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The IPTS REPORT

EDITED BY THE INSTITUTE FOR PROSPECTIVE TECHNOLOGICAL STUDIES (IPTS)
AND ISSUED IN COOPERATION WITH THE EUROPEAN S&T OBSERVATORY NETWORK

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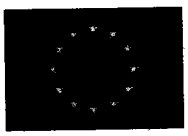
Joint Research Centre



ENGLISH VERSION

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regarding access to such information is what can make or break fortunes. One side of the coin, in other words, involves so-called 'trusted intermediaries', who find irresistible the temptation to put their objectivity on hold and give inaccurate information to the public, in order to increase (or at least not to jeopardize) their profits. The other side of the coin involves the selective and early sharing of the accurate version of the information about a firm's performance to a lucky few within the firm or closely associated with it.

The higher the trust placed in the system, the more powerful the shock when scandals break out. In the US such trust was very high (so much so that when twenty years ago I suggested to US colleagues that such numbers may be doctored, the only excuse they could find for my being overly suspicious was that I was European...). High levels of trust help explain reliance on self-regulation (e.g. for the auditing/accounting industry).

The problem of course is that the self-regulation mechanism works if the punishment exacted by the market is swift and high enough to counter the temptation of high profit through breaching the self-imposed code of conduct. Unfortunately, consumers usually cannot exact such punishment. They cannot easily act with one voice, they do not have the information until much later, if at all, and hence many cases may go unpunished. Moreover, when scandals erupt and consumers flee, all firms in a sector suffer, and the economy as a whole is punished for the mischief of identifiable firms. Self-regulation is not a panacea – sometimes it is just too expensive to recover from single episodes of violation of self-made rules, and the cost falls on society as a whole. There are hence solid arguments in favour of tighter oversight of such activities.

One of the reasons it has been hard to put in place such regulatory oversight in certain cases (besides the anti-government spirit, which has been dominating political discourse in some countries for quite some time) is to be found at the political level. Those whose very large fortunes benefit from anaemic oversight, lobby heavily and successfully to limit/redirect legislation which aims to address the problem.

As we highlighted in the editorial of issue 62, one would need to look into the role of political "campaign financing, and lobby groups, and the co-opting impact of the 'revolving-door' practices allowing transitions back and forth between powerful posts in public life to lucrative jobs in the private sector". In recent weeks Harvey Pitt, the chairman of the US Securities Exchange Commission, has been heavily criticized for being too friendly to the same firms his agency is overseeing and/or investigating. His career is illustrative of the revolving door practice: he started as a junior attorney at the SEC, went on to private practice and became one of the best-known attorneys defending auditing firms, and now he is at the helm of the agency overseeing them.

The deeper systemic problem that these scandals and the reluctance to address their root cause may be pointing to is the prevalence of a system which has been dubbed 'buddy capitalism', which allows 'insiders' to reap tremendous benefits without abiding by the avowed ethic of the system. In other words they are shown a shortcut, instead of the long and winding, tiring and uncertain path of working one's way up.

There may be quite a few implications for Europe in all this, and not only in terms of the similar economic structures/systems on both sides of the Atlantic. To begin with, the US firms involved in these scandals have often had operations in Europe, too. Second, the

Future Development of B2B E-Commerce: The Value Chain Perspective and Lessons for SMEs

Paul Desruelle, *IPTS*

Issue: Despite the strong signs that economic actors are adopting e-commerce in many aspects of their operations, SMEs appear to be lagging behind large companies.

Relevance: A challenge for policy-makers is how to foster adoption of e-commerce by SMEs, which constitute the immense majority of enterprises. Initiatives that address business networks and consider companies in the context of their value chain seem to have been particularly successful. The value chain perspective could indeed provide more insight into how e-commerce affects firms, and make it easier to understand that development of B2B e-commerce cannot take place uniformly for all economic actors, neither in its speed, nor in its realization.

