there is a long way to the Auctioneer elimination and to the appearance of the overall artificial intelligence appliances web in its place. Nevertheless there are some singes of the movement in the direction to market atrophy. Institutionalization of goods exchange is an example (Williamson, 1986). Contracts form the direct linkages between producers and consumers of definite product. Though contract prices are set not without the influence of the market, they are sticky during the contract period what assures nearly determined decision-making as the Auctioneer can not intervene.

Surely there are sometimes great ex post transactions costs that weaken the determined character of firm's running. Nevertheless the contracturalization of goods exchange is a step towards the Auctioneers elimination. The part of the economy, where this process develops mostly, is networks. Modern network represents a sketch of future non-market economy. May be the path to this new economy is composed both of the construction of the information's market and of networks development and expansion.

7. Short Conclusion

The general conclusion is about the types of the economy regulation. At the beginning of this article we have distinguished two of them – the "direct" one and the market, the Auctioneer. Now we can add the third type – the informational one. It is similar to direct but differs from it in scale. The informational type means the overall direct control over the whole economy in contrast to small town very limited economy's regulation mechanism though direct as well.

From the Auctioneer the informational type differs in the lack of the black box on the way of informational flow and in the quality of information that producers receive. The present situation can be estimated as a transition's beginning. This thesis correlates with the statement about the contemporary transition from industrial to postindustrial economy and society. The informational type of the economy's running is the feature of mature postindustrial economy. There is a very long way to it.

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IT and Innovations in Multinationals: Experiences From Product Development at SCA and IKEA

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Abstract

The aim of this paper is to formulate a theoretical framework for investigating and understanding the role IT plays for innovations and, in particular, for the innovation process, i.e. "how and when" innovations emerge. We support our conceptual discussion with concrete examples on how two large Swedish multinationals, the forestry giant SCA (Svenska Cellulosa AB) and the leader in furniture retailing IKEA, use a particular type of IT-solution, in their product development processes. We conclude that single IT tools play different roles for each phase of the innovation process, but that interdependencies between phases and coordination between IT tools is a key issue.

Keywords: Innovation process, IT, multinationals, SCA, IKEA.

1. Introduction

Successful innovations, in terms of new products and production technologies, are recognised as the key to competitive advantage (Tidd et al., 2001), especially for multinational enterprises (MNEs). Since the 1960s, information technology (IT) has been applied to most business activities (Davenport and Short, 1990). This holds also, increasingly, for the management of innovations (Bessant and Buckingham, 1993). MNEs have invested in a large variety of IT solutions, ranging from Intranets to CAD/CAM and ERPs, with the purpose of improving their performance in innovation tasks and even their control on the innovation process (Tidd et al., 2001, pp 113-114). IKEA and SCA, two large Swedish MNEs, are not exceptions to this trend. But they often use IT in different and unexpected ways, and its role in their innovation efforts is far from being clear-cut and unequivocal.

The key question becomes then: what *concrete* role do these heterogeneous IT solutions play in a firm's innovation work (e.g. in product development)? How are they concretely

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used? What do they contribute with and why? Answering these questions requires, first of all, making clear what is meant by IT and to focus on *specific types* of IT solution and their *functions*. Secondly, it requires to make clear what is meant by *innovation* and to identify its key dimensions. Innovations and IT are, in fact, broad and complex phenomena that must be qualified and treated within a structured framework. Therefore, the aim of this paper is twofold: 1) creating this framework and 2) applying it to a couple of empirical settings where specific IT solutions are used in innovation work. This is nonetheless just the first step towards answering the above questions on IT's role for innovations, since they can only be answered by investigating as many empirical settings as possible.

Section 2 includes our theoretical framework on IT and innovations. The theoretical discussion is followed, in Section 3, by two empirical accounts: SCA's innovative activities on customized packaging solutions; and IKEA's work on developing one of its best-selling product, the sofa table "Lack". We apply here our theoretical framework in order to highlight the relevant questions listed above. The empirical material was collected through personal in-depth interviews with over 40 individuals at SCA, IKEA and at other involved firms (suppliers, partners, customers etc.). We conclude the paper, in Section 4, with the discussion of the two cases according to our theoretical frame and with a series of relevant issues about the role of IT tools in the innovation process and its single phases.

2. A Theoretical Framework on the Role of IT for Innovations

Our basic assumption is that IT is a tool whose concrete role in innovative efforts, such as product development, largely depends on factors outside the tool itself. Each IT solution's "internal" technical features are certainly important, but they must be confronted with what surrounds it in terms of where and when it is used, for what purpose and by whom.

Understanding innovations requires having clear "what" is innovated (the innovation *object*), "how and when" (the innovation *process*) and, finally, "where" it is innovated (the innovation *context*). Our theoretical framework stresses therefore these three factors and the tight interplay between them. In this paper, we focus on the role of IT within the innovation process, but at the same time we need to take into account also the other two factors, the innovation object and context. Firstly, we need to identify the dynamics of the innovation *process* and how it proceeds. Secondly, we need to consider the specific characteristics of the innovation *object*. Thirdly, we need to frame the process in its intra-organizational and inter-organizational *context*. Only after we recognize the interplay among the three aforementioned issues (innovation process, context and object), can we discuss the role of IT within the innovation process. We arrange this theoretical framework by first tackling IT-tools and their potentials. We move then to the issue of innovation, starting from the necessity to specify its process-like nature and, then, its object and context.

2.1. Information Technology as Tools

We consider IT as a series of *tools* used during the various phases of the innovation process. Like any other tool, IT has technically defined internal *potentials* but is also attributed great *expectations* for stimulating and enabling innovative processes. The range of IT-solutions is

nonetheless so wide that both potentials and expectations vary widely and make it *impossible to treat IT under a single heading*. Despite being increasingly integrated, such IT-applications as CAD systems differ greatly from e.g. ERPs or Intranets. Integration creates strong interdependences among IT tools that make it difficult to separate the effects of one form the others, but we need to stress the different functions and effects of the single IT tool. This holds especially for their influence on the innovation process and its outcomes. We therefore restrict our empirical investigation to single specific IT-solutions, by considering abstract technical potentials, expectations and actual use for each of them.

The *potential* functions of IT tools for businesses are suggested by Informatics and Computer Sciences. Examples are data collection and processing, process and output monitoring or steering, inter-system and inter-individual communication, simulation and informative functions to sustain decisions by managers (Simon, 1977). IT tools can also become the necessary *precondition* for the performance of key business routines. This list of internal potentials does not necessarily correspond to the actual patterns of utilisation of IT's heterogeneous family of tools: the specific innovation process, its object and its context are all fundamental issues to be taken into account. Potentials feed *expectations*, usually nurtured by IT-developers and top management, but often a mismatch results in the tool's concrete application in innovation processes.

2.2. Innovations: The Innovation Process, Object and Context

The innovation process: A better understanding of the role of IT for innovations requires considering the ways a specific IT tool can impact on the different phases of the innovation process. This depends on how and when this tool comes on to the scene of the innovation process. We therefore present a generalised description of the phases characterising the innovation process, inspired by Van de Ven et al. (1999), Tidd, Bessant and Pavitt (2001) and Håkansson and Waluszewski (2002). This non-linear and path-dependent process (Rosenberg, 1994) starts from *idealization* and moves through spirals of *concretisation* leading to the *emergence* of a viable innovative solution. The innovation process proceeds then with *introduction* and *spatial diffusion* leading to local *utilisation* by firm-internal or external users. While being modified and adapted to local contexts, the innovation is *exploited* until it decades or is so substantially changed to be no longer recognised as the "original" innovation. We claim that any single IT-solution play very different roles in e.g. idealization as compared to exploitation.

The innovation object: Of course, also the nature of the innovation object (e.g. product vs process and incremental vs radical innovation) and its characteristics (complexity, tacitness, novelty etc.) affect the way IT-solutions intervene in the innovation process. But we treat the innovation object as a given and focus instead on the relevance of the innovation context for the use of the IT-solutions in the innovation process.

The innovation context: We envisage this context as expressed by the firm's *internal network* including the *focal unit* (Forsgren et al., 2000; Andersson et al., 2001), which initiates the innovation process, and by the surrounding external *business network* (Håkansson and Snehota, 1995). On a more detailed level this context is textured in terms of

specific routines (Nelson and Winter, 1982; Grant, 1996), organizational structures (Bartlett and Ghoshal, 1987; Hedlund and Rolander, 1990; Gupta and Govindarajan, 1991), cultural cues, knowledge and capabilities (Kogut and Zander, 1993; Nelson and Winter, 1982). *We claim that each specific IT-solution plays very different roles for a given phase of the innovation process, depending on the specific innovation context.* The way the MNE is internally organized, the initiating unit characteristics, the level of corporate and external embeddedness (Andersson et al., 2001; Andersson and Forsgren, 1996) all intervene in affecting how the IT-solutions we focus upon are concretely used, irrespective or their technical features and the managerial expectations about them.

The possible roles of IT in the innovation process can be *enabling*, *speeding up*, *focussing*, *directing* and *integrating*, but also *leaving unaffected* or even *restraining* the whole process, or just *specific phases* of it. But it all depends on the innovation object and context.

3. Experiences from Innovations at SCA and IKEA

3.1. Customized Packaging Solutions at SCA Packaging

SCA produces and sells absorbent hygiene products, packaging solutions and publication papers (SCA business areas are: SCA Hygiene Products, SCA Packaging and SCA Forest Products). SCA net sales amount to more than 9 billion Euros annually. At the beginning of 2002, the number of employees was approximately 40,000, in some 40 countries.

SCA Packaging division is Europe's leading producer of corrugated board and containerboard, and one of the world leaders in "*customized packaging solutions*". 35 million packaging units are delivered daily from SCA's more than 220 plants in Europe, North America and Asia. Customers range from food companies to retailers and producers of industrial products. These packaging solutions are the *objects of innovation* efforts by SCA Packaging. They differ one from the other in terms of characteristics (mainly size and design), applications and functions. Differences in product innovation are mainly due to the specificity of customer needs.

SCA uses IT systems throughout the value chain, from the development stage to the final product. IT is used for online sales, logistics, supplies, communication and administration. SCA Packaging perceives IT p*otentialities* to be very high, especially for product development activities. Today IT influence on innovation processes is mostly in terms of speed of the development, but major steps have already been taken to improve quality and content of the innovations and their processes. *MIDAS* is one of the most interesting information systems used within SCA Packaging. MIDAS is an IT tool that helps designers to develop and tailor optimal packaging solutions for the many different customers needs. Although IT solutions at SCA are usually independently chosen and managed by the single unit, MIDAS is a clear exception. It has been developed in house by SCA Packaging HQs and it has been adopted by almost all the subunits in the division. It is composed by an extensive database of CAD drawings, user instructions, properties and material details, and basic box characteristics. All this enables designers to have the necessary information available when developing a new "packaging solution".

The *innovation object* is *incremental* product developments with rather low complexity and explicit nature. SCA consumer and industrial packaging solutions use, in fact, basically the *same* materials, corrugated board and containerboard (although they might be sold with other packaging materials, such as plastics, metal or glass). They have also similar components, but very specific functions (protect, carry, store, display, etc), which, depending on the specific solution and customer, could be more dominant than the others (e.g. strength and corrugated container resistance are fundamental for industrial machinery transport boxes).

The *idealization* of new packaging solutions starts in one of the many units distributed in the different countries and does not involve any participation of SCA Packaging headquarters. The solution is clearly customer driven and its *concretization* is the result of the interaction between the customer and SCA local unit's development team. Thus, SCA Packaging units rely to develop their solutions on: a) their capabilities, resources and previous experience, b) the interaction with the customer, c) SCA's internal network of information and resources. Information is obtained through interaction with other sister units dealing with similar customers and through the access to different product solutions already existing and made available via MIDAS. Resources such as raw materials are mainly provided by SCA Packaging mills (testliner and kraftliner) and by SCA Forest Products (pulp and recycled paper). The new packaging solution created is then *sold* to the specific customer, but *introduced* in many different markets. This is because the innovated package *follows* the customer's products and production facilities. Moreover, by *sharing* the new solution developed (and its documentation) with the other SCA Packaging sister units, there are good chances of finding other customers for the same packaging solution, through the other units local market and network. It is in this way that the innovation of one unit is *exploited* in many different markets and by many other SCA units, for many more customers.

Approximately 800 persons are involved with RandD, an effort that awarded SCA with more than 4000 patents. RandD resources and responsibility are distributed to the various business areas. At SCA Packaging, RandD specifically focuses on product development with emphasis on improved performance, cost effectiveness and better design. SCA Packaging has a large decentralized network of resources devoted to product development, which operate close to the customers, and a central more traditional RandD center, which conduct mainly basic research on raw materials. The cooperation with suppliers is very limited and almost all the efforts are dedicated to the interaction with customers, mostly face-to-face. This is mainly due to the very nature of developing "customized solutions".

What is MIDAS' role in the overall innovation process of customized packaging solutions? During the fist stage of *idealization*, ideas come from the very intense interaction with customers and the understanding of their needs. In the following stage of *concretization*, customers still play a central role for determining the functions and applications of the packaging solution. But it is through MIDAS that the package characteristics are determined and finally *emerge*. Because of the CAD database and the interactive applications that MIDAS withholds, this IT tool became fundamental for the integration, diffusion and exploitation of new products information (MIDAS generated documents are then stored and

made available for the all network of sister-units.), and for the development of the final blueprint. MIDAS covers mainly products' technical details, but very little production process specifications and marketing information. To summarize, MIDAS does not appear to be useful or used in: a) the *early stage* of idealization, since the SCA unit mainly interacts with the customer, b) the introduction, which is managed by personal interaction with customers, and c) utilization, since customers have no access to MIDAS. But it largely contributes in the specification, concretization and product emergence phases. MIDAS plays moreover a sustaining role in the internal diffusion of the innovation.

3.2. IKEA and the Table "Lack"

IKEA is a worldwide leader in furniture retailing, with sales, in 2001, of over 10 billion Euros. IKEA employs over 65000 people in its retailing, warehousing and product development operations. Its home furnishing products are distributed through a worldwide network of 180 retail outlets. Ikea's business idea relies on developing and procuring, in close connection with over 2000 suppliers, furniture products that reunite "form, function and affordability" and that are made available to over 200 million consumers in self-service show-rooms. IKEA's strategic centre, "Ikea of Sweden", is in charge of developing each of its over 10000 products.

IKEA is a production-led retailer: "Ikea of Sweden" neither picks suppliers' already existing products nor designs products without taking into account the available production facilities. "Ikea of Sweden" is instead constantly involved with suppliers and develops products that are "engineered for manufacturing" in order to obtain as low production costs as possible. This is particularly important for a product manufactured in large volumes like the sofa table "Lack", one of IKEA's absolute bestsellers reaching the 2.5 million units sold yearly. "Lack" was launched over 20 years ago, but its retail price has been kept constant through all these years. The secret behind this miracle has been a continuous work of product development where "Ikea of Sweden" and its suppliers are constantly involved. Innovation efforts around "Lack" aim at marginal improvements of materials, production technology and colours.

One of IKEA's central information systems is named PIA (Product Information Assistance). This system was introduced in 1998 also to support product developers at "Ikea of Sweden" in the management of innovation projects, such as those around "Lack". For this purpose, PIA is equipped with a database including a large amount of product-related information: supplier identities and contracts, production technology and quality certifications, technical descriptions of "Lack" and the related CAD files. PIA includes also an application that allows product developers to launch also electronically each innovation projects they start on e.g. "Lack". They can set dates, budgets and goals for the project. By compiling regularly a series of flaps they can follow up actively each single projects from start to conclusion, when the product is launched in retailing. PIA is fundamental for innovation efforts around "Lack" especially because of a particular internal routine at IKEA: each product modification, before being introduced to the retailing units, must be preceded by a PIA-borne message called "News" and by a detailed "Technical Description" that can be produced only by using PIA. These documents are the information basis to create product-

related information material for sale points and for packaging. Without "News" and "Technical Descriptions" no product can be sold in the IKEA universe.

The *object* of this innovation at Ikea is marginal product modifications, with low complexity but relatively high tacitness. The innovation *process* starts from *idealisation* at "Ikea of Sweden" and becomes *concretised* in a development project that specifies goals, dates and budgets. At this stage of the project, suppliers of materials, lacquers and "Lack" manufacturers are engaged in the innovation process. The specific technical solutions adopted *emerge* in the interaction between "Ikea of Sweden" and these various actors. The innovated "Lack", e.g. with a new type of veneering material, is *introduced* to all IKEA retail units around the world, in absolutely standard form. In this way, the marginally new "Lack" is *spatially diffused* and gets *locally utilised* by each IKEA store. During a certain period of time, the specific new "Lack" is *exploited* by retailing units to sustain their sales volumes. After a while "Ikea of Sweden" considers though the time ripe for a further new modifications of this product, which signs the *decay* of the one currently present in retail stores. The innovation process can thus start again in a cyclical fashion.

The innovation *context* typical for marginal developments of "Lack" includes "Ikea of Sweden" as a driving actor. This unit involves actively its external network of suppliers in finding technical solutions to achieve project goals that it usually defines rather independently. To find concrete solutions, face-to-face meetings are usually held, especially on the factory floor. "Ikea of Sweden" pushes then the new "Lack" in unvaried and standardised shape to all retail units all over the world. The only possibility retail units have to affect product development is during the periodic meetings with "Ikea of Sweden". But retail units give only feedback on the already introduced modifications of "Lack", rather than suggesting future ones. IKEA would, in fact, never be able to cope economically with all the requests for adaptations and new features suggested by local retail units.

What concrete role does PIA play in the innovation process involving "Lack"? Product developers claim that they never use PIA in the idealisation phase, since ideas derive from other sources, such as meetings with suppliers, retail units or personal intuition. The same holds for the concretisation of the innovation project goals, dates and budgets, even though some "Lack"-related projects are actually inscribed into PIA at this stage. But soon, product developers escape from PIA and avoid it through the whole phase of emergence of concrete solutions, during which they instead interact with their supplier network. Because of the "News" and "Technical Description" routines, PIA becomes instead fundamental for the introduction of the new "Lack" to the retail units. Spatial diffusion and local utilisation depend largely on the local context in terms of retail unit interest and consumer tastes. But still, PIA-borne documents are presented to and used by these units, also in handling physically "Lack" inside the store. Moreover, consumers are reached by PIA-borne information in the form of assembly instructions, price tags and packaging information. Finally, also the famous IKEA catalogue relies for advertising information and product pictures on key documents generated inside PIA. All in all, PIA contributes, quite unexpectedly, much more to the phases of innovation introduction, diffusion and utilisation, rather than to idealisation, concretisation and emergence.

4. Discussion and Conclusions

The two empirical descriptions highlight the different roles of specific IT tools in the innovation process. MIDAS and PIA are differ in terms of potentials and functionalities and they affect differently the innovation process and its various phases at SCA and IKEA (see Tab. 1). While MIDAS speeds up and directs concretisation and emergence of innovations, PIA leaves these phases substantially unaffected. Conversely, while PIA enables innovation introduction, diffusion and exploitation, MIDAS almost disappears from the scene in these phases. The variation in this pattern of effects is due to 1) MIDAS and PIA's different potentials and technical functionalities; 2) the different innovation contexts at SCA and IKEA, in terms of routines and intra- and inter-organizational networks; 3) the different innovation objects (customised vs. standard products).

	Idealiza-tion	**Concret-ization**	**Emergence**	**Introduc-tion**	**Diffusion**	**Exploita-tion**
MIDAS	NO/YES*	YES	YES	NO	NO/YES**	NO
PIA	NO	NO	NO	YES	YES	YES

*MIDAS intervenes in the late idealization stage, after a customer has already specified its needs, by presenting and combining already existing packaging solutions.

**MIDAS intervenes in the diffusion of the same, given, packaging solution between sister units.

Table 1: A Comparative Table on MIDAS and PIA's role in the innovation process.

Tab. 1 shows that the role of a specific IT tool seems to be localized on just one or a few adjacent phases of the whole innovation process. Is this a rule or just a coincidence? We assume that this pattern is related to how the IT tool's specific functions relate to the innovation context and object, thereby delimiting also the scope and domain of usability of a certain IT solution. Since single IT tools cannot cover all phases of the innovation process the question is how to sustain the whole process by using IT. Shall firms use many single separate IT tools or a whole large integrated system? Neither approach is best: what really matters is *matching* each single phase with the right IT tool and building in *inter-phase coordination* between tools. This calls for a deep *understanding of the innovation process*, both as a whole and in terms of its specific phases, each one with different IT requirements. Single IT tools are to be chosen depending on their potentials. They have to fit the single phase they should sustain and not overlap with each other, but they must also be integrated in order to mirror the way the innovation phases are interrelated within the whole process. The critical aspect is, in fact, that as different phases are connected and interdependent, so have to be also the single IT tools. A large integrated system or a collection of single separate IT tools can both satisfy these conditions.

If you do not understand the innovation process, its different phases and how they relate to each other, you will never be able either to create or to use IT tools to sustain innovations. This holds especially true for tools that should cover the whole innovation process. A

further complication is that the actual performance of IT tools is affected also by the ways the context interplays with each innovation phase. So that the understanding, necessary to create and use IT tools in the innovation process, should stretch also to cover the details of the context where innovation unfolds.

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Privacy in Emerging Technologies as a Management Challenge

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Abstract

The introduction of new ICT technologies into organizations and corporations brings with it the challenge of compliance to a wave of new privacy regulations. As these regulations become more complex, and as privacy itself takes on branding and competitive advantage aspects as well, the challenge of dealing with the privacy issues in emerging technologies becomes a pressing management issue. In this short note we give a brief overview of the challenges involved in successfully integrating new ICT technologies into organizations in a privacy-conscious manner. This paper is part of ongoing studies into privacy issues in technology undertaken at KPN Royal Dutch Telecom Research Labs in the Netherlands.

Keywords: privacy, management, emerging technologies.

1. Introduction

Recent surveys have shown that spending on IT, after suffering during the recent hi-tech slump, is set to recover this year, with the greatest increase in spending in the security area. A survey conducted by Merrill Lynch has forecast a 3% increase in corporate IT budgets for 2002, and 8% for 2003. Security ranked as the top priority for 2002 expenditures. (Itworld.com, Jan. 3, 2002).

This increased spending in the security area brings with it the introduction of numerous technologies with privacy aspects that need to be addressed.

This concern is often most pronounced when government is involved; consider the recent increase in interest in the application of smart ID cards to combat terrorism (See "*Big Brother Aside, Smart Cards are Making Global Converts",* International Herald Tribune, November 16, 2001). For example, Malaysia has recently a multi-purpose card to cover aspects as diverse as driver's licenses and passports, and Macau and Hong Kong have recently introduced smart cards to better control their border with China (See "*Smart cards enjoy boom time in Asia",* Global Sources, January 28, 2002. For detailed information on

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smart card issues, see "*Secure Personal Identification Systems: Policy, Process and Technology Choices for a Privacy-Sensitive Solution",* Smart Card Alliance White Paper, February 2002.). And although national ID cards seemed very unlikely in the United States, in recent months this idea has been gaining support ("*National ID Card Gaining Support",* Washington Post, December 17, 2001.).

The issue of privacy and emerging technology, however, also is of great importance in the corporate sphere. To address privacy concerns, there has been a wave of recent regulation adjusting traditional privacy laws to new technologies. However, in the organizational and corporate environment, companies are often too busy with operational aspects to dedicate resources to privacy, and the result can be that companies are not up-to-date regarding privacy compliance. A recent survey in Australia showed that one thirds of companies surveyed were either not complying with new Australian privacy legislation or were unaware as to whether they were complying. (*Deloitte Touche Tohmatsu, Privacy Survey, September 2001).*

In this short note we provide a brief overview of some of the aspects involved in an organizational policy towards dealing with privacy issues arising from emerging technologies.

This note is structured as follows. In the following section we discuss the motivation behind privacy compliance. Next we discuss two emerging technologies as examples of technologies that will pose major privacy challenges in the years ahead. We close with some aspects of how to measure and audit privacy on the organizational level.

2. Privacy – The Need to Comply

Privacy can be a difficult issue to get the attention of senior management. This is often due to the fact that privacy is not considered a revenue generator, and thus privacy-compliance, particularly in the case of introduction of emerging technologies, is viewed as an add-on to be dealt with after the fact. In this section we briefly outline the danger of this approach, and underscore the practical importance of drawing attention to the privacy issue and achieving privacy-compliance.

The two reasons for achieving privacy compliance that we consider are legal issues and branding issues.

2.1. Legal Compliance Issues

A major reason for organization to formulate privacy policies is complying with relevant legislation. As of the end of 2001, approximately $175 million had been awarded in the United States in settlements of consumer privacy violation cases, with about 70 cases pending. (Privacy and American Business, quoted in Information Security Magazine, November 2001). Major legislation covering privacy has been appearing on both the national and international level.

We briefly mention some major pieces of privacy legislation. Due to the transfer of personal information on customers across national borders via the Internet, legal regulations in one

country may have international consequences. The American Gramm-Leach-Bliley Act of 1999 (http://www.senate.gov/%7Ebanking/conf/index.htm) contains numerous privacy requirements for financial institutions, including that requiring "clear disclosure by all financial institutions of their privacy policy regarding the sharing of non-public personal information with both affiliates and third parties". One of the most sweeping privacy initiatives of recent years has been the EU Privacy Directive, which is relevant to any organization dealing with personal data of customers from Europe. The European Privacy Directive has led to new privacy regulations for any corporation receiving personal data from Europe. These issues are addressed within the so-called Safe-Harbor Agreement. American information on this agreement can be found at http://www.export.gov/safeharbor/. European information can be found at http://europa.eu.int/comm/internal_market/en/media/dataprot/news/datatransf.htm.

Other relevant legislation includes the Children's Online Privacy Protection Rule, an American act which covers any website collecting personal information from children under 13 (http://www.ftc.gov/privacy/coppafaqs.htm). There are numerous other privacy bills currently being considered by the Congress in the US. For a complete list see the following list maintained by the Electronic Privacy Information Center: http://www.epic.org/privacy/bill_track.html. A site with links to international privacy legal developments can be found at http://www.media-awareness.ca/eng/issues/priv/laws/lawintl.htm.

Legal considerations can also sometimes require organizations to intrude on the privacy of their employees. For example, companies can be held liable in the United States for the email actions of employees (see "*Weighing Employee Privacy",* USA Today, July 10, 2001.). So-called "know-your-customer" regulations also require financial institutions in many countries to maintain certain information about customers and their transactions.

Another issue at stake in forming privacy policy is that of being held liable for failure to uphold one's one policy. This situation has been recognized as a problem by the Federal Trade Commission of the United States (FTC assistant director, quoted in "*Privacy: The Liability Link*", ComputerWorld, August 27, 2001.); namely that businesses are dissuaded from posting privacy statements so as to limit their own liability.

2.2. Branding and Public Image Issues

Privacy is increasingly being seen as a branding issue, in which companies can positively differentiate themselves from their competitors by providing privacy protections as a value-added aspect of their product or service. A clear and robust privacy policy can help a company's brand and help to attract customers (see "*A New Covenant With Stakeholders: Managing Privacy as a Competitive Advantage", KPMG, 2001.*).

There can also be severe consequences from negative press resulting from privacy violations. Recently privacy advocates have taken to shaming privacy violators as means to encourage compliance. One example is the Big Brother Awards given in 9 countries to companies, organizations, and individuals that the privacy advocacy group Privacy International deems to be violating privacy (see http://www.privacyinternational.org/bigbrother/). Several companies in the United States have experienced a drop in share value

or business as the result of an announcement by the Federal Trade Commission that an inquiry into privacy practices would be conducted ("*FTC Casts an Eye on DoubleClick",* The Industry Standard, February 16, 2000.).

3. Emerging Technologies and Their Privacy Aspects

There are numerous emerging technologies that carry with them particular privacy issues and which will play a major role in the privacy debate in the coming years.

We will briefly mention two such technologies:

3.1. Location Based Mobile Services

Location-based services are intended to use a user's location to offer him or her location-specific information and advertising. Thus for example, one can submit a query as to which restaurants are to be found in a particular neighborhood and then receive both sponsored (sponsored search results refers to a company paying a fee to have its link included in a prominent place in the search results) and unsponsored search results, in much the same manner as regular Internet searches.

Mobile Internet has experienced much delay and controversy leading to its introduction. There are numerous standards with varying degrees of compatibility. It is clear however that when UMTS (3rd Generation) services are introduced (there are already trials in Japan and Europe) it will signal a major change mobile telephony. One of the major advantages of UMTS is the increased bandwidth and the location-based services it offers.

It is clear that a major part of the revenue model for mobile Internet is based on location based services (see for example comments, Lawrence Ponemon, PriceWaterhouseCoopers, ComputerWorld, Dec 19, 2000.). Such services however provide operators, businesses, and intermediaries a wealth of very sensitive personal information regarding people's mobility.

Wireless security protocols themselves will be very robust in the 3G context, providing much more powerful encryption algorithms than those in the second generation, GSM networks (more information of security and other aspects of third-generation mobile networks can be found at www.3gpp.org). The issue of consumer privacy thus becomes primarily an issue of procedural handling of personal data rather than security.

3.2. Biometrics

Biometrics involve identifying or authorizing an individual on the basis of physical characteristics such as iris scans, fingerprints, voice recognition, facial recognition, and so forth. Biometrics have been accused of being unreliable (for a thorough overview of biometric issues, including performance concerns, see "*Consumer Biometric Applications: A Discussion Paper",* Ann Cavoukian, Information and Privacy Commissioner Ontario (Canada), September 1999) but their use is projected to increase. A recent survey by the Institute of Management and Administration's (IOMA) Security Director showed 20% of security directors currently use biometrics and that the majority of the rest were planning to introduce it (*"Biometrics Use Projected To Increase",* IndustryClick, Oct 22, 2001).

Efficiency issues aside, however, biometrics has already raised major privacy concerns among privacy advocates (see for example *"Have a drink – and check your privacy at the door"*, International Herald Tribune, March 22, 2002.).

One of the privacy issues raised by biometrics is that it allows for an easier cross-referencing of identification information. Thus, for example, a car-rental company in the United States briefly experimented with requiring fingerprinting with rentals that begin at the airport ("*Dollar Ends Program to Fingerprint Car Renters",* Los Angeles Times, January 9, 2002). The prospect of such fingerprints being cross-reference with police databases has raised serious privacy concerns among privacy advocacy groups.

Another major area of controversy regarding privacy and biometrics comes from image recognition technology. This is technology in which identification and authorization can be made on the basis of detailed video images of an individual. Such technologies are already widely in use for identifying criminals in soccer stadiums, in airports, casinos, and public areas. These systems have raised major privacy concerns among privacy advocates (for a critical look at facial recognition systems, see the following essay of the American Civil Liberties Union: http://www.aclu.org/issues/privacy/facial_recognition_faq.html) as they do not require the user to consent to giving their biometric data (as opposed to say a fingerprint where the individual must place their finger on a reader).

For companies that use biometrics to control entry to facilities or with their transaction with customers, keeping abreast of privacy regulations and standards with relation to biometrics is critical. For useful links see also www.ibia.org, the homepage of the International Biometric Industry Association. For information on biometrics and privacy from biometrics company Visionics see http://www.visionics.com/newsroom/biometrics/privacy.html. Further resources are given in the references section at the end.

4. Measuring and Assessing Privacy Compliance

Measuring privacy compliance, particularly in the case of emerging technologies, requires a carefully crafted approach combining procedural and technical expertise.

We briefly mention three aspects involved in measuring and assessing privacy compliance:

4.1. Delegating Privacy

The first challenge is to how to delegate privacy within an organization. Within the United States, the appointment of a Chief Privacy Officer has become common (see "*The Chief Privacy Officer",* Information Security Magazine, 2001; and "*Chief Privacy Officer"* Ruth Nelson and Anne Ladd, PriceWaterhouseCoopers, November 2000). Formulation of a privacy policy often falls under the legal department of an organization (http://www.ahima.org/infocenter/models/PrivacyOfficer2001.htm contains a sample chief privacy officer job description, composed by the American Health Information Management Association). The delegation of privacy often involves identifying competent individuals within the organization and giving the assigned individual the authority to mandate changes that may be required to achieve privacy compliance.

There are several relevant links in the reference section. For more on privacy delegation, see also the publication "*Privacy Basics",* Privacy Council, 2001.

4.2. Awareness of Standards and Developments

Privacy regulations and standards are constantly changing and it is critical for organizations to keep abreast of these developments.

An example of a recent standard is the P3P (Platform for Privacy Preferences), an initiative of the World Wide Web Consortium (W3C), which provides amongst others a technical mechanism for helping inform users about privacy policies before they release personal information (http://www.w3.org/P3P/).

There has been a proliferation of privacy seals on the Internet, such as that of the American Better Business Bureau (http://www.bbbonline.org/privacy/) and that of the non-profit organization TrustE (http://www.truste.org/).

In different jurisdictions there are different standard bodies and industrial groups at work (see for example "*Initiative on Privacy Standardization in Europe",* Draft Final Report, European Committee for Standardization, November 2001.). In addition, many countries have national evaluation laboratories that analyze the social implications of emerging technologies.

In the reference section below we provide references to legal, social, and technical references on privacy.

4.3. Designing and Implementing Policy

There are numerous manners in which to design and implement appropriate privacy policy. For a thorough discussion, we refer the reader to (Ghosh, 2001). Countries in which there is a privacy commissioner or data protection authority also frequently provide resources and references (see for example "*Privacy Impact Assessment: Some approaches, issues and examples",* Blair Stewart, Office of the Privacy Commissioner, New Zealand; for the example of the Netherlands, see www.registratiekamer.nl). Many major consultancy companies also now offer privacy compliance as a standard consulting service.

5. Summary and Further Work

This short note has aimed to provide a very general overview of privacy policy in organizations, and in particular the issue of emerging technologies. It is part of work that is being carried out at KPN Research Labs in the Netherlands aimed at finding a unified approach to privacy issues that arise in emerging technologies (cf. "*Challenges of Developing Innovative Privacy Policies",* Boaz Gelbord, in preparation.). A particular focus of this research is into how the R&D environment can play a leading role in developing technologies that provide privacy solutions.

At present our work is directed at finding effective privacy metrics that can be applied to emerging technologies to assist organizations in making accurate privacy policies.

References and Further Reading

Information on legal aspects of privacy can be found in (Agre. and Rotenberg, 2001; Gurwith, 2002; Strum, 1998; and Turkington and Allen, 1997).

More general privacy issues relating to the social aspects of privacy and surveillance can be found in (Garfinkel, 2001; Parker, 2000; Schneier, 2000; and Whitaker, 2000).

Technical information on encryption, including mathematical background can be found in (Menezes, Oorschot and Vanstone, 1996; and Schneier, 1996). A collection of articles on privacy-enhancing technologies (so-called PET's) can be found in (Federnath, 2001).

A list of privacy-related links is provided below.

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Internet Addresses:

http://www.ieee-security.org/index.html, The homepage of the IEEE Computer Society Technical Committee on Security and Privacy.

http://www.cdt.org/, The home page of the Center for Democracy and Technology, a privacy advocacy/ political organization. Many useful links to privacy organizations and latest privacy-related news.

http://radburn.rutgers.edu/andrews/projects/ssit/default.htm, The homepage of The IEEE Society on Social Implications of Technology.

http://www.cpsr.org/, The homepage of Computer Professionals for Social Responsibility.

http://www.privacyrights.org/, The Privacy Rights Clearinghouse, a privacy organizing dealing primarily with identity theft.

http://www.privacyinternational.org, A UK-based privacy watchdog.

Logistics Competence Provided and Required in Third-Party Logistics Relationships

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Abstract

The third-party logistics industry has shown a strong growth over the last 20 years and during the same period the associated outsourcing of logistics has increased its strategic importance. The purpose of the paper is to describe the views of both shippers and third-party logistics service providers in Europe on the relative importance of resources and skills within the various phases of designing, implementing and operating a logistics system.

Keywords: logistics industry, logistic systems, outsourcing, service provider

1. Introduction

The third-party logistics industry has shown a strong growth over the last 20 years and during the same period the associated outsourcing of logistics has increased its strategic importance (Berglund et al., 1999, Berglund, 2000, Cass, 2000). Lynch (1996) is of the opinion that with the intense competition of today, streamlining and downsizing are virtual necessities, and logistics partnerships afford a convenient and cost-effective vehicle to carry them out. It has also been suggested that an integrated co-operation between the provider and the buyer of logistics services could be one way for the buyer of the services to obtain a high service performance and thereby achieve a competitive advantage. An extensive literature now exists about third-party logistics in the areas of activities involved, driving forces and barriers (see e.g. van Laarhoven and Sharman, 1994, Andersson, 1997, van Laarhoven, et al., 2000). Positive effects have also been documented, such as cost reductions and service improvements (see e.g. Andersson, 1997) but there is a limited knowledge about precisely how these effects are achieved and what demands this process puts on the service providers. The purpose of the paper is to describe the views of both shippers and third-party logistics service providers in Europe on the relative importance of resources and skills within the various phases of designing, implementing and operating a logistics system. The main purpose is to describe the perception of third party logistics

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service providers' current sufficiency of resources and skills as well as their future development in these two areas.

2. Logistics Performance, Resources and Skills

Investigations into the influence of third-party logistics on logistics performance have mainly focused on efficiency (Virum, 1993; Bagchi, et al., 1995; La Londe, 1992; Maltz, 1994). Andersson (1997) points out that TPL can lead to reduced costs and to reduced cycle times and higher levels of quality such as better order completeness and improved on-time-delivery performance. According to Andersson (1997) shippers believe that the main operational benefits with third-party logistics derive from economies of scale, more efficient operations and increased knowledge. That service providers are able to reduce costs in transport and warehousing by achieving economies of scale is a since long established fact (Fernie, 1989; LaLonde and Cooper, 1989; Andersson, 1997; Berglund 2000). More efficient operations could for instance be explained by better operational expertise, introduction of new people and creativity aspects (Andersson 1997). Successful management of complex logistics systems has mainly been attributed to good operational skills and knowledge. Andersson (1995) has shown in a case study how the learning process has influenced cost and service performance, where initially inexperienced personnel had a negative influence on both cost and service.

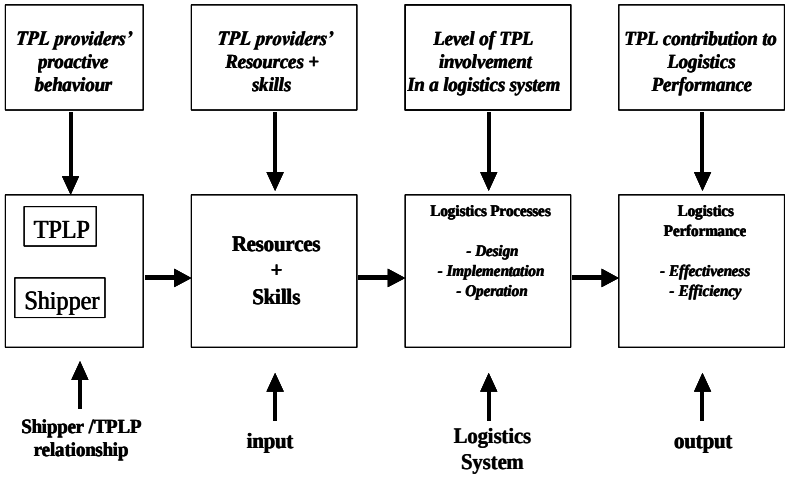


Figure 1:A basic model of the relationship between resources skills and performance.

Different kinds of provider knowledge are according to shippers' opinions, also a major source of long-term service benefits (Andersson, 1997). One of the basic hypotheses in the

project on which this paper is based is that the performance of the outsourced logistics systems is dependent of the resources and competence of the third party logistics providers (See Fig. 1).

2.1. Factors Influencing Logistics Performance and Competitiveness

Lambert, et al (1998) recognises effective logistics management as a key competence required to improve both the profitability and competitive performance of a firm. Bowersox (1996) refers to the strategic importance of logistical management by describing logistics as the competency that links an enterprise with its customers and suppliers. Christopher (1992) discussed logistics competence in the same manner with regards to supply chain management. Gagnon (1999) argues that it might be necessary to adopt the view that the primary goal of an operations strategy is to develop and leverage resources in order to create new market qualifiers and order winners. This content of a strategy would be supported by logistical capabilities deeply anchored within business processes and organisational routines (Nelson et al., 1992; Stalk, et al., 1992).

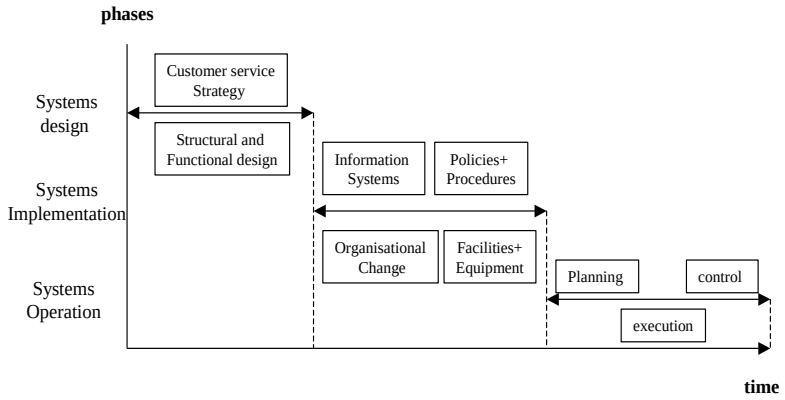


Figure 2: Logistics processes divided into different phases.

In a similar manner the outsourcing of logistics activities to a logistics service provider must also be seen as part of an overall logistics strategy and thus the means of acquiring better or non-existing logistics resources and skills (Bowersox, 1996; van Damme et al., 1996; Gentry, 1996). In previous research the term logistics knowledge has not been clearly defined and it must be noted that it was supposedly mainly related to operational skills. However, to understand the forces determining overall performance it is also necessary to take into consideration the implementation and the design of the logistics systems, which must, to some extent, have an important influence on the logistics performance. Therefore, in order to understand what resources and skills are important for the logistics performance

the design, implementation and operation phase of a logistics system must be investigated (See Fig. 2).

The design phase is characterised by decision making concerned with the channel structure (e.g. which/how many suppliers, wholesalers, distributors) and network structure (e.g. which/how many supplying, manufacturing, and distributing locations). It comprises also decision making about functional elements of the system. The implementation phase is characterised by decision making about the required information systems, policies and procedures, installing facilities and equipment, and changing organisational structures and hiring and training employees. Finally the operational phase is about planning, executing and controlling the day-to-day processes of a system.

Efficient operations and economies of scale are well established concepts and their importance in third party logistics have, as described above, been well documented. However, there is very limited knowledge about the importance of resources and skills in achieving more efficient operations and the benefits of scale economies, as well as their provision in third party logistics relationships. The concepts of logistical resources and skills are, however, widely referred to by many authors in the logistics arena as logistics competence.

2.2. Resources, Skills and Competence

The concepts of competence, capabilities (or skills) and resources descend from a body of literature that is commonly referred to as Resource Based Theory. Numerous writers including Penrose (1959), Wernerfeld (1984), Nelson and Winter (1982) or Schoemaker (1992), or Prahalad and Hamel (1990) have argued that the success of a firm is rooted in its competences and thus its ability to configure its resources and skills. According to Nanda (1997) competencies are 'higher order routines' which develop and configure organisational resources. Nanda draws on the concept of organisational routines (Nelson and Winter, 1982) to explain the anatomy of competencies. Organisational routines are regular and predictable patterns of activities, which are made up of a sequence of co-ordinated actions by individuals and are learned and perfected by continued repetition.

Resources are the strengths or weaknesses of a given firm and can be defined as tangible or intangible assets, (Itami, 1987; Wernerfelt, 1984;). Hofer and Schendel (1978) elaborated these terms a little more and defined the following resources:

- Financial– e.g. cash flow, dept capacity, new equity availability
- Physical– e.g. buildings, manufacturing plants, warehouses, inventories
- Human– e.g. scientists, engineers, sales personnel, Financial analysts etc.
- Technological– e.g. patents, licenses
- Organisational– e.g. quality control systems, cash management systems etc, financial schemes (pensions, share options etc), organisational culture,

Skills [or capabilities] and resources are closely related terms – access to a resource leads to a capability, a capability arises from the possession of a resource and is the potential input from the resource stock into process (Nanda, 1996). A useful typology of capabilities can be derived from Katz's (1974) approach in examining administrative [managerial] processes. He defines abilities [capabilities] as skills that must be effective in action under varying conditions. Katz (1974) suggests three basic skills, which can be developed:

- technical,
- human,
- conceptual

Technical skill implies an understanding of, and proficiency in, a specific kind of activity, particularly one involving methods, processes, procedures, or techniques. Human skill is the ability to effectively work with people [i.e. to manage]. Conceptual skills are the 'creative ability' to co-ordinate and integrate activities and interests towards a common objective.

3. Methodology

In 2000 a group of 11 research organisations and consultants from seven European countries started a project about the role and impact of third party logistics providers (TPLPs) on Logistics and Transport. The three year project was initiated by the European Commission as a part of the Fifth RTD Framework Programme. The project consists of four different parts and elements of one of them are used in this paper. The data collection was based on in depth face-to-face interviews with leading third-party logistics service providers and shippers from four industries (see Tab. 1). The data presented in this paper is a partial result of a survey conducted between November 2000 to June 2001, and in which 76 respondents were interviewed in total.

Industry	TPLP	Shipper	Total
Electronics	12	16	28
Automotive	8	6	14
Food(retail)	9	9	18
Chemicals/Energy	3	13	16
Total	32	44	76

Table 1: The distribution of the respondents.

The sample of TPLPs was determined from a previously compiled list of leading TPLPs in Europe (a result of a separate sub-project) irrespective of their countries of origin. The number of shippers that was to be interviewed in each European country was determined by its relative contribution to Gross European Product. Ten of the shippers in the total sample were determined to be 'European shippers', i.e. not relating to nationally based operations.

4. Survey Results

4.1. TPLP Involvement in Europe Today

Berglund (2000) and other writers (for example: Sheffi, et al., 1990, Van Damme, 1996) point to the fact that TPL providers are with respect to the services they offer quite diverse. For some clients they may act 'only' as provider of transport on a spot-basis, for others they might act as contract distributors and for other clients again they might be the general source of logistics knowledge. TPLPs will, however wide their spectrum of capabilities is, only supply those services to their customers that are in demand. This is reflected in the degree of involvement of a TPLP in a particular TPLP/client relationship.

A general observation revealed from the survey of 32 TPLPs and 44 Shippers (Fig. 3) is that TPL involvement in strategic and tactical decisions in logistics is still comparatively low. Involvement here means the quantitative participation of a TPL provider in a defined management task. With regard to the functional design of logistics systems TPLPs seem to be particularly active in warehouse and transportation management design.

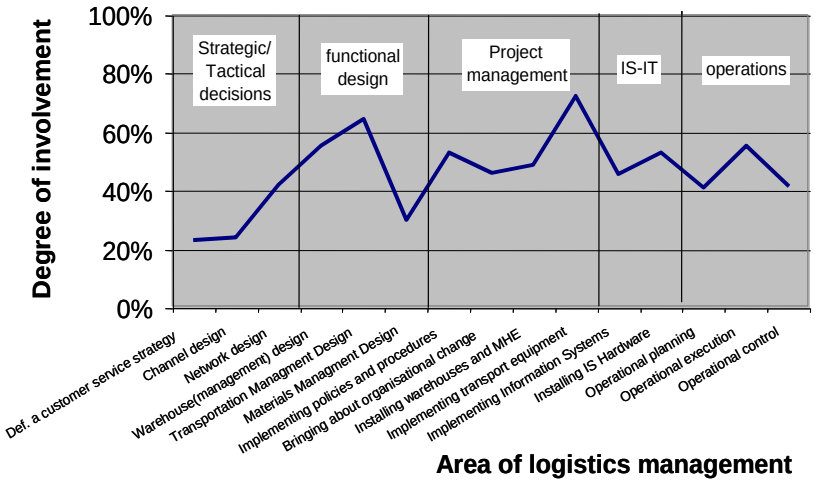


Figure 3: Degree of TPL involvement in Europe.

The degree of involvement in these areas of management hints to a partnership type relationship between shippers and TPLPs, whereas materials management design comprises activities that seem rather to be kept 'in house'. In most areas of management that could be referred to as project management TPLPs seem to have an input that is equal to those of shippers or higher. Similarly, TPLPs seem to have achieved a level of input in IS and IT management which shows them being responsible for roughly 50% of all activities in these

areas. Operational activities are also largely outsourced, so it seems. Shippers seem to retain though an equal responsibility in operational planning and control. Overall TPLP seem to have a particularly strong involvement in the areas of management that are transport related. This could reflect that these areas of logistics management have already a history as most commonly outsourced logistics activities.

4.2. The Importance of Different Resources and Skills

In the survey respondents were asked how important they would rate a number of resources and skills on a 5 point Lickert scale ranging from not at all important to most important.

T-test shippers/TPLPs	***Design Phase***		**Implem. Phase**		***Operational Phase***	
Resource/Skill	sig.2-tailed	Mean diff.	sig.2-tailed	Mean diff.	sig.2-tailed	Mean diff.
Financial Resources	0.84	0.05	0.02	0.62	0.70	-0.11
Physical Resources	0.64	-0.12	0.09	-0.41	0.24	0.31
Technical Resources	0.11	0.35	0.66	-0.08	0.43	0.14
Human Resources	0.00	0.58	0.01	0.54	0.00	0.72
Organisational Resources	0.15	0.30	0.59	-0.11	0.42	-0.15
Technical Skills	0.00	0.65	0.12	0.28	0.03	-0.42
Human Skills	0.02	0.42	0.00	1.17	0.00	0.99
Conceptual Skills	0.09	0.36	0.04	0.54	0.90	0.02

Table 2: 2 independent sample t-test on Resource/Skill importance.

The shippers' and the providers´ views of the relative importance of resources and skills within the various phases of designing, implementing and operating a logistics system only differ marginally. A t-test shows that the differences between the mean perception of shippers and TPLPs is either not significant, or if so, rather small and negligible. The most important resources and skills, in all phases, are: human and organisational resources and technical and human skills. In the design phase conceptual skills were also viewed as important.

The conceptual skills are considered to be more important in the design phase than in the implementation phase and they are regarded of less importance in the operational phase. Physical and technical resources are regarded as more important in the operational phase than in the design or implementation phase.

In designing a logistics system human and organisational resources as well as technical, human and conceptual skills are reported as having the highest relative importance (See Fig. 4). The resources and skills that the respondents regard as relatively most important to implement a logistics system are: human and organisational resources and technical and human skills (See Fig. 5).

In order to be able to operate the logistics system technical and human resources are perceived, by shippers as well as providers, as than important (See Fig. 6). Only physical resources are reported on average between important and not important.

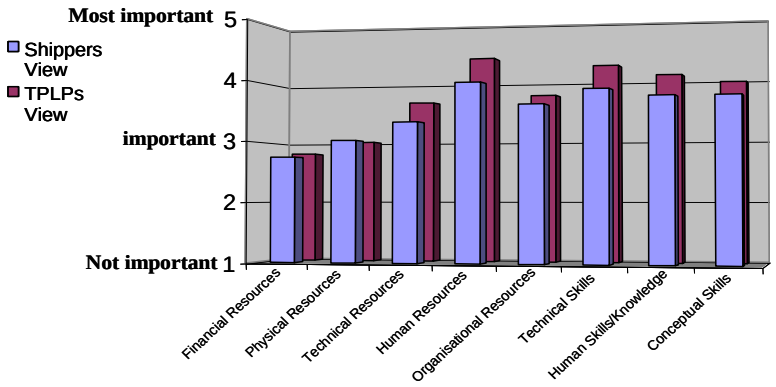


Figure 4: Relative importance of resources and skills when designing a logistics system.

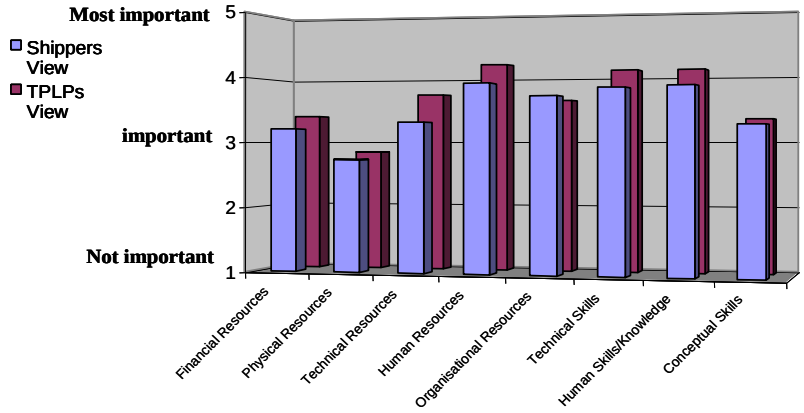


Figure 5: Relative importance of resources and skills when implementing a logistics system.

4.3. Third Party Logistics service Providers' Resources and Skills

Respondents in the survey were asked how sufficient/adequate they perceived TPLP resources and skills in a given TPL relationship at present and how they would think these would develop within the next 5 years. On average both types of respondent, shippers as

well as TPL providers, perceive service providers' current resource base to be 'sufficient' for the design and implementation and operation of logistics systems (Fig. 7). Slight deficiencies are identifiable in the areas of human and organisational resources – resources that are perceived to be of great importance. Future expectation on the development of these is seen very positively whereby third-party logistics providers rate their own capability of developing (or acquiring) these resources more conservatively (see Fig. 8).

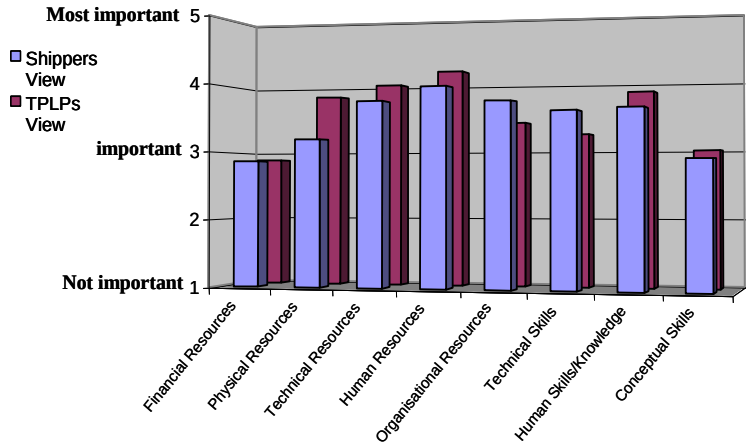


Figure 6: Relative importance of resources and skills when operating a logistics system.

It must, however, be understood that the goal of any TPL service providers is to be equipped with resources just sufficient enough, to carry out tasks for their clients in the most efficient way. Berglund (2000) points already out that there seems to be an ever lasting conflict of interest between shippers and TPLPs with regards to 'overstocking of resources' – shippers have the tendency to demand from their providers more flexibility, but are on the other hand not willing to pay for excessive resources. This becomes particularly apparent in the areas of cost intensive physical and human resources. Achieving better efficiency is, however, commonly recognised as one of the main reasons for outsourcing in logistics (Sheffi, 1990, Lieb et al., 1990, 1993, 1997, 2000).

With regards to skills shippers on average believe that TPL service providers currently lack the necessary skills to design logistics systems (Fig. 9). In all phases (design, implementation and operation of a logistics system) shippers also perceive a lack of conceptual skills. Third-party logistics service providers believe that they are presently at least adequately equipped with human, technical and conceptual skills, throughout all

phases. Since they also perceive them selves as understaffed, one could interpret both perceptions as being competent in general, but unable to cope with the quantitative demand.

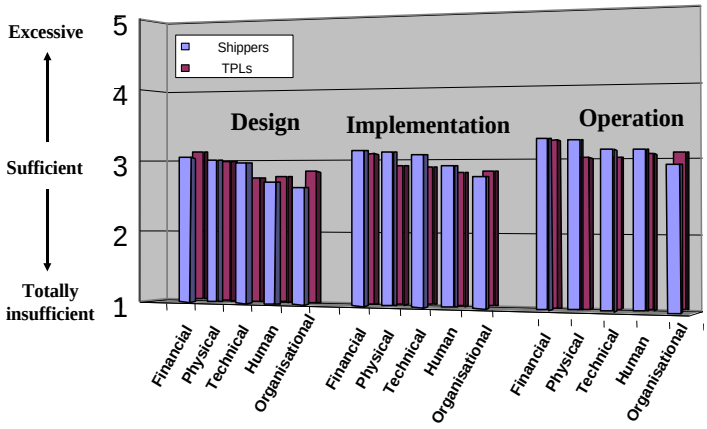


Figure 7: Comparison of shipper and provider views on the providers´ current resources.

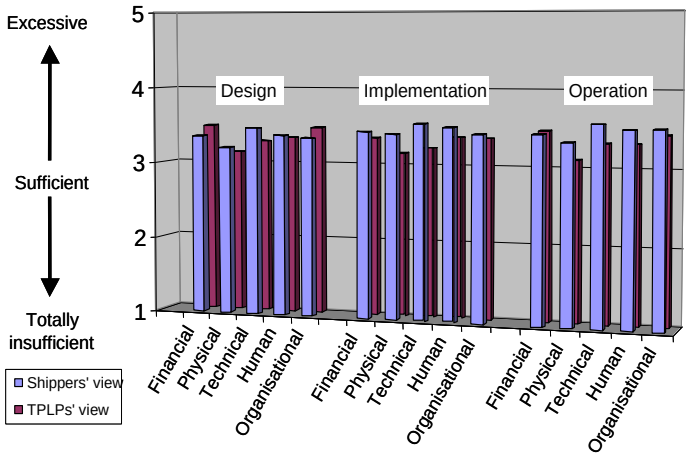


Figure 8: Comparison of shipper and provider views on the providers´ future resources.

On average both types of respondents see TPLP's skills developing towards a level of adequacy (Fig. 10). With regards to skills necessary to implement and operate logistics systems the differences between shippers' and TPLPs' perceptions seems to be only marginal, whereas developments in skills necessary to design logistics systems are clearly seen less optimistic by shippers than by TPLPs themselves. It is impossible to say though whether third party logistics service providers misjudge their ability to develop better skills or whether shippers underestimate this ability.

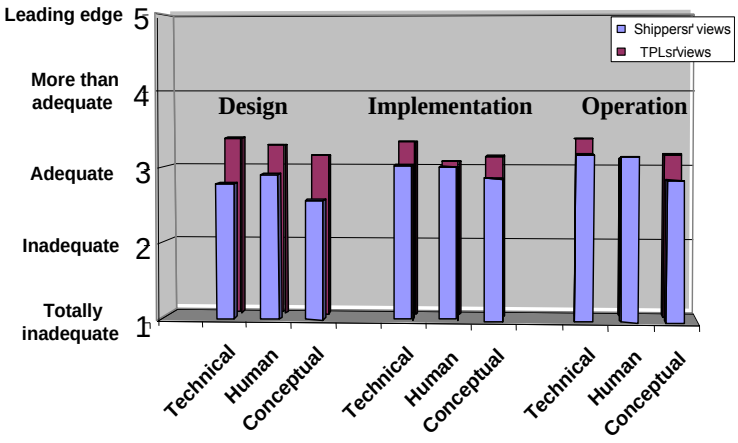


Figure 8: Comparison of shipper and providers views on the providers´ current skills.

In contrast to the perceptions about the resource sufficiency there appears to be a clear difference between the average shippers' and the average service providers´ perception of the TPLP's current skills (Fig. 8) as well as their future likelihood of development (Fig. 9). This in itself is of interest. First, it points to the fact that knowledge and capability are indeed intangible and thus less transparent assets then physical or financial assets for example, particularly when observed and evaluated from outside an organisation. Secondly the observed differences in perception about TPLP skills point to the difficulties TPLPs have to convince their clients that they have certain abilities and knowledge.

These are, however, only averages that are limited in the evidence they give. A more differanciated look on the weaknesses and strengths of TPLP resources and skills might reveal more insight.

4.4. Deficiencies of TPL Resources and Skills

Fig. 10 depicts the proportion of respondents that have perceived resources and skills critical to the design process of a logistics system either as insufficient or totally insufficient.

It becomes apparent that in areas of human and organisational resources, i.e. in areas that are defined as quantitative input into the design process, mostly TPLPs perceive themselves as deficient. Mostly shippers on the other hand perceive the biggest deficiencies the qualitative input into the design process in the necessary skills. This could mean that the focus of TPL competence is from a shippers' point of view clearly on skills and capabilities that are at their disposal rather than on resources. TPLPs have of course a rather more differentiated view on their deficiencies and see their lack of skill more rooted in the shortage of personnel and internal organisational structures.

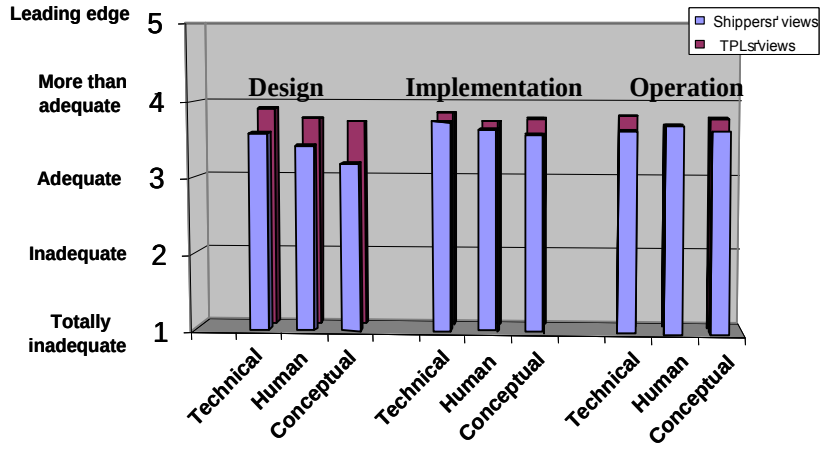
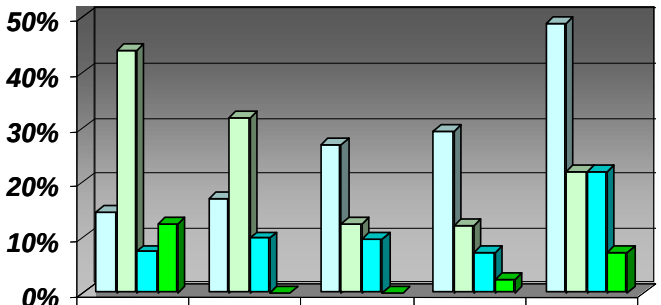


Figure 9: Comparison of shipper and provider views on the service providers` future skills.

For the future far less respondents see deficiencies in TPLP resources and skills that are necessary to design logistic systems. Areas that maintain to be a problem are human resources from the more differentiated TPLP point of view (12% of TPLPs see a human resources deficit also in future), and conceptual skills from a shippers' point of view. After all, still 22% of shipper believe that TPLP will not be able to develop sufficient conceptual skills to design logistics systems.

With respect to resources and skills that are critical for the implementation of logistics system (Fig. 11) deficiencies seem to be perceived by shippers and TPLPs in similar proportions and this surprisingly for the present as well as for the future anticipated state of TPLP resources. Areas of proportionally bigger differences are the current perceptions about technical skills and again human resources. More shippers (23%) than TPLP 12%) see technical skills as an area of deficiency and more TPLPs (38%) than shippers (26 %) see human resources as a main problem area. This could be explained again by the tendency of shippers to judge TPLPs capabilities more from a qualitative point of view rather than

differentiating between the qualitative and quantitative elements that form a capability. What comes at the biggest surprise is that almost shippers as well TPLPs seem to be convinced that TPLPs are able to cut back on their deficiencies. Areas that will remain rudimentary short are from a TPLPs' point of view human resources, and technical resources from both perspectives.

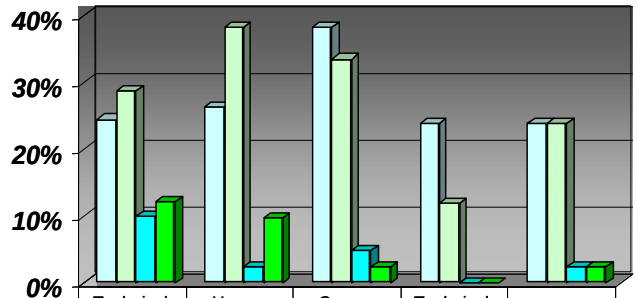


	Human Resources	Organ. Resources	Technical Skill	Human Skill	Conceptual Skill
Shippers-now	14.6%	17.1%	26.8%	29.3%	48.8%
TPLPs-now	43.9%	31.7%	12.5%	12.2%	22.0%
Shippers-future	7.5%	10.0%	9.8%	7.3%	22.0%
TPLPs-future	12.5%	0.0%	0.0%	2.4%	7.3%

Figure 10: Deficiencies in critical design resources and skills – now and in future.

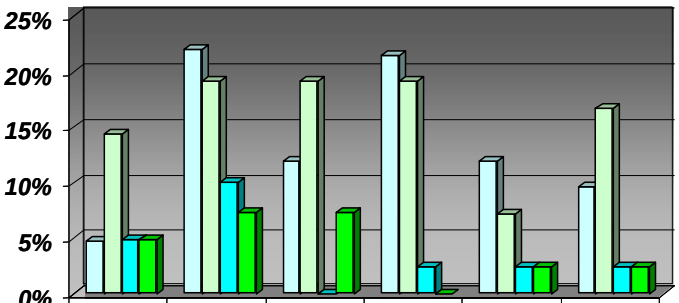
The lowest deficiency ratings can be observed for resources and skills that are critical for the operation logistics systems (see Fig. 12). This doesn't come as a surprise considering that this is the area with the highest level of outsourcing. The number of shippers as well as TPLPs that claim to see deficits of TPLP resources and skills in this area hardly exceed 20%. Deficiencies in this amount are from both types of respondents only perceived for technical and organisational resources.

From TPLPs point of view human resources resembles also a problem area of similar significance. With the exception of technical resources, that require usually a lot of investment and human resources seen particularly from some TPLPs as a problem areas, there seems to be a common anticipation that these deficiencies disappear in future. The sustaining deficit in human resources might point to the shortage of driver currently experienced in all European states.



	Technical Resources	Human Resources	Organ. Resources	Technical Skill	Human Skill
Shippers-now	24.4%	26.2%	38.1%	23.8%	23.8%
TPLPs-now	28.6%	38.1%	33.3%	11.9%	23.8%
Shippers-future	10.0%	2.4%	4.8%	0.0%	2.4%
TPLPs-future	12.2%	9.8%	2.4%	0.0%	2.4%

Figure 11: Deficiencies in critical implementation resources and skills – now and in future.



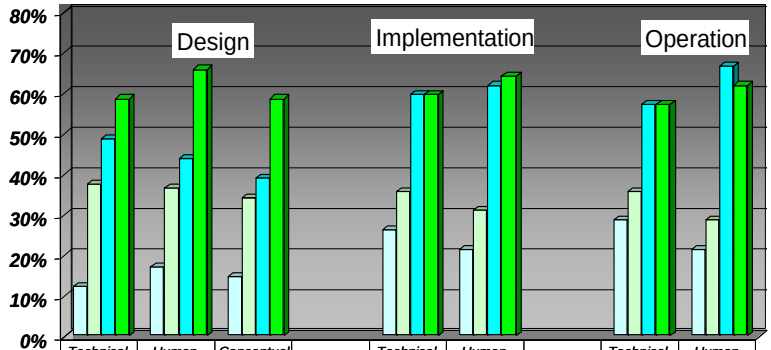
	Physical Resources	Technical Resources	Human Resources	Organ. Resources	Technical Skill	Human Skill
Shippers-now	4.8%	22.0%	11.9%	21.4%	11.9%	9.5%
TPLPs-now	14.3%	19.0%	19.0%	19.0%	7.1%	16.7%
Shippers-future	4.9%	10.0%	0.0%	2.4%	2.4%	2.4%
TPLPs-future	4.9%	7.3%	7.3%	0.0%	2.4%	2.4%

Figure 12: Deficiencies in critical operational resources and skills – now and in future.

4.5. Leading Edge TPLP Skills

Fig. 13 depicts the proportions of respondents that perceived TPLP skill as either 'more than adequate' or as 'leading edge'. The view is here purposely only taken on skills that are critical to the relevant process phases, because it is assumed that it is only the area of skills where TPLPs seek to achieve more than a state of adequacy.

First of all there seems to be an overwhelming trust from both shippers as well as TPLPs in the development of TPL capabilities. At least in implementing and operating logistics systems between 60% and 66% of surveyed shippers and TPLPs believe that TPLPs will be able to excel. A similar amount of TPLPs believe they will be able to achieve this in the areas of designing logistics systems. Only about 40% of shippers share this view. At present between 30% and 35% of TPLPs believe they have already achieved a state of excellence throughout all phases of logistics management. Shippers are slightly more moderate in their judgement on this particularly in TPLPs capability to design logistics systems. Only between 12 and 17% of shippers believe that their TPL service provider is more than adequately skilled to design logistics systems.



	Technical	Human	Conceptual		Technical	Human		Technical	Human
Shippers-now	12.2%	17.1%	14.6%		26.2%	21.4%		28.6%	21.4%
TPLPs-now	37.5%	36.6%	34.1%		35.7%	31.0%		35.7%	28.6%
Shippers-future	48.8%	43.9%	39.0%		59.5%	61.9%		57.1%	66.7%
TPLPs-future	58.5%	65.9%	58.5%		59.5%	64.3%		57.1%	61.9%

Figure 13: Strengths in TPLP skills – now and in future.

5. Conclusions

From the current state of Third Party Logistics in Europe it can be concluded that TPLPs still play a minor role in strategic and tactical decision making areas of logistics. Their expertise and competence is still mostly reflected in transport related areas of management.

Surprisingly they have established themselves as having the same role as shippers in implementing IT and IS systems.

Human resources are, according to the opinion of both shippers and service providers, the most important resources when designing, implementing and operating a logistics system. However, it can be observed that particularly providers realise their lack of human and organisational resources that are vital to design and implement of logistics systems. Based on shippers' as well as third-party logistics service providers´ projections, this will change for the better in future although TPLPs seem to take this problem more seriously.

Third-party logistics providers' skills are on average viewed as adequate and qualifies them as particularly competent in implementing and operating logistics systems. Currently, TPL service providers are mostly perceived as being rather deficient in the necessary skills to design logistics systems, hardly ever feature leading edge capabilties. Furthermore shippers are convinced that third-party logistics providers will not be able to acquire this capability in the near future. The skill set of TPL providers is seen as increasing from a low level for conceptual skills (below adequate) through to adequate for implementation and operations. This is not unexpected given the historical development of many of Europe's leading third-party logistics service providers, starting from an asset based operational background. Previous studies have revealed that the level of value added services (i.e. services requiring more skills) had not increased from 1994 to 1999 (van Laarhoven et al., 2000). This was put down to an inability to replicate more customised value added services across shippers and a restricted skill set within the third-party logistics industry.

The overall view of the service provider skills and resources has significant implications for their training efforts and the need to attract a greater skill base through more diversified recruitment policies. In addition it seems also necessary for TPLP providers to convince their clients of their capabilities.

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IT^{Plus} Unified Messaging Solution – Libritas Model Advantage

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Abstract

A Return on Investment (ROI) analysis, shows how A 50 Company could achieve a three year 1,192% IRR (this study covers a three-year time period from the beginning of the Libritas IT^{Plus} UM deployment) with a payback of 5 months by deploying the Libritas IT^{Plus} Unified Messaging Solution (UM). In first year hard cost alone the Company would save $64,150 by using the Libritas Solution. A 50 Person Company deploying the Libritas IT^{Plus} Unified Messaging Solution would gain additional benefits from Libritas unified sign-on, visual voicemail, follow-me features, conference calling, fax to e-mail, caller ID and web hosted Microsoft Exchange services.

Keywords: unified messaging, single point of access, connectivity, redundancy.

1. Introduction.

For a modern corporation, timing is critical to business success. Being well informed is essential to competing efficiently and effectively in an information intensive profession. During the past three decades the methods of sharing data and managing critical information have proliferated. Where previously correspondence came in the form of a letter delivered by post, today we have e-mails, faxes, telephone calls, cell phone calls, attached documents and good old fashioned letters. How can professional managers deal with all the disparate information they are constantly being bombarded with? Simply collecting all the incoming messages is overbearing. Making intelligent decisions based on that data is another issue entirely. The primary culprit is fragmentation of delivery. The fax machine is down the hall and regularly runs out of paper or jams, your e-mail server is run in-house and if your system administrator is out of the office when it crashes, all incoming and outgoing e-mails come to a dead stop. Voice communications are similar: you might receive a call on your work line, but are in a meeting, and are unable to retrieve the message until much later, missing an important deadline with a client. The same with cell phones. Keeping one turned

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on during a meeting is rude, but missing a critical customer call could be catastrophic to your business. Attached files are likewise becoming more important as the world migrates to digital documentation. The conditions described above are exactly why the Libritas IT^{Plus} UM Solution was built and deployed: to address all the messaging needs of a professional user in one place. Not having voicemail, e-mail and faxes functioning on a single messaging platform is extremely inefficient and costly.

2. Unified Messaging Services

Libritas IT^{Plus} Unified Messaging (UM) Solution enables users a single point of access to all three types of messages: voice, fax and e-mail. Libritas UM allows access via any communication device, such as telephone, or via the Internet. Libritas allows users to manage all of their messages from a familiar inbox using hosted Microsoft Exchange. Unified messaging provides professionals with more flexibility when traveling, improves employee productivity while in the office, and gives companies the competitive edge they are looking for. Libritas IT^{Plus} UM Solution provides unparalleled functionality and flexibility, at a price 40% below the cost of running an in-house solution.

Libritas IT Plus UM Solution Benefits	
IRR without factoring Impact of improved customer response time	1,192%
Yearly Cash Savings	⇩40%
Missed Messages	⇩33%
Each of 50 users would gain 10 hours per month as a result of improved contact management features	500 hrs per month gained

Table 1. Unified Messaging Solution Benefits.

3. Data Services

Connectivity: The Libritas Adaptive Multi-Track Connectivity provides T-1 and or DSL adaptable connectivity from our Bay Area co-location site to A 50 Person Company's office. We offer redundant lines and adaptable Connectivity that is always up! A company's connectivity can be expanded as it grows, and the appropriate bandwidth delivered for the task. All Libritas servers are supported by an industry standard T-1 or DSL connection. A second line is installed for redundancy in case the main line goes down for scheduled or unscheduled maintenance. This architecture assures no single point of failure and provides a platform for expansion as your company grows.

All telecommunication lines go down. Libritas has engineered the Libritas IT^{Plus} UM Solution to overcome this persistent and very expensive shortcoming of digital communications. Libritas' seasoned technical staff is working to keep all your data and communication services running 24 X 7.

Security. Libritas Fire Wall, Network Address Translation and Virus Scanning automatically detect and monitor unauthorized "guest" and constantly work to keep clients' sites free from unauthorized access. The Libritas Security System was designed to protect users' most sensitive data and applications from unauthorized users, fraud and other misuse.

Virtual Private Network – Libritas VPN gives employees the ability to receive secure access to their company servers when off premises. A VPN provides a higher level of security while accessing personal and shared files.