Introduction

Despite the recent economic downturn and the bursting of the "new economy bubble," there are now strong indications that economic actors are adopting e-commerce in many aspects of their operations[1,2]. SMEs, however, seem to be lagging behind large companies in this respect. The enabling conditions for the development of e-commerce in Europe were established by the recent de-regulation of the EU telecommunications markets and by development of an appropriate regulatory framework. National and EU authorities have also launched a number of actions aimed at further facilitating the development of e-commerce.[3] The conditions for development of e-commerce are, however, complex. A number of factors influence the way companies decide whether or not –and to what extent– to adopt e-commerce technologies and practices. The E-commerce Business Impact Project (EBIP), a recently completed project that involved the OECD, the TNO-STB and Telematica institutes (the Netherlands), and the IPTS, examined how e-commerce was being implemented in different economic sectors and sought to assess its present and expected future impact[4]. As part of its contribution to EBIP,

The recent de-regulation of the EU telecommunications markets and the development of an appropriate regulatory framework are creating the conditions for the adoption of e-commerce in Europe

The views expressed here are the author's and do not necessarily reflect those of the European Commission.

operate. One of the most obvious networks of this type is that which links suppliers and customers involved in successively adding value to products and services, i.e., the value chain. If we turn to possible patterns of e-commerce development in value chains, at least three main scenarios seem to emerge. These are presented in Table 2.

In the first scenario, e-commerce technologies are expected to have a strong disruptive effect on existing value chains by lowering entry thresholds and leading to the emergence of new players. This situation follows most closely the predictions of the "new economy" model. A basic condition for this scenario to occur is that the application of e-commerce technologies in fact lowers barriers to entry and increases competition. This is expected to be more apparent in sectors heavily based on the exchange and trading of intangibles. For example, in the banking sector, entry of new players such as insurance companies, retailers, postal and telecommunications companies, and the emergence of new value chain intermediaries, such as large concentrated units taking advantage of the economies of scale made possible by increased networking, could significantly impact existing value chains.

In a second scenario, existing pivotal firms are expected to lead -if not impose- adoption of e-commerce technologies across significant value chain segments. For example, this is likely to happen in the upper part of the automotive industry value chain, in which a limited number of pivotal players (e.g. car manufacturers and their most powerful suppliers) are expected to define the way this industry adopts e-commerce. Other companies will have to adapt in order to avoid disappearing from the value chain.

A third scenario could occur in fragmented sectors such as, for example, in textiles/clothing (characterized by the presence of some very large firms but also of a multitude of firms of all sizes). In such sectors, isolated pockets of electronic commerce could emerge in different segments of the value chain, but homogeneous development of e-commerce is not expected to occur and adoption of e-commerce technologies along the value chain can be expected to be much slower in this scenario than in the previous ones.

Interestingly, in the first scenario, e-commerce development is expected to have a strong disruptive effect on existing value chain structures,

In terms of the speed and extent of e-commerce development across value chains, three different situations can be identified. In the first, e-commerce takes off widely and has a disruptive effect on existing market structures

In other situations pivotal firms may lead by adopting e-commerce technologies and thus forcing supplier, customers and competitors to follow suit

Alternatively, in highly fragmented industries adoption may take place only in isolated pockets

Table 2. Proportion of non-nationals in labour force by category

Scenario	Key characteristics of the sector	Main actors driving e-commerce development	Extent of e-commerce development along the value chain	Effect of e-commerce development on re-structuring of existing value chains	Sector example
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Strong pivotal firms	Traditional pivotal players	Large	Small	Automotive (manufacturing)
3	Fragmented	Varied	Limited to pockets (i.e., to segments of the value chain)	Small	Textile/ clothing

even provide SMEs with a "toolbox" that enables them to assess the potential for developing electronic relationships within their value chain.

In summary:

- Smaller companies can be under a wide diversity of external conditions pushing them or not to adopt e-commerce.
- Even if all basic conditions enabling e-commerce development are in place, it may be very tempting for some (or indeed many) companies to adopt a "wait-and-see" attitude.
- Taking the perspective of the value-chain provides additional insight on these complex issues.
- Initiatives targeted at value chains or business networks, rather than at individual enterprises, may result in more European SMEs benefiting from e-commerce.