Microsoft Hosted Exchange 2000. Internet time mandates a messaging and collaboration platform with little downtime and nominal maintenance so that end-user efficiency and productivity is maximized. Microsoft Hosted Exchange 2000 allows for shared contact lists, group scheduling and e-mail management from one software platform, that functions simultaneously on a desktop or remotely via a web browser. Client's voice, e-mail and faxes are all run off data in his/her Microsoft Exchange contacts; introducing the advantage of "click to call" dialing, and access to a complete history of the business contact in question. With Hosted Microsoft Exchange a copy of user's complete outlook Exchange data is stored off premise for added security and safety. A 50 Person Company requires no server hardware or software due to the ability of Libritas to manage Microsoft Exchange 2000 remotely.

4. Voice Services

Telephony. Libritas Voice Over IP Telephony offers many advantages over standard Office Phone Systems. Libritas delivers a Web-based Interface that can be accessed with any web browser, allowing access to a personal message center, where a user can review past call records, install call forwarding protocols, manage conference calls, and engage in Instant Messaging. All of these features as well as the time saving benefits provided, are available at the click of a mouse.

5. Improved Communication Drives Projects to Completion Faster

Maintaining product quality amidst the rapid pace of business and technology innovation is challenging for even the best of companies. Improving employee and customer collaboration can help A 50 Person Company reduce project time cycles. The net result is both improved profits due to cost avoidance, and a strengthened leadership position as a premier area law firm.

At the very heart of collaboration is the ability to share voice messages, e-mails and faxes.

Accelerating turn around time because of better collaboration amongst internal teams and better communication with customers is a key success factor in reaching your goals for improved profitability and efficiency. A 50 Person Company expects Libritas IT^{Plus} UM Solution to provide critical collaborative tools required to improve document and voice message access, storage and collaboration, thereby improving each employee's ability to respond to customer demands.

Voice Feature	Description	Business Benefit
Auto Attendant	A company wide automatic attendant that routes calls to individuals or specific departments and individuals	Saves time for staff Customer Satisfaction ⇧
Advanced Find Me, Follow Me	Tracks an individual to multiple telephones according to a preplanned sequence	Missed Calls ⇩ 60%
Web Based Interface	One place to go on the internet to visually see all your voice communications, incoming, outgoing and messages	Efficiently manage your Voice messages, without having to wade through unimportant ones
Dynamic Conferencing	Conference 10 parties at once, adding, muting or removing parties with a click	Quick & inexpensive way to have that important meeting
Visual E-mail and Voice Mail as E-mail	All Voicemails are E-mail attachments Send voicemail to anyone via e-mail	Transcription Time ⇩ 100% Time Savings 157 min/mo/person
Interface with MS Exchange for Unified Messaging	Outlook integrates with MS Exchange giving unified contact data	Employee Satisfaction ⇧
Prioritized Call Treatment	Assign priority and call routing based on importance of specific contacts	Missed Important Calls ⇩ 60%

Table 2. Voice features.

6. Streamlined Communications and Improved Productivity

Ensuring the reliability and stability of A 50 Person Company's messaging and collaboration platform is a mission-critical activity in context of ensuring reliable internal and external customer communication. The Firm's management team knew it would be possible to get the uptime necessary for increasing headroom capacity and fail-over protection through the Libritas Technology Platform. Selected features that contribute to improved productivity include:

Adaptable Bonded Libritas Connectivity – Features telecommunication clustering which significantly enhances end-user availability while lowering direct IT costs. The bandwidth

clustering technology developed by Libritas allows a user to remain operational even when one method of connectivity has gone down. Automatic fail over to another line and constant bandwidth management by the Libritas servers has proven to be essential to offering the reliability critical to providing Libritas IT^{Plus} UM Solutions.

Multiple message types integrated in one Unified Messaging Solution – Supports voicemail, e-mail, faxes and attachments. Supports transaction logging, forwarding via e-mail, conference call on demand, "find me, follow me," single sign-on, group calendaring, caller ID and many other labor saving functions.

Outsourcing to Libritas – Eliminate PBX and Exchange server hardware, Windows NT and Exchange software and the support required of System Integrators. Just in up front hard costs alone, A 50 Person Company could save over $64,000 by using Libritas and not installing a PBX and Microsoft Exchange Server in house. Libritas provides the highly skilled IT and communication specialists, so that a client's internal staff may focus on their primary business activities and not on running a telecommunication network or overly complicated voice system.

7. Enterprise-Wide Deployment Yields Greater Corporate Agility

The specific business value available to A 50 Person Company because of deploying Libritas IT^{Plus} UM Solution to meet its critical messaging and collaboration needs represents a ten fold return on investment. Increasing collaborative capabilities, both internally and with customers, leverages the firm's ability to accelerate project time cycles and reduce unproductive clerical work, helping grow its business while reducing costs. The ROI analysis showed that upgrading to Libritas IT^{Plus} UM Solution is not simply the best means to achieve a company's business objectives; it is also a smart financial move.

8. Conclusion

Libritas focused on two areas of costs. Hard cost are outlays associated with buying equipment, licenses, services and software and represent cash expenditures out-of-pocket. Soft costs, such as downtime associated with having to perform functions that the Libritas ITplus UM Solution has automated or removed entirely, are non hard costs, calculated on an hourly labor cost basis.

The improvement in productivity, increased efficiency and faster response times are bound to generate more revenue for the Company. To provide a conservative assessment of the benefits offered by Libritas IT^{Plus} Unified Messaging Solution, no revenue or other upside projections have been accounted for in relation to improved voice efficiencies. Additional revenues were not allocated for increased uptime and productivity gains from reducing missed important calls, though these amounts are substantial.

Customer Profile. A law firm specializing in labor, communications and corporate law, has 10 partners and 40 staff in two offices in northern California.

Business Situation. Using the Return on Investment framework, A 50 Person Company wanted to assess the financial benefits of increasing revenue, improving customer satisfaction, and decreasing costs through improved communication and knowledge management using the Libritas ITPlus Unified Messaging SolutionTM.

Critical Success Factor	Business Enabler	Projected Business Benefit
Grow Business	Unified Messaging allows staff to more efficiently focus on business critical activities. Libritas provides the IT communication infrastructure.	Improved knowledge & coordination: Revenue ⇧ Productivity ⇧ Employee Satisfaction ⇧
Improve Customer Satisfaction	UM allows total communication management: e-mail, voice mail & fax all manageable from one platform.	Reliability ⇧ 70% Staff Productivity ⇧ Increased Customer Dependence ⇧
Reduce Operating Costs & Headaches	Libritas provides a robust single source for data, voice, fax, and e-mail messages for a nominal monthly fee.	Exchange & PBX ⇩ 100% Data Line & SW Costs ⇩ 40% Voice Charges ⇩ 20-40%

Table 3. Business benefits.

Value to Business. The ROI Analysis projected a 1,192% IRR with a 5 month payback if the Libritas ITPlus Unified Messaging Solution is implemented.

Value to Operations. The ROI Analysis projected a 100% consolidation of messaging servers, a 100% consolidation of the voice PBX, phones and fax servers. The company divorces itself from the headaches of managing the infrastructure technology.

Technology Enablers. Adaptive Connectivity – Libritas provides improved communication uptime and reliability by using redundant communication lines.

Availability. Improved customer communication helps to increase Sales and Productivity.

Agility. Improved efficiency in team and customer collaboration accelerated project time lines.

Reliability. Decreased server downtime and improved connectivity uptime improves IT resource utilization.

Scalability. Add, move or delete staff from phone and e-mail systems quickly, easily and without hidden costs.

Libritas has designed a proprietary, web-based provisioning system that gives customers the freedom and flexibility to maintain user accounts without contacting Libritas. Telephone

integrators assume a 20/80 revenue split: 20% of their revenue comes from equipment sales and 80% from updates and service charges. The Libritas UM Solution allows the customer to perform Moves, Addes and Changes on their own and cuts this expensive consulting cost out completely. This allows rapid deployment and "turn-up" of new users and reduces the cost of servicing a large customer base. Currently, Libritas services over 100 customer accounts with only three operational staff members. The automation of the Libritas system allows for substanital customer growth without increasing operational headcount.

A successful business model in the telecom/IT outsourcing space has to provide tangible cost/feature benefits, be scalable, revenue-driven and profitable. Libritas has just such a model

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More information about Libritas, can be found at http://www.libritas.com and http://www.gobeam.com.

Implications of IT Development for the Furniture Industry

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Abstract

Rapid IT development has already changed many aspects of our life and IT will influence us even more in the future. All businesses are influenced by IT. One of the industries not directly connected with IT is the furniture industry. However there are major implications of importance comparable with the introduction of plastic, IKEA or mass production lines.

These implications can be clustered into a few areas such as:

- structural. The industry is organized around two market groups: office and home with separate companies, types of contracts and market distribution and delivery channels with very little interaction between them. But our homes are becoming more and more also our working place and working places more and more meeting places;
- ways to market, present and sell. There are unique features of the Web such as virtual reality, interactivity and agent and/or human advice that can revolutionize the way we can choose and buy our furniture;
- information about furniture. Development of cheap computers can e.g. contain data about all material as well as keep historical information for ecological purposes;
- a part of data system. Furniture used by several users can adapt depending on the identity of the user, e.g. working positions in flexible offices, beds in hotels or chairs in trains.

Keywords: IT, furniture, market structure, marketing, new products

1. Background

The Information society opens up for new possibilities and for new challenges. The Information Communication Technology (ICT) enables new ways to work and spend leisure time as well as to contact government agents and authorities.

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One obstacle today in attaining a well functioning Information Society is that still not everybody is connected to Internet. Several initiatives have been taken in order to reduce the digital divide between the initiated and those who do not have access to the world of Internet, World Wide Web, PCs, SMS, WAP etc. The technical development of new man-machine interfaces, new devices and the use of Internet-like applications in existing equipment such as TV sets and telephones contribute to improve the accessibility, as do the use of broadband techniques to enterprises, governments and households. More and more people use Internet in their work and also after working hours. We are in a transitional period when all effort is concentrated on achieving the goal of having the same natural access to Internet as to water, electricity, TV, transportation or telephone.

Due to the rapid development in sensor, bluetooth and in wireless LAN (Local Area Network) techniques most of the things that can communicate will communicate. Soon more than 50 % of the traffic in telecom network will be originating and terminating without human intervention.

One of the oldest and most traditional industries that until now has not been so much changed in structure, distribution channels and marketing by the introduction and spread of Internet is the furniture industry. There are still two main types of furniture companies one for home market and the other for business market e.g. for offices, schools and theatres.

There are two types of stores and two types of distribution channels. There are different norms, types of contracts and prices depending on whether the furniture is aimed for the home or the business market.

2. Structural Changes

2.1. Home as a Working Place and Office as a Meeting Place

Due to the technical development especially in ICT and the political ambition to reduce the digital divide and give every citizen connection to Internet, our patterns of work and leisure are changing. With laptop and wireless connection many can work and communicate anywhere and anytime.

Work anywhere means that we can work not only at specific places such as offices but also at home, while traveling or in hotels. Soon everybody will be connected at home with the possibility to spend his/her time with a PC and on Internet. Thus, home is becoming a working place for many and a place to use PC and be connected to Internet for everybody.

With all the possibilities to work anywhere and anytime, there is one important requirement that can't be met in the home environment. It is the need of meetings physically in real space and not only in cyberspace. We need real meetings scheduled with fixed agendas as well as informal but at specific times and places like coffee breaks or just spontaneous meetings. Maybe the most important role of the future office will be to become a meeting place.

2.2. Implications

Changes in our life styles and in usage of different places signify that the furniture industry also has to adapt. The traditional division on business/office and home furniture is becoming obsolete.

Many work positions/desks in offices are used by more than one person. Individually adapted working places are mostly found at home for business as well as for pass-time activities. If it is the policy to give everybody Internet connection and the possibility to communicate from home, it should also be the policy to have ergonomic furniture. In this way the majority will not sit hours in strange ways inappropriate for the human body and PC usage.

The furniture industry can gain from cross-fertilization using experiences from ergonomic and functional working place development in home environment as well as from cozy, inviting, relaxing and inspiring furniture from kitchens or living rooms in office environment.

To achieve that it will be necessary to reorganize the industry, especially distribution channels as well as to find new ways to promote, market and sell products.

3. Marketing Activities

3.1. New Techniques

Some new techniques suit well marketing activities for the furniture industry. The two most relevant are virtual reality and agent technique.

Virtual reality is the simulation of a real or imagined environment that can be experienced visually in the three dimensions of width, height, and depth and that may additionally provide an interactive experience visually in full real-time motion with sound and possibly with tactile and other forms of feedback. The simplest form of virtual reality is a 3-D image that can be explored interactively at a personal computer, usually by manipulating keys or the mouse so that the content of the image moves in some direction or zooms in or out (http://whatis.techtarget.com).

Agent is a piece of software, which acts to accomplish tasks on behalf of its user. On the Internet, an agent (also called an intelligent agent) is a program that gathers information or performs some other service without your immediate presence and on some regular schedule. Typically, an agent program, using parameters you have provided, searches all or some part of the Internet, gathers information you're interested in, and presents it to you on a daily or other periodic basis.

An example of an agent is Infogate, which alerts you about news on specified topics of interest. A number of similar agents compare shopping prices and bring the news back to the user. Other types of agents include specific site watchers that tell you when the site has been updated or look for other events and analyst agents that not only gather but organize and interpret information for you.

An agent is sometimes called a bot (short for robot). The practice or technology of having information brought to you by an agent is sometimes referred to as push technology (http://www.ee.mcgill.ca, 1996)

3.2. Implications

Internet have some unique features that can add value to the marketing and sell process of furniture that can never be achieved in the traditional sell process.

Virtual reality can give us possibility to try furnishing our flat in as many combinations as we want. If you want to buy a new sofa to your living room, you could put your existing room with all the furniture that is already there in cyberspace. You can change color and style of the sofa you intend to buy. You can move furniture around to see how a new sofa fit in. You can ask an agent to look around to find the cheapest model or to find some other types of sofa. You can ask for a professional designer to look through what you already have at home and give some advice of changes and visualize them for you.

You can still go and see and touch furniture in some shops. You can start the process at home or you can start it in a shop or vice versa. It is important to point out that until now it has not been possible to visualize and try furnishing this way. It would not be practical to bring all the sofas we could be interested in to our homes and then to try see how they fit in. It would also be very difficult to compare results by putting them side by side.

4. Information About Furniture

4.1. Emerging Techniques

Some emerging techniques such as penny computers, bluetooth and MEMS can considerably change the way to get access to information about furniture.

Penny computers are very cheap and unsophisticated computers. Meil Gershenfeld, who runs the Physics and Media group (at Media Lab, MIT), is building such useful devices as a medicine shelf that knows if you have got the right prescription and can signal your doctor when you have taken it. Each pill bottle contains a computing device that costs a penny, he said (Beckett, 1998).

Micro-electromechanical systems (MEMS) present a technology that combines computers with tiny mechanical devices such as sensors (devices, which sense or detect a change in physical quantity or process variable and converts that change into a useful output or indication (Bursic, 2001)), valves, gears, mirrors, and actuators imbedded in semiconductor chips. Paul Saffo of the Institute for the Future in Palo Alto, California believes MEMS or what he calls analog computing will be “the foundational technology of the next decade”. Analog computing is a term used by Paul Saffo of the Institute for the Future in Palo Alto, California, to describe silicon-based microsensors that sense and react to external (natural) stimuli in something that approximates the rhythm of reality rather than the “artificial” binary behavior of digital computing. Saffo foresees that, by implanting tiny machines

including sensors and actuators in the same materials used to manufacture digital memory and processors (and by using some of the same manufacturing techniques), the next decade will increasingly find uses for "intelligent" material that responds to its environment in analog or dynamically responding fashion. Examples include packages that can “talk back” to their handlers; airplane wings that can reshape themselves as they meet turbulence; chairs that can mold themselves into the best supporting shape for each person (http://whatis.techtarget.com).

Bluetooth: A short range wireless technology that connects electronic devices (see, e.g., http://www.cellphones.about.com/library/glossary), including cell phones, printers, digital cameras or palm top computers.

4.2. Implications

There are more and more requirements on all manufacturing industries to inform about all materials and components in manufactured products as well as longer term producer responsibility for their disposal. This is valid also for the furniture industry. In Sweden there is Möbelfakta. Every piece of furniture has a special label – “Möbelfakta” – with information among others on type of the material, glue and disposal requirements etc. Most of these labels are in paper and can easily after some time disappear or be altered. Instead information could be imbedded in the piece of furniture itself and activated when needed. One could also be able to collect data on changing conditions during the whole life cycle of the product.

Another example is self-instructing information on how to assemble pieces of furniture. Parts of a bookshelf or a kitchen table could themselves inform us how they should be put together. They could do it directly by “talking” to a person working on it or via sending information to PDA (Personal Digital Assistant), PC or mobile phone and these devices in their turn would inform us about ways to do that. If we try to put the furniture together in a wrong way, pieces would react and the right solution will be pointed out.

5. Furniture as a Part of Data System

5.1. Data Systems

Data systems and networks are already essential parts of all companies, organizations, nations or communities. The most global data network is Internet connecting many data systems in an enormous data system. To find your own part in this global system and to protect your information from intrusion and undesired changes there are Intranets with firewalls and identification procedures. Typically the log-in procedure includes identification and matching of your own profile.

5.2 Implications

Whether you like it or not, traditional offices and organizations will soon be a curiosity. Creative managers and organizations are discovering a way to gain a competitive edge with new flexible work methods. “…With the new methods, employees are able to telework from remote locations… Fixed desks for employees will disappear…” (Van der Geest, 1997).

Flexible offices are becoming more and more common and fewer and fewer people have their own desks at an office or factory plant. It means that the same work desk/position is used by more than one person and should be adapted to their bodies and preferences. One way to do that could be to connect the working position furniture to the data system. The way to use it could be by identifying the user in a log-in procedure where the user's preferences on furniture are stored. That could for example mean that wherever you are working you get the correct sitting conditions.

This could be used not only in the flexible offices but also in hotels where your preferences for bed and working desk could be encoded in the same way as smoking or non smoking are already adapted to your needs and preferences. The same goes for seats in airplanes, trains, theatres, concerts or cinemas.

6. Conclusions

The furniture industry is only beginning to be influenced by the IT development. IT can and will change this industry in many aspects. With IT changes in structure, marketing and sales activities' will give new possibilities and put new requirements on the furniture industry. There are also great opportunities for development of new products: furniture with IT elements in the form of small computer devices such as MEMS or penny computers as well as to have furniture connected to and being part of data systems and networks.

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Outsourcing Logistics Operations as the Key Component of a Coastal Transport Industrial Zone in Saint Petersburg

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Abstract

The development of the transport system in the Saint Petersburg region would be one of the most progressive ways of finding Saint Petersburg's modern identity and development strategy. It is possible to create a coastal transport industrial zone in Saint Petersburg. This proposal develops the well-known ideas of Maritime Industrial Development Areas and Inland Container Depots taking into consideration the recent global trends in management of coastal cities, globalization of trade and transport market conditions and the present geopolitical situation in the Baltic Sea region. The emphasis should be placed on value added services and logistics in the tertiary sector. Third Party Logistics operators should play a dominant role in providing outsourced logistics services in the Coastal Industrial Transport Zone in Saint Petersburg such as repackaging, final assembly, quality control, customization and distribution, servicing vendor-managed inventories, and electronic data interchange.

Keywords: outsourcing, transport systems, value added services, distribution centers,

1. The Definition of a Coastal Transport Industrial Zone in Saint Petersburg

The development of a territorial transport system in the Saint Petersburg region is one of the most crucial requirements in Saint Petersburg's contemporary identity and strategic planning (Romanov, 2000).

The modern basis of the territorial transport system in the Saint Petersburg region was established by the end of the Seventies. It consists of all types of transportation and a developed transportation network. Further, it has high technical and scientific potential for self-sufficiency and for expansion in the event of advantageous geopolitical and economic

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conditions. The transport system is a crucial element of St. Petersburg's economy and is essential to the revenues of the City Council. Therefore, in considering its development, we should not confine ourselves to estimating transport flows; improving the transport system itself, its service and security, will attract additional cargo flows into the St. Petersburg region (Romanov, 2000).

Critical analysis shows that at present there are no concise, intelligible and well-defined concepts for development of the transport system in the Saint Petersburg region.

A proposal for the creation of a Coastal Industrial Transport Zone in Saint Petersburg (the Zone) and its subsequent enlargement to include the whole Leningrad Oblast is offered by the author as a means for developing the transport system in the Saint Petersburg region (Romanov, 2001b). This proposal develops the well-known ideas of Maritime Industrial Development Areas and Inland Container Depots taking into consideration the recent global trends in management of coastal cities, globalization of trade and transport market conditions and the present geopolitical situation in the Baltic Sea region. This Zone will be a polynuclear system (whereas Maritime Industrial Development Areas are connected mainly with seaport activity) and comprise the sea port of Saint Petersburg, road, rail, waterway, pipeline and air transport facilities, inland container terminals, distriparks, research and educational centers, and recreation areas.

It is necessary to set up the Zone Agency responsible for the project's implementation and its following operation. It would bring together representatives of transport and logistics companies and other private businesses; representatives of city and state governments; public agencies, chambers of commerce and academic institutions. The Agency would play a key role in identifying transportation and other infrastructure projects, analyses and planning work and organization of public support. It should not be state controlled and should be based on public/private partnership and maintained by governance having broad support throughout various parties and classes of society. This would help deal with the changing political environment.

The emphasis should be placed on value added services in the tertiary sector. This would improve the city’s economic performance, competitive position and attractiveness to clients. The structure of value-added services which would be provided by the Coastal Industrial Transport Zone in Saint Petersburg is shown in Figure 1. Value Added Services comprises two components: Value Added Logistics and Value Added Facilities. In its turn Value Added Logistics divides into General Logistics Services and Logistics Chain Integration Services (World Bank, 2000). General Logistics Services relate to traditional activities such as loading/unloading, warehousing and distribution. Logistics Chain Integration Services take over parts of the production chain such as assembly, quality control, customizing and packing and after sales services that manufacturers do not consider part of their core business. Value Added Facilities provide cleaning, repair, parking, security, renting and leasing.

The above mentioned services would be performed in specially designed logistics parks called distriparks. They should be located close to cargo and multimodal transport terminals

and have comprehensive facilities for distribution operations at a single location, and use the latest information and communications technologies.

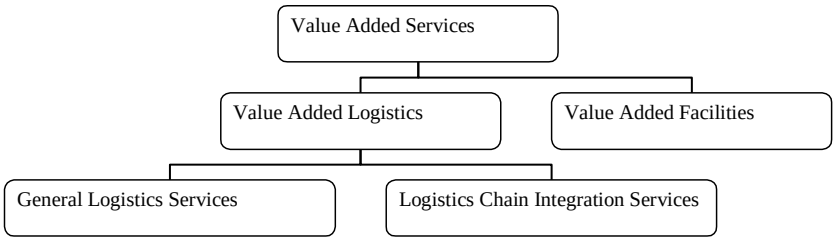

Figure 1: The structure of Value Added Services.

The sources of funding for the Zone development and operation would be private as well as public. The role of the city administration in financing of the project might be primarily the improvement of public infrastructure (transport facilities, institutional) helpful to the project implementation. State funding sources could be state loans and grants, allocation of current sources and new dedicated funds. The mixed financing schemes such as public-private partnerships would be used for combined expenditures on new infrastructure construction and following operation. It would be also possible to create a special fund for financing the project construction.

Broadly speaking, the Zone would provide transportation and processing of all the types of cargo flows, and new transport technologies in the St. Petersburg region (Romanov, 2001a). It would enable the region to gain benefit from added value services and, as a result, faster transformation into service oriented economy. It would allow Saint Petersburg to become the most advanced transport centre in the Baltic region and Russia and not lose its competitive edge in cargo transit. The concept of the Zone is being now developed by the author at the stage of investment plan.

2. The Preconditions for Creation of the Zone

St. Petersburg has all the necessary preconditions to make the creation of the Zone successful. It is the second largest economic center of Russia. More than 500 industrial companies are situated here, one million people are employed in them. Simultaneously, about 300,000 people work in transport, including auxiliary companies (Rybakov, 1998). Shipbuilding is the key industry of the city. Conditions also exist for improved organization of cargo distribution, handling and processing in St. Petersburg.

Cargo transit would provide advantages to the city. The rate of trade growth between Western Europe and Asia is constantly increasing by 8-10 % per year (Most, 1999). As of this moment the 7 main transit routes connected with Eurasian integration passing through

the Seaport of St. Petersburg are: “The Baltic Bridge”, “The Hanseatic Way”, “The Far East Link”, “The South-East Link”, “The Asian Link”, “The North Link” and “The South Link”.

The Port of Saint Petersburg is Russia's main port. Today there are 100 piers with a total length of 8393 meters; 78 of them have modern facilities. The port accepts cargo boats with draught up to 11 meters and width up to 40 meters. There are also 5 cargo zones (Vasiliev, 1996). The port meets European requirements: it has a business-center, customs houses, warehouses, equipment parks, services, telecommunication, stores, shops, hotels, garages, printing-offices and computer centers.

According to estimates of Russian and Baltic experts, the turnover of the St. Petersburg Seaport is constantly increasing despite the 1998 economic crisis. In 2000 it reached 33.8 million tons and in 2001 –36.9 million tons. No port in the Baltic sea has experienced such growth.

By the end of 2001, the Seaport of St. Petersburg accounted for 13% of Russian exports and 27% of imports.

3. Outsourcing Logistics Operations in the Zone

The formation of the Zone requires clear principals of organization and management. Therefore, it is essential to analyze the worldwide experience and recent trends in the field of management.

In today’s business world a growing number of companies begin to utilize the competitive advantages of the outsourcing management strategy. This strategy allows using outside resources in order to perform activities traditionally handled by internal resources. Organizations outsource major, non-core functions to specialized, efficient service providers. It involves the wholesale restructuring of the corporations around core competencies and outside relationships. This helps them focus on their core business activity, decrease capital expense, increase flexibility, and improve customer service and efficiency (Burns, 1999; Cap Gemini Ernst & Young and University of Tennessee, 2000, 2001).

One of the decisive issues in successfully setting up and managing the Zone is that of using outsourced logistics operations. An increasing role in providing outsourced logistics services is being now played by Third Party Logistics (3PL) and Fourth Party Logistics (4PL) providers. (Kaneshige, 2001; Cap Gemini Ernst &Young and Ryder System Inc., 2001; Van Hoek and Chong, 2001). They are external suppliers that perform all or part of a company’s logistics functions.

3PL are important participants in the logistics service market satisfying the demand from companies who want to outsource the execution, planning and control of significant portions of their supply chain. (Gooley, 2002). A broad range of logistics supplier would able to expand into the 3PL including firms specialized in basic transport and warehouse, consultants, information providers and intermediaries.

4PL are logistics providers that participate in supply chain coordination rather than in supply chain operational services. They help gain greater added value in the clients' supply chain and create e-supply chains. (Van Hoek and Chong, 2001). They are highly information based and coordinate multiple asset-based players on behalf of their clients. This implies emphasis on using information to support supply chain competitiveness and on total supply chain effectiveness and overall process management of the logistics activities being executed by the 3PL.

Companies might turn over their various logistics and transportation operations to the specialized 3PLs and 4PLs of the Zone. The field of future outsourced logistics services in the Zone would include freight forwarding, integrated logistics, warehousing, just in time transportation, inventory management, vendor management, product life cycle management, import/export services, logistics consulting, price marking, and product repair and reprocessing.

Special attention in the Zone should be paid to business analytics, global positioning systems, decision support and information technology. Information technology and particularly Internet based applications will open up new opportunities for distributors, manufacturers and customers to increase efficiency and reliability, exchange information for forecasting and replenishing products on an on-line basis. It would also allow partners in the supply chain to share real-time information, promote information about new products, conduct online transfers of funds, improve customer service, and simplify the processes of collaboration and outsourcing and finally integrate businesses. However, for the first time the logistics services requiring complicated information and web technologies would have to be outsourced to skilled western companies. In logistics sphere information technology would provide better efficiency, integrity, reliability and commitments between partners.

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Consumer Behaviours in Media Streams

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Extended Abstract

The paper develops the concept of consumer behaviours based on 'media stream' consumption and feedback. Behaviours of an older youth age group, 18-25 are profiled with particular emphasis on their use of three forms of access device, the PC, mobile phones and iTV. It is suggested that the behaviours observed may represent an emergent and significant far reaching change in the consumer relationship to media and by implication the manner in which organisations build and sustain relationships with consumers.

Based on an extensive primarily qualitative empirical study this paper examines consumer behaviours in the 18-25-age group in relation to three interactive technologies, the Internet, as accessed via the PC, Interactive Television and a more extended examination of mobile phone use and behaviours. The paper closes by considering what the observed behaviours may imply for organisations seeking to convey their presence or message to this group.

The two principal research programmes were conducted in the United Kingdom; both involved highly qualitative research including over 100 depth interviews and 16 focus groups (all quotations in this paper unless otherwise cited are those of individuals interviewed). Additionally the mobile phone research featured a longitudinal study with a group of 300 users being visited twice at an interval of eighteen months. This research included a further 150 depth interviews. The research was completed between August 2001 and March 2002 (excluding phase one of the longitudinal study). Whilst the initial research programmes examined a wide range of gender, experience and age profiles this paper concentrates on just one group, the 18-25 year olds. This group was found to have a media use notably different from other groups. The findings from this group may well be indicative of the future 'your teenager will decide the technologies you use in the future', Fortune Magazine (October 2000).

Whilst the findings were designed to provide behavioural insight I will examine behaviours only as they relate to technology, in particular iTV, mobile devices and the PC. Whilst all the devices comprised some element of the groups 'media diet' it was found that their

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specific use was very different, despite all the technologies claiming to deliver interactivity. Therefore we can begin by asking how did this age group experience media in general?

This younger age group appear to live amongst an environment of quite consciously created noise and images "*anything for background noise. Because I don't like silence*". In many cases these images and noises run together for example, the CD or radio plays and the television is on simultaneously. Given the spread of age and autonomy of the sample (including students and young adults comparatively free from parental authority) such usage appears to be more than 'signs of a struggle to fashion some limited degree of autonomy in the face of parental authority' (Moore, 1996). Rather this mode appears to be 'fundamental social and natural' (Reeves and Nass, 1998). It resembles a stream or flow; from this 'stream' of media they pick out items of interest. Importantly this flow is physically inclusive in that 'media' events often accompany and are accompanied by physical events although the two sets of events may in no way relate to one another, for example the extreme case of a youth riding a bicycle and texting simultaneously, or can be as mundane as driving whilst listening to a CD and holding a conversation. Theirs is a world of complex assemblage where meanings, understandings and identities are taken, often without apparent concentration or intention from this seemingly disordered cacophony. Their attitude toward the media event does not present 'hard' bodies 'in contact over a large surface' (as say the older age groups might be defined), Spinoza (1993), classically discussing networks, but is well defined by his notion of 'soft' bodies 'in contact over a small surface'. In other words they are constantly available for persuasion or contact (however such availability is tempered by a high degree of cynicism and 'hearing' is highly selective), making many transitory contacts, this leads to such statements, in the context of the mobile phone, as "*when I lost my mobile I was like panic stricken"* and *" I keep mine on all the time, yeah never turn it off"*. More generally and consciously to this group they "*tend to pick and choose, you'd read what you want to, only what catches you*" and "*it's like the story you want*". This use of story or narrative is particularly interesting as it suggests a very conscious awareness of this self-construction. The consciousness of such construction extends to both their informational and emotional use of media "*I just put something on to make me feel good, sometimes before I go out*". They appear to function on the basis 'that everything is shaped by culture, we then acknowledge that we create our reality. We therefore contribute to it and can change it' (Staniszewski, 1995). Importantly it is a 'reality' created from (of preference) minimal personal disturbance.

Resistance to operating outside the flow was well illustrated when it was necessary to deliberately access content outside their 'media stream', such as when using a PC. In many cases this was negatively perceived "*it means switching on your computer as well*". A range of statements point to the use of the PC being discordant with 'normal' activities, such deflection of attention or action is perceived very negatively. It must be remembered that this is not a comment about the Internet (although the medium itself was not without adverse comments) but about the access device and that ultimately 'dispositions must be attributed to the instrument/world complex. Instruments are human constructions' (Harre and Krausz, 1996) that will perform the same functions but with differing meanings in different situations and different users. Simple contributory factors to this instrument/word

construction are issues of connection tariff, physical location of devices and speed of performance. Importantly it is the combination of the medium and the delivery mechanism that leads to dissonance within the individuals 'life flow' "*I wouldn't just turn it on to browse, like I might the newspaper, I would just, if I wanted to find something specific*" therefore to some extent using the PC at home (there are also adverse connotations with the PC being a 'work' related device) is seen as 'unnatural' or too interrupting to this groups desire to gain their life experience and meaning as a 'unity of process- of one large megaprocess that encompasses many smaller ones in its make-up' (Rescher, 1996). That this group has despite these comments been able to utilise the PC device is unquestionable. However this could be viewed as 'unnatural' trade off, the desire to communicate and sustain networks against the preferred mode of living. This may lead us to question the PC (in its present device form) continuing to hold its current position particularly as email communication, the prime reason for social PC use by this group, becomes more readily available on mobile devices, through GPRS technology and 3G developments, devices that appear in their portability, flexibility and co-operation more in 'harmony' with this group.

In illustration of this previous point if we now compare PC access to television (and iTV) and mobile devices (including devices such as Walkman or MP3 players) we find a very different relationship. Here the devices are actually used as part of the process of creating environment in both public and private spaces. This act of creation tends to reinforce media events or items already at least partially discerned from the media flow 'each time the refrain is picked up it is articulated anew, yet it still remains recognizably the same repetitive series' (Brown and Capdevila, 1999). The act of creating the streams of 'noise' (or content) previously referred to can be seen as a deliberate act of shaping the individuals immediate environment. It is both conscious and unconscious, and may involve initial acts of choice, to turn devices on and to access channels (although here remote control devices allow easy channel 'hopping' within a personal range of channels) considered likely to fulfil emotional or intellectual needs. Indeed there are constant references to this 'environment' being used to create moods or emotions, say before going out clubbing. These media use activities may have a public or social dimension, as in watching television. In this case iTV facilities for watching sport were particularly valued when watching with others, it was felt they stimulated discussion and made the single activity of "*watching the match more interesting and fun*". In the personal domain many mobile devices were seen as opportunities to create environments specific to the individual whilst in more public places "*yeah, when I go on the train…with my Walkman on*". As identified by Green (2000) the device can be used to create 'fictive boundaries', boundaries allowing the individual to be emotionally removed from the immediate physical local. The availability of the individual using the mobile phone is seen in the same manner, the creation of the 'surreptitious environment', or we might say the private space within the public space leading to forms of behaviour defined by Goffman (1971) as 'civil inattention'. SMS messages can also be viewed in the same manner, they allow the individual to be communicated to and to communicate, to borrow from cybernetics they are involved in 'negative feedback; one adjusts or fine-tunes ones thoughts and behaviour on receiving back the response to one's overtures' (Young, 1994) or as defined by Giddens (1991) 'A self-identity has to be created

and more or less continually reordered against the backdrop of shifting experiences of day-to-day life and the fragmenting tendencies of modern institutions'. In this case the choice of media, text rather than voice, may reflect the situation or mood of the individual, the device itself is thus highly flexible and can become moulded to the individual situation without the individual of necessity disturbing the flow of life. Importantly they can be ever receptive "*you can't ignore it if you get a text message, you just have to have a look*", and of course be sure this mode of receptivity is reciprocated by their friends thus ensuring 'a party of more than one whose members are perceived to be together' (Goffman, 1971).

This mode of construction and availability contrasts markedly with older groups that tend to be less available and more deliberate or purposeful in their usage and construction. In short the 18-25 group looked to access media content or 'items' from amongst a flow, which was ever present (they simply turn devices on to break up silences but not always without more emotional or informational purposes). Individual 'items' tended to emerge from this flow. It is popular, particular in older groups to denigrate this behaviour as somehow demonstrating a lack of concentration, perhaps we should not be too critical, rather this phenomenon indicates an element of behavioural adaptation designed to gain maximum benefit for minimum effort from our media saturated lives. Perhaps more realistic would be to acknowledge that 'the concept of one's public and private self, separately or together, changes with age and experience' (Stone, 1996). However this younger age group represents what one might call the APC age, those born after the proliferation and access to PC technologies. In turn this begs the question whether the observed mode of behaviour will be modified as the group ages or whether in fact it is an environmental response or adaptation that will manifest itself in this generation as it ages and thereafter in new forms in future generations. If this were to be so, it may in turn have considerable significance for organisations seeking to build and sustain relationships with a population where this behaviour becomes increasingly dominant. A significance that will certainly lead us to challenge many current organisational forms and structures.

Many questions emerge from our work regarding 'media streams', device access and emergent behaviours. In particular are a range of issues relating to the methods and intentions of organisations seeking to establish and maintain relationships with a population highly likely to illustrate behaviours increasingly close to our youth group. To briefly highlight just a few we might begin by questioning why most definitions of customer contact are made from the suppliers view rather than the consumers, in which a subject/object relationship is established. They also tend to concentrate on the particular media channel, regarding the delivery device as in some sense neutral to the experience. Yet our work indicates that the channel device symbiosis is highly complex with both channels and devices owning sets of characteristics that are substantially moulded and modified during human interaction. Again little value appears to be given to the social and physical context of the recipient. When these are added to the equation differing models emerge. Firstly there are clear distinctions between public access and private. Indeed there is some evidence that if access devices are considered in this manner the traditional desk top PC is potentially highly challenged (by new mobile devices that appear to incorporate better co-usage within 'flow'), it neither possesses the public sharing attributes of large screen iTV

televisions and possible opportunities for spontaneity "*it's instead of going onto* (terrestrial TV) *news which would just take about half an hour to get the information across on* (iTV) *you get it straight away"* or the close 'bodily' privacy of mobile devices (eliciting comments such as "*you'd feel like you'd lost your right arm*", where the device takes on a prosthetic quality, also see Taylor (2001)). As functionality improves in mobile and more televisual devices these in turn will see exchanges of functions. Secondly we often de-privilege sound in favour of vision. Sound, radio, human voice etc is particular important to our younger age group. Currently sound is inherently more portable, it is also easier to 'background' requiring less 'foregrounding' attention to extract fragmented content and meanings from media flows. As a control device sound requires less physical intervention, therefore it in turn disrupts 'life flow' less. Thirdly organisational concepts of channel integration or ubiquity often appear to mean everything everywhere. Certain device types handle certain media better. Substantial brands may wish, indeed need, to have a presence across all or most media. However they will need to ask whether this presence is one of 'being there', their brand somehow represented, or 'doing there', actually transacting. Beyond this they will have to ask what form this 'doing' should take, our work clearly indicates that the expected mode and form of transaction differs in relation to both the mobility and the public/private nature of the device.