Keywords

e-commerce, e-business, value chains, SMEs

Notes/References

1. We define e-commerce for the purpose of this article as "the application of information and communication technology (ICT) to any of the activities involved in making commercial transactions". This definition covers all the steps of the transaction process: from transaction preparation (e.g., advertising), to transaction completion (e.g., delivery, payment) and to post-transaction support (e.g., market analysis and development). We will however be considering only transactions between businesses (B2B), excluding therefore B2C transactions.

2. See for example the section on *The evolution of the European E-economy* in the European Information Technology Observatory 2002 Report, 10th edition, EITO 2002.

3. For up-to-date information on related EU activities, see DG Information Society's Web pages on the eEurope initiative, the regulatory framework for e-commerce, the EU Telecom Regulatory Framework and other programmes: **http://europa.eu.int/information_society/index_en.htm**

4. The EBIP synthesis report is expected to be published by OECD in 2002. Some national sectoral reports have already been published. See EBIP pages on the OECD Web site: **www.oecd.org**

5. This article takes as its starting point the work done on this subject at the IPTS, for the full report see: P. Desruelle, K. Ducatel, J.C. Burgelman, M. Bogdanowicz, Y. Punie, P. Verhoest, *Techno-economic impact of e-commerce: Future development of value chains*, IPTS Technical Report Series, No. EUR 20123 EN, November 2001. The report is available from the IPTS web site.

6. A time horizon extending to Year 2005 was considered.

7. Final benchmarking report on national and regional policies in support of e-business for SMEs, Enterprise DG, European Commission, 28 June 2002:
http://europa.eu.int/comm/enterprise/ict/policy/benchmarking.htm

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About the author

Paul Desruelle is a senior researcher at IPTS. He holds an Engineering Diploma from the school of Hautes Etudes Industrielles (HEI), Lille, France, and Master and PhD degrees in engineering from the University of Wisconsin-Madison, U.S.A. Before joining the IPTS he worked as a scientific officer in the ESPRIT and Information Society Technology (IST) European research and development programmes. At the IPTS he is part of the ICT group where he works on the assessment of techno-economic and social impacts of IST.

would become less and less an individual entrepreneurial activity and more and more the result of structured planning. This theory highlights the fundamental role of innovation management in development policy.

Another important theory on innovation was developed in 1996 by Leydesdorff and Etzkowitz and is known as the "Triple Helix model". In an effort to explain the apparent success of US innovation policies, this theory offers a model of innovation policies in which Government, University and Industry are all involved. On this view, it is not only the parent companies that are involved directly in the spin-off process but also policy-makers, given their role in creating the right environment.

In addition, another interesting contribution present in the literature is a theory put forward by Williamson (1975) which identifies a systemic solution to creating an efficient innovation process. According to Williamson, small companies are able to specialize better during the initial phases of the innovation process, when a large number of unstructured activities are required. In the later stages, large companies can then re-absorb these structures to implement the final stages of the innovation when it has to be engineered, requiring the sort of well-defined structure typical of large companies.

Spin-offs can therefore enhance the efficiency of the innovation process. Small companies can develop a technical innovation and their parent companies can exploit commercial advantages through their links to the new firm. The flexibility typical of small firms can make them better suited to adopting innovations during their early phases, when experimentation is fundamental to finding improved solutions, thus making them much more competitive in this context.

In high-tech sectors big firms are often better suited to place the product in the right market and to use the critical success factors (CSF) they have built up over many years to engineer both the processes and the product.