The foregoing merely outlines a few of the many questions raised by this research, the full significance of the findings are still unclear. However what does appear clear is that we are beginning to experience significant changes in media use and our relationship to media. Often this is associated with increased mobility .The many modes of access, new media and new devices certainly now require a level of sophistication when thinking of consumer contact well beyond the simplistic 'channels to market' concepts of the late 80s and 90s, such thinking also requires internal organisational change on an unprecedented level.

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INFORMATION TECHNOLOGY MANAGEMENT

Formalization and Automation of Global Software Development Processes

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Abstract

Globalization of modern economics leads to the increase of the software projects with geographically distributed development teams. Unfortunately, modern quality standards do not provide suitable facilities for description of distributed processes. In this paper our experience in formalization and automation of global software development is described. This development process incorporates three teams in Russia and USA, divided by 12-hour time difference in total.

Keywords: global software development, round-the-clock development, software quality, formalization of processes.

1. Introduction

Intensive development of metacomputing, IT and telecommunication technologies and globalization of their application sphere resulted in software development becoming an industry that works according to general rules of economics. Requirements for the development process, its management and quality of software products were formed and documented in specialized European and American standards ISO 12207, SW CMM, SPICE (ISO/IEC 12207, 1995), (Paulk, 1995); (ISO/IEC TR 15504-CMM, 1998). Software manufacturers had to react correspondingly and carry out an internal reengineering of processes according to standards' requirements. On the other hand, internationalization of software manufacturers and the development of telecommunication technologies resulted in further distribution of software development: companies can be distributed between different continents and development teams are longer guaranteed to have common traditions, management and responsibility. Still, there are some things in common, such as

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customers, project plans and some important phases of development process, such as software builds, their testing, debugging and so on.

It should be mentioned that organization and "quality adjustment" of distributed processes are not described in abovementioned standards. Therefore, the organization of distributed process according to the ISO and SEI standards becomes crucially important. What is the main point of such organization?

2. Formalization As a Key to Real Management

The philosophy of quality management demands the elimination of reasons, which lead to the production of poor product. Therefore, a unified language should be used for minimizing the consequences. This unified language is the language of formalization.

In SW CMM standard twelve of the fifteen key processing areas (KPA) on the Repeatable, Defined and Managed levels relate to management and organization categories (Paulk, 1995). In distributed production some of these processes require extra attention – for example, Intergroup coordination, Integrated software management, Quantitative process management and Software quality management. Creating of technology and effective managing is possible only in the case when all the processes are well enough formalized and documented. The more the process is formalized the easier it is to satisfy the standards requirements and to create metric system – the more the process is controlled.

It should be mentioned that formalization is not limited to the formal creation of block diagrams and the description of algorithms with SADT set of tools and IDEF methodology. The main goal of the formalization is to ensure the following:

- Full identification and actualization of the processes;
- The unification of the requirements and specifications;
- Decomposition, detailed functional and algorithmic description of the process;
- Creation of the model using standard methods, terminology, notations;
- Selection of routine operations and procedures that do not depend on the content of the project and repeat from one project to another;
- Selection of main points – program modules and units connection nodes, "switchpoints", "decision points" etc.;
- Elaboration of the mechanism of detection of mismatches between the formalized model and real process.

The "external" (ISO, CMM, SPICE) standard's requirements to carefully regulate and document all steps of formalization leads to the necessity of elaboration and inculcation of internal standards. The goal of the internal standardization is the maximal automation of software product engineering and standardization of the processes of management and decision-making: "standard process (procedure) – standard demand (specification) – standard decision (realization)". Such standards must:

- Be based on the processes, products, resources, standard tools and terminology in the field of software development;
- Be founded on real and tested theories;
- Be the basis of the processes' realization;
- Contribute to the development of software with predictable quality;
- Contribute to the increase of labour productivity among the developers;
- Maintain the accordance of software tools with standards by objective methods (the system of functional points and metrics);
- Initiate or motivate the creation of essential tool support;
- Eliminate the differences in approaches, national traditions and technologies in case of international global software development;
- Have a beneficial economic effect in use.

The basis of the creation of internal standards' system is the software manufacturer' system of approaches concerning the possibilities of carrying out particular processes both for the customer and for internal use. Several basic levels should be selected for which the standards are created such as methodological, instrumental, training and so on.

The internal standardization is long, difficult and not very pleasant process connected with large money spending and passive resistance of the members of the company, who consider it to be a waste of time and money. The most acceptable way is a complex approach, when the standards of all levels are worked out according to coordinated plan in order to reach the main goal – the increase of labour productivity among the developers and the quality of final version of product.

There is a base of systematic standardization of the processes of software tools development within the company. At the present moment in ISO and IEC there exist a number of standards concerning the work structure, transmission type and semantic metamodel for descrition and data communication.

3. Distributed Project: Development of RescueWare

This work describes our experience of formalization of distributed software development process on the example of development of RescueWare tool. This project is performed on contract with the US company Relativity Technologies.

First of all, several words about the product. RescueWare is the interactive tool that supports reengineering of legacy software systems. RescueWare offers a full range of capabilities for analysis, transformation and improvement of legacy systems:

- Support for legacy understanding, including source code analysis and navigation tools, diagramming tools etc;

- Knowledge mining, including such functions as business rules extraction and creation of data dictionaries, redocumentation and so on;
- Generation of programs in the modern programming languages (in particular, transformation of programs from Cobol, PL/I and Adabas Natural to C++, Java and Visual Basic).

The transformation of legacy systems is a laborious process, and thus RescueWare is a sophisticated tool that uses a lot of complicated algorithms. Development of RescueWare was heavily dependent on the latest research results and the whole project can be regarded as a fairly good example of cooperation between academic and industrial communities (Terekhov and Erlikh, 2001). The methods used in RescueWare are protected by two US patents. The product itself became an established leader in the field of Legacy Understanding & Transformation and was recognized as such by Gartner Group for two years in a row.

So it comes as no surprise that the development of such product is a large-scale project: the works have been going on during the last five years and the size of the created code is very large (more than 61Mb of source code). Several geographically distributed teams participate in the project: in Cary (North Carolina, USA, the customer), in St. Petersburg (Russia, the main team of developers) and in Novosibirsk (Russia, another independent team of developers that could be regarded as an independent subcontractor). It is notable that the teams are situated in different time zones and the whole project is the typical example of "round-the-clock development". The maximum number of people working on this product in LANIT-TERCOM (St. Petersburg) at times exceeded 100 people, and the whole team numbered up to 130 people.

Such large-scale project required special care in project management from all the involved parties in order to improve the quality of the development and testing processes. Every member of the company and especially managers should know their own area of responsibility and that of their colleagues, the distribution of tasks and the quality estimation criteria of all tasks. Only this approach guarantees the achievement of the goals and the quality of the final product.

The first result of process formalization was a detailed description of our development, testing and release processes (Onosovsky and Terekhov, 2000). The article (Kiyaev and Terekhov, 2001), which discusses different approaches towards the preparation of the company for certification, is also mostly based on the experience of this project.

In 1999 the customer set the task of automation of product build process and installment of software configuration control in order to improve the processes and increase the productivity of work. In particular, the following tasks were to be solved:

- Achievement of maximum effectiveness of the development and testing of the product. This includes division of processes into highly independent parts and decrease of idle time, which is a result of interdependence of subsystems and time difference;
- Organization of automatic daily build of the product;

- Increasing customers control over source code. The customer should always have the latest set of all programs in the product with the guarantee that they are full and have no errors.

Solution of these problems required the reexamination and reconstruction of the existing processes, special efforts from the management and solving a number of technical and technological problems. The next paragraph describes the organization of the project and our approach.

4. The Organization of the Distributed Development Process in RescueWare

4.1. The Issues of Configuration and Version Control

The development of high-quality software is impossible without the use of special means of configuration and version control. Its main goal is to store the source codes of the project with detailed logging of all changes with the possibility to rollback to the previous versions if necessary. We have defined three different types of source codes that had to be stored. First of all, there are programs that are in work at the moment. When these programs are completed and tested by developers, they should be integrated with other subsystems, i.e. included in the daily build. And after that, the source codes used in that build should be saved.

Thus, we have created three different branches of configuration control (they are called "safes" because we use Microsoft Visual Source Safe as our tool for configuration control):

- Development safe – all results are saved and stored there. This safe may contain unfinished components;
- Candidate safe – all code that is ready for the build is stored there. It gives opportunity to release Emergency Fix Package for already released versions;
- Release safe – all code after successful daily build is stored there.

We also had to create a number of utilities, which expand basic functions of Visual Source Safe. Some of them are listed below:

- Application for comparison of two projects stored in the safe;
- Caching system for the file history which speeds up the analysis and viewing of source code changes in the safe;
- Synchronization system for projects in the remote safes.

4.2. Daily Build Process

We decided to create our own system of process automation, because the existing tools for automation of testing and development could not satisfy our requirements of support of distributed processes. We have started with identification of all manual software development and testing processes in order to decide, which of them could be automated.

It turned out that the product can be divided into two mostly independent parts (see Fig. 1): back-end (algorithmic functionality of the product) and front-end (graphical user interface). Back-end is being developed in St. Petersburg, while the development of front-end is distributed between Cary and St. Petersburg. Finally, Novosibirsk team develops so called stand-alone tools, which have to be integrated into front-end of the product.

Testing of the product can also be divided into two parts – automated (daily build and automated tests) and manual (functional testing of the whole product). Automated testing requires a lot of time and contains a number of simple tests. This testing does not need manual intervention and can be done at any time and anywhere. Manual testing can be done only by QA engineers in St. Petersburg.

After investigation of development and testing processes, their main stages were automated and distributed among different time zones.

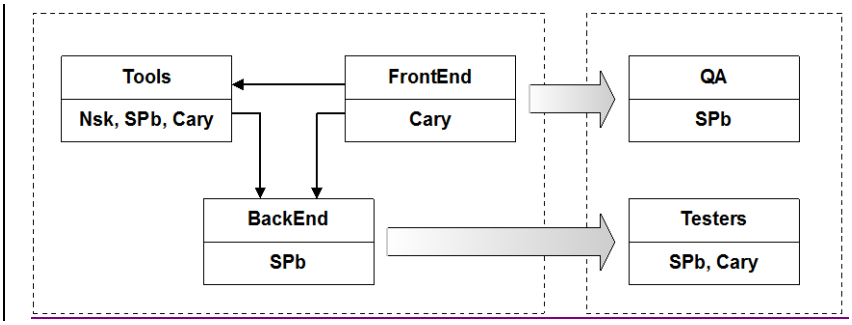

Figure 1: General scheme of development and testing (SPb – St. Petersburg, Nsk – Novosibirsk.)

The build process was moved to St. Petersburg. Final process is represented on the Fig. 2 (time of all operations is quoted according to St. Petersburg time zone).

The process starts with preliminary stage:

- Closing the Nsk safe (1) and transferring the source code to SPb (6);
- Closing the SPb safe (5) and initiation of back-end build (8);
- Closing the Cary safe (2) and transferring source codes to SPb (6).

Transferring the full set of source codes to Cary (3)

SPb:

- FE Build (8);
- Automated testing initiation (9).

Cary:

- Creation and build of installation package (4);
- Transferring the installation package to SPb (7) for further testing.

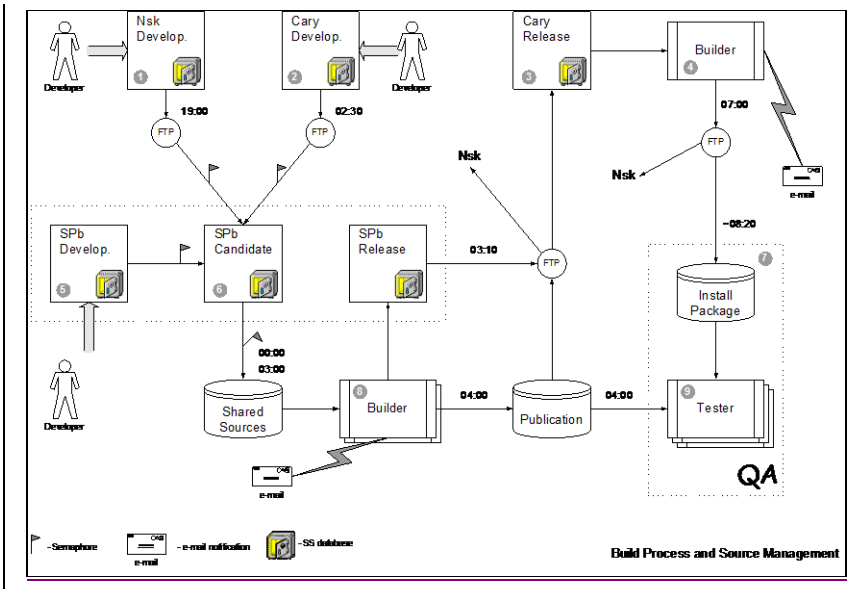

Figure 2: Distributed process of development, testing and release of the product.

All tasks required by customer can be performed using this method:

- The installation package is created at the customer side in Cary, so the customer gets the full set of source codes;
- Developers in Novosibirsk and St. Petersburg can use source codes at their working time (development time in St. Petersburg is shifted towards the evening to decrease the difference in time between St. Petersburg and Cary);
- Automated testing is initiated in St. Petersburg in the night hours, therefore QA engineers do not spend their working time and the computers are loaded to the maximum;
- Automated testing finishes and installation package from Cary is ready before the beginning of the working day of QA engineers. It is possible to initiate the testing of product functionality.

As a result of this approach, we have created the internal standard for all teams that includes the timetable of the build with optimal usage of working time of developers and QA engineers and also takes into account the network requirements. Based on this standard, we have also created special automated system that provides the replication of the safes (source codes transferring), automated building of the product and automated regression testing. This fixed schedule might not be really pleasant for separate developers, but is absolutely necessary for organization of efficient work of large distributed team.

4.3. Incidents Registration

In our distributed team the registration of incidents (errors and enhancement proposals) is organized by using a special tool – Visual Intercept by Elsinore Technologies. This application is the primary tool for all participants of the software development process:

- Team leaders can estimate the current condition of software product, the number of incidents and the dynamics of the changes in quality;
- Testers use this tool for storing the information about the errors they find and also to confirm fixing of the errors;.
- Users can also submit their information about the errors and make their own suggestion for improving the product (there is a special Web interface for this);
- Developers get information about the errors and provide information about their fixing.

Every incident can be described by following parameters such as:

- Status, Priority, Severity, Category;
- The name of developer responsible for fixing this error;
- The name of tester responsible for checking the fix;
- The set of test files that demonstrate this error;
- The history of changes of the information about this error.

Basic requirements for using Visual Intercept are documented in internal normative document of the company.

Formalization and standardization of the working rules for Visual Intercept helps to raise the effectiveness and reduce the time spent on correction of errors. Also, this tool is really helpful for project managers, because it helps them to control the development process and the quality of software product.

One very important technical problem had to be solved in order to achieve acceptable working conditions for all teams – the response time of incidents database. The main problem is enabling on-line work with the common data storage for the distributed development teams. One of the possible approaches (which is, by the way, quite popular at the moment) is to give up the idea of working on-line and use off-line methods, such as mail robots. We have decided to pursue on-line environment and created the replication system

by means of MS SQL Server (Visual Intercept is based on it MS SQL Server database) for synchronization of different versions of error databases.

4.4. Automated Regression Testing

The standardization of the processes can also raise the efficiency of work of quality assurance team. Our system of automated regression testing contains special testing applications in Cobol, Natural and PLI, as well as real applications taken from large-scale industrial projects. At the moment the whole size of regression testing database is about 13,000 tests. It is really impossible to conduct the testing process with such amount of source code using only one computer. Therefore we have designed and implemented an approach that uses developers' computers in the night hours for the automated regression testing. Currently, this testing takes about 20 computers and lasts for eight hours. Therefore the whole testing is finished before the beginning of QA engineers' working day. The results of this automated testing are stored in a special database, normalized using internal metrics, published as tables and bar charts on the Web and sent to employees by e-mail. This approach simplifies the process of source code analysis and deciding on changes.

5. Main Results of Automation of the RescueWare Development Process

The main results of formalization of the processes are listed below:

- Definitions of terms such as "Version", "Official release", "Working release" and "Daily release" often differ in various papers. Formalization of these terms and standardization of the working rules allows combining the continuous development process with discontinuous process of sending the latest version of the application to the customer;
- Formalization of the software configuration management and separation of development, build and release versions simplifies the versioning of source code and working with different versions of the product simultaneously;
- The building process – both of the whole product and its separate parts – requires formalization, because this process is "isolated" from the developer. Developers work only with source codes, while the build is carried out either automatically or on special request, but always in standard environment. It helps to avoid the situations of incompatibility;
- The storing of control information and building instructions together with source codes, and the existence of standard procedures enables the universal reproducibility of the results. All this information should be sent to the customer along with the completed software product;
- Work of distributed teams divided by several time zones requires the standardization and automation of the processes of source codes transfer;

- The results of all automated processes such as source code transfer, software build and night testing are automatically sent as reports by e-mail. These reports are differentiated by their type (successful, unsuccessful, critical) and sent to all involved parties;
- Logging the incidents information during daily build, along with their analysis and determination of responsible teams, leads to decreasing of the number of such defects.

6. Conclusion

Formalization is a very useful method for improving the quality of any process. Moreover, in the distributed software development formalization becomes crucially important for organization of communication between different teams. This is the only way to achieve predictable results of work and to provide transparency and effectiveness of basic processes. Also, formalization of the processes helps to determine the responsibility of all participants, thereby simplifying the process of acceptance testing.

In this paper we have presented our experience in formalization of distributed development and testing processes. The automation of basic processes together with their formalization helps to solve the problems caused by the geographical and time distribution of teams. It also helps to reduce the number of incidents during daily builds, to optimize the computer usage and even to get some advantages of so called "round-the-clock" development. This automation required from us to enhance the standard tools for support of distributed development processes.

Our approach (system of safes – fixed timetable of their usage – the formalization of the transferring of software versions – the method of working with errors – the automation of testing) can be considered as quite typical for projects with distributed development teams and can be used by other companies without any major changes. Moreover, we believe that the future versions of programming standards should adequately describe not only corporative, but also distributed processes of software development and testing.

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Visual Modeling and Software Project Management

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Abstract

During last decades in Software Engineering the concept of software development process was formed where analysis and design played a significant role. Visual modeling takes an important place there. However practice of the last years has shown, that these approaches are rather a philosophy, than a guideline for creation of effective software development strategies. Concerning visual modeling it appears that frequently it is visualized not what requires formalizing and wide discussion, but what is rather easy to visualize. Thus, a question on revising a place of visual modeling in software development process is still actual. In this paper we argue that this place is project management. We introduce the idea of a conceptual field of the project as a scope of its integrity. We regard as one of the main goals of project manager to keep a balance between conceptual field activities and basic project activities. We think that visual modeling can help in this.

Keywords: management, visual modeling, software process.

1. Introduction

Brooks noticed that the main problem of a large-scale software project is the complexity of supporting its conceptual integrity (Brooks, 1975). However in a real situation it is not easy to estimate the efforts which would be both effective and not excessive. One of the main goals of the project management is to achieve this balance. The balance between "theory and practice, technology and people, customer value and provider profitability, strategies and tactics" (Royce, 1998) is emphasized as a main perspective of software project management.

For a long time many researchers in software engineering believed in visual modeling. (Ross, 1977; Jacobson, 1992; UML, 2001).

The use of visual modeling in software engineering was accompanied by creating specific diagram languages as well as diagram-based techniques: structured analysis (Iordan, 1989), plenty of object-oriented methodologies finally evolved to Unified Modeling Language (UML) (UML, 2001) and Rational Unified Process (RUP) (Kruchten, 1998). Later the

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diagram-based techniques developed using UML (a good survey of such techniques is presented in (Fowler, 1999)).

The main prerequisite of the approaches mentioned above was the use of analogies with drawings in civil or mechanical engineering. This idea is actively criticized now (for example, by adherents of agile methodologies (Fowler, 2001)) because it was found hard to support the integrity of this information. Approaches that suggest using the visual modeling with code-generation techniques are not widely spread because of hard special work that needs to be done for customizing these approaches to a concrete project (Koznov, 2000). We think that code-generation techniques may be effective in cooperation with patterns (Gamma et all, 1995) or product line approaches (Clements, 2002) but these trends are out of scope of this paper.

Thus, to the present moment a wide experience of using the visual modeling in software engineering is accumulated and really, in many respects it has not justified the hopes. In this paper it is offered to revise the place of visual modeling in software process. For this purpose a new process model is introduced. It is based on an idea of conceptual field and division of the project activities into basic, conceptual, supplementary and correction.

The conceptual field is pointed out as the area of using the visual modeling in software project (independently of the diagrams type). In the paper visual modeling is considered as a way of thinking about software project problems (Quatrani, 1998). The principle difference of the approach presented here from others is a snapshot strategy that means we don't recommend creating information pieces that need to be supported during project life-cycle. We suggest some principles of operating diagrams and diagram-based techniques to dynamically manage the software project. Similar ideas are discussed in (Cockburn, 1999) but apart of the visual modeling and in the context of human aspect of software development process. One page method is similar to IDEF0 (IDEF0, 1993) (particular to author/commenter cycle), but concentrates on resolving some concrete problems instead of analysis the complicated area.

This approach accumulates author's experience of using visual modeling in different commercial and research projects in Saint-Petersburg State University and LANIT-TERCOM Corporation (Russia) for the last ten years. Author actively participated in one of them and investigated others. A lot of interesting information about visual modeling usage in software and business reengineering industry author obtained from feasibility studies performed in the IT-departments of some Russian banks.

2. Definitions

2.1. Visual Modeling

Visual modeling is a usage of images in various business-fields (in the industry, science, management etc.). There are additional limitations on these images distinguishing them from arbitrary pictures – they are created from the standard "patterns" having defined semantics and way of usage. Such kinds of limitations lead us to the semiotic approach and further to the visual modeling languages.

In a basis of visual modeling usage in software industry lies a simple observation that many people frequently draw pictures, when explaining a complex subject. Moreover the writing has appeared from the regulations of arbitrary images for the reproduction of exact sense. For example it was noticed that later ancient Egyptian hieroglyphs looked more like letters when the previous ones were more similar to the real objects described. So we see a fundamental role of the visual images and the visual channel of the person's perception for the creation of human mental world that is required to allow for people to do something together. This is due to the communicative effect of the visual modeling, permitting by means of images to transfer the information through the boundaries of the professional specialization, through the class and time barriers. So it is possible to make accumulation of the information and use it, for example, to control complex activities. The last makes attractive usage of visual modeling in management.

2.2. Conceptual Field of Project

In terms of conceptual field we shall understand some information assets of a project – its mission, main ideas and working schemes. The last means the empirically discovered rules assisting to control the project, and refinements of the main ideas arising during the project life-cycle. Speaking about operation with the conceptual field, we shall understand first of all operation with the working schemes, because the relations between the ideas and mission are hard to formalize.

The mission of the project is its place and role in a surrounding world. For example, the mission of the system of electronic document circulation is handle of a clerical work on a company, creation of transparent structure, increase of efficiency of business of the company.

The main ideas of the project are creative discoveries, due to which the project originates and is fulfilled successfully. They can be introduced from outside, can be created specially for the given project and/or during its life-cycle. For example, project business-idea is the answer to a question, why this software enterprise decides to develop system of an electronic document circulation: there are many kinds of such systems in the market. The reason is there was found a company ready to pay for it because of the uniqueness of its administration activities, where it is impossible to use existing systems, available in the market.

The working schemes are the detailed ideas of the project life-support mechanisms (for software projects it means process and product architecture). Process and product architecture may be strictly documented or not: it depends on the formalization style of the project. Finally the working schemes have to be presented in the minds of developers and should be clearly realized by managers and leading project technical staff. They have to be “alive” i.e. to be followed by the project. Working schemes can be reused from one project to another, but it always requires the customization because of the individuality of each software process.

2.3. Operating the Conceptual Field: Long-Time and Snapshot Strategies

We will distinguish two different strategies of operating the conceptual field of the project: long time and snapshot.

The long time strategy means that the working schemes of the project have to be thoroughly elaborated and strictly followed by. But there are a lot of different work products in the software project – documents, specifications, etc., and a lot of efforts should be taken to support all of them in actual state. In this case, for example, design specification has to reflect all software architecture changes. And for each process policy change, the corresponding corrections of documentation have to be performed.

The snapshot strategy means that the only thing that needs to be clarified at the moment are formalized during project performing. Afterward these formalisms should be instantly used and after completion they have to be put into archive. In future no special efforts to keep them in the actual state are undertaken.

The main difference between long time and snapshot strategies is that in latter case formalization resolves a particular project's problems instead of achieving the goal to correspond some methodology. From this point of view the idea of separating two strategies of operating conceptual field is similar to "pull-push" theory (Zmud, 1984) widely used in the management.

The long time strategy takes a lot of resources applied for the whole conceptual field. Disadvantages of this approach are discussed in (Cockburn, 1999). But this approach is considered to be quite useful for the special parts of the conceptual field, because there are some situations where the supporting integrity is a way to manage the complex activities.

3. Conceptual Field of Software Project

3.1. Place of Conceptual Field in Software Project: Ideal Model

Ideally the project activities should be divided into: conceptual field (adjustment of the basic management system of the project, elaboration of the software architecture principles, etc.), basis (coding, testing, etc.), supplementary and correction (to correlate the results of the conceptual field activities and the basic activities).

The supplementary and correction activities can be fulfilled permanently for the maintenance of corresponding the conceptual field and basic activities i.e. they support a sufficient level of the project integrity (gathering the project's information, performing some special integration activities – configuration management, testing, reporting, etc.).

Many participants of the project (architects, testers, etc.) can work with the separate parts of conceptual field. But it is the manager who oversees the conceptual field of the project – product architecture, the strategic goals of the project, political aspects (top management, customers), etc. The manager has the necessary overview, as he is not absorbed by some separate part of process and sees it as a whole.

3.2. Degree of a Project Unconceptuality

Unfortunately the software industry doesn't have any well-defined standard process. Moreover inside of every particular project there is a great variability of requirements, ways of implementations, etc. In this situation it's impossible to produce the general rules for achieving and supporting the project conceptual integrity. But for every project there is an empirical balance between: formal process assets (plans, policies, reviews, enterprise standards etc.) and success of the project; product architecture plan on one side and possibility and needs to change it on another, conceptual and "ad hoc" ways of carrying out the project.

The main question of the paper is how to direct the conceptual work from mind abstractions to an immediate practice. This is the problem of correct relations between project conceptual field and project activities. It is addressed to the project management. It is manager who decides whether it is possible to produce the next product version with patches instead of a correct solution that however takes time. But he can also find it better to miss this deadline and to implement the conceptual decision because the next deadlines can demand so many efforts that the project would be closed.

Degree of a project unconceptuality depends on specific project's parameters, such as its scope, technical and administration heterogeneity, kind of software (interesting software classification one can be found in (Jones, 1996), process model and technologies, financial state and perspectives of the project, etc.

3.3. Comparison With Software Methodologies

The suggested process model (basic project activities, conceptual field activities, supplementary and correct activities) is a special view on a particular software process and can be also applied to a software methodology. Below some of the well known methodologies are considered from the point of view of this model.

Almost the whole Capability Maturity Model (CMM) (Paulk et al., 1993) is in the conceptual field activities, supplementary and correction activities because its subject is a software process. Only software product engineering key process area may be considered as a set of the basic project activities. So establishing and supporting CMM in a project requires a lot of supplementary work. It could be effective in case of possible reuse of such kind of work.

Pairs phase/workflow of RUP (Kruchten, 1998) may be compared with suggested process model: for example, design on elaboration phase belongs to the conceptual field activities, but in a construction phase – to supplementary and correction activities. One can see a lot of conceptual field activities (mainly based on UML) but lack the real mechanisms for supplementary and correction activities. There is round trip problem for diagrams (and other software assets) and the code.

Extreme Programming (XP) (Kent, 1999) recommends not to perform the unnecessary conceptual work and is oriented to the balance of the project results (nearest) and project activities. Actually, the conceptual field exists implicitly in the minds of developers, when

they apply this methodology. So this approach does not suit the big teams. The disadvantage of this approach is the absence of a border between conceptual and basic project activities. So this methodology can be applied only by experienced manager who should also be a technical leader of the project.

4. Visual Modeling and Operating the Project Conceptual Field

We suggest usage of visual modeling in conceptual field activities. There were attempts to exploit it in the basic project activities, for example, as an alternative to common programming (Raeder, 1985), but they were not successful. One of the possible reasons of the failure is that the specifications on programming languages are intended not only for human, but also for computers and cannot be expressed in a compact graph view (which would let operating the text on programming language by means of diagrams). There are some exceptions from this rule (database scheme and reactive systems (Koznov, 2000) modeling), but in these cases there is a problem of integration of the software presented by visual modeling and by general way. The experience of software development has shown that it is convenient to visualize the essence of the complex subject, omitting numerous details.

4.1. The Long Time Strategy

One particular case of a long time strategy should be noticed. It is very useful, when the main project's diagram (one or the set of such diagrams) exists. It may be used for the presentation purposes and for introducing new people into the running project. Such diagrams have to be good. Once created, they exist for a long time. The author observed architecture diagram of a telecommunication system (28 units and a lot of links) being used in demonstrational purpose for many years. This diagram even outlasted the project itself.

The initiative in creating such diagrams usually comes from managers, because developers don't need them – everything is clear to them, and if something is not clear, they would prefer the traditional communication.

These diagrams depict main ideas and working schemes of the project with large granulation scale and it is not hard to correct them. One more reason why it is easy is that there are a few of such diagrams.

4.2. The Snapshot Strategy

Here are the principles of operating diagrams by snapshot strategy:

- Diagrams should have a context. Author experienced many situations (during business-processes specifications, usage of reverse engineering tools, etc.) where creation UML diagrams was an end in itself. The creators were not aware of the aim of the work but through they had to do as many diagrams as they could. But diagram presence does not automatically guaranties the clarifying of the complex domain area. It needs some context. For example diagrams look naturally inserted into some text (report, description etc.). But this is not enough, the diagrams should be "good";

- What does a “good” diagram mean? Such kind of a diagram has to produce integral impression. In particular it means that there should not be a lot them. One diagram has to contain multiple information levels to have possibility to return to the diagram form a different discussion points, to refer to it from the various parts of a report, etc. Numerous ways ought to lead to the same diagram. Each new view of a complicated subject should not be depicted in the separate diagram but to be demonstrated on the same one. Otherwise there will be so many diagrams, they will change so fast each other that it will become impossible to understand anything. For example this is a typical situation for Power-Point presentations. But “good” diagrams lay at the discussion table, hang on the wall in the manager’s room, etc. The idea of multiple views (UML, 2001) is more applicable for the same subject and different information consumers;
- Diagrams should be intuitionaly obvious. From one side such kind of diagrams should be created on a well-defined and wide-known diagram language. But the standard language doesn’t permit some familiarities which are able to make the diagram much more clear and expressive. And UML extension mechanism (UML, 2001) and graphic editors customization facilities do not help because of the unpredictability of such kinds of particularities. That is why graphic editors like Visio are often used instead of CASE-tools. (Actually Microsoft stopped integrating Developer Studio with Rational Rose based CASE-tool. At the moment it develops its own graphic editor on the base of purchased Visio.) CASE-tools are more preferred when using visual modeling in basic activities of project (in case of detailed design of database applications, modeling reactive systems) because in this situation we have to create a lot of diagrams and would like to have some special facilities to operate them.

4.3. One Page Method

This method was used in feasibility studies of complicated software projects, for research projects, when supervising students’ thesises and preparing seminars, lectures, training, etc.

One or more project’s participants work with an expert to formalize and integrate project’s assets – actually to make a snapshot of project conceptual field. There are some points when the project looses orientation and has a chance to fail without such revision.

A set of meetings is conducted. At first the project problem is identified and after that is elaborated more and more and is transformed to decision. This jump happens suddenly and is stimulated by the expert. The main idea of the method is frequent meetings (from several times per one day to the one per 2-3 days) and concentrated work around the one specification. Every time the same page with text and/or diagram is discussed and after that corrected and discussed again. This page contains the scheme, the essence of understanding the problem (with blank spots) that turn into decision scheme, working plan, etc. The iteration is completed when the conceptual problem is resolved and can be implemented (without expert). So all work is carried out in the conceptual field of the project. This iteration can take from one week to several months.

It is desirable to use diagrams in such kinds of specifications. They increase its expressive power and contribute to the appearance of the fruitful associations of the clients. As a rule

one small diagram is enough. However it is possible for the specification to contain more diagrams in case if its size is more than one page because of some peculiarities of a problem domain, or clients, or project problems. All specification also may consist of the only diagram with pieces of text inserted in graphic elements. The use of the following diagrams is productive in visual modeling in this case: structured analysis (Ross, 1977), entity-relationship diagrams (Chen, 1976), data-flow diagrams (Iordan, 1989), functional diagrams (Z.100, 1993).

5. Conclusions

The approach offered in this paper revises the visual modeling position in software process from the perspectives of management. The usage of the visual modeling in management is not new idea: for example, Structured Analysis Design Technique suggested in 70th was widely used in the complex industrial projects (not only software ones!). Unfortunately at the last time the visual modeling is developed in software industry mainly from the perspective of analysis and design usage.

In order to clearly determine the place of visual modeling in software project, the notion of the conceptual field is introduced. After that the usage of visual modeling in management is separated from its' usage in software analysis and design. The snapshot strategy is suggested as a main way of operating visual modeling in management. One page method as a one possible implementation of the snapshot strategy is considered.

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The Balanced Scorecard for IT Strategy

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Abstract

The methodology of Balanced Scorecard (BCS) is used in companies all over the world. This article demonstrates the basic concept of BSC and how the methodology of Balanced Scorecard can help to define IT strategy and choose the best approach to achieve a company's business goals. In BSC there exist four perspectives: financial, growth, internal process and customer. The same perspectives can be use to analyze a company's needs for improvement and software implementation. It helps to decide which IT tool is most suitable for company's strategy. When the decision of implementation is taken using the perspectives of BSC, the requirements are defined and results are measured, during and after realization of IT project.

Keywords: Balanced Scorecard, Strategic Management, Project Management, IT methodologies, Business Improvement

1. Introduction

The idea of Balanced Scorecard (BSC) methodology was introduced in 1992 by David Norton and Harvard Business School professor Robert Kaplan. From the 90's a growing number of companies have used BSC as a performance measurement and management tool. The idea of BSC reflects changes in the business environment. Only the financial perspective is not enough to analyze a company's marketplace and performance. Aspects such as customer loyalty, innovation, and process improvement are very important in "the age of information". Using BSC, it is possible to reflect more than only the financial situation. BSC is strongly linked with software and IT technology. More than a dozen software packages are offered by IT vendors to support BSC creation and to provide data and connection to other systems. Also Balanced Scorecard can be used to define and support information technology strategy in the organization and to measure results of software implementation.

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2. Concept of Balanced Scorecard

A Balanced Scorecard provides a means for linking the strategies of different businesses within an organization to the overall corporate vision. It supplements traditional financial measures with criteria that measure performance from a variety of perspectives. But perhaps the most important aspect of a Balanced Scorecard is that it allows organizations to link long-term strategy with short-term actions. (McLemore, 1998)

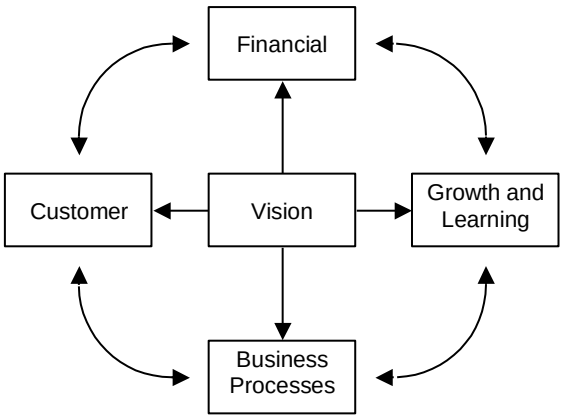

Figure 1: The Idea of Balanced Scorecard. Source: Robert S, Kaplan, David P.Norton, (2000) Strategiczna karta wyników. Jak przełożyć strategie na działanie. PWN, Warszawa.

2.1. Four Perspectives of Balanced Scorecard (www.balancedscorecard.org):

2.1.1. The Learning and Growth Perspective

This perspective includes employee training and corporate cultural attitudes related to both individual and corporate self-improvement. In a knowledge-worker organization, people – the only repository of knowledge – are the main resource. In the current climate of rapid technological change, it is becoming necessary for knowledge workers to be in a continuous learning mode. Metrics can be put into place to guide managers in focusing training funds where they can help the most. In any case, learning and growth constitute the essential foundation for success of any knowledge-worker organization.

2.1.2. The Business Process Perspective

This perspective refers to internal business processes. Metrics based on this perspective allow the manager to know how well their business is running, and whether its products and services conform to customer requirements (the mission). These metrics have to be carefully designed by those who know these processes most intimately; with unique missions these are not something that can be developed by outside consultants.