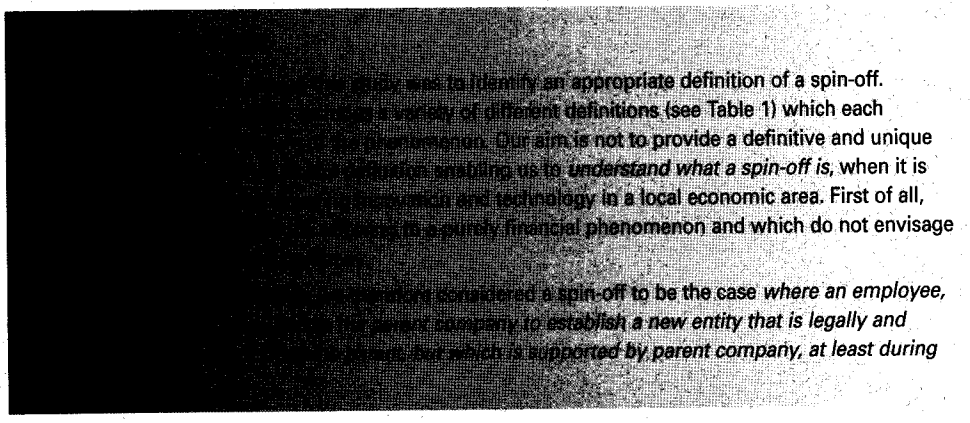
Innovative new ventures cannot be managed in the same way as established lines of business. Therefore, many large firms in the high-tech industries have found it worth creating dedicated structures to manage innovation. Examples of this include the Siemens Business Accelerator (SBA), and the Nokia Venture Organization (NVO). These special-purpose business units provide help and play an advisory role for new firms originating either within the company or externally.

However, sometimes both the companies and from R&D people involved in setting up the new venture are concerned about the level of risk invol-

Schumpeter's model of innovation gave the central role to entrepreneurs, who innovate in the pursuit of profit. Later theories, such as the "triple helix model", see an entwining of government, universities and industry, thus envisaging a role for policy-makers in the process

As small enterprises, spin-offs have the flexibility needed to experiment freely in the early phases of the innovation process

Given that innovative new ventures cannot be managed in the same way as established ones, many firms have opted to set up dedicated structures to manage innovation



[redacted] (8) and support structures (4) so as to obtain a complete [redacted] Although our analysis is not based on a statistically representative [redacted] to be sufficient to identify guidelines for policy-makers interested in innovation [redacted] as a tool for innovation rather than simply as an economic [redacted] by examining the case of Lombardy, which, although it offers a [redacted] many ICT companies and a large Technical University, appears to be [redacted] the technical skills developed in the region. The basic idea was therefore to [redacted] both public and private structures. For this reason we [redacted] which represent a contribution to generating innovation.

[redacted] when studying this kind of situation is that data from previous years is [redacted] purposes because it is *skewed* by the Internet bubble of [redacted] of many of the spin-offs from the biotech and ICT industries was greatly [redacted] and non-European firms to help us understand the problem, without [redacted] given its apparently scant relationship with the value of a spin-off, and [redacted] the long-term relationship between the spin-off and the parent company, its kind [redacted]

conviction that it can generate higher returns and more stable and solid businesses.

The typical structure of a spin-off business tends to be agile and informal, so it can manage innovation directly without being involved in non-value added activities outside its own core business.

Another important characteristic necessary to speak about spin-off is that management of new venture isn't directly on the hand of parent company, even better for parent it's reserved only a supervisor role.

Internal Effects

First of all it is necessary to understand what stakeholders are involved in the process, in order to simplify the classification. In our analysis we considered the following stakeholders to be involved:

- Parent company management
- Parent company employees
- External advisers guiding the spin-off process
- Financial backers
- Institutional subjects

Within this group it is possible to identify two subsets, *directly involved stakeholders*

A spin-off can have a direct effect on a company's organization, not only because a number of employees leave to set up a new firm, but also because this kind of process tends to lead to greater market focus overall

Table 2. Spin-off Classification

REASONS FOR SPIN-OFF	DEFENSIVE OFFENSIVE
SPIN-OFF MARKET IN RELATION TO PARENT COMPANY	SAME DIFFERENT
ORIGIN	TOP-DOWN BOTTOM-UP
KIND OF RELATIONSHIP	COMMERCIAL EQUITY

It is possible to identify different criteria to classify a spin-off. In our research we use four categories which each point to two different kinds of spin-off.

ups, the presence of young and innovative economic players, can alert venture capitalists to the opportunities of financing start-ups or young firms which, despite good business plans and ideas, sometimes need additional financing to that they receive from the parent company. Moreover, it should be noted that *parent support* is not seen here as entailing financial support throughout the lifetime of the spin-off. Rather it is more of an integrated action in which different divisions of the parent company are involved. At the end of the process of developing the spin-off firm, it is often possible to float it on the stock market, thus creating economic value for the parent company as well as benefits in innovation terms. A high-tech company IPO (initial public offering) can be profitable for all the parties involved[1].

Apart from market-driven approaches to spin-offs there are measures policy-makers can take to promote and manage spin-off activity. One such channel is to improve processes and competencies in technology parks and technology transfer offices. Structures of these kind have many of the characteristics needed to manage the spin-off process. Many technology parks promote university spin-offs, and can increase the quantity and quality of spin-offs by offering large companies the competencies and infrastructure to incubate start-ups in a integrated setting offering a range of facilities, such as connections with research centres to test and develop innovation, and the presence of other start-ups with which to create synergies.

It sometimes happens that large companies do not use spin-offs as a technique to foster innovation because they are unsure of how to manage it. Clearly, a stable and consolidated business activity requires different management techniques to a new or fast growing one, thus making it necessary to use dedicated structures to manage spin-offs as a specific process. Creating a technology cluster is by no means straightforward, it requires a variety of different efforts, but once working patterns have been developed it becomes easier establish companies and to help them bring their products to market.

One risk for companies creating spin-offs is that when technical staff leave they could take core knowledge of the parent company with them. To avoid this risk, companies are likely to avoid spinning-off projects and technologies which are –or may become– important for company survival (see figure 1). Moreover, it is reasonable to expect parent companies to retain a shareholding in the new company so as to exert some indirect control over its management and growth, and also to sign commercial partnership agreements with it to ensure present or future collaboration.

Management patterns

Three specific questions that arise in relation to the spin-off process are how best to manage spin-offs, how to use them to sustain high rates of innovation, and how to identify best practice for future innovation models.

There are a number of steps policy-makers can take to promote and manage spin-off activity, such as improving processes and competencies in technology parks and technology transfer offices

Large high-tech companies often fail to use the spin-off mechanism to foster innovation as they are unsure of how to manage it

One risk for companies creating spin-offs is that when technical staff leave they could take core knowledge of the parent company with them