In addition to the strategic management process, two kinds of business processes may be identified: a) mission-oriented processes, and b) support processes. Mission-oriented processes are the special functions of government offices, and many unique problems are encountered in these processes. The support processes are more repetitive in nature, and hence easier to measure and benchmark using generic metrics.

2.1.3. The Customer Perspective

Recent management philosophy has shown an increasing realization of the importance of customer focus and customer satisfaction in any business. These are leading indicators: if customers are not satisfied, they will eventually find other suppliers that will meet their needs. Poor performance from this perspective is thus a leading indicator of future decline, even though the current financial picture may look good.

In developing metrics for satisfaction, customers should be analyzed in terms of the kinds of customers and the kinds of processes for which we are providing a product or service to those customer groups.

2.1.4. The Financial Perspective

Kaplan and Norton do not disregard the traditional need for financial data. Timely and accurate funding data will always be a priority, and managers will do whatever necessary to provide it. In fact, often there is more than enough handling and processing of financial data. With the implementation of a corporate database, it is hoped that more of the processing can be centralized and automated. But the point is that the current emphasis on financials leads to the "unbalanced" situation with regard to other perspectives.

There is perhaps a need to include additional financial-related data, such as risk assessment and cost-benefit data, in this category.

2.2. The Process of Balanced Scorecard Creation

Typical implementation process of BSC has 5 to 7 steps (Fig. 2).

2.3. BSC for Projects

Projects can be considered “mini-organizations,” requiring the same clarification and benchmarks as the parent organization. Because projects are more structured and controlled than the organization as a whole, they have accrued a reputation of a high failure rate in one or all of the critical success factors. In order to better manage the project and the overall

health of the organization providing the services, a BSC approach can be used to perform health checks throughout the project life cycle (Steward, 2001).

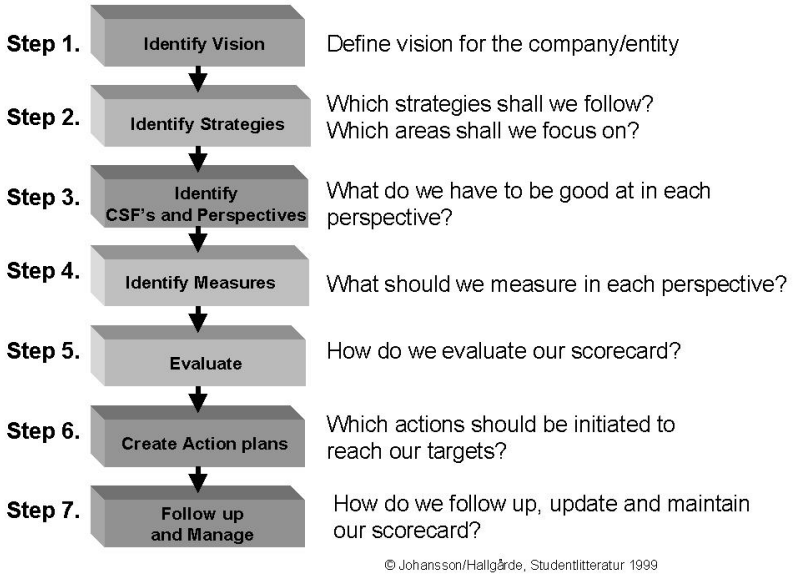

Figure 2: Steps of the Balance Scorecard implementation (www.qpr.com).

Critical Success Factors are identified early on in the project initiation phase, through consultation with stakeholders. Consider indicators that will determine how well the project is progressing at each phase: initiation, planning, execution and closing. Some possible examples of KPI (Key Performance Indicators – measures), which can be reported as numbers: percentage of time spent to date; percentage of budget spent to date; percentage of deliverables produced to date; ratio of actual work effort compared to estimated work effort; ratio of risks that actually occurred compared to risks identified; ratio of final requirements completed that were a result of change orders compared to original set of requirements; and ratio of dropped requirements against final delivered set of requirements (Shelley, 2001).

Performance indicators need to be established early on in the project, refined at the start of each phase, tracked as the project progresses and results published as part of the post-implementation review (Shelley, 2001).

3. The Balanced Scorecard for IT

Balanced Scorecard can help to choose and successfully implement information technology tools and methodologies, on both strategic and operational levels. Two Balanced Scorecards should be created in any organization. The first BSC is created on the strategic level, which was described above. Secondly, the operational BSC is created directly for the IT project. This BSC can help define business goals and requirements for an implementation. The first BSC helps us to find the best solution to improve the most important areas in the organization. The second BSC helps to increase the probability that the implementation will achieve success.

3.1. Strategic Level

In the business world there exist lots of tools, methodologies and software brand names. Consultants, vendors and IT companies offer dozens of different "best solutions". Unfortunately, what can be successful for one company, can bring only a waste of time and resources for the second. There are situations where the company implements an expensive software system and then realizes that it didn't need them, or that the system was too complex and wasn't concentrating on the company's real problems. The system often works properly, without any technical problems, the staff was educated how to use it, but nobody works with the system because nobody really needs it.

The problem is: How to find the best IT methodology for our organization? What will be better to implement: Customer Relationship (CRM), but analytical, call center, or sales module? Activity Base Costing, Knowledge Management, Document Management, maybe Enterprise Resource Planning, or better Supply Chain Management solution? Answer is not simple, often definitions of methodologies are not clear. Most of them based on process business approach, so in many points different systems can give same results. It's nearly impossible (however depends on size of a company) to start implement more than two, or three systems at the same time. Lack of resources (money, people...) and of course time, cause, that choice of right methodology can be vital for the organization. That choice often can decide, in high competitive environment, about success, or fail of the company. But questions are: What does it mean right choice? How we know which way to choose? What system to implement? Do we really need IT system? May we need more than one system, but which one is the most important for our company? Which module of the system should be implemented first? From what department/process we should start?

Balanced Scorecard can help to find a solution. Implementation of IT systems cannot be separate from company vision and strategy. All resources and activities across all organization should be involved for supporting company's mission, IT systems too. In Balanced Scorecard are defined vision and strategy. In each of four perspectives are Critical Success Factors (CFS). We should concentrate on CSF's, so is logical that IT systems should support them first. Importance of the IT systems increase, that cause often IT system become one of the CSF's.

About technology and IT system we start to think when company's vision and strategy are defined. Because technology should support them, analysis of existing solutions is required. Between different methodologies and system offered on the marked should be chosen, these, what can help us to achieve company's goals. When CFS's are defined, we can check how IT systems can help to realize them faster, cheaper, and more efficient. However IT system usually has influence on all company, different systems concentrate on different areas, parts of process, departments. It means systems do not concentrate on all perspectives of BSC in same level (Tab. 1).

Methodology/ System	**Balanced Scorecard Perspectives**			
(In alphabetical order)	**Financial**	**Customer**	**Internal Process**	**Learning/ Growth**
Activity Based Costing (ABC)	+			
Business Intelligence (BI)			+	+
Customer Relationship Management (CRM)		+	+	
Document Management (DM)			+	
Enterprise Resource Planning (ERP)	+		+	
Knowledge Management (KM)			+	+
Supply Chain Management (SCM)			+	

Table 1. Concentration of different IT methodologies and systems on improving of BSC perspectives.

3.2. Operational Level (IT Project)

Software implementation it's complicated process, what can be prepared and analyzed using BSC methodology. For project can be build operational BSC. Before implementation starts, should be define CFS's for IT project, measures and at the end action plan, similar is for strategic BSC. In BSC for project is important to remember about balance of all perspectives.

Some aspects of all perspectives. According to IT system implementation.

Financial: cost of system (software, hardware, implementation, consulting services), ROI of the system, payment terms, and project's budget…

Internal Business Process: what process (part of process) will be automated, process mapping and optimalization, what aspects are most important: quality, time of process, cost,…

Learning and Growth: what new skills of staff are required (front and back office, IT team), what information should be stored and reported by the system, how system will be linked with other IT systems, what data can be exchanged with other systems and communication channels…

Customer: how system can improve customer service, what aspects of system are required by customers, what are customers needs and expectation…

Measurements (Key Performance Indicators), gives information: Was implementation successful, or it was next filed project? They show how system meets business goals. This information is important for company where was installed system and for IT company which install software. Action Plan is similar as all Project Management plans, needs to define resources (internal, external), project timing, deadlines, mile stones, team leaders…

4. Summary

Balanced Scorecard is relatively new methodology, but already has strong and growing position in the business world. Mostly is implemented in big organizations, however start to be use in medium enterprises too. Most of BSC were created on strategic level and still is not popular as project management support. In my opinion BSC is an excellent tool to choose the best IT strategy, and find best IT methodology, between various systems offered on the market. BSC can help to link company's vision, business goals and systems requirements to improve competitiveness and meet customer's expectation.

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Generation-Based Software Product-Line Evolution: A Case Study

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Abstract

Product-line development is a modern approach in software engineering, designated for saving efforts in development of product families by means of controlled assets reuse starting with architecture and up to source code. In this paper a case study of the generation-based product-line, i.e. a product-line, which development is managed via high-level formal models and the source code is produced by means of generation techniques, is introduced. Evolution problems of such a family are analyzed and possible solutions are presented.

Keywords: software product-line, software process management, generative techniques

1. Introduction

Broad expansion of computer equipment resulted in the use of computers in many fields, from education to space flight control. At the same time the demand for the quality of the computer software becomes stronger and stronger. Upon such conditions, new management strategies should be elaborated to provide the desired number and quality of software-intensive products. One of such strategies is the product family development. As it is defined in Kolter (1986), a *product family* is a group of similar products within a market segment (or mission domain). When we have in mind a process of joint manufacture of products in product family, we will call this the *product-line*. Thus, *software product-line* is a process of joint development and maintenance of similar software-intensive products family. In Svahnberg and Bosch (1999) and Batory (1998) the notion of product-line architecture is presented, i.e. a software architecture and set of reusable components shared by a family of products, but this notion is limited to technical aspects of product family development. But to introduce a product line approach in the industrial software development, one should address a lot of other issues, e.g. deadlines in every product. Software product-line incorporates all aspects of joint development of software products family, including technical and management aspects.

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From the financial point of view product-line approach has both advantages and disadvantages. In every specific case special analysis should be carried out to decide whether to use or not the product-line approach in particular product family development. The cost of introducing product-line approach is high enough, but in practice these expenses could be generously repaid in future. For instance the CelsiusTech company, that develops Ship System 2000 software for Swedish Navy and Danish Navy, has changed its hardware to software cost ratio from 35:65 to 80:20 by introducing a product-line approach (Brownsword et al., 1996). Moreover, in Cohen (2001) impressive data are presented: changing the development of four-product family of large-scale military systems to product-line approach saves $25 million by the end of four-year maintenance period.

One of the popular reuse techniques is a generation technique (Hervé and Guéhéneuc, 2001; Bassett, 1997; Cheong and Jarzabek, 1999; Czarnecki and Eisenecker, 2000). *Generation* is producing of source codes and other application assets on the base of high-level formal model (Koznov, 2000). In case of the *generation-based product-line* generation techniques are used not only for enabling reuse, but also as a basis for management practices. At the same time, in such product-lines a considerable part of every product (e.g. database scheme, source code modules, etc) is produced on the base of formal models (mainly visual models, e.g. UML models) by means of generators.

In this paper a common structure of product-line development process is proposed. Also a case study of generation-based product-line for the family of database-centric applications is presented. The goal of the study is to discover the product-line evolution problems and propose a tool support to cope with underlying complexity that accounts for these problems.

2. Basic Concepts

Every software development process has its own schedule, resources and financing. But to support a product-line development, a company needs some common infrastructure. We will refer this infrastructure as *product-line factory*. The model of the factory is built on the base of the SEI's Framework for Software Product Line Practice (Clements and Northrop, 2002), but due to global nature of this framework, in this paper we introduce the compact model of the factory, intended to clarify some aspects of our case study.

There are two poles in the organization of product-line development process. The first pole is a directive process, like in Cohen (2001). In such a case, all product development processes are controlled by the same top-managers that understand that the support of the factory is a very important task and consider this issue in project plans and other management activities on the top-level. In this case the initiative comes from top-management, and the common infrastructure is easier to be established. Another pole is a federative process. In such a case every product development process is managed and performed by its own team, and every product manager should participate in debates to make a decision about some common assets. In this case the initiative comes from product managers and developers, not from top-managers.

2.1. Product-Line Factory

Software product-line factory is an infrastructure intended to support managed joint development and maintenance of products included into the family. The easiest reuse practice is to copy-and-paste the code fragments from existing applications (Humphrey, 1990). But the logical links between applications is broken in such case, so the controlled applying of changes becomes very difficult. In practice, after the use of copy-and-paste reuse technique the applications become independent from each other. In particular, if it is necessary to correct an error in application, found in pseudo-common (i.e. copied from the same source) part of code, another applications will need efforts to find and correct this error too. A product-line factory should manage all the assets valuable for several (more than one) products or for several subsystems of one product. Also the factory should provide special services to product development processes intended for safe access to these assets.

A common model of the product-line factory includes *Repository*, *Support Practices* and *Tools*. *Repository* contains common assets, such as domain model, generic architecture (Cheong and Jarzabek, 1999) and others, as well as product-specific assets, like high-level visual models, source code, etc. *Support practices* are intended to keep the factory actual in spite of the contradiction between product-line long-time performance and short-time response demands of every product. *Tools* designate a package of useful software, e.g. integrated development environment, CASE-tool, code generator, etc.

Factory assets are not universal. The unique factory should be elaborated for every software product-line. Thus to support a particular product-line factory, a complex tools development could be necessary. One should compare the efforts and costs of factory development and maintenance to efforts and costs of the independent maintenance of family products, without any joint process. If the family contains two or three simple products (and there are no perspectives of expansion), product-line factory support could be too expensive. But if there are a lot of products in the family or the products are mission-critical, the development and maintenance of the factory will be justified for sure. In any case, a serious technical and economical analysis should be carried out before using product-line approach for specific product family development. The example of such analysis can be found in Cohen (2001).

2.2. Product-Line Evolution

In general, the product-line lifecycle consists of start-up and evolution stages. Product-line start-up includes development of the first product, some common assets and a design of product-line factory. Evolution includes development of new products, support of existing ones, and support and development of factory assets. To support the evolution of the product-line, its factory should evolve as well. The main goal of product-line factory evolution is to keep supporting all developed products and provide support for newly developed ones. More particularly, when a new product is developed, the factory services should be used and the factory should be improved (for example by making new assets out of components that were developed for the new product but are intended to be usable in another products). On the other hand, when some product is tuned or revised, developers should keep its connections with factory.

The purpose of the factory is a long-time performance of the product-line. At the same time, the purpose of every product development process is to provide a product according both to its schedule and specification, i.e. to gain a short-time response. This contradiction is a main source of complexity in product-line evolution. Due to short-time response demand all changes are often applied just to the code of particular product, even if they affect the modules provided by means of factory services and break the integrity of the factory. That's why the product-line evolution demands special resources to evolve the factory.

3. The Case

The family selected for the case study is a family of database-centric applications, developed by LANIT-TERCOM and Saint-Petersburg State University Services Software department. The generator and other tools are integrated into the REAL case-tool (Terekhov et al., 1999), developed by LANIT-TERCOM, Ltd and Saint-Petersburg State University.

3.1. Case Study Method

The main goal in this case study is to analyze problems, arising during the evolution of generation-based product-line. To archive the goal, the author conducted interviews with main architects. Moreover, the author participated in the development of several products of this product-line itself.

3.2. Studied Products

According to three-level model introduced by Bosch and Högström (2001), we will distinguish the following product groups in the studied family of database-centric applications: enterprise main funds applications, student data applications, and library data applications.

Nowadays there are five major products being developed in the family, main of them are *FacultyStudent* and *TerStore*. FacultyStudent is a members of "Student data applications" product group, intended for accounting the students of some faculty. TerStore is a member of "Enterprise main funds applications" product group. This application is intended for accounting of LANIT-TERCOM, Ltd basic funds, such as computers, etc.

3.3. Why Product-Line?

The first product in the family was FacultyStudent. System architects noticed, that the considerable part of the application user interface have a poor business-logic and can be classified into the following types (Strigun et al., 2001): forms, intended for viewing or editing the properties of a single problem domain object, forms, listing elements of some complex problem domain data views and forms, setting the relations between objects. Basing on these features and analyzing an experience of previous products development in the same domain, the system architects had decided to use generative approach for this product development process. When new database-centric applications were to be developed, the approach chosen had been proven to be very fruitful, so it had been generalized and product-line factory had been established. The solution was proven to be of a considerable benefit in other database-centric applications.

3.4. Product-Line Factory in The Case

Product-line architects selected the problem domain data logical model as a source model for automated generation of the following assets: relational database; object-oriented API for accessing data storage in terms of logical data model; libraries of forms for viewing and editing problem domain objects properties (card forms), browsing complex views of problem domain objects (list forms), and, at last viewing and setting complex relations between problem domain objects (relation forms).

The first product contains about a hundred of database tables and more than a hundred of generated forms. But the source for these forms is a logical model of domain data and generator templates (one for each type of forms, i.e. card template, list template and relation template) (Strigun et al., 2001). In this case the reuse was gained due to generative techniques. During the first product development some practices were proposed by product architects to manage and support the development process. These practices include product development group organization, development process, configuration management strategy and quality assurance strategy. All these practices exploit the generation techniques, so the studied product-line is the generation-based product-line.

3.5. Evolution Problems in The Case

In this section we will describe the main problems encountered in the studied case: problem of product assets reuse and problem of common assets evolution.

As new features were implemented in the most evolving product of the family, other products became mature enough and demanded some of these features too. This is a source of the problem of product assets reuse. In current situation, no practices for controlling high-level model fragments reuse exist. When some product needs a fragment of logical domain data model of other product, the corresponding elements are just copied-and-pasted. A special tool is needed to indicate the model fragments valuable for more than one product and move them to factory common assets repository. One of the major problems and goals in the evolution of the factory being studied is to alienate all common assets from the first product (and make them available for use in other products). Also some means should be provided for versioning the common assets, because when one product needs some changes in the factory, these changes could break the integrity of other products, especially when they are at the latest stages of development (Svahnberg and Bosch, 1999).

While the product-line evolves, common assets evolve too and some of them need to be re-applied. But the generated code is often patched and extended manually, because generator input does not provide a full specification of the system, so its output is not the final result. The impact of these manual changes on the factory consists in breakage of the links between the factory and products. It means that the generated code is no longer an image of corresponding factory assets and regeneration of such a code will destroy changes. These issues result in the problem of common assets evolution. Hence, the regeneration is delayed as much as possible. As a result, lots of changes are inserted into the generated code to improve/correct it, even if corresponding improvements are already incorporated into the factory. In this manner the links between the factory and the product becomes more and

more weak: a number of manual changes to generated code would become so large and they are so spread to the code that regeneration is very destructive action. In some cases the factory stops to provide its services to product development processes, which code was actively patched and becomes a fast-prototyping facility. To avoid this a strategy of manual changes control for the studied product-line should be elaborated.

Currently, developers should provide comments for every change in source code. This strategy is of organizational kind and demands permanent self-control from developers and in case of intensive development and close deadline this strategy is too risky.

Special tools should be elaborated to control manual changes to generated code. Because the product development is performed with use of versions control software (Microsoft Visual SourceSafe), all versions of code could be storied: the original generated version and all changed versions. When a changed version is put under SourceSafe control, the automated comparison of original generated code to changed code should be performed. Corresponding support comments should be inserted into the changed code automatically. Also the registry of changes should be created and updated automatically. With the tool proposed the developers would have the previously generated version of code, and the registry of changes. This information helps to apply needed changes into new version of generated code and dramatically decreases the risk of loosing important changes.

4. Related Works

Product-line approach is widely studied by many researchers. We classified existing works into the following groups: general ideas about product-line approach (Batory, 1998), generative techniques (Hervé and Guéhéneuc, 2001; Bassett, 1997; Cheong and Jarzabek, 1999; Czarnecki and Eisenecker, 2000), product-line evolution problems (Svahnberg and Bosch, 1999).

Batory wrote (Batory, 1998), that now many methodologies are aimed at one-of-a-kind applications, but future software development will center on product-line architectures, component and plug-and-play development. Also he proposes the GenVoca methodology and tool for supporting product-line architectures, based on parameterized inheritance.

Hervé and Guéhéneuc (Hervé and Guéhéneuc, 2001) propose two different generative approaches to design patterns reuse: one is *pure-generative* (in this case the reference is the model) and another is *conservative-generative* (the reference is the user source code). Basset (Bassett, 1997) proposes a frame technology to reuse the assets in COBOL. Cheong with Jarzabek (Cheong and Jarzabek, 1999) propose the use of frame processor in component-based product-line development. Czarnecki and Eisenecker (Czarnecki and Eisenecker, 2000) propose multiple ways of using generative approach in software engineering.

Svahnberg and Bosch (1999) present a case study of existing industrial product-line. They consider its evolution (generations and releases) and propose some categories of product-line evolution. But they don't consider any issues, appearing when product code move away from common assets, as well as issues, concerning managerial aspects.

When we faced with a task of analyzing the real generation-based product-line we found that existing works typically consider product-lines or generative techniques, but not the use of such techniques in product-line development. In this paper a case study of generation-based product-line is presented.

5. Conclusions

Due to wide experience product-line architects managed to establish a development process with high reuse of assets inside one product. This reuse is supported by means of generative technique. The basic concepts of database-centric applications domain were generalized to be templates for generating particular components. This fact allowed developing another products in such a manner on the base of the same technique and assets.

The studied product-line development process is more federative than directive. In federative development process product teams members understand, that support of the factory is a substantial task, but the short-time response is more important for them, because they are responsible for the specific product, so long-time performance perspective is sacrificed. In this case the staff tends to resolve the contradiction between factory long-time performance and product short-time response demand by technical means: they are willing to exploit new technologies, but not to change the organizational structure, whereas in case of directive process, organizational practices are emphasized. Every real product-line development shows both directive and federative characteristics. The pure processes both have disadvantages. The pure directive process may result in bureaucracy (demand for lots of documents, intended for managing the process, resulting in reduce of productivity). The pure federative process may result in the factory degeneration: it becomes useless to product development process or turns into a part of some product (usually the first family product).

Analyzing the studied product-line we concluded that considered problems partly result from the federative nature of the development process. As a result of this nature, the factory is tightly coupled with the first product of the family. The important direction for this factory evolution is to become independent of the products. In the studied case the federative nature is an essential part of the development group, and directive approach cannot be applied directly. On such conditions the strategy for successful evolution of product-line in federative development group should be elaborated during the further investigations. Also it is assumed to provide according tool support and elaborate organizational practices to cope with the problem of product assets reuse and the problem of common assets evolution and analyze the benefits of this support.

Acknowledgements

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Basic Technology for Creating Mobile Distributed Systems

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Abstract

Basic technology for creating mobile distributed information systems is considered, and its practical implementation is discussed.

Keywords: business process reengineering, information systems, multiagent technology

1. Introduction

Modern manufacturers are working in rapidly changing environment and cannot make long-term plans based on current market conditions. To prepare to external changes, the structure of the company has to be highly flexible and all changes in the structure of the company should be done in evolutional way. Therefore, the reengineering of the company should be a continuous dynamic process, but not a disaster.

At the present moment every large company has its own information system, but often these systems consist of differing and odd applications and data storages, therefore the control and support of such system seems to be almost impossible.

This explains the necessity of reengineering of information system. The main purposes of reengineering are:

- New business requirements accounting;
- The unification of software tools;
- The substitution of current structure for component-structure of the company;
- Transparency and scalability of the system.
- However the evident approach – to replace existing information system with a completely new one, is really unacceptable because of following reasons:

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- New information system will not use the experience of using and improving of existing system;
- The changing of information system requires the conversion of data to into new format, and also personnel training for using new tools, which leads to the interruption in the work of informational system and company in whole.
- There fore it is reasonable to divide the reengineering process in two steps. The goals of preliminary stage are:
- The elaboration of unified representation of corporative information;
- The integration of existing applications in one system.

The next stage consist of changes of existing information systems with new ones without interruption of the work of the whole system.

The new idea in creating and reengineering of information systems is usage of multiagent communication mechanisms of applicable tools and toolkits. With usage of such mechanisms, the information system consists of independent components, which can perform some defined operations and even can be moved in information network.

Therefore the multiagent infrastructure of the system represents the semantic shell of the information system, showing the business rules and the intercommunication of its participants.

The main goal of agent technologies is the integration of heterogeneous application in global infrastructure and the creation of flexible and configurable information systems.

The usage of program agents in creation of Information systems provide following possibilities:

- Dynamic reconfiguration the information system;
- The encapsulation of developed programs in integrated system;
- The unification of the used software;
- The access to international information space in order to develop mobile commerce and e-commerce;
- The improvement of the control of information system by means of remote monitoring of its components;
- Reduction of network intercommunication costs by means of agent's mobility;
- Reduction of support's costs by means of remote execution of applications.

2. The Methodology of Construction

In last years the problems of reengineering and construction of new and particularly multiagent technologies became very popular. Many research departments and large

companies are working on these problems, therefore there was created a number of standards of different levels.

In our team a special seminar is concerned these problems, five graduation works were defended and also some software tools were developed. The main goal of these work is the studying of new standards and approaches, their approval on real examples, and, finally, the development of new technologies of construction of modern information systems.

To achieve maximum generality, it is suggested to construct technologies on two steps: firstly, base technology (so called "meta-technology") is formulated and being equipped with toolkit, and than for every project domain the special technology is constructed with usage of basic technology.

2.1 Construction Principles

The effective solution of basic technology development's problems for construction of mobile global information systems has to be based on following principles:

- The follow of international standards for all stages of system life cycle – the model analysis and specifications' definition (ISO 10303,ISO 15704, ISO 15288), construction and integration (ISO 10303, ISO DIS 14750, ISO 18876). These standards define the basic rules for company's description, information protocols, the list of standard processes and development stages.
- Usage of GERAM methodology [ISO WD15704 (1998)] and specialized methodologies for construction of organized business-processes. GERAM methodology generalizes basic description methods for data domains and consists of following basic components: referent architecture, special methodologies, languages, common and special models, toolkits, common software modules and specialized modules. On the basis of GERAM methodology special methodologies are created, which represent the data domain's features and used architectural solutions.
- The component construction of applicable tools and toolkits. Component technologies (DCOM, CORBA, EJB) have to provide following functions: transaction processing, object request brokers, message brokers, and configurable security. These functions make the components independent from programming language and used platforms, real-time connection of new components, virtual modules, adaptation of applications to new business rules, independent engineering, integration and usage.
- Multiagent construction of toolkits and applicable tools [FIPA (2001)]. The main feature of engineering and reengineering of mobile information systems is a dynamic of construction of new business rules and effective modeling of network organizations. Multiagent systems are used both for technological and application-oriented problems. Multiagent infrastructure is in fact a multilevel shell of the information system, which represent business rules and communication of its participants. The main characteristic of multiagent system is its mobility. The mobility is represented in four aspects – mobile users, computers, programs and data. Hereinafter the mobile global information system

will be considered as a set of technological and software tools mounted on mobile and stationary objects (cars, airplanes, ships, trains) and executed software modules, represented as mobile agents.

- Electronic communication between all participants of business projects based on e-commerce standards OASIS and ebXML. The requirements for technical architecture, businees projects description, services, agreements, messages, which provide the electronic communication between the participants of business project are described in ebXML. For using these specifications specialized toolkits are needed, which provide the construction of mobile software components following the Open-edi referent model (ISO/IEC 14662) of e-business.

3. Basic Technology

The architecture of basic technology defines:

- Methodologies, which have to be used in different stages of system's life cycle;
- The referent model of data domain as different representations and the unified method of description of company;
- The ontological basis, defining basic terms of data domain and its interdependence;
- Language tools for model analysis of specifications, formalization and programming;
- Toolkits automating basic process of information system construction life cycle (specifications and analysis, engineering, testing, projects management).

The structure of technological platform includes FIPA and OMG MASIF specifications. The agent communications are performing as messages in FIPA ACL language. The software architecture is based on intercommunications between several JAVA virtual machines and communications between them based on JAVA RMI (Remote Method Invocation), and also on the event-mechanism of intercommunication for every virtual machine.

The distributed architecture of agent platform consists of basic storage and agent storages, base technology and application's toolkits.

The actual executed environment for all types of agents is represented as agency, consisted of the core of agency and some places of mounting. The core has all necessary functions for support of several agents execution and represent following services.

3.1. Communication Service

This service is responsible for all remote communications between distributed components such as: interagent communications, agent's transfer, agent's localization through the regional registers. The intercommunication can be initiated through CORBA IIOP, Java RMI or direct connection.

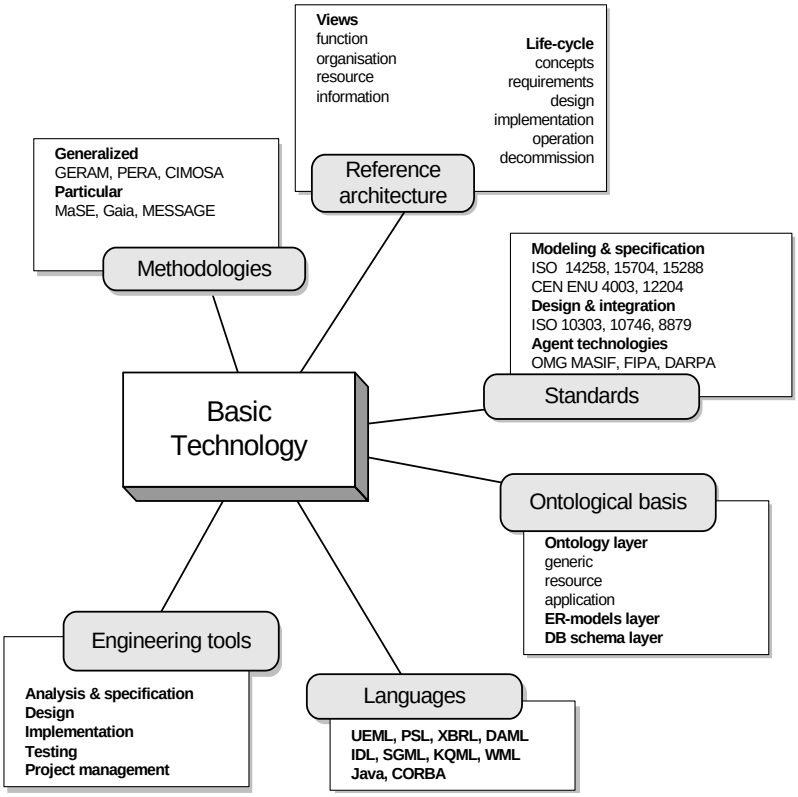

Figure 1: Basic Technology.

OMG MASIF CORBA interfaces can be used instead of communication service. Therefore every agency has MAFAgentSystem interface, and every region has MAFFinder interface.

3.2. Registration Service

Every agency has to get information about all agents and places of mounting and to transfer this information to regional registers.

3.3. Management Service

Management service provide to users necessary monitoring and control information about agents and the places of mounting and also give opportunities of construction, transferring, stoppage and elimination of agents, services and mounting places.

3.4. Security Service

Two security mechanisms are supported – the external and the internal ones.

The external security mechanism is responsible for intercommunication between distributed components, i.e. between agencies and regional registers. The X.509 and Secure Socket Layer (SSL) protocols are used. They provide confidentiality, data integration and authentication between partners.

The internal security mechanism provides access to agents and is based on Java security mechanisms.

3.5. Persistence Service

This service is responsible for the storage of the information about agents and places of mounting. Data is stored on a reliable magnetic mediums for restarting system in case of its malfunctions.

Toolkits of technological platform provide a support of four stages of engineering of mobile global information system.

- Level 1 – conceptual description of structure, main goals, business projects and information components.
- Level 2 – initial engineering of organizational representation, goals, agents, ontologies and intercommunications.
- Level 3 – detailed engineering based on further decompression of organizational representation, goals, agents, information objects and agent's communication protocols.
- Level 4 – software solution in development environment (programming, debugging, testing, verification protocol) based on agent's platform and communication protocols.

As a result, necessary applications are organized from program modules represented as agents and informational description represented as databases schemes.

4. Technology Approval

During the development of the basic technology the approval of main technological elements was initiated.

In considered problem, the informational system is represented as a set of distributed storages of financial information. The existing architecture cannot provide conjoint information about company in whole because of dissimilarity of used software tools.

Accounting operations in multidivisional financial organizations give typical example of such scenario, because their software tools were developed by different companies and in different system environment. Therefore the consolidation of financial information and progressive reengineering becomes crucially important.

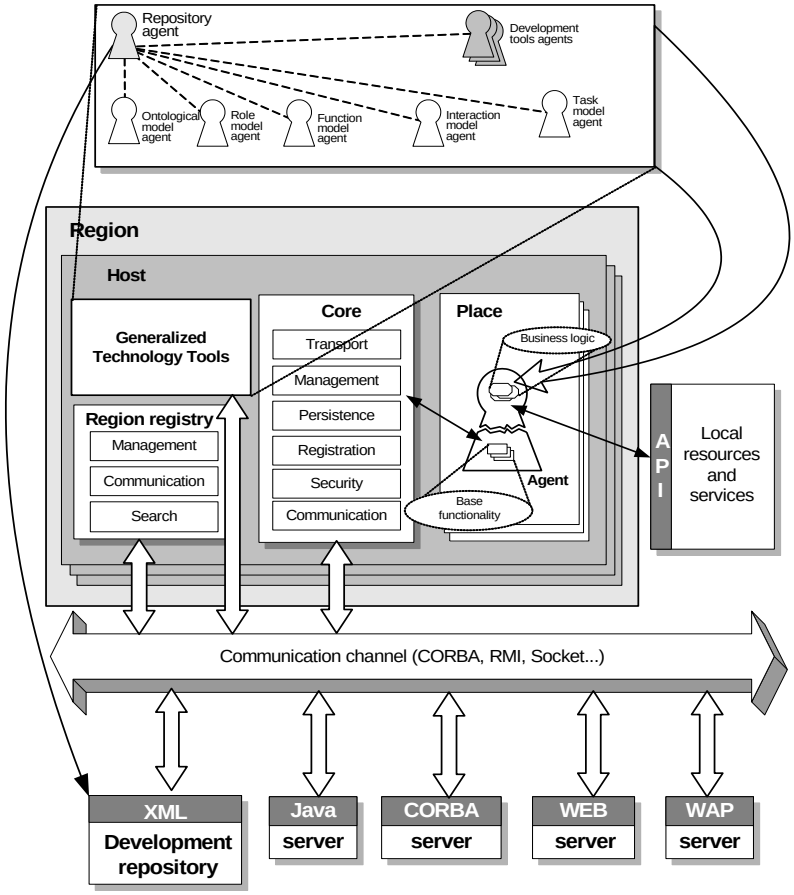

Figure 2: Multiagent Technology.

Following technologies were used for integration of given informational system:

- Suggested solution is based on multiagent infrastructure construction consisted of a set of autonomous, mobile, interactive, configurable shared software agents (Rothermel and Schwehm, 1998);
- The construction of the set of intercommunicated agents requires the description of shared informational entities as ontologies. The usage of ontologies makes possible the creation of the unified storage of corporative information and defines the unified language for all agents;
- For providing effective storing and analysis of corporative information the set of basic business components is created designed as CORBA-servers. Created components fill the Object Management Group (OMG) international standard's requirements in field of finances;
- To increase the interoperability of separate elements and to provide the openness of the system for transferring information between agents the XML format is used;
- The consolidation of financial information from different sources is performed via General Ledger Facility (OMG GLF, 2001). All interfaces to this database also fulfill the OMG standard's requirements;
- Special software tools are developed for organizing the accounting based on the information stored in General Ledger Facility. All these software components fulfill the XBRL standard's requirements.

4.1. Multiagent Architecture

During the approval of basic technology the multiagent system (MAS) was created. This system consists of the set of intercommunicated agents, functioning in common environment. These agents can perform independent operations for solving their local tasks and cooperate with other agent for solving large-scale corporative tasks (Green et al., 1997).

In this project the MAS uses agents for getting information from existing sources, for global collecting of information, for providing communication between basic business components, for remote monitoring and control, and also for increasing the scalability and flexibility of the system in whole.

4.2. Agent Types

For construction of MAS several types of agents were developed.

Adapter-agent. The agents of this type are designed for using on the nodes of corporative network, containing data sources These agents are responsible for getting information from databases, its conversion to the type required by used ontology and its transferring to collector-agent. This agents can be dynamically configured for particular data storage by means of request vocabulary in XML format.

Collector-agent. These agents are responsible for collecting information from distributed sources and its storing in common corporative database represented as a General Ledger

Facility. The mobility of collector-agents increases the efficiency and reliability of intercommunication with adapter-agents. They can be moved to the network node, witch contains data storage and corresponding adapter-agent.

Administrator-agent. This agent provides user's interface for remote monitoring and agent's system control. Administrator-agent may activate the full system of agents by means of only one terminal. Therefore, the information system administrator, using the access to local area network can get information about all agents and CORBA-servers and also configure them without interruption of the work of the system.

The main advantage of creating of business-components and their integration tools is the development process control, improving and scalability of software tools, working in global heterogeneous environment.

5. Conclusion

The further development of the technology can be initiated in following directions:

- The creation of software tools as software agents for modeling of distributed processes;
- The expansion of standard business-components library (scheduling, supply networks management, marketing);
- The creation of software tools for e-commerce mechanisms mased on ebXML specifications and universal modeling methodology (UMM), and also the ontological basis interconnecting for description of companies intercommunication.

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Effective Project and Infrastructure Management in IT-area

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Extended Abstract

The article describes several approaches for project and infrastructure management in big IT projects. The main challenges of project, infrastructure and human resources management are shown by the example of software development company. Software development projects classification for different types of IT-projects is given. There are listed some component parts of the state of the project. Some recommendations for optimizing infrastructure of IT-company and challenges for HR-management are given.