Figure 1. The Spin-off Process

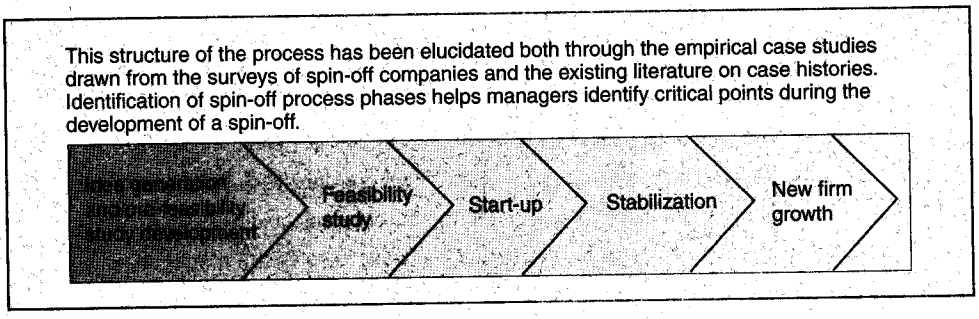
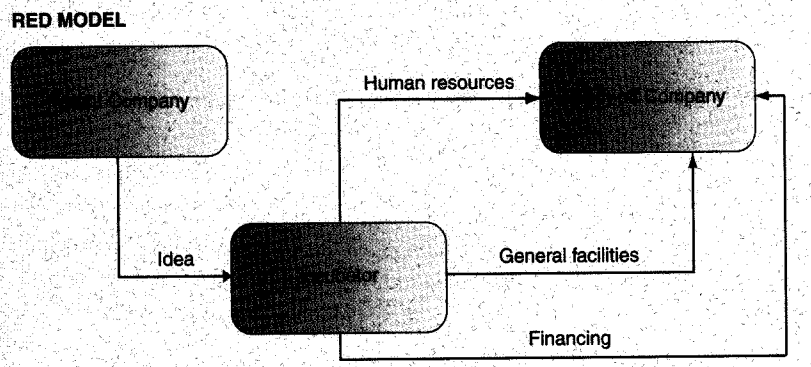
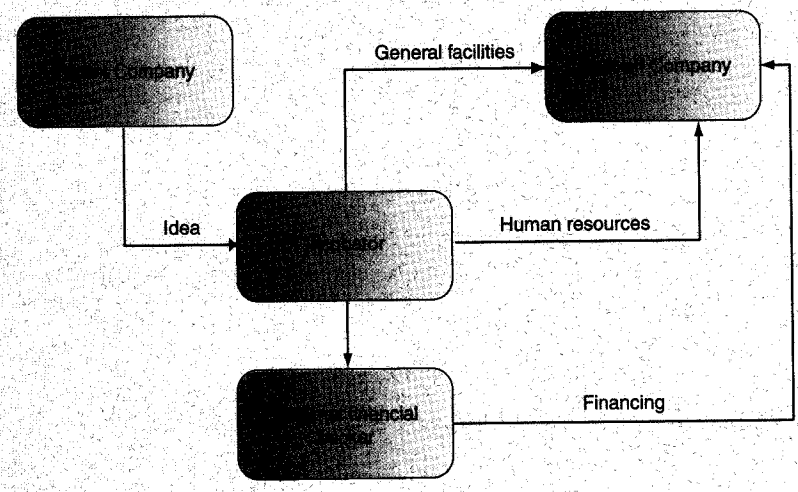


Figure 3. Spin-off models with an incubator



This is an important model which can offer a number of advantages and help resolve critical situations that arise. The incubator structure (internal or external to the parent company) manages the process and not only provides services to the new firm, but above all it creates optimal conditions in which to establish the new firm and improve the process. Incubator staff play a guiding role during the process.



Similar to the previous model (red one) it differs in that the incubator does not have funds of its own but needs to find them outside, in the financial market, preferably through partnerships with venture capitalists, so-called "business angels"[2] or technology funds set up by public bodies.

tions with the spin-off through commercial agreements, whether the spin-off firm operates in the same, or another, market. The spin-off may become a client or a supplier for the parent company, and grow through exploiting a captive market. This can help ensure its economic survival during the initial start-up period, as well as giving it a stable structure and enhancing its prospects for growth.

Conclusions

Our research has found that implementing spin off processes can be a priority strategy for high-tech companies wanting to explore every new business opportunity. Furthermore, spin-offs often create new local conditions permitting the creation of economic value for all the parties involved, through from the parent company to the overall

The spin-off may become a client or a supplier for the parent company, thus ensuring its economic survival during the initial start-up period

Table 3. Classification of cases studied

Company name	Country	Market	Nature	Applied model
Wr@p/Merloni	Italy	Electronics	Spin-off	Green
Loquendo/Telecom Italia	Italy	TLC*	Spin-off	Green
Accessmedia	Italy	TLC	Spin-off	Blue
[illegible]	U.S.A.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	TLC	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	TLC	[illegible]	[illegible]
[illegible]	Italy	TLC	Support-structure	Pink
Biosearch Italia	Italy	Biotech	Spin-off	Pink
Novuspharma	Italy	Biotech	Spin-off	Pink
Newron Pharmaceuticals	Italy	Biotech	Spin-off	Pink
Roche Milano Ricerche	Italy	Biotech	Spin-off	Pink

**telecommunications division*

economic fabric. The benefits include job creation, enhanced innovation, and new relationships between market players.

In conjunction with the management of large companies which have R&D departments that may be a potential source of innovative spin-offs, policy-makers may be interested in fostering this activity, and the "Triple Helix" model suggests that their intervention can be effective.

Two particular areas where action may be taken include financial incentives to establish high-tech start-ups and to create dedicated structures for managing similar processes, and modifying the prevailing culture of R&D centres, through training to improve the market focus of R&D managers. Last but not least, it is essential to demonstrate to managers that spin-offs do not necessarily deplete company competencies, but can in fact develop and enhance them.

Prospects for Integrating Text Mining and Knowledge Management

Luciana Bordoni and Ernesto d'Avanzo, *ENEA*

Issue: The increasing amount of information available on the Web raises new and challenging problems in relation to information retrieval. Search engines can play an essential role in the usability of Internet-based information systems, subject to the existence of applications that can analyse and evaluate the relevance of the information for the user. New approaches based on the integration of text mining with knowledge management can offer enhanced information management solutions.

Relevance: Individual users and policy-making organizations that use collaborative information retrieval find themselves involved in the process of information research and knowledge updating. Thus, knowledge management is an important part of the smooth functioning of any policy-making organization.

Introduction

Knowledge management (KM) is a relatively recent business practice in which digital content in many forms and formats is brought together within an integrated architecture that permits the underlying semantic data in the corpus to be used as an aid to strategic understanding and decision making. KM is aimed at serving business practices, having originated in the business world as a method for unifying the vast amounts of information generated from meetings, proposals, presentations, analytic papers, training materials, etc. KM is primarily utilized by large organizations, although the problem of navigating a multiformat document corpus is relevant to any individual or group that creates and consumes distributed knowledge. In his paper, 'The Knowledge Creating Company', Ikujiro Nonaka argues that "making personal knowledge available to others is the central activity of the knowledge creating company" (Nonaka, 1991). The challenge for KM is to translate 'tacit' knowledge, which is personal, hard-to-formulate, 'in people's heads', and difficult to communicate, into 'explicit' knowledge, which is formal, systematic, and which can be shared. Knowledge is created by making 'tacit' knowledge 'explicit'. Through knowledge creation, a company can translate its ideas into innovative technologies and products. In the past few years, KM has received increasing attention from industry,

The challenge for knowledge-management (KM) is to translate 'tacit' knowledge, which is personal, hard-to-formulate, 'in people's heads', and difficult to communicate, into 'explicit' knowledge, which is formal, systematic, and which can be shared

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- Gain insights about trends, relations between people/places/organizations, etc. by automatically aggregating and comparing information extracted from documents of a certain type.
- Classify and organize documents according to their content; i.e. automatically pre-select groups of documents with a specific topic and assign them to the appropriate person.
- Organize repositories of document-related meta-information for search and retrieval.
- Retrieve documents based on various sorts of information about the document content.

This list of activities shows that the main application areas of text mining technology cover two aspects: (1) knowledge discovery and (2) information extraction.

An information extraction system searches for specific information in a document, according to predefined guidelines. The guidelines are specific to a given topic area. For example, if the topic area is news reports of terrorist attacks, the guidelines might specify that the information extraction system should identify (i) the terrorist organization involved in the attack, (ii) the victims of the attack, (iii) the type of the attack, and the other information of this type that can be expected in a typical document of the topic area.

Most information extraction systems are built manually for a single topic area, which requires a large amount of expert labour. For example, the highest performance at the Fifth Message Understanding Conference (MUC-5, 1993) was achieved at the cost of two years of intense programming effort (see Box 1).