Keywords: SW development, project and infrastructure management, state of the project.

1. Introduction

This article discusses problems of project management and infrastructure management in IT-companies. IT-company is considered as the company which develops software – either customer-specific or so called "product software". Companies related with system integration, software reselling etc. are not considered in this article.

IT-companies (according to above definition) typically have two types of problems: how to manage projects and how to organize and manage the infrastructure in optimal way. First problem is related with the problems of specific tasks (projects) management, while the second problem is more general and belongs to industrial engineering and human resource management sphere.

Quality standards and recommendations (like ISO 9001, CMMI etc.) can not help with management problem – they just describe the development process. Availability of certified project managers in the company also does not solve the problem because IT-area is quite specific and general knowledge in project management area is not enough. Moreover project management is not closely related with the management of infrastructure in IT-company.

So when using standard approaches (CMMI, ISO etc.) it is necessary to have the "control-gear" that will meet the following requirements:

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Providing effective project management for different types of projects in IT-area (number of these types is high, examples are given in other sections)

Providing appropriate infrastructure and control approach for effective project and company management

Availability of indicators (including integral ones) of current project(s) status

Providing approaches for management of high-qualified personal taking into account competition at labour-market.

The rest of the article discusses possible approaches for project management in IT-companies. The problems of infrastructure, types of the projects, problems of people interaction are also discussed.

2. Types of Projects

In this article the following project definition will be used: project is the activity, that should be performed with required result achieving and taking into account predefined restrictions. This definition is not very formal but useful. In this section we consider only one possible grading of the projects and do not take others into account.

In big IT-companies tens and hundreds of projects can be run simultaneously. Even if the company is specialized in some business area, the typical types of the projects can be determined. Among them:

- **"Standard" IT-projects.** In these projects target setting from business point of view and sometime detailed developmental works are performed by the customer. The main goal of the project of such type is "on-time&on-budget" development. Only system, not business analysis is typically used in such projects.
- **"Product" IT-project** resembles standard one. In this case however the customer itself does not exist – target setting is performed inside either project team or inside the company. This fact creates complications in terms of project management.
- **"Business-analysis inside" IT-projects** are usually performed if the customer do not have specific point of view on the problem. In this case significant (sometimes bigger) part of the project resources is used for business optimization. Company business analysts or outside specialists for business analysis are needed for project team in such projects.
- **Pilot IT-project.** The main feature of pilot IT-projects is incompleteness. Result of pilot project is the part of implemented functionality. Definition of this functionality and trade-off between functionality and project duration leads to the difficulties in terms of project management.
- The main feature of **innovation IT-project** is planned use of new approaches and new technologies. It leads to the project risks extension, but "up-to-dateness" of the project in case of success is significant.

- **"Out-innovation IT-projects"** are usually scheduled according to the possibility of separation of new technological solutions during the project. These solutions can afterward be used in other projects. So project manager of such project should take into account not only "time-budget" restrictions, but also creation of new technologies.
- **Research IT-projects** differ from others because the result of the project can not be defined beforehand. This fact contradicts with project definition given,but IT-projects of this type are claimed on the market.

3. Project Management – Flexibility Regarding to the Project Type

Effective project management in spite of common goals (result achieving, resources non-exceeding etc.) should meet the following requirements:

- project manager should be able to estimate the state of the project at every point (not only at start and finish);
- "corrective actions" should be suggested at every point of the project – if necessary;
- project results should be estimated at every point of the project.

State of the project like the state of any system can be estimated as the current value of some characteristics. While project planning not only classical project plan (tasks and time) should be prepared but also the plan for changing the state of the project. Sometimes changing of these characteristics is not evident – for example, level of customer satisfaction should not be continuously increasing function.

Main project characteristics are:

- scheduled project duration, task fragmentation;
- project budget and it's administration;
- functionality implemented up to now;
- level of customer satisfaction;
- success of new technologies usage;
- availability of the components for external use (use in other projects);
- "inside" satisfactions – project members' responses.

For every type of project (see previous section) the recommendations for project characteristics can be given. Having these project classification and recommendations project manager is able to manage the project in the optimal way.

For top managers of IT-company there are three main challenges for effective project management. First, from objective point of view, project managers are not interested in openness of project characteristics, whereas top management needs all information to be opened as much as possible. Second, top management of IT-company should think not only

about the characteristics of the specific project but also about the composite characteristics of all projects. So, the problem of resource management arises. Third, IT-company should provide the effective mechanisms for human resources management – taking into account high qualification of all employees.

4. Infrastructure and Human Resource Management

From general point of view IT-company should embody the infrastructure that is able to get information about customer (market) needs, make some SW development and give the customer (market) the product it needs. Not taking into account marketing and sales infrastructure, some principles of software development infrastructure are listed below.

1. SW development division should be divided into some subdivisions for better management.
2. Every subdivision should have its own primary line of development. Typically, this line is formed by domain area (for example, one subdivision works in the area of DMS systems, another – ERP, etc.) It allows accumulating of knowledge inside the subdivision and, in the future, significantly reduces prime cost of development.
3. Together with division in terms of domain area, there should be also division according to the project types. It is very important because every type of IT-project requires specific human features. People working perfectly with standard projects sometime are not able to take part in "business-analysis inside" project because different skills and features are needed in several project types.

From our point of view the following types of projects are similar from the view of necessary skills:

- Standard, pilot and product projects
- Business-analysis inside projects
- Research and out-innovation projects

It is useful to take into account these recommendations when forming project group.

Every subdivision should be interest in receipt of project. This means that every subdivision should have enough resources for actions related with customer attraction and necessary researches.

It is useful to have special subdivision that works in research and development area. The main task of this subdivision is long-term investigations.

It is important to note that every IT-company development infrastructure, even if built according to above mentioned principles is individual. Some examples of infrastructure are given in presentation.

Human resource management in IT-companies is complex enough because of high qualification of personal. In this direction top management should solve the following problems:

- Personnel management – taking into account own point of view of personnel
- Uniting strict project management and creative thinking of employees
- Keeping personnel in the company when headhunters are active.

These problems can be solved by increasing level of loyalty, providing enough independence for key people etc.

MODELING AND ANALYSIS TOOLS

Measuring Knowledge Assets of High-Tech Virtual Enterprises and Networked Organizations

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Abstract

The well-known approaches to assessing knowledge assets are considered in the context of high-tech virtual enterprises and networked organizations. Factors influencing the translation of knowledge assets into competitive advantage for the case of high-tech industries in the area of St. Petersburg and its region are presented. The paper formulates an approach to quantitative assessment of knowledge assets of virtual enterprises and networked organizations. The importance of balanced development of different components of the company's intellectual capital is stressed and a technique of constructing a proportionality-sensitive quantitative criterion for measuring knowledge assets is proposed. The technique is based on the use of the power-function weighted mean as an integral objective function.

Keywords: virtual enterprises, networked organizations, knowledge assets, intellectual capital, management, high-tech products, integral criterion

1. Introduction

Knowledge assets (intellectual capital) are the intangible resources that determine competitive advantage and the success of companies in the market economy. The rapid expansion of high performance information and communications technologies opens new possibilities for companies to come together electronically to form virtual enterprises and networked organizations. We will consider the implication of knowledge assets for virtual high-tech manufacturing enterprises and networked organizations in the context of the geographical area of the city of St. Petersburg and its region. The purpose of creating virtual high-tech enterprises and networked organizations is to exploit emerging market conditions, to bring together resources of industrial enterprises, professional teams and separate persons, universities and research centers with common research and technological (RTD) interests, and produce new products. These products would not be economically or

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technically feasible for the companies to produce individually, but the electronic sharing of knowledge facilitates collaboration between the companies to overcome their limitations at all stages of the product life-cycle.

Fig. 1 shows the general overview of a network based virtual enterprise architecture and its functional components:

- Repository of production capacity data (enterprise identifier; idle production capacities; nomenclature of instrumentation, equipment, machinery classified according to EU or other standards; nomenclature of components and services produced by the enterprise; other)
- Repository of computer aided design (CAD) data of partner-enterprises and data about CAD systems of separate enterprises
- Customer/customers
- Research-and-Development (R&D) Center – R&D subcontractor/subcontractors
- CAD subcontractor/subcontractors
- Production subcontractor/subcontractors
- Supplier/suppliers
- Coordinator organizing the interaction of Customers and virtual production partners. The role of Coordinator may be played either by the Coordinating Center set up by the partners or by an independent firm operating on commission.

The virtual enterprise operates as follows: Customer places an order for the product; Coordinator organizes whatever activities are necessary: R&D, design, production of components, assembly, etc. It is evident that the virtual manufacturing enterprise has to meet many challenges such as

- Sufficient trust in the network and security controls
- High-level of control and coordination to prevent delays in the production schedule
- Application systems interoperability to solve problems of different hardware and software platforms
- Sharing expertise, technologies and application systems
- Cultural change.

To meet these challenges managers of virtual high-tech enterprises and networked organizations need reliable criterions and means for measuring knowledge assets. KB- and SB-Management (Knowledge-Based and Skills-Based Management), that is management based on monitoring and greater accountability for the company's intellectual capital, the employees' skills and competencies, is gaining importance in high-tech industries. The

process of assessment of and measuring the company's intellectual assets may be described as follows:

- developing the strategy of the company, setting company's goals and objectives;
- identifying core knowledge items and competencies needed to realize the goals and objectives;
- identifying the key success factors for the knowledge items and competencies;
- identifying representative quantitative indicators for the key success factors;
- developing an integral quantitative criterion for overall assessment of the company's knowledge assets.

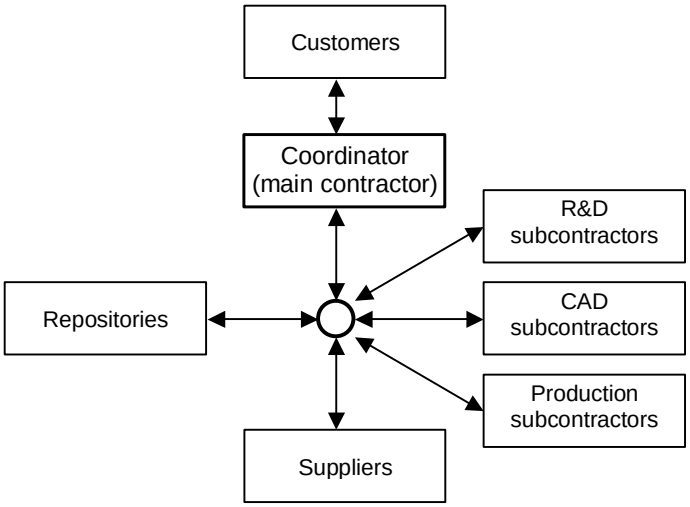

Figure 1: The General Overview of a Network Based Virtual Enterprise.

Various authors have proposed different frameworks of breaking down the company's intellectual capital into primary components. For example (Marr et al., 2001; Malhotra, 2001). We will distinguish the following primary groups of company's Total Knowledge Assets (TKA):

- Human Resources (HR)
- Stakeholder Relationships (SR)
- Cultural Assets (CA)

- Routines & Practices (R&P)
- Research & Development Capital (R&D)

It is the application of intellectual capital to practical situations that, primarily, yields any returns in terms of financial performance. The key success factors are the most important determinants of the respective knowledge items and competencies needed for future performance. Specific indicators which are considered reliable measures for the critical success factors are to be determined based on analysis of statistical data as well as the results of brainstorming sessions and interviews. Suppose we have obtained quantitative criterions C_{HR}, C_{SR}, C_{CA}, $C_{R\&P}$, and $C_{R\&D}$ for the factors HR, SR, CA, R&P, and R&D, respectively. The popular way to construct an integral criterion C_{TKA} for the company's Total Knowledge Assets would be to use an additive criterion, that is the weighted sum of the group criterions:

$$C_{TKA} = w_{HR}C_{HR} + w_{SR}C_{SR} + w_{CA}C_{CA} + w_{R\&P}C_{R\&P} + w_{R\&D}C_{R\&D},$$

where w_{HR}, w_{SR}, w_{CA}, $w_{R\&P}$, and $w_{R\&D}$ are the normalized weights of the factors HR, SR, CA, R&P, and R&D , respectively. The drawback of the additive criterion is that it is not sensitive to the desired proportionality of the group criterions: it allows free trade-off between partial criterions so that any decrease of one partial criterion can be easily compensated for by an increase of another so that C_{TKA} remains constant. Say any decrease $-\Delta C_{HR}$ of C_{HR} can be recompensed for by the increase

$$\Delta C_{SR} = \frac{w_{HR}}{w_{SR}} \Delta C_{HR}.$$

Yet it is well-known that human capital lies at the crux of intellectual capital and is the most important component in value creation and its lack cannot be compensated for by an increase in other components. Therefore, the TKA criterion must be capable to express the acceptable degree of trade-off between partial criterions. An approach to the construction of such criterions in relation to the assessment of the company's TKA is proposed in Section 3 of this paper.

2. Knowledge Assets of Virtual Enterprises and Networked Organizations

2.1. Stakeholder Relationships

This component of intellectual capital contains a most important sub-component that may be referred to as Customer/Supplier Capital that represents the value embedded in the relationships of the firm with its customers and suppliers. The most significant production decline in St. Petersburg was registered in 1995 by state enterprises whose production cycle is rigidly connected with other state enterprises. More than 60 percent industrial stoppages

in 1995 were connected with sales' problems which signifies that there is no sufficient links between the user and supplier.

The virtual enterprise idea also meets the interests and needs of smaller and medium size enterprises (SME). SMEs get the means for solving their supply and sales problems. Using the channels provided by a virtual enterprise they get access to updated information about suppliers and users' demands. A virtual enterprise provides SMEs greater possibility to use electronic means and innovative interactive methods for the presentation of their products and services.

Stakeholder Relationships include also licensing and partnership agreements and financial relations. Virtual Enterprises and Networked Organizations provide an opportunity of attracting investors for enterprises that have difficulties self-financing to the full extent their production cycle, exorbitant bank interest rates preventing the use of bank loans.

Regional stimulating factors such as economic development zones with their customs and taxation preferences and privileged treatment for economic activity attract Western investment projects. Another regional factor is the City Administration. There are many projects initiated and supervised by the City Administration, such as the construction and reconstruction of residential houses, cultural and infrastructure facilities, financed from federal and municipal funds. Many enterprises are fulfilling municipal orders in construction and transportation. That is why a connection to the City Administration could be one of the decisive links of a virtual enterprise.

2.2. Human Resources

Human Resources, or Human Capital, constitute the company's employees' capabilities reflected in education, experience, knowledge, wisdom, intuition and expertise. Human capital embodies the key success factors that provide competitive edge in the past, present, and the future. Human capital is the property of individuals, it cannot be owned by the organization.

However, due to volatile nature of these assets, it is often difficult to devise measures for many of them. Nevertheless, the following factors as key indicators of human capital may be proposed: education, language skills, professional skills. For instance, education can be measured in terms of such indicators as percentage of employees having, or working towards advanced degrees (including certification studies); and, the number of graduates and holders of doctorate degrees in fields considered fundamental for long-term company's growth – including computer sciences, life sciences and engineering.

SB-management (Skills-Based-management), that is management based on inventory and monitoring of professional skills, proficiencies and knowledge of the employees, allows the enterprise to keep a detailed inventory of personnel's qualification (SkillView, 2001; Ankoudinov et al., 2002), and continuously, promptly and effectively solve complex personnel management problems – not in the traditional manner as it has been and still is in so many HR departments in which the summit of detailing the employee's professional skill is a transcript supplement to his/her diploma and work-book good service records.

Subsection 3.2 of this paper presents an approach to quantitative assessment of professional skills and effectiveness of assigning functions and tasks to employees.

2.3. Culture Assets

For Virtual Enterprises and Networked Organizations, Culture may be considered as a framework (management philosophy and corporate rules) that encourages partners to operate both as an autonomous entity and as a whole to achieve the alliance's objectives. The culture asset of a whole virtual enterprise may be viewed as a sum of culture vectors of participants if and only if all these vectors are directed one way, that is express common goals and tasks. Therefore, creation and growing the asset of Culture may appear to be quite a problem. Developing the spirit of loyalty of separate participants to the common goals and tasks, may take time and considerable organizational effort.

Within separate enterprises such assets of organizational culture as empowerment, entrepreneurial spirit and casual start-up, the atmosphere facilitating the communication processes, of sharing tacit knowledge (not hoarding) should be fostered.

2.4. Routines & Practices

Routines & Practices, or Process Capital, represents the firm's intellectual assets that support its present activities, and related infrastructure for creation, sharing, transmission and dissemination of knowledge for contributing to individual knowledge workers productivity and transformation of knowledge from human capital to structural capital.. It is embodied in management style, process manuals, codified as well as tacit rules and procedures of workflow processes and behavior. For Virtual Enterprises and Networked Organizations security accreditation and privacy policy are important. The infrastructure assets include information systems, laboratories, technology, management attention and procedures.

The following quantitative indicators may be used: parameters of communications and computerization infrastructure; extent of Internet use; extent of software (an index based upon the relationship between the extent of expenditure for hardware and the extent of expenditure for software).

2.5. Renewal and Development Capital

Renewal and Development Capital reflects the firm's Intellectual Property that is capabilities and actual investments for future growth such as research and development, patents, trademarks, brands, copyrights, registered design, trade secretes, and processes and that may be considered as determinants of the firm's success in the future market. Investments in R&D are expected to facilitate introduction of innovative ideas and their translation into value-adding products and services that contribute to future economic growth.

The St. Petersburg economy, as the Russian economy in general, needs consulting services, new technologies and products, and also has a large reserve RTD experience which has to be employed for the benefit of both sides. Academia, universities and R&D institutions get a greater possibility to perform R&D projects for groups of SMEs, to transfer their research results into industries. They get a new possibility for dissemination and awareness actions

which aim to stimulate and promote the rapid take-up of RTD results in mechatronics and mechatronics-related fields. Closer contacts between Eastern and Western universities have proved beneficial to both sides because Western universities have a much greater experience in marketing and transferring RTD expertise than their Eastern counterparts whereas Russian Universities have traditionally a high theoretical potential.

As quantitative indicators the following may be used: amounts of investments in R&D; scientific publications (the extent of the scientific activity – represented in terms of scientific publications, and the quality of that activity – in terms of citations by other scientists); registration of patents (per employee patent registrations); R&D workforce qualification.

3. Quantitative Assessment of Knowledge Assets of Virtual Enterprises and Networked Organizations

3.1. Complex Quantitative Assessment of Intellectual Capital

Objective functions $F(p_1,...,p_n)$ are used to evaluate to what extent a complex object characterized by a collection of indicators $\boldsymbol{p}=(p_1,...,p_n)$ fits its end purpose. A power-function weighted mean may be used as the objective function (Hardy et al., 1934),

$$F(\boldsymbol{p}) = M(r;\boldsymbol{w};\boldsymbol{p}) = \left(\sum_{i=1}^{i=n} w_i p_i^r\right)^{1/k},$$

where w_i are the normalized weights of the indicators p_i, $i=1,...,n$, r is the convexity parameter of the objective function. The advantage of the form $M(r;\boldsymbol{w};\boldsymbol{p})$ is that as r varies from $-\infty$ to $+\infty$, the objective function changes from maximin to minimax; with $r=0$ we obtain a multiplicative form, and with $r=1$ a linear form (Ankoudinov, 1980). The objective function parameters r and $\boldsymbol{k}=(w_1,...,w_n)$ are determined indirectly from expert estimates. For maximization problems, as is the case with the TKA objective function, the convexity parameter *r* should be less than unity. The smaller the r, the less freedom there is to compensate a decrease in one parameter p_i of $M(r;\boldsymbol{w};\boldsymbol{p})$ with an increase of another one.

The primary groups of company's Total Knowledge Assets that we have introduced earlier, may be, for instance, aggregated as follows: TKA = HR + SA, SA = SR + OA, OA = CA +R&P + R&D, where SA is Structural Assets and OA is Organizational Assets. Then the criterion for TKA can be constructed in this case as the composition of power-function weighted means

$C_{TKA} = M(r_{TKA};(w_{HR}, w_{SA});(C_{HR}, M(r_{SA};(w_{SR}, w_{OA});(C_{SR};$
$M(r_{OA};(w_{CA}, w_{R\&P}, w_{R\&D});(C_{CA}, C_{R\&P}, C_{R\&D}))))),$

where w_{SA} and w_{OA} are the normalized weights, r_{TKA}, r_{SA}, and r_{OA} are convexity parameters of the objective functions for TKA, SA, and OA, respectively. Parameters w_{HR}, w_{SR}, w_{CA}, $w_{R\&P}$, $w_{R\&D}$, w_{SA}, w_{OA}, r_{TKA}, r_{SA}, and r_{OA} can be determined by expert estimation procedures so as to express in the best way the contribution of each factor to the total Knowledge Assets efficiency and the allowed extent of trade-off between the factors under consideration. This is the principal advantage of using power-function weighted means as objective functions. Still another advantage is that with the normalized weights (that is $w_{HR}+w_{SA}=1$, $w_{SR}+w_{OA}=1$, and $w_{CA}+w_{R\&P}+w_{R\&D}=1$) if we express C_{HR}, C_{SR}, C_{CA}, $C_{R\&P}$, and $C_{R\&D}$ in per cent, 100% of all these factors will correspond to 100% of C_{TKA}.

3.2. Quantitative Assessment of Professional Skills

As an example, we also present a model for quantitative assessment of practical skills of the personnel. The main components of the model we use, are three sets:

- m staff persons (employees);
- n production process (business-process) functions;
- k professional skills to be taken into account for determining the degree of a person's correspondence to a production function assigned to him/her.

Measuring an employee's level should be based on a sufficiently detailed classification of professional skills. One can measure the level of each skill-knowledge item based on some rating scale (SkillView, 2001; Ankoudinov et al., 2002). We take into account the following parameters:

- actual rating p_{is} of employee i in skill s;
- required level r_{js} of skill s for function j.

The set of actual level ratings $(p_{i1}, p_{i2},...,p_{ik})$ for employee i $(i=1,...,m)$ will be called *employee i's profile*. The profile of every employee, entered into his/her personal professional record (certificate), is formed on the basis of a set of detailed tests and/or results of previously accomplished assignments. It should be noted that formal curricula, resume, and years-of-experience records may insufficiently informative in this case.

The record of skill levels $(r_{j1}, r_{j2},...,r_{jk})$, required for function j, is called the *profile of function j*. A function profile is formed during the design of a technological process and should be fixed in the Technological Process Certificate. The set of differences $(p_{i1}-r_{j1}, p_{i2}-r_{j2},...,p_{ik}-r_{jk})$ expresses correspondence of skill levels $(p_{i1}, p_{i2},...,p_{ik})$ of employee i to those required for the function j. A negative value of $p_{is}-r_{js}$ $(s=1,...,k)$ means that employee i engaged for function j has to raise his/her level of skill

s, therefore values $p_{i1}-r_{j1}, p_{i2}-r_{j2},...,p_{ik}-r_{jk}$ may prove useful for choosing this or that way of training for employee i to fill the gap. Nevertheless, the set of $(p_{i1}-r_{j1}, p_{i2}-r_{j2},...,p_{ik}-r_{jk})$ does not account for different significance of skill items for different functions. Using the same initial data of $[p_{is}]_{m\times k}$ and $\lfloor r_{js} \rfloor_{n\times k}$, one can construct an estimate α_{ijs} of *adequacy* of assigning function j to employee i with respect to skill s as

$$\alpha_{ijs} = \frac{\min\{p_{is}, r_{js}\}}{\sum_{s'=1}^{k} r_{js'}},$$

and define adequacy α_{ij} of assigning function j to employee i as $a_{ij} = \sum_{s=1}^{s=k} \alpha_{ijs}$. Evidently, $0 \le a_{js} \le 1$. We introduce a criterion of *effectiveness* of assigning function j to employee i as $e_{ij} = a_{ij} w_j$, where w_j is the weight (significance) of function j $(j = 1,...,n)$. Of course, the effectiveness may depend on factors that are often beyond the control of the worker. One of such factors is the atmosphere of teamwork and collaboration that should be taken into account in the criterion of Cultural Assets. We suppose that the weights are normalized so that $\sum_{j=1}^{n} w_j = 1$. We also introduce an estimate of *versatility* (flexibility, or multi-functionality) of employee i as $V_i = \sum_{j=1}^{n} e_{ij}$. The value of V_i is nothing else but a potential efficacy of full utilization of employee i in the context of the set of functions of the technological process under consideration. Notice that $0 \le V_i \le 1$, and for the sum $\sum_{i=1}^{m} V_i$ for all employees $0 \le \sum_{i=1}^{m} V_i \le m$ holds. We have also used indicators of significance and adequacy (not for assigning employees but for methodologies and tools!) in our previous publication (Ankoudinov et al., 2001). Such indicators may be used to formulate decision-support optimization models for SB-management (Ankoudinov et al., 2002).

4. Conclusion

The paper formulates an approach to quantitative assessment of knowledge assets of virtual enterprises and networked organizations. While opening new possibilities to raise competitive advantage, virtual enterprises and networked organizations offer such challenges as sufficient security controls, high-level of production coordination, application systems interoperability, sharing expertise and technologies, etc. Factors influencing the translation of knowledge assets into competitive advantage for the case of high-tech industries in the area of St. Petersburg and its region are presented. Of course, more real-life studies are necessary to verify and develop this approach. The importance of balanced development of different components of the company's intellectual capital has been stressed

and a technique of constructing a proportionality-sensitive quantitative criterion for measuring knowledge assets have been proposed. The technique is based on the use of the power-function weighted mean as an integral objective function.

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Algebraic Modeling and Performance Evaluation of Business Processes

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Abstract

An algebraic approach to the modeling and performance evaluation of business processes is developed based on fork-join queueing network formalism and idempotent algebra. As an illustration, a model of computer system security operation is considered. We introduce a related performance measure, and show how it may be used to analysis of actual systems.

Keywords: business process, computer system security, performance evaluation, fork-join queueing networks, idempotent algebra

1. Introduction

Most of the innovative activities under Continuous Improvement Efforts, Business Process Reengineering (BPR), and other programs companies try to implement to achieve better results in their operation are based on extensive use of information technology and systems. Among other analytical functions, the information systems normally provide for modeling of business processes on the basis of both mathematical methods and computer simulation. Although pure mathematical approaches can be inferior to computer simulation in versatility and flexibility, they allow one to get results easier and faster provided that there is an appropriate mathematical model and related solution methods. Of particular interest are the models that enable one to get closed-form solutions when evaluating business process performance measures and other quantitative characteristics. Clearly, the last models together with their solutions could be efficiently incorporated into any information system.

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One of the performance measures commonly used in analysis of business processes is the mean cycle time of a process. Such BPR activities as Reducing Cycle Time and Reducing Time to Market are directly involve the problem of evaluating the cycle time. In general, the above problem appears every time one is interested in evaluating performance of a recurring (cyclic) process of similar actions. As an illustration, one can consider service of a sequence of customers, repetitive corporate management routines, logistics operations, and others.

In this paper, we concentrate on evaluating cycle time for the process of computer security operation. In fact, the explosive growth in computer systems and networks has increased the role of computer security within organizations (Stallings, 1995). In many cases, ineffective protection against computer security treats leads to considerable damage, and even can cause an organization to be paralyzed. Therefore, the development of new models and methods of performance analysis of security systems seems to be very important.

We propose a model of computer security operation, and introduce its related performance measure that can be evaluated in a closed form. It is shown how the model can be applied to performance evaluation of actual systems. Finally, a technique of security system performance analysis is described and its practical implementation is discussed. In fact, the proposed models and methods are quite general, and they can be applied to analysis of many other business processes and systems.

We conclude with an appendix, which contains technical details concerning fork-join network representation of the model, idempotent algebra, and related results.

2. An Example: Security Operation Model

As an example of a business process we consider a computer security system operation in an organization. In fact, we deal with the current security activities (see Fig. 1) that mainly relate to the actual security threats rather than to strategic or long-term issues of security management (Guster and Krivulin, 2001).

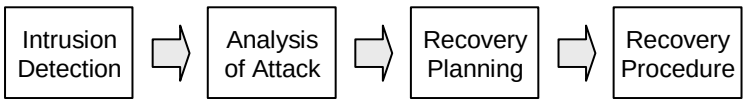

Figure 1. Computer systems security activities.

Consider the model of security operation in an organization, presented in Fig. 2. Each operational cycle starts with security attack detection based on audit records and system/errors log analysis, traffic analysis, or user reports. In order to detect an intrusion, automated tools of security monitoring are normally used including procedures of statistical anomaly detection, rule-based detection, and data integrity control (Stallings, 1995).

After security attack detection and identification, the integrity of system/application software and data in storage devices has to be examined to search for possible unauthorized

modifications or damages made by the intruder. The investigation procedure can exploit file lists and checksum analysis, hash functions, and other automated techniques.

In parallel, the system vulnerabilities, which allow the intruder to attack, should be identified and investigated. The vulnerability analysis normally presents an informal procedure, and therefore, it can hardly be performed automatically.

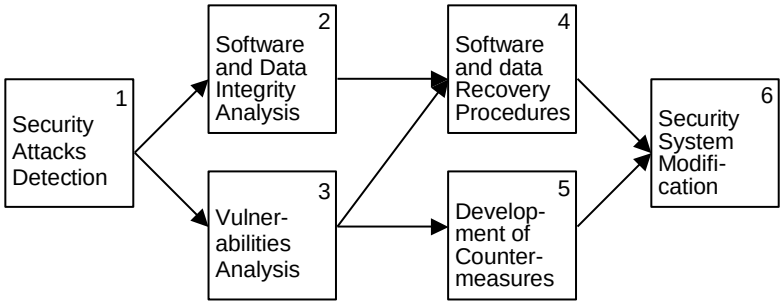

Figure 2. A Security analysis and modification model.

Based on the results of integrity analysis, a software and data recovery procedure can be initiated using back-up servers and reserving storage devices. It has to take into account the security vulnerabilities identified at the previous step, so as to provide for further improvements in the entire security system.

Along with the recovery procedure, the development of a complete set of countermeasures against similar attacks should be performed. Finally, the operational cycle is concluded with appropriate modifications of software, databases, system security policies and procedures.

We assume that the organization has appropriate personnel integrated in a Computer Emergency Response Team, available to handle the attack. The team would include at least two subteams working in parallel, one to perform integrity analysis and recovery procedures, and another to do vulnerability analysis and development of countermeasures. At any time instant, each subteam can deal with only one security incident. Any procedure may be started as soon as all prior procedures according to the model in Fig. 2, have been completed. If a request to handle a new incident occurs when a subteam is still working on a procedure, the request has to wait until the processing of that procedure is completed.

We denote by $\tau_1(k)$ a random variable (r.v.) that represents the time interval between detections of the k th attack and its predecessor. Furthermore, we introduce r.v.'s $\tau_i(k)$, $i = 2,\ldots,6$, to describe the time of the k th instant of procedure i in the model. We assume $\tau_i(1), \tau_i(2),\ldots$, to be independent and identically distributed (i.i.d.) r.v.'s with finite mean

and variance for each i, and denote $\tau_i = \tau_i(1)$, $i = 1,\ldots,6$. At the same time, we do not require of independence of $\tau_1(k),\ldots,\tau_6(k)$ for each k, $k = 1,2,\ldots$

3. Security Operation Performance Evaluation

In order to describe system performance, we introduce the following notations. Let $\bar{T}_A$ be the mean time between consecutive security attacks (the attack cycle time), and $\bar{T}_S$ be the mean time required to completely handle an attack (the recovery cycle time), as the number of attacks k tends to ∞.

In devising the security operation performance measure, one can take the ratio

$$R = \bar{T}_S / \bar{T}_A .$$

With the natural condition $\bar{T}_S \le \bar{T}_A$, one can consider R as the time portion the system is under recovery, assuming $k \to \infty$.

First note that the attack cycle time can immediately be evaluated as the mean: $\bar{T}_A = \mathrm{E}[\tau_1]$. Consider the cycle time of the entire system, which can be defined as the mean time between successive completions of security system modification procedures as $k \to \infty$. As one can show (see Appendix for further details), the system cycle time γ is given by

$$\gamma = \max\{\mathrm{E}[\tau_1],\ldots,\mathrm{E}[\tau_6]\}.$$

In order to evaluate the recovery cycle time, we assume the system will operate under the maximum traffic level, which can be achieved when all the time intervals between attacks are set to zero. Clearly, under that condition, the system cycle time can be taken as a reasonable estimate of the recovery cycle time.

Considering now that $\mathrm{E}[\tau_1] = 0$, we get the recovery cycle time in the form

$$\bar{T}_S = \max\{\mathrm{E}[\tau_2],\ldots,\mathrm{E}[\tau_6]\}.$$

4. Performance Analysis and Discussion

In fact, the above model presents a quite simple but useful tool for security system operation management. It may be used to make decision on the basis of a few natural parameters of the security operation process.

Let us represent the ratio R in the form

$$R = \max\{\mathrm{E}[\tau_2],\ldots,\mathrm{E}[\tau_6]\}/\mathrm{E}[\tau_1],$$

and assume the attack rate determined by $\mathrm{E}[\tau_1]$, to be fixed.

Taking into account that the above result has been obtained based on the assumption of an infinite number of attacks, we arrive at the following conclusion. As the number of attacks

becomes sufficiently large, the performance of the system is determined by the time of the longest procedure involved in the system operation, whereas the impact of the order of performing the procedures disappears.

It is clear that in order to improve system performance, the system security manager should first concentrate on decreasing the mean time required to perform the longest procedure within the security operation model, then consider the second longest procedure, and so on. The goal of decreasing the time can be achieved through partition of a whole procedure into subprocedures, which can be performed in parallel, or through rescheduling of the entire process with redistribution of particular activities between procedures.

In practice, the above model and its related ratio R can serve as the basis for efficient monitorization of organizational security systems. Because the introduction of new countermeasures may change the attack cycle time, the monitoring requires updating this parameter after each modification of the system.

Finally note, the above model can be easily extended to cover security operational processes, which consist of different procedures and precedence constraints. It is also quite applicable to analysis of many other business processes and systems.

Appendix

In order to describe the above systems in a formal way, we exploit the fork-join network formalism proposed in (Baccelli, 1989). The fork-join networks actually present a class of queueing systems, which allow for splitting a customer into several new customers at one node, and merging customers into one at another node.

To represent the dynamics of the networks, we use the (max,+)-algebra based approach developed in (Krivulin, 1995, 1996, 1998, 2000).

Idempotent Algebra

The (max,+)-algebra is the triple $\langle R_\varepsilon, \oplus, \otimes \rangle$, where $R_\varepsilon = R \cup \{\varepsilon\}$ is the set of real numbers with $\varepsilon = -\infty$ added, and $\oplus$ and $\otimes$ are binary operations defined as

$a \oplus b = \max(a, b)$, $a \otimes b = a + b$, for all $a, b \in R_\varepsilon$.

There are the null and identity elements in the algebra, namely ε and 0, to satisfy the conditions $a \oplus \varepsilon = \varepsilon \oplus a = a$, and $a \otimes 0 = 0 \otimes a = a$, for any $a \in R_\varepsilon$. The absorption rule involving $a \otimes \varepsilon = \varepsilon \otimes a = a$ for any $a \in R_\varepsilon$ is also valid.

The operations $\oplus$ and $\otimes$ retain most of the properties of the ordinary addition and multiplication, including associativity, commutativity, and distributivity of $\otimes$ over $\oplus$. However, the operation $\oplus$ is idempotent; that is, for any $a \in R_\varepsilon$, one has $a \oplus a = a$.

The algebra of matrices is introduced in the regular way. Specifically, for any $(n \times n)$-matrices $A = (a_{ij})$ and $B = (b_{ij})$, the entries of $C = A \oplus B$ and $D = A \otimes B$ are given by

$$c_{ij} = a_{ij} \oplus b_{ij} \text{ and } d_{ij} = \bigoplus_{k=1}^{n} a_{ik} \otimes b_{kj} .$$

As the null and identity elements, the matrices

$$\mathcal{E} = \begin{pmatrix} \varepsilon & \cdots & \varepsilon \\ \vdots & \ddots & \vdots \\ \varepsilon & \cdots & \varepsilon \end{pmatrix}, \quad E = \begin{pmatrix} 0 & & \varepsilon \\ & \ddots & \\ \varepsilon & & 0 \end{pmatrix}$$

are respectively taken in the algebra.

Let $A = (a_{ij})$ be any $(n \times n)$-matrix. In the same way as in the conventional algebra, one can define $A^0 = E$ if $A \neq \mathcal{E}$, and $A^m = A \otimes A^{m-1} = A^{m-1} \otimes A$ for any integer $m \geq 1$.

Finally, one can define the matrix functions

$$\mathrm{tr}(A) = \bigoplus_{i=1}^{n} a_{ii}, \quad \|A\| = \bigoplus_{i=1}^{n} \bigoplus_{j=1}^{n} a_{ij} .$$

Algebraic Representation and Related Results

We consider a network with n single-server nodes and customers of a single class. The topology of the network is described by an oriented acyclic graph with its nodes representing servers, and its arcs determining the transition routes of customers. The nodes that have no predecessors are assumed to represent an infinite external arrival stream of customers. Each node without successors is considered as an output node, which releases customers from the network. An example of a network with $n = 6$ nodes is given in Fig. 3.

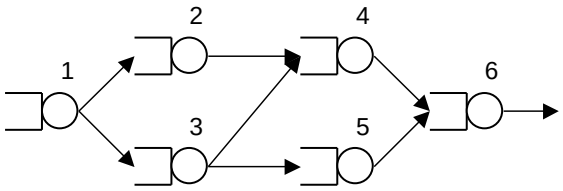

Figure 3. A network scheme.

Each node of the network includes a server and a buffer with infinite capacity, operating as a single-server queue under the first-come, first-served discipline. At the initial time, the servers and their buffers are assumed to be free of customers, except for the buffers in nodes with no predecessors, each assumed to have an infinite number of customers.