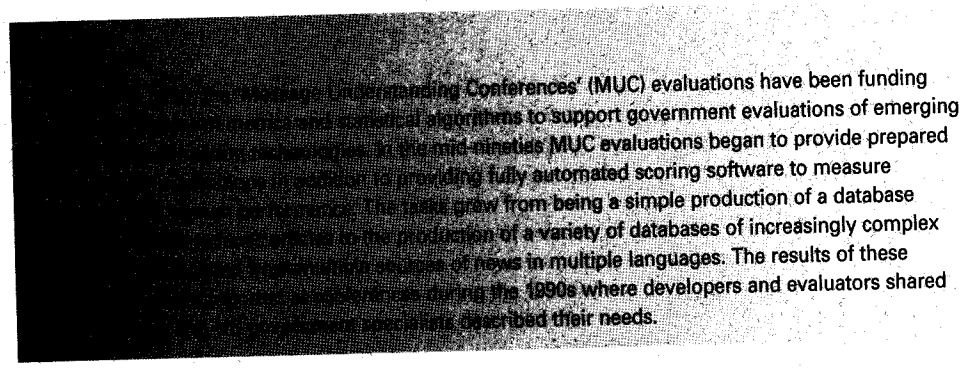
Similarity between documents using keyphrase extraction

As long ago as 1977, the THOMAS system (Oddy, 1977) illustrated how keywords or phrases could be used to guide users in uncovering useful reference documents. Keyphrases are a particularly useful type of summary information. They condense documents into a few words and phrases offering a brief and precise description of a document's contents. They have many applications: classification or clustering of documents, searches and browsing interfaces, retrieval engines, and thesaurus construction. Keyphrases are often chosen manually, usually by the authors of a document but sometimes by professional indexers. Manual keyphrase assignment is tedious and time-consuming, requires expertise, and can give inconsistent results, so automatic methods benefit both the developers and the users of large document collections. Consequently, several automatic techniques have been proposed.

A wide range of techniques have been applied to the problem of phrase extraction. Turney was the first to treat extraction as a supervised

An information extraction system searches for specific information in a document, according to predefined (subject specific) guidelines. Such systems are usually built manually for a single topic area, which requires a large amount of expert labour

Keyphrases have long been known to be a particularly useful type of summary information. However, such phrases are usually chosen manually by either document authors or professional indexers



Understanding Conferences' (MUC) evaluations have been funding … and statistical algorithms to support government evaluations of emerging … In the mid-nineties MUC evaluations began to provide prepared … in addition to providing fully automated scoring software to measure … The tasks grew from being a simple production of a database … to the production of a variety of databases of increasingly complex … of news in multiple languages. The results of these … during the 1990s where developers and evaluators shared … described their needs.

Keywords
information extraction, text mining, knowledge and content management

Note

1. relating to knowledge or to the degree of its validation.

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develop when the quantity of water flowing down-river exceeds a certain threshold, and flooding occurs. A political crisis may arise when a country upstream starts claiming a significant quantity of the river water for domestic purposes, to the extent that it causes water shortages in the countries further downstream. Unfortunately, conflicts resulting from this type of water claim appear to have become more frequent in recent years as the cases of disputes over the waters of the Euphrates/Tigris, the Rio Grande, or the Aral Sea demonstrate.

Water quality related problems may be caused by short- or long-term effects. Non-compliance with existing wastewater discharge regulations by municipalities and industries upstream may eventually cause a dramatic deterioration of the river water quality downstream, leading to severe water-supply problems, economic costs and even the outbreak of disease, for instance, during the summer. Catastrophic short-term effects may be caused by accidental spills of large amounts of hazardous chemicals from industrial plants, when a vessel carrying chemicals is damaged by a collision, or when the tailings dam holding back mining wastes is breached.

Risk-management plans addressing the kinds of issues listed above have been developed in recent years for many of the hydrographical regions of Europe. Most of them, however, are primarily focused on the very local geographical, economic and political conditions. Although bilateral cooperation is common, multilateral approaches are relatively rare. The current situation in Europe