The operation of each node can include join and fork operations performed respectively before and after service. The join operation is actually thought to cause each customer coming into a node not to enter the queue but to wait until at least one customer from all preceding nodes arrives. Upon arrival, these customers are replaced by a new customer, which joins the queue. The fork operation at a node is initiated every time the service of a customer is completed. It consists in replacing the customer by several new customers, each intended to go to one of the succeeding nodes.

For the queue at node i, $i = 1,\ldots,n$, we denote the k th departure epoch by $x_i(k)$, and the service time of the k th customer by $\tau_i(k)$. Considering that the network starts operating at time zero, it is convenient to set $x_i(0) = 0$ and $x_i(k) = \varepsilon$ for all $k < 0$, $i = 1,\ldots,n$.

Now we introduce the notations:

$$\boldsymbol{x}(k) = \begin{pmatrix} x_1(k) \\ \vdots \\ x_n(k) \end{pmatrix}, \quad T(k) = \begin{pmatrix} \tau_1(k) & & \varepsilon \\ & \ddots & \\ \varepsilon & & \tau_n(k) \end{pmatrix},$$

It has been shown in (Krivulin 1996) that the dynamics of the network can be described by the equation

$$\boldsymbol{x}(k) = A(k) \otimes \boldsymbol{x}(k-1)$$

with the matrix

$$A(k) = \bigoplus_{j=0}^{l} (T(k) \otimes G^T)^j \otimes T(k)$$

where l is the length of the longest path in the network graph, $G = (g_{ij})$ is the matrix with its entry $g_{ij} = 0$, if there exists arc (i, j) in the network graph, and $g_{ij} = \varepsilon$, otherwise.

The cycle time of the system is defined as

$$\gamma = \lim_{k \to \infty} \frac{1}{k} \|\boldsymbol{x}(k)\|$$

provided that the above limit exists.

Now suppose that $\tau_i(1), \tau_i(2), \ldots$, are i.i.d. r.v.'s with the finite mean and variance for each $i = 1,\ldots,n$. Under these assumptions, the next result presented in (Krivulin, 2002) is valid.

Theorem 1. *Let* $B = \mathrm{E}[A(1)]$ *be the matrix obtained from* $A(1)$ *by replacing all its entries with their mean values, considering that* $\mathrm{E}[\varepsilon] = \varepsilon$. *Then the cycle time is given by*

$$\gamma = \bigoplus_{i=1}^{n} \frac{1}{i} \mathrm{tr}(B^i) \ \textit{with probability 1.}$$

The Security Operation Model

Clearly, the network depicted in Fig. 3 just represents the security operation model under consideration. The matrix G of the network graph takes the form

$$G = \begin{pmatrix} \varepsilon & 0 & 0 & \varepsilon & \varepsilon & \varepsilon \\ \varepsilon & \varepsilon & \varepsilon & 0 & \varepsilon & \varepsilon \\ \varepsilon & \varepsilon & \varepsilon & 0 & 0 & \varepsilon \\ \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & 0 \\ \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & 0 \\ \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon \end{pmatrix}.$$

Since for the network, we have $l = 3$, the matrix $A(k)$ is written as

$$A(k) = [E \oplus T(k) \otimes G^T \oplus (T(k) \otimes G^T)^2 \oplus (T(k) \otimes G^T)^3] \otimes T(k).$$

Consider the matrix $A(1)$, and define $\tau_i = \tau_i(1)$, $i = 1,\ldots,6$. Simple algebra gives us

$$A(1) = \begin{pmatrix} \tau_1 & \varepsilon & \varepsilon & \varepsilon & \varepsilon & \varepsilon \\ \tau_1 \otimes \tau_2 & \tau_2 & \varepsilon & \varepsilon & \varepsilon & \varepsilon \\ \tau_1 \otimes \tau_3 & \varepsilon & \tau_3 & \varepsilon & \varepsilon & \varepsilon \\ \tau_1 \otimes (\tau_2 \oplus \tau_3) \otimes \tau_4 & \tau_2 \oplus \tau_4 & \tau_3 \oplus \tau_4 & \tau_4 & \varepsilon & \varepsilon \\ \tau_1 \otimes \tau_3 \otimes \tau_5 & \varepsilon & \varepsilon & \varepsilon & \tau_5 & \varepsilon \\ \tau_1 \otimes \tau_3 \otimes \tau_5 \otimes \tau_6 & \tau_2 \otimes \tau_5 \otimes \tau_6 & \tau_3 \otimes (\tau_4 \oplus \tau_5) \otimes \tau_6 & \tau_4 \otimes \tau_6 & \tau_5 \otimes \tau_6 & \tau_6 \end{pmatrix}.$$

It remains to proceed to the matrix $B = \mathrm{E}[A(1)]$, and then evaluate γ. First note that both $A(1)$ and B have the lower triangular form, and so any power of B takes the same form.

As it easy to verify, we have for any $i = 1,\ldots,6$,

$$A^i = \begin{pmatrix} i\mathrm{E}[\tau_1] & & \varepsilon \\ & \ddots & \\ \ldots & & i\mathrm{E}[\tau_6] \end{pmatrix},$$

where the entries below the diagonal are omitted for the sake of simplicity.

Furthermore, for each i, we get

$$\mathrm{tr}(A^i) = i(\mathrm{E}[\tau_1] \oplus \cdots \oplus \mathrm{E}[\tau_6]),$$

and thus

$$\gamma = \bigoplus_{i=1}^{n} \frac{1}{i} \operatorname{tr}(A^i) = \mathrm{E}[\tau_1] \oplus \cdots \oplus \mathrm{E}[\tau_6].$$

Turning back to the ordinary notations, we finally arrive at

$$\gamma = \max\{\mathrm{E}[\tau_1], \ldots, \mathrm{E}[\tau_6]\}.$$

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Econophysics Approach to Analysis of Financial Time Series

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Abstract

In this talk we present the application of nonlinear dynamics, complexity theory and artificial intelligence methods to the analysis of financial time series. In particular, we discuss new concepts and algorithms used in chaotic dynamics. Latter offers a striking explanation of irregular behavior and anomalies, which do not seem to be inherently stochastic. Among the methods we discuss are such concepts as space embedding, Lyapunov exponents, dimensions and nonlinear prediction and noise reduction. Related approach such as neural network technology is also discussed. Applications to the analysis and prediction of high-frequency noisy financial data are considered.

Keywords: nonlinear analysis, chaotic dynamics, embedding, correlation dimension, neural network prediction.

1. Introduction

In this talk we consider dynamic processes in three sectors of the international financial markets – currency, monetary and capital. Novelty of an approach consists in the analysis of financial dynamics by neural network methods in a combination with the approaches advanced in econophysics (Mantegna et al., 2000). The neural network approach to the analysis and forecasting of the financial time series used in the present talk is based on a

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paradigm of the complex systems theory and its applicability to the analysis of financial markets (LeBaron, 1994, 1996; Peters, 1996). The approach we used is original and differs from approaches of other authors (Baestaens et al., 1994; Poddig, 1996, 1998) in the following aspects. While choosing the architecture of a network and a strategy of forecasting we carried out deep data preprocessing on the basis of methods of complex systems theory and methods of nonlinear and chaotic dynamics (Kantz et al., 1997; Schuster, 1984; Peters, 1996). In the present talk we do not describe stages and methods of this data preprocessing in details. We present here only the results of one tests from rich arsenal of chaotic dynamics methods. Our preliminary analysis has however allowed to optimise parameters of the neural network, to determine horizon of predictability and to carry out comparison of forecasting quality of different time series from various sectors of financial market.

Specifically we studied dynamic processes in the currency, monetary, capital markets in the short-term periods, predicting daily changes of prices of the following financial assets: futures on a rate US dollar – DM (it is designated as DM), futures on eurodollars (ED), futures on American stock index Standard & Poor's 500 (SP).

2. Nonlinear and Chaotic Analysis

In recent years, there has been a growing interest in the search for models of nonlinear and complex behavior in financial market. These nonlinear models tend to display very complex patterns. Indeed, it is now widely accepted that the linear approach does not allow to take into account the particularly irregular behavior that can be observed on numerous financial assets. Several approaches can be concurrently considered to treat many types of nonlinearities which can be observed. Traditional models are stochastic (e.g. ARCH, GARCH, EGARCH, FIGARCH, etc. (Mills, 1993; Franses, 1998)). However a lot of constrains are often added to the models that are being built which results in relatively simple but identifiable models, while the original complexity is reduced.

Another approach to analyze nonlinearities and complexity of financial data is based on the deterministic chaos theory (Kantz et al., 1997; Schuster, 1984; Peters, 1996). In particular, deterministic chaos offers a striking explanation for irregular behavior and anomalies in systems, which do not seem to be inherently stochastic. Chaos theory offers completely new concepts and algorithms for time series analysis, which can lead to a thorough understanding of the signals. This theory introduces a broad choice of powerful methods including phase space embeddings, Lyapunov exponents, dimensions and entropies, nonlinear prediction and noise reduction, as well as statistical tests for nonlinearity.

The main reason why it is possible to apply methods of chaotic dynamics to time series analysis is in following. The most essential structure of dynamic system, namely the attractor (the subset of phase space attracting trajectories of a system in the infinite time limit) can be reconstructed through the single dynamical variable treated as a time series. According to the Grassberger and Procaccia (Grassberger et al., 1983) approach one has to construct the embedding space and pseudoattractor therein. Suppose that the given time

series X_n is generated by some nonlinear chaotic dynamics. Suppose also that some integer m is greater than this dynamic system attractor. Then reconstructed m-dimensional embedding space is formed by vectors Y_n as

$$Y_n = (X_{n-\tau}, X_{n-2\tau}, \ldots, X_{n-(m-1)\tau}),$$

where X_n are time series observations and τ is the lag or delay time. As follows from Whitney's embedding theorem (Kantz et al., 1997), phase space representation of dynamical systems and time delay representation of the corresponding time series lead to diffeomorphic pictures, in other words they are "approximately the same". Moreover, the reconstructed pseudoattractor and attractor in phase space possess the equal fractal dimensions, Lyapunov exponents and other quantitative characteristics.

However, a priori we do not know if the given time series is generated by some deterministic dynamics or it is purely stochastic. The crucial point in separating these different situations is the study of the scaling properties of the correlation sum $C_m(R)$ and the study of behavior of the correlation dimension $D(m)$ depending on the embedding dimension m. The correlation sum $C_m(R)$ is the probability that a pair of points in the pseudoattractor embedded into m-dimensional embedding space is within a distance R of one another. If the plot of $\log C_m(R)$ versus $\log R$ has linear part at small R, this indicates on self-similar geometry of the attractor (Kantz et al., 1997; Peters, 1996). The correlation dimension is taken as the average slope of the cumulative curve over the middle one-quarter of the vertical scale, and the error is taken as half the difference of the maximum and minimum slope over the same range. By increasing m, the correlation dimension will increase. However, for chaotic data the correlation dimension will eventually saturate at its true value. For random data there is no such saturation and correlation dimension increases monotonically. In order to explain such behavior of correlation dimension note that in frames of the method of Grassberger and Procaccia correlation dimension for real chaotic systems is a good approximation of the fractal dimension of the strange attractor. A fractal embedded in a higher dimension retains its true dimension because of nonlinear correlations between points. Therefore for the deterministic chaotic time series the correlation dimension converges to its true value. At the same time for the random series the points fill up whatever space they are placed in, because they move around at random (Peters, 1996). As a rule the truly chaotic deterministic systems are low-dimensional. The effect of adding the noise results in increasing of the correlation dimension.

The results of correlation dimension computation for detrended logs of futures prices on SP, ED, DM are presented in Fig.1. Among all series one can single out the ED series which conditionally can be called as noisy chaos series. For this series correlation dimension eventually saturates at some value which is less than 5 within computational error. Namely, for ED time series the correlation dimension is equal to 3.7±0.3. Moreover for this series the correlation dimension computational error at each value of embedding dimension is small enough (these errors are shown by bars). The large error would mean that the plot of logs of

correlation sum versus the logs of distance has no linear region and the notion of the attractor's correlation dimension for such data sets is meaningless due to their random character of data. In Fig.1 one can see that SP and DM time series should be treated as random rather than noisy chaotic.

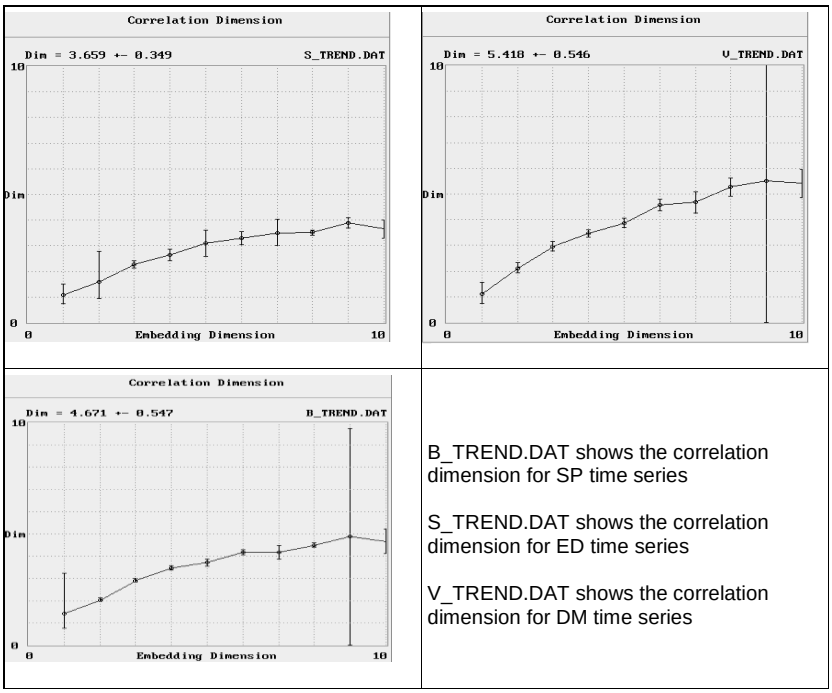

Figure 1: Correlation dimension versus embedding dimension for SP, ED and DM time series.

We also have calculated the value of the largest Lyapunov exponent for ED time series using the method by Wolf (Wolf et al., 1985). It turns to be equal to 0.27±0.03 in accordance with chaotic character of this financial asset. Indeed, positive Lyapunov exponent reflects the sensitive dependence on initial conditions which is one of the major properties of deterministic chaos. This property is responsible for an irregular behavior of the deterministic chaotic systems which is often treated as random one.

The Lyapunov exponent is a measure of the rate at which nearby trajectories in phase space diverge. The Lyapunov exponent is given in units of bits per data sample. In terms of Lyapunov exponent one can calculate the horizon of predictability of the time series.

Namely, this time horizon is inverse proportional to the value of Lyapunov exponent and for ED time series is equal to 3–4 days.

Information obtained in this section is used bellow in neural network prediction of SP, ED, DM time series.

3. Neural Network Predictions

For prediction of data sets under consideration the neural network we have used had two inputs. As the first input we used the daily returns expressed as follows: to 1,5% return there corresponded the value 1.5. As the second input we used the mean values for the last 5 days. The presence of noise in analysed time series can degenerate the learning and generalisation ability of networks. It means that some smoothing of time series data is required. We used the simplest techniques for smoothing, i.e. 5-days moving average shifted backwards for one day. Thus such neural network aims to predict smoothed daily return to next day. Among all possible configurations of neural nets we chose the recurrent network with hidden layer feedback into input layer known as the Elman-Jordan.

We divided each analysed time series into 3 subsets: training set, test set and production set. As the training set, i.e. the set on which the network was trained to give the correct predictions, we took the first 900 observations. The test set was used for preventing the overfitting of the network and for calibration and included the observations numbering from 901 up to 1100. The production set included observations, which "were not shown" to the network and started from the 1101-th observation up to the end of the series.

The quality of prediction was estimated by the following parameters:

Training time and number of learning epochs – the quantities showing how long the network can improve its predictions to achieve the best results on the test set. By the learning epoch we mean the single presentation to the network of all samples from training set. These parameters can vary depending on the given learning rate and momentum. Leaning rate and momentum are established on the basis of desirable accuracy of the prediction. For the neural network we used both these parameters were equal to 0.003.

Coefficient Q compares the accuracy of the model to the accuracy of a trivial benchmark model or trivial predictor wherein the prediction is just the mean of all of the samples. A perfect fit would result in a Q value of 1, a very good fit near 1, and a very poor fit less than 0. If neural model predictions are worse than one could predict by just using the mean of sample case outputs, the coefficient Q value will be less than 0.

R-squared – the coefficient of determination which is a statistical indicator usually applied to regression analysis being the ratio of predicted values variation to the actual values variation.

Mean absolute error – this is the mean over all patterns of the absolute value of the actual minus predicted values.

Max absolute error – this is the maximum of actual values – predicted values of all patterns.

% of proper predictions of returns signs – this is the ratio of number of samples for which signs of predicted values coincide with signs of actual ones to the number of considered samples.

The above characteristics of neural network prediction quality for the analysed series are given in Tab. 1. The table consists of three blocks. The upper one gives characteristics of the network training. The middle one refers to the whole time series, which includes training, test and production sets. The bottom block describes only the results for production sets. N denotes the number of learning epochs, τ stands for training time, N_{whole} denotes the number of samples in the whole time series while N_{prod} stands for the number of samples in production set, % of signs means the percent of proper predictions of returns signs.

Characteristics	S&P500 futures	DM futures	ED futures
N	30512	6779	1873
τ (hours)	19	4	1
N_{whole}	1173	1170	1170
Q	0.7408	0.7594	0.7436
R–squared	0.7431	0.7612	0.7452
mean abs.er., %	0.182	0.196	0.179
max abs.er., %	2.172	1.291	2.281
% of signs	86	83	83
N_{prod}	77	74	74
Q	0.8032	0.5897	0.4517
R–squared	0.8062	0.6319	0.5697
mean error, %	0.217	0.279	0.201
max.error, %	0.799	1.046	1.234
% of signs	88	86	88

Table 1: Numerical characteristics of neural network predictions quality.

The table shows that the best predictions are obtained for S&P500 futures, the worse predictions are obtained for the Eurodollar (ED) futures. Deutsche mark (DM) futures has intermediate quality of predictions. This follows from values of coefficient Q for production set (see the bottom block of Tab. 1) although it hardly can be seen by sight from Fig. 3 and Fig. 4. It should be noted that despite the approximately equal quality of learning (see values of coefficient Q in the middle block of Tab. 1) the training time for S&P500 is five times bigger than that for DM and training time for DM futures is four times bigger than training time for ED. This obviously means that to find hidden regularities in S&P500 futures is noticeably complicated than in DM futures and all the more in ED futures. At the same time the best quality of prediction is obtained just for S&P500 and the worse for ED. All this points out that hidden regularities found by neural network in S&P500 preserve their character much more longer than that found in ED. In other words ED futures have more unsteady hidden regularities what results in the worse quality of predictions.

In summary one should mention that ultimate goal of any financial forecasting is profitability. The latter is always connected with some trading rule and/or the money management strategy. This problem is out the scope of the present talk (see, however, our recent paper (Kuperin et al., 2001).

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The Information System of Sale Analysis and Delivery Control in Newspaper Industry

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Abstract

An analytical information system to support sale analysis and delivery control of newspapers is presented. The system architecture and its information infrastructure are outlined. A brief description of the main system components is also given.

Keywords: information system, sale analysis, delivery control, computational statistics

1. Introduction

An information system developed in cooperation with the Bild Sales Department at Axel Springer Verlag AG (Germany) to support the analysis of sales and the control of deliveries of newspaper products is considered. It is assumed that the sale and delivery procedures are subject to the following scheme. After printing the circulation, the publisher sends it to wholesalers, which in turn distribute the newspapers between its retail sellers. If an amount of the newspaper items appear not to be sold, the items can be returned back to the publisher. The allowed part (quota) from the gross amount, which can be returned free of charge, is defined corresponding to agreements between the publisher and wholesalers.

Clearly, the publisher is not interested in significantly enlarging the allowed part of the return, since that yields losses incurred in producing and salvaging returned items. At the same time, natural fluctuations of the demand do not allow the publisher to reduce considerably this part. The low level of the return quota could make wholesalers decrease the overall amount of newspapers to order. This could lead to newspaper shortage at retailers, and therefore, to lost sale. Finally, reducing the amount of newspapers sold brings the publisher into decreasing its total revenue.

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It is easy to see that optimal determination of the return quota presents a rather difficult problem. One of the main difficulties is a high degree of heterogeneity of the market conditions under which the retailers are operating. In order to handle the above problem, we propose an approach based on breaking all the retailers into a relatively small number of groups (classes) each including retailers with similar operating conditions and results. Furthermore, for every group, a reasonable return quota is established based on a thorough analysis of its related micro market environment, operating conditions, and the past history of sales of each retailer in the group. Having a set of distinguishing characteristics which allow each retailer to be assigned to a group, one can determine an appropriate quota for each retailer of a wholesaler, and then evaluate the overall quota and other sale/delivery control parameters for the wholesaler (target control parameters).

The scheme of analysis described above actually involves several stages and requires essential information and software support. Since the number of retail sellers can range from tens to hundreds of thousands, and each retailer can be described by several tens of micro market, operating, and other parameters, the analysis can present a rather difficult problem because of huge data arrays to be processed. Obviously, the solution of the sale/delivery control problem requires of development an efficient, flexible, and user-friendly software tool. Below we describe an analytical information system, which can be considered as one of the successful attempts to solve the problem. The system has been developed based on SAS/AF[1] application development tools (CLR, 1999; GAD, 1999; SPG, 1999).

2. The System Architecture and Its Components

The system consists of several modules operating together under the central control based on the common information infrastructure (Fig. 1).

The top level of control is maintained by the module of Tasks Manager ("RISK Manager"), which provides for invoking other modules, and supporting the overall information infrastructure of the system. A screenshot of the module window is presented in Fig. 2.

Other system modules are intended to perform various tasks including analytical functions (e.g., analysis of variance, estimation of a backlog of demand), graphical representation of data (visualization of time series, drawing of plots of control quality curves), and auxiliary functions (import of data from the corporate database, determination and modification of the borders of subsets and classes, and others). After execution of each module, control is returned to the Task Manager. Some modules (e.g., the module of Sales/Delivery Analysis of Retailers) can invoke additional modules.

2.1. Information Infrastructure

One of the main functions of the Task Manager is to create and maintain the common information infrastructure that underlies operation of each module as well as the entire system. The key element of the infrastructure is a Meta Base, which retains descriptions of

[1] SAS/AF is registered trademark of SAS Institute Inc.

all data sets including actual data, imported from the corporate database, and actual and virtual data sets created by the system.

A special feature of the problem under consideration is that the number of retailers is very large. Moreover, the information, which can be obtained from the corporate database and used in the analysis, includes not only sales data for each retailer, but also a great amount of additional information about retailer's operation conditions (e.g., the type of shop and its open hours), and local market environment (the type of settlement, population statistics, and many others). As a result, the datasets coming from the corporate database appear to be of very big size. Taking into account that the proposed sale/delivery analysis involves partitioning the original data sets into subsets in different ways, one can see that the overall amount of information to maintain could grow very fast, and lead to information overload.

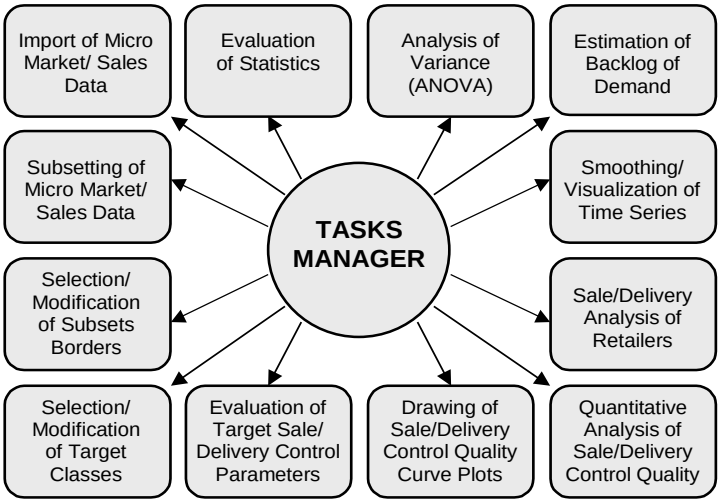

Figure 1. The main components of the system.

In order to overcome the above problem, an approach has been developed which allows the system to retain descriptive information of each subset rather than the subset itself. The information about these "virtual" (not existing) datasets together with the information of the actual datasets is located in a special dataset referred to as Meta Base. For every virtual dataset, the Meta Base includes a query, which can be used by any module to create a temporary copy of the dataset if needed. In order to describe actual datasets, the Meta Base uses specific "empty" queries. Any virtual dataset can be converted into an actual dataset with the Tasks Manager that also makes appropriate modification of the Meta Base.

When invoking a module, the Tasks Manager passes information about one or more virtual or actual datasets specified by the user to the module. If a dataset does not actually exist, the module creates a temporary copy of the dataset. Before returning the control back to the Tasks Manager, the module deletes all temporary datasets. If the module creates a new actual or virtual dataset itself, it passes back the information that the Task Manager uses to registry the new dataset in the Meta Base.

Figure 2. A screenshot of the Tasks Manager window.

Another important element of the information infrastructure is auxiliary datasets (tables) created and maintained by various modules. These tables can serve to save results produced by the modules or current selections of their options and parameters. The main components of the information infrastructure are presented in Fig. 3.

3. Description of Modules

3.1. Import of Micro Market/ Sales Data

The module is intended to provide connection to the corporate server, selection of a database, and import of data according to a specified query. The module allows one to indicate the name of the server, the name of database, the username, and the password. In order to create a query, the user should manipulate list-boxes available in the module window to specify wholesalers, newspapers, time period, and some other parameters.

Depending on the particular query, the module can create one or several datasets (e.g., one dataset for each wholesaler or newspaper from those selected by the user). All the datasets are registered in the Meta Base after returning back to the Tasks Manager.

3.2. Evaluation of Statistics

The module provides for calculation of new variables, which are then added to the dataset. The extended dataset is registered in the Meta Base as a new dataset. The module allows of creating and calculating new variables for any number of datasets according to a list of datasets received from the Tasks Manager. A related screenshot is presented in Fig. 4.

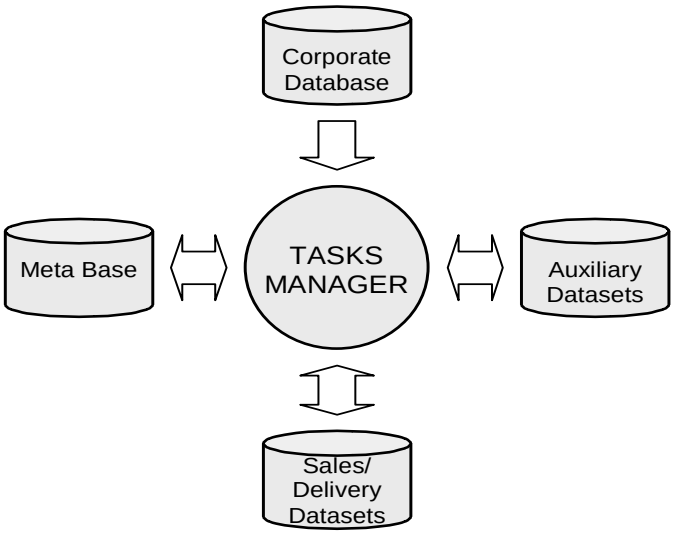

Figure 3. The components of information infrastructure.

For each dataset, the module can calculate any variables selected from a fixed set of statistics and auxiliary variables. The set of variables is broken into 5 groups of variables:

1. Classification variables,
2. Local market characteristics,
3. Retailer-oriented statistics,
4. Time-oriented statistics,
5. Performance measures.

The classification variables allow one to assign each retailer to a particular group according to the retailer's operation condition or sale results (e.g., open hours of the shop or average amount of items sold per day). These variables normally take a few integer values (e.g., from 0 to 9), and they are calculated on the basis of the other variables that can be both old variables received from the corporate database and new ones produced by the system.

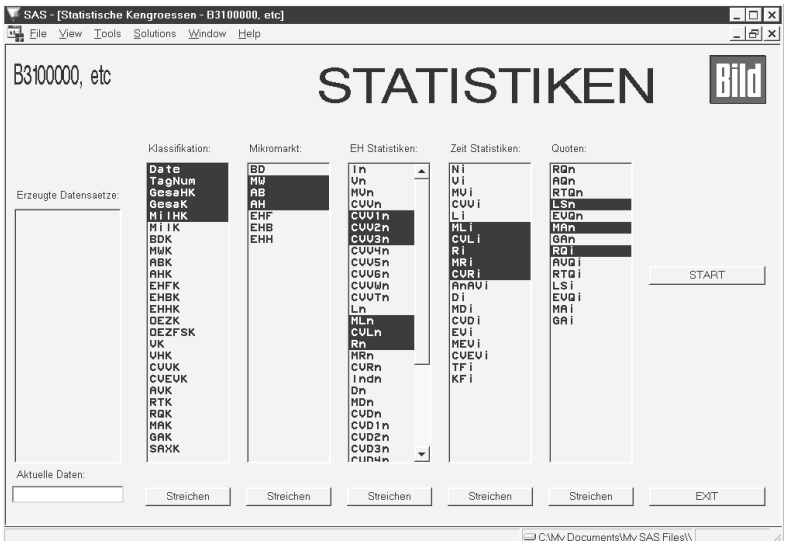

Figure 4. A screenshot of the Evaluation of Statistics window.

The local market characteristics present new variables derived from existing micro market parameters. Specifically, among them are the average number of householders per retailer and the ratio of male and female parts of local population.

The retailer-oriented statistics include the characteristics that describe each retailer on the basis of observing the retailer's results during the entire time period presented in the dataset. For a retailer, these statistics include the total amount of delivery (sale, return), and the mean value, standard deviation, coefficient of variation for daily delivery (sale, return).

The time-oriented statistics are calculated for each day over all retailers. Among them is the total amount of delivery (sale, return), and the mean value, standard deviation, coefficient of variation of delivery (sale, return) calculated over all retailers for each day.

The performance measures include the ratio of the total amount of sale (return) to the total amount of delivery, the ratio of the total amount of sale to the total amount of estimated demand, and some others.

3.3. Analysis of Variance

The module is intended to reveal dependence between variables in a dataset specified by the user in the Tasks Manager. The standard 2-factor ANOVA is implemented. As independent and dependent variables, any variables in the dataset can be selected. The module starts with examination of the dataset so as to create a list of all variables, which then become available to the user. The results of ANOVA are displayed in the window, and stored in an auxiliary dataset of the module. The module also allows one to print the results.

There is an auxiliary module, which provides for viewing previously stored results. One can use it to compare results obtained for different datasets or variables.

3.4. Estimation of Demand Backlog

The purpose of the module is to estimate for each retailer the actual demand for those days when the demand is unknown since all delivered items appear to be sold. The estimation of backlog at a retailer for a particular day is based on the past sale history of the retailer and on the results of all other retailers at the current day. A statistical technique is implemented which combines nonlinear regression and Kaplan-Meier procedures.

The user interface of the module provides for changing some parameters of the procedure. As a result, the module produces a new dataset, which together with existing variables includes estimates of demand backlog.

3.5. Smoothing and Visualization of Time Series

There are three modules intended to handle time series. The module of smoothing provides for implementation of various procedures of smoothing time series, including procedures of moving average, auto regression, and median filters. It allows the user to vary many parameters of the procedures.

Another two modules are designed to provide the user with various ways of visualization of time series, including their preview in the module's window, high quality graphical output in a separate window or to a printer, and output in the HTML format. One of the modules is intended to handle time series representing time-oriented statistics. The second module offers the potential of visualization of time series for a particular retailer (Fig. 5).

As time series variables, any variables in the dataset can be selected. Both the modules allow the user to view several curves simultaneously. The modules make it possible to display both the entire time series and its subset for a particular weekday.

3.6. Quantitative Analysis of the Sale/Delivery Control Quality

The system includes two modules designed to evaluate some measures that describe the efficiency of sale/delivery control for a particular wholesaler, and to generate related reports. The first module allows the user to evaluate the efficiency measures for the entire time period, whereas the second module evaluates them for every weekday separately. The measures include the total and mean (for one retailer) values of delivery, sale, return, and demand estimates, the total revenue, etc.

The modules provide for preview of non-formatted reports, graphical output of formatted reports in a separate window and to printer, and output in the HTML format. The obtained results are stored in an auxiliary dataset. There is an auxiliary module designed to view, compare, and print the stored results.

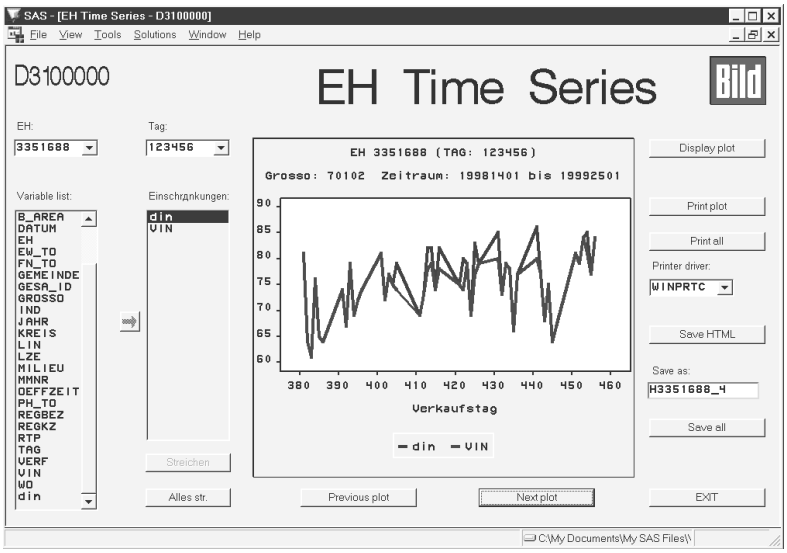

Fig. 5. A screenshot of the window of a time series visualization module.

3.7. Sales/Delivery Analysis of Retailers

The module is intended to visualize the dynamics of particular retailers, and includes tools to find out retailers with their evolution sufficiently different from that of the other retailers in a dataset. The main module allows the user to display plots representing the amount of delivery and sale, and the estimate of demand for a particular retailer at each working day. The module makes it possible to preview plots, output plots in a separate window and to printer, and output plots in the HTML format.

The module allows the user to select a particular retailer from the list of all retailers in the dataset, or to make selection by using an additional module of graphical analysis. The last module offers a graphical representation of retailers' characteristics (ratio of the total amount of sale to the total amount delivery, the ration of total estimated demand to the total amount of sale) in the form of interactive scatter plots and histograms. The plots allows the user to select retailers interactively by clicking on an appropriate point in a scatter plot, or by drawing a border line, which isolates "a tale" in a histogram (Fig. 6).

3.8. Drawing of the Sale/Delivery Control Quality Curves

The module is used for fitting and visualization of 2-parametric curves representing the daily part of the retailers who have not sold all the available items as a function of the corresponding ratio of the mean values of supplied and sold items. Practical experience shows that the curves allow one to describe the above function quite adequately (see Fig. 7).

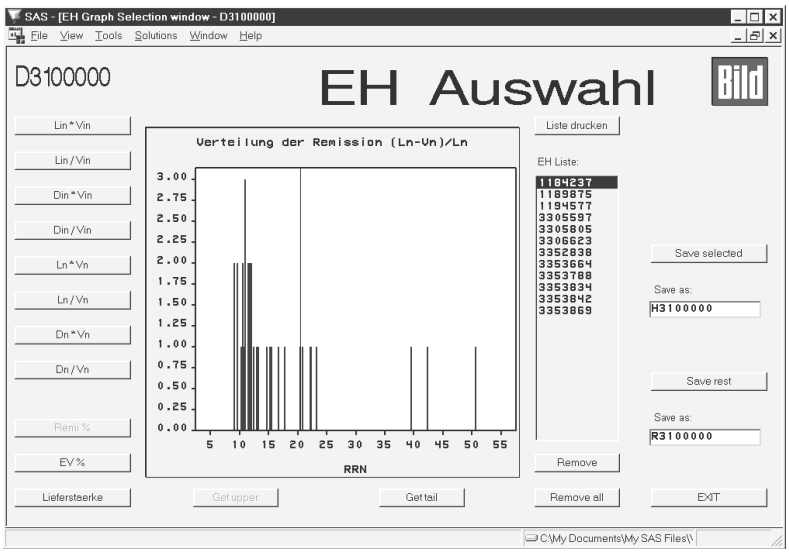

Figure 6. A screenshot of the window of the Retailers Selection module.

The curve fitting serves as the basis for partitioning of the retailers into groups with the common parameters of their related curves. It turns out that the retailers assigned to one group have similar operating conditions and results. In other words, the parameters of curves can be exploited to identify special features of the local market, and retailer's behavior. The curve parameters evaluated in the module are stored in an auxiliary dataset to further use when determining the target sale/delivery control parameters for wholesalers.

3.9. Subsetting of Micro Market/Sales Data

The module is intended for interactive determination of data subsets by using of histograms for variables specified by the user. In order to create subsets, the user first selects one to four variables from the list of all variables in the dataset. After selection of variables, an auxiliary module is invoked which displays a histogram produced from the values of the variables, evaluated for each retailer (Fig. 8).

For each specified variable, separation of subsets is effected by clicking on the plot area to locate two borderlines that break the dataset into three parts respectively with the small values of the variable (to the left of the first border), medium values (between the border lines), and large values (to the right of the second border). As a result, three subsets are created each including retailers having only small, medium or large values of the variable. Every subset can further be partitioned based on the next variable in the same way.

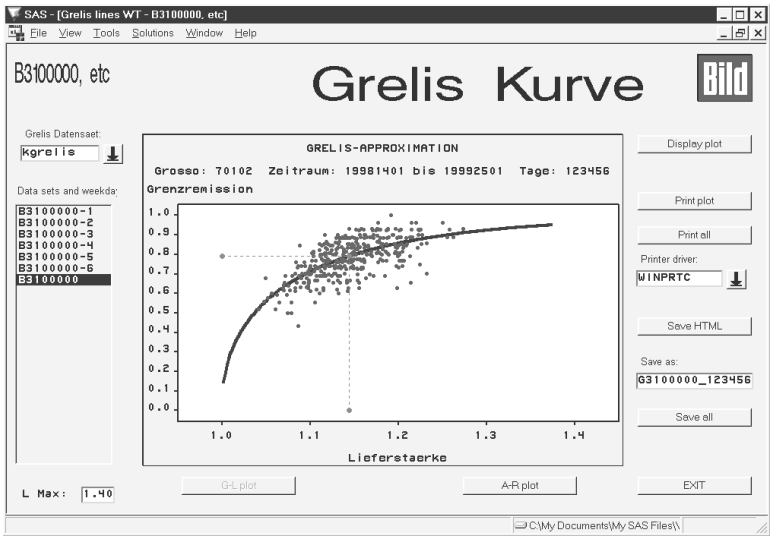

Figure 7. A screenshot of the window of the Sale/Delivery Control Curves.

All subsets make their appearance as virtual datasets. Any one of them can be converted using the Task Manager into an actual dataset later.

3.10. Selection/Modification of Subset Borders

The module supplements the previous one. It provides the user with an instrument to determine subset boundaries numerically rather than graphically. The module offers a list box for selecting variables, and a set of input fields for direct input of boundary values.

3.11. Selection/Modification of Target Classes

The module provides for direct manual input and modification of the boundaries that determine the target classes of retailers. Each class combines the retailers with similar operating conditions and sale results, and has the common return quota. The description of a class actually includes a few variables and their ranges determined by two boundaries. The

module allows one to fix classes by changing target variables and setting the boundaries for their values.

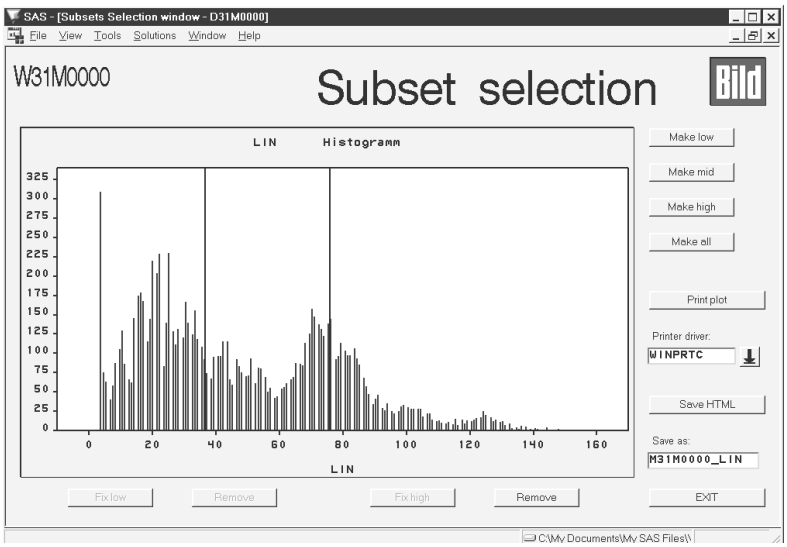

Figure 8. A screenshot of the window of the Subset Selection module.

3.12. Evaluation of Target Sale/Delivery Control Parameters

The module evaluates the final (target) sale/delivery control parameters including allowed return quota for all wholesalers and all kind of newspapers. It produces a final report, which can be viewed in the module window or output to printer. The obtained results can be then used when making agreements with wholesalers.

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Solving Resource Allocation Problems Using Agent Technology

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Abstract

In this paper, we present results of agent-based modeling for the solution of resource allocation problems in manufacturing. After a concise problem description, we start by identifying the agents necessary for the required shop floor control functionality. We propose a bidding procedure based on costs accumulated at a single machine during the production process. We present some results of computational experiments performed so far that demonstrate the feasibility of the suggested bidding scheme.

Keywords: Simulation of Business Processes, Manufacturing, Agent-Based Modeling, Distributed Systems

1. Introduction

Recently, distributed approaches to shop floor control have attracted a greater interest in the community (Roy and Anciaux, 2001; Tranvouez et al., 2001). The two main reasons are the following: Firstly, important steps have been made towards a theoretical foundation and experimental evaluation of multi-agent-systems over the last five years. Secondly, the development of modern middleware and the further dissemination of the Java programming language have greatly reduced the implementation effort for this kind of systems.

In this paper, we study a resource allocation scenario that stems from flexible manufacturing. Problems of this type have been discussed in the context of multi-agent-systems, for example in (Ottaway and Burns, 2000), in (Dewan and Joshi, 2001) and in (Okubo et al., 2000).

Traditionally, in the context of shop-floor control, one uses a contract-net based solution for resource allocation problems. The existence of managers (clients) and contractors (servers) is essential for this approach. The basic idea comprises manager agents looking for task-solving entities and contractor agents offering task-solving abilities. The manager agents announce tasks, receive and evaluate bids from potential contractors. The contractor agents

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receive task announcements of the manager agents, evaluate his capability to respond and, if possible, respond with a bid and finally perform the task if his bid is accepted. The basic manager-contractor approach has the drawback that the acceptance competence is exclusively with the manager agent.

An approach to solve this problem is the coordinator architecture introduced, for example, by (Zelewski, 1997). Here, in addition to the manager and contractor role one integrates the coordinator (mediator) role into the multi-agent-system. Because the coordinator has the character of a centralized entity, the coordinator will be a bottleneck in large systems. Problems arise also in the case of a failure of the coordinator. However, for relatively small problems the coordinator architecture shows some advantage over the pure manager-contractor architecture.

Contract-net based resource allocation approaches can be used at the lowest level of distributed, hierarchical shop-floor control systems. Bidding procedures must be used in situation, where no valid schedule is available. The analysis and design results for such a system in the semiconductor manufacturing domain are described in (Mönch, 2001). The work center agents introduced in (Mönch, 2001) can be viewed as coordinator agents.

The paper is organized as follows. We present a concise problem description in the next section. Then we derive the necessary agents. The main part of the paper deals with the development of a method to determine costs in contract-net based resource allocation scenarios. We finish the paper by presenting some computational results that indicate the feasibility of the suggested bidding scheme.

2. Statement of the Problem

We are interested in solving the following job shop scheduling problem (Pinedo, 1995): Given n jobs, which have to process on m different machines, we are interested in minimizing the value of the performance measure average weighted tardiness (AWT) of the jobs:

$$AWT := \frac{1}{n}\sum_{i=1}^{n} w_i \max(0, c_i - d_i), \tag{1}$$

where we denote by

w_i : weight of job i ,

c_i : completion date of job i ,

d_i : due-date of job i .

Note that this performance measure is attractive in due-date oriented manufacturing environments (for example in semiconductor manufacturing).

We assume that each single machine is able to perform processing steps of more than one product. Furthermore, in order to investigate a more realistic scenario we consider the following process restrictions:

- There exists sequence-dependent setup times, which usually are a multiple of the pure processing time.
- In the manufacturing environment under investigation, we find charge production. Here, we define a charge as a temporary collection of different jobs with the aim to process these jobs at the same time on the same machine.
- Transportation times are assumed included into the processing times of the single jobs.

For problems of this type, there is a vast literature. However, we found only a small number of papers dealing with questions like how to choose costs.

3. Agentification of the Problem

Multi-Agent-Systems offer a way to obtain the desired compromise between centralized control and fully decentralized control (cf. (Baker, 1998) and (Parunak et al., 1998)). Starting with the PROSA architecture (Van Brussel et al., 1998), we distinguish between decision-making agents and staff agents. Decision-making agents solve decision problems while the staff agents try to support them in the course of the decision-making process. In the PROSA architecture, we find order, product and resource agents as abstract classes. Starting from the results related to the PROSA architecture, we identified three basic agent types in our application scenario:

- Each job agent represents a single job. A job agent is responsible for finding the appropriate resources in order to process the remaining process steps of the job.
- Machine agents represent a single machine on the shop floor. The machine agents keep track of the production progress of the machine and its response to the requests of the mediator agent.
- Mediator agents are required to realize a matching between the job agents and the machine agents. A mediator agent is a kind of a staff agent as suggested in the PROSA architecture. It supports the decision-making entities job agent and machine agent during the fulfillment of their own goals.

4. Bidding Scheme

We are interested in a robust bidding scheme that mimics the situation on a real shop floor. The basic idea is the introduction of properly chosen machine costs. We use these machine costs to give each job agent a certain amount of currency.

Our approach is different from other proposals in the literature (more recent examples for bidding schemes can be found, for example, in (Krothapalli and Deshmukh, 1999) and (Ottaway and Burns, 2000)). However, it is often not obvious, how the authors choose appropriate costs.

4.1. Machine Hour Rates

Machine hour rates are calculated as follows (cf. Warnecke et al., 1996). In a first step, we calculate the following two quantities for each machine of the shop floor (usually we choose one year as a fixed period T):

1. $t_{fail,i}$ is an estimate of the time (per period T) that the i th machine is unavailable due to technical reasons. The time for repair, preventative maintenance, breaks and holidays is included into the quantity $t_{fail,i}$.
2. $t_{tech,i}$ is an estimate of the time that the i th machine is unavailable due to technological reasons. The quantity $t_{tech,i}$ is determined by tests in order to choose appropriate parameters of the machine.

We obtain the amount of time of machine i, designated to processing jobs (per period T) as follows:

$$t_{t,i}(T) := T - (t_{fail,i} + t_{tech,i}). \tag{2}$$

In a second step, it is necessary to calculate the costs that accumulate at a single machine. We have to distinguish between variable and fixed costs. Variable costs depend on the production consumption of the machine. Examples for variable costs C_{var} (per period T) are:

- costs for special materials for processing of process steps on the machine (for example, special gases in semiconductor manufacturing)
- costs for using the machine during the production process (for example for electrical energy)
- costs for maintenance, which depend on the number of completed process steps.

Fixed costs C_{fix} are necessary in order to model expenses that are independent of a machine's usage (for example, rental costs for the shop floor, wear and tear of the machine).

We determine the machine hour rate m_{hi} for machine i by using the following formula:

$$mh_i := \frac{C_{\text{var},i} + C_{fix,i}}{t_{t,i}(T)}, \tag{3}$$

i.e., the machine hour rate is given by the cost of the machine related to one single time unit of usage. Machine hour rates are implemented in many enterprise resource-planning systems.

4.2. Costs for Producing Jobs of a Single Product

We denote the set of products by $P := \{p_1, \ldots, p_m\}$. Each product p_i has a process flow $S := (s_{1i}, s_{2i}, \ldots, s_{ni})$. Here, we denote by s_{ki} the k th process step of p_i. The time t_{ki} is required for processing s_{ki} on machine ki. The costs for the production of a job of product p_i are calculated as follows:

$$C(p_i) := \sum_{k=1}^{n} aver(mh_{ki}) aver(t_{ki}) \tag{4}$$

We use the notation $aver()$ in order to indicate, that we use average values for machine hour rates and for processing times in the case of parallel machines.

4.3. Costs for Job Agents

The goal of the job agents is to optimize the purchase of scarce machine capacity provided by the machine agents. The achievement of this goal is controlled by the objective function

$$g_J := \max(c_J - d_J, 0), \tag{5}$$

where we denote by

c_J : completion time of job J,

dJ : due-date of job J.

Note, that the objective function of a single agent (5) is a part of the objective function of the whole production system (1).

Suppose, that agent A_J is designated to produce a job of product p_i. The budget

$$B(A_J) := (1 - w_t - w_m) \frac{C(p_i)}{\sum_{k \in P} \lambda_k C(p_k)} + w_t T_J + w_m M_J, \tag{6}$$

where

T_J : measure of the due-date priority of job J,

M_J : measure of the importance of job J from management point of view,

w_t : weight for due-date priority,

w_m : weight for management importance,

λ_k : frequency of jobs of product p_k,

is given to the agent after release into the shop floor. Here, $w_t + w_m \leq 1, \quad w_t, w_m \geq 0$ and $\sum_{k \in P} \lambda_k = 1$ and $\lambda_k \geq 0$ are valid.

The due-date priority of a job J is given by the ratio:

$$T_J := \frac{\text{remaining processing time}}{\text{due-date-actual time}}, \tag{7}$$

The job agent pays a price P to the corresponding machine agent for carrying out a process step of the job on the machine represented by the machine agent. This price reduces the budget $B_{old}(A_J)$ of the job agent by P. The new budget is denoted by $B_{new}(A_J)$. In order to avoid a hold of jobs, that have a too small budget, a refresh of the budgets is carried out after a fixed amount of time. We consider only these jobs for budget update that required no machine capacity for a time $t_{threshold}$. We determine the new budget $B_{new}(A_J)$ as follows:

$$B_{new}(A_J) := \max\left(\frac{\sum_{k=l+1}^{n} aver(mh_{ki}) aver(t_{ki})}{\sum_{k \in P} \lambda_k C(p_k)}, B_{new}(A_J) \right), \tag{8}$$

where we suppose, that the job has finished the process step s_l and the next process step is s_{l+1}. The update scheme (8) ensures, that each job agent has at least that budget required to pay the machine costs based on (4) for its remaining process steps.

4.4. Costs for Machine Agents

The goal of the machine agents is full utilization of the machines. This goal includes especially the minimization of setup-times and a maximization of the load, because this yields an increase of the dynamic capacity of the shop floor. Therefore, we consider the following combined objective function

$$G(M_i) := \min_{k \in I} (\alpha_1 SC_k + \alpha_2 (1 - UM_k)), \tag{9}$$

where $\alpha_1 + \alpha_2 = 1$ and $\alpha_i \geq 0$ are valid. Here, we use the following notation:

I: Set of indices of the jobs (charges) that are waiting in front of the machine,

SC_k: normalized setup costs,

UM_k: normalized fullness of charge k,

α_i: weight of the i th objective.

A machine agent offers the job agent (product p_i, actual process step s_{ki}), processing capabilities at the price:

$$P(M_i) := (1 - w_s - w_{ch}) \frac{mh_i t_{ki}}{\sum_{k \in P} \lambda_k C(p_k)} + w_s SC_k + w_{ch}(1 - UM_k), \quad (10)$$

where $w_s + w_{ch} \leq 1, w_s, w_{ch} \geq 0$ hold. We denote by w_s the weight of the setup costs and by w_{ch} the weight of the fullness of the charge. Note, that in case of a full load the necessary price to be paid is lower than in case of a non-full charge. Shorter processing times lead also to lower prices under the assumption of identical machine hour rates.

5. Results

We implemented a prototype multi-agent-system based on the JAFMAS framework (Chauhan, 1997). For more details on the implemented system we refer to (Stehli, 2002) and (Mönch and Stehli, 2002).

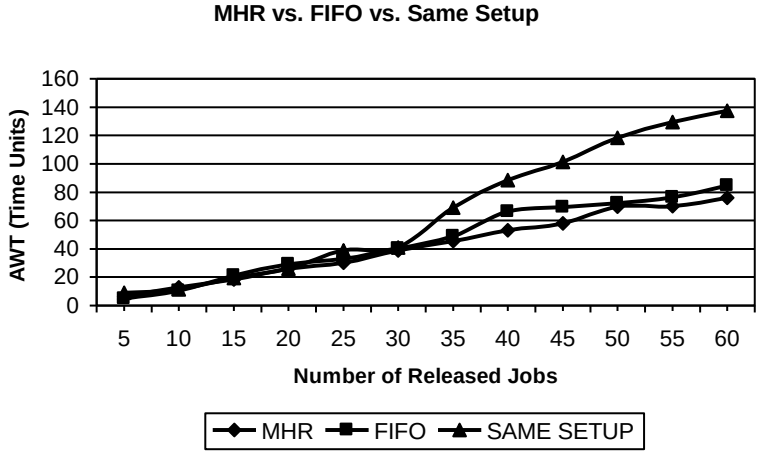

Figure 1: Performance Comparison based on AWT.

5.1. Experimental Design

We consider a (simple) manufacturing system that consists of four different machines. Each single machine is able to process more than one process step. Usually, the same process step can be processed by more than one machine, i.e., we consider the parallel machine case. We

consider the case of three different products. Each single product consists of three or four process steps.

5.2. Performance Evaluation

We use the performance measure AWT given by (1) in our experiments. The product mix uses the same number of jobs of each product. We compare our bidding scheme based on machine hour rates (MHR) with the First-In-First-Out (FIFO) and the Same Setup dispatching heuristics. Results of simulation runs can be seen in Figure 1. MHR outperforms the two other simple heuristics that are widely used in shop-floor control. MHR is better suited to the task of distributing the jobs over machines with different characteristics. In the case of an overload of the system the same setup heuristic performs very bad, because the setup state of the machines is constant all the time.

6. Summary

In this paper, we present the results of agent-based modeling for resource allocation problems in manufacturing. We propose a new bidding scheme based on machine hour rates. We present some computational results. In order to measure the performance of our approach more sophisticated dispatch rules (for example the apparent tardiness cost rule (Pinedo, 1995)) and other contract net approaches should be included into the experiments.

Acknowledgement: The author would like to thank Marcel Stehli for his valuable modeling and programming efforts.

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Multiplayer Games, ERP and Competitive Models

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Anstract

A basis to model discovery and prediction planning is stated. The new AI agent computing business bases defined during the last several years can be applied to present precise decision strategies on multiplayer games with only perfect information between agent pairs. The game trees are applied to improve models. The computing model is based on a novel competitive learning with agent multiplayer game tree planning. Specific agents are assigned to transform the models to reach goal plans where goals are satisfied based on competitive game tree learning. The planning applications include OR- ERP and Enterprise Modeling as goal satsfibility and micro-managing ERP with means-end analysis on EP. The paper is based on agent plan computing where the interaction amongst heterogeneous computing resources is via objects, multiagent AI and agent intelligent languages. Modeling, objectives, and agent planning issues are examined.

Keywords: Multiplayer Game Trees, Management Sciences, Business Planning, Prediction, AI, ERP, EM

1. Introduction

A new basis for ERP with multiplayer gamesa with the new computing paradigms is essential. New design techniques are presented with applications introducing intelligent business objects. The development of intelligent business objects with agents to reiterate new generations of business objects in the multimedia environment is new progress. The project designs financial software applying knowledge bases to specify the multiagent design. Practical applications with intelligent multimedia and specific business object design techniques are put forth for intelligent business objects. New direction for forecasting and business planning (Nourani, 1998a, 1999a) is put forth applying Morph Gentzen. We have further showed how computable AI world models for KB and knowledge management are designed. KR with G-diagrams for models is applied for keying to knowledge bases. Model discovery at KB's are with specific techniques defined for trees. New applications to business with intelligent object languages are presented in brief. Intelligent multimedia and the new Morph Gentzen logic from the preceding chapters are applied as a preliminary basis

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for to forecasting. We present a brief overview to new KR techniques applied wBith localized keying to models G-diagram for business models and as a minimal efficient computable way for knowledge management. Further motivations might be found at (Riggins and Rhree, 1998) and (Hagel and Armstrong, 1997).

The corporations have to specify how to conduct business before they implement an ERP system. The best way to do that is by defining how decisions are made in terms of planning. ERP and EM are to be applied to elect supply chain policies, which can in part specify how the business is to operate. Applying resource planning processes business planning models could be developed. Apply ERP to the planning process, we might develop tactical planning models that plan critical resources up to sales and delivery. Planning and scheduling require definition of their respective policies, processes, and the analyses of supply chain parameters. EM can be applied to determine the scope of the project to fit within the resources available (including budget) and the time required and to assign stake responsibility. ERP has to select the operational planning teams that will manage the process. Amongst the tasks are: feasible production schedules, mapping the operational planning process to develop scheduling models for production and plan inventories. Develop plan for building a data warehouse, KM and interfaces to legacy systems and ERP. Determine the order that these parts can be implemented. ERP applies implementation teams consisting of business representatives, functional representatives, IT personnel and system knowledgeable people. The representative to be the team leader. The planning process and ERP implement schedules and raise critical success factor problems to appropriate senior management. Conducting gap and risk analysis between functionality that will be implemented and system capability. ERP and EM can be applied to determine flexibility factors to modify implementation plans, as specific functionality appears more critical.

2. Software Agents and Business Objects

The basic micro ERP design tools apply agents and business objects. A new view to business computing for certain MIS applications with agent computing and intelligent multimedia is presented. Interactions amongst heterogeneous computing resources are via objects, multiagent AI, and design language abstract monitors. The applications to business based on the basis put forth for modular object languages are briefed. Intelligent Objects form our 1994 papers are reviewed introducing new business applications with agents. Software agents are specific agents designed by a language that carry out specified tasks and define software functionality. Most agents defined by our examples are software agents. With a rapid advancement of technology in recent times and a wide application of object-orientation principles in various diverse sectors of industry, the concept of business object was developed. A business object is a representation of something that is active in business domain, with at least the essential information on its business name and definition, attributes, behavior, relationships, and engagement rules. A business object is an application-level entity, developed completely independent of its application areas. A set of attributes describes the state of the entity, and there is a specification for the actions to take concerning the entity itself. The projects since Auckland provide the basis for a simple

methodology that will enable semi-technical personnel to develop and apply business objects in medium- and small-sized businesses within a relatively short time span, with relative ease and low cost. To this end, available modules of existing software should be reused wherever possible to minimize cost. Intelligent multimedia business objects are presented for the applications. IOOP (Nourani, 1995b) is a recent technique developed by the author combining AI and software agents with OOP. For our project the modular programming concepts are combined with software agent computing, new Intelligent OOP-IOOP object-coobject pairs. CORBA views designs with objects to be business objects, a business process object, or a presentation object. For these applications, an object is defined to be a uniquely identifiable real-world entity.

3. The New Agent-Based and Business Processes

The new MIS as an academic and business field might be depicted by the enclosed figure. Software agents are specific agents designed by a language that carry out specified business processes and define software functionality. Most agents defined by our examples are software agents. Academic MIS essentials might be redefined as the figure indicates. There is agent computing, cyberspace computing, intelligent multimedia and heterogeneous computing. Plans and goals (see the preceding chapters) are applied to business planning (Nourani, 1998a, 1998b) and OR.

3.1. Stock Forecasting and Agent Splitting Trees

A basis for forecasting is put forth at preliminary stages. The idea is to apply Morph-Gentzen logic as a basis for intelligent multimedia forecasting (Nourani 1998a, 1998b, 1999a, 1999b). The figure indicates a graphics sequent for predicting the fourth quarter earnings from the second and third combined with a market condition graph. The way a market condition graph is designed is a propriety issue. It is obtained by Morph Gentzen sequents from known stock market parameters. The design might apply agents splitting trees since (Nourani, 1997), where “splitting trees” is since a well-known decision tree technique. Surrogate agents are applied to splitting trees. The technique is based on the intelligent tree project the author developed since 1994's.

4. KR, KB, and Visual Model Discovery

Model diagrams allow us to model-theoretically characterize incomplete KR. To key into the incomplete knowledge base we apply generalized predictive diagrams whereby specified diagram functions a search engine can select onto localized data fields. The predictive model diagrams (Nourani, 1995) could be minimally represented by the set of functions $f_1,\ldots, f_n$ that inductively define the model. Data discovery from KR on diagrams might be viewed as satisfying a goal by getting at relevant data which instantiates a goal. The goal formula states what relevant data is sought. We propose methods that can be applied to planning (Nourani, 1991) with diagrams to implement discovery planning. In planning with G-diagrams that part of the plan that involves free Skolemized trees is carried along with the proof tree for a plan goal. Computing with diagram functions allows us to key to active

visual databases with agents. Diagrams are well-known concepts in mathematical logic and model theory. The diagram of a structure is the set of atomic and negated atomic sentences that are true in that structure.

Models uphold to a deductive closure of the axioms modelled and some rules of inference, depending on the theory. The generalized diagram (G-diagram) (Nourani, 1991, 1994a) is a diagram in which the elements of the structure are all represented by a specified minimal set of function symbols and constants, such that it is sufficient to define the truth of formulas only for the terms generated by the minimal set of functions and constant symbols. Such assignment implicitly defines the diagram.

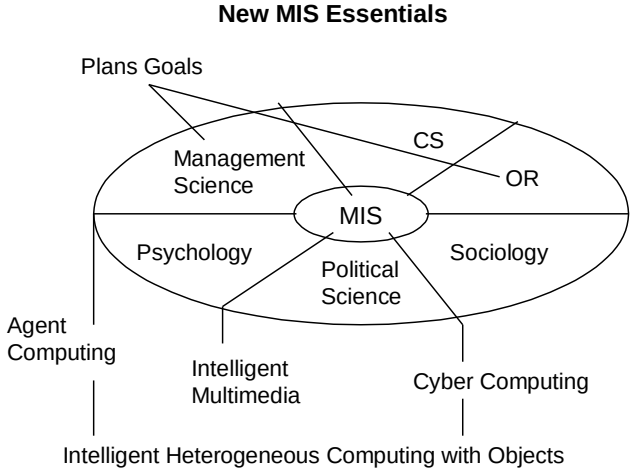

Figure 2. The Agent-based Business and MIS Model[1].

4.1. Prediction and Discovery

Minimal prediction is an artificial intelligence technique defined since the author's model-theoretic planning project. It is a cumulative nonmontonic approximation attained with completing model diagrams on what might be true in a model or knowledge base. A predictive diagram for a theory T is a diagram $D(M)$, where M is a model for T, and for

[1] The specific agent business modeling techniques are the technical property of the author's businsess. Commerical applications must be with proper credit and permission.

any formula q in M, either the function $f : q \rightarrow \{0,1\}$ is defined, or there exists a formula p in $D(M)$, such that $T \cup \{p\}$ proves q; or that T proves q by minimal prediction. Prediction involves constructing hypotheses, where each hypothesis is a set of atomic literals; such that when some particular theory T is augmented with the hypothesis, it entails the set of goal literals G. The hypotheses must be a subset of a set of ground atomic predictibles. The logical theory augmented with the hyposthesis must be proved consistent with the model diagram. Prediction is minimal when the hypothesis sets are the minimal such sets.

A generalized predictive diagram, is a predictive diagram with $D(M)$ defined from a minimal set of functions. The predictive diagram could be minimally represented by a set of functions $f_1,\ldots, f_n$ that inductively define the model. The free trees we had defined by the notion of provability implied by the definition, could consist of some extra Skolem functions $g_1,\ldots, g_l$ that appear at free trees. The f terms and g terms, tree congruences, and predictive diagrams then characterize partial deduction with free trees.

4.2. KR with Keyed Functions

Let us see what predictive diagrams do for knowledge discovery knowledge management. Diagrams allow us to model-theoretically characterize incomplete KR. To key into the incomplete knowledge base. The following figure depicts selector functions F_i from an abstract view grid interfaced via an inference engine to a knowledge base and in turn onto a database. Generalized predictive diagrams whereby specified diagram functions a search engine can select onto localized data fields. A Generalized Predictive Diagram, is a predictive diagram with $D(M)$ defined from a minimal set of functions. The predictive diagram could be minimally represented by a set of functions $f_1,\ldots, f_n$ that inductively define the model. The functions are keyed onto the inference and knowledge base to select via the areas keyed. Data discovery from KR on diagrams might be viewed as satisfying a goal by getting at relevant data which instantiates a goal. The goal formula states what relevant data is sought. We have presented planning techniques, which can be applied to implement discovery.

Practical AI Goal Satisfaction Practical AI systems are designed by modelling AI with facts, rules, goals, strategies, knowledge bases. Patterns, schemas, AI frames (Fikes- Kheler 1985) and viewpoints are the micro to aggregate glimpses onto the database and knowledge bases were masses of data and their relashionships-represenations, respectively, are stored. Schemas and frames are what might be defined with objects, the object classes, the object class inheritances, user-defined inheritance relations, and specific restrictions on the object, class, or frame slot types and behaviors. A scheme might be: Intelligent Forecasting IS-A Stock Forecasting Technique; Portfolios Stock, bonds, corporate assets; Member Management Science Techniques}. Schemas allow brief descriptions on object surface properties with which high level inference and reasoning with incomplete knowledge can be carried out applying facts and the defined relationships amongst objects. Relationships: Visual Objects A and B have mutual agent visual message correspondence. Looking for

patterns is a way some practical AI is a carried on with to recognize important features, situations, and applicable rules. From the proofs standpoint patterns are analogies to features as being leaves on computing trees. Forward chaining is a goal satisfaction technique, where inference rules are activated by data patterns, to sequentially get to a goal by apply the inference rules. The current pertinent rules are available at an agenda store. The carried out rules modify the database. Backward chaining is an alternative based on opportunistic response to changing information. It starts with the goal and looks for available premises that might be satisfied to have gotten there. Goals are objects for which there is automatic goal generation of missing data at the goal by recursion backward chaining on the missising objects as sub-goals. Data unavailability implies search for new goal discovery. Goal Directed Planning is carried out while planning with diagrams. That part of the plan that involving free Skolemized trees is carried along with the proof tree for a plan goal. If the free proof tree is constructed then the plan has an initial model in which the goals are satisfied.

5. Infinite Multiplayer Game Trees and ERP

Games play an important role as a basis to economic theories and can be applied to ERP as a basis to EM prototypes. Intelligent tree computing theories we have defined since 1994 can be applied to present precise strategies and prove theorems on multliplayer games. Game tree degree with respect to models is defined and applied to prove soundness and completeness. The game is viewed as a multiplayer game with only perfect information between agent pairs. Upper bounds on determined games are presented. The author had presented a chess playing basis in 1997 to a computing conference. For each chess piece a designating agent is defined. The player P makes its moves based on the board B it views. P,B might view chess as if the pieces on the board had come alive and were autonomous agents carrying out two-person games as in Alice in Wonderland. Game moves are individual tree operations.

5.1. Intelligent AND/OR Trees and Splitting Agents

AND/OR trees (Nilsson ,1969) are game trees defined to solve a game from a player's stand point. Formally a node problem is said to be solved if one of the following conditions hold.

1. The node is the set of terminal nodes (primitive problem- the node has no successor).

2. The node has AND nodes as successors and the successors are solved.

3. The node has OR nodes as successors and any one of the successors is solved.

A solution to the original problem is given by the subgraph of AND/OR graph sufficient to show that the node is solved. A program which can play a theoretically perfect game would have task like searching and AND/OR tree for a solution to a one person problem to a two-person game. An intelligent AND/OR tree is and AND/OR tree where the tree branches are intelligent trees. The branches compute a Boolean function via agents. The Boolean function is what might satisfy a goal formula on the tree. An intelligent AND/OR tree is solved iff the corresponding Boolean functions solve the AND/OR trees named by intelligent

functions on the trees. Thus node m might be $f(a_1,a_2,a_3)\&g(b_1,b_2)$, where f and g are Boolean functions of three and two variables, respectively, and ai's and bi's are Boolean valued agents satisfying goal formulas for f and g.

The chess game trees can be defined by agent augmenting AND/OR trees (Nilsson, 1969). For the intelligent game trees and the problem solving techniques defined, the same model can be applied to the game trees in the sense of two person games and to the state space from the single agent view. The two person game tree is obtained from the intelligent tree model, as is the state space tree for agents. To obtain the two-person game tree the cross-board-coboard agent computation is depicted on a tree. Whereas the sate-space trees for each agent is determined by the computation sequence on its side of the board-coboard. Thus a tree node m might be $f(a_1,a_2,a_3)\&g(b_1,b_2)$, where f and g are Boolean functions of three and two variables, respectively, and ai's and bi's are Boolean valued agents satisfying goal formulas for f and g.

A tree game degree is the game state a tree is at with respect to a model truth assignment, e.g. to the parameters to the Boolean functions above. Let generic diagram or G-diagrams be diagrams definable by specific functions. Intelligent signatures (Nourani, 1996a) are signatures with designated multiplayer game tree function symbols. The following theorem is from (Nourani, 1999a). The agent logic above allows us to define agent causal nets with specfic models which can be carried on intelligent trees.

Theorem 1. Let T be a theory on an intelligent signature language L. T is (a) A Sound logical theory iff every axiom or proof rule in T preserves tree game degree; (b) A Complete logical theory iff there is a function set pair defining a canonical structure C and a G-diagram, such that C with has a generic diagram definable model.

The following specifics are from (Nourani, 1999c). Let N be the set of all functions from ω to ω. Let A be a subset of N. Gale and Stewart (1953) associated with A a 2-person game of prefect information GA. Player I begins by choosing n_0 in ω; player II chooses n_1 in ω; then I chooses n_2 in ω; and so on. Let $a(i)=n_i$. I wins GA if and only if a in A. We say that GA is determined if one of the players has a winning strategy.

Proposition. If GA is determined, the complexity upper bound on the number of moves to win is A's cardinality.

Theorem 2. For every pair p of opposing agents there is a set $A_p \subset N$. The worse case bound for the number of moves for a determined game based on the intelligent game tree model is the sum of $\{|A_p|: p \text{ agent pairs}\}$.

Proof Sum over the proposition (see Nourani, 1999c).

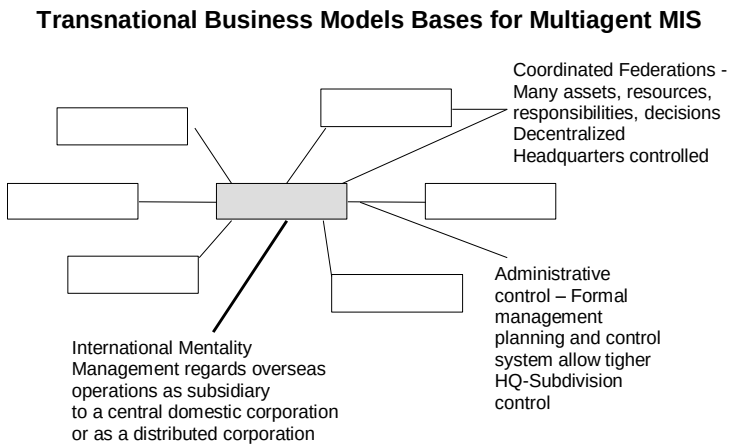

Figure 3: Transnational Business Models Bases for Multiagent MIS.

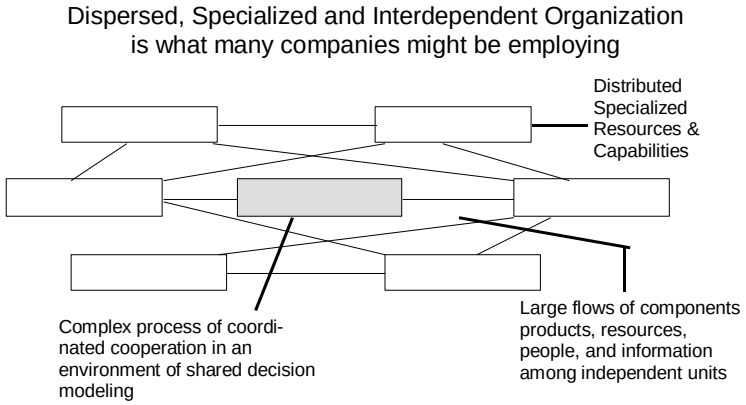

Figure 4: A multiagent MIS Model.

6. Multiplayer Management Process Models

We have defined specific application areas for multiagent computing to corporate ERP models and their strategic management of multinational enterprises in (Nourani, 1998a). The areas applied to are global planning, external enterprise assessment, and goal-setting applications for operations research and market forecasting (Nourani, 1998b). The figures indicate the specific models starting with a transactional business model which might be applied to examine EM on ERP prototypes.

The organizational knowledge (van Heijst et al., 1994) is one of the main bases to competitive advantage. Enterprise modelling includes stock management, payroll, and advanced administrative tasks applying decision support. The following figure is a glimpse onto applying meas-end analysis decision support where the hidden steps are designed and computed with parameter agents.

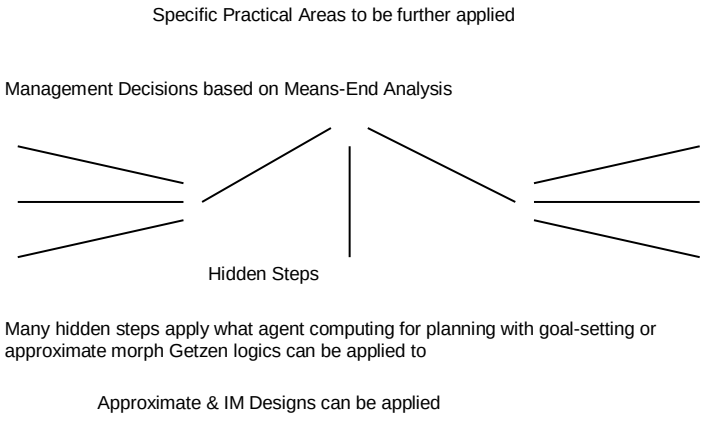

Figure 5: Meas-end analysis decision support

7. Conclusions

A new basis for business modelling and ERP are stated with new essential computing paradigms. Design techniques are presented with applications introducing agent business processes. Multiplayer games are presented with applications to economics based on the agent process models. Practical applications with intelligent multimedia and specific business object design techniques are put forth for intelligent business objects. New direction for forecasting and business planning (Nourani, 1998a, 1999a) is put forth applying Morph Gentzen. The project designs financial software applying knowledge bases

to specify the multiagent design. The splitting tree decisions is a technique due starting from Berekely and Stanford due to Breiman, Friedman, Olshen and Stone. The splitting agent decision trees, is however, due the author since 1994. KR with G-diagrams for models is applied for keying to knowledge bases. Model discovery at KB's are with specific techniques defined for trees. Corporate models and organisational management is presented with the agent process model. Means-end analysis micro-techniques basis is put forth.

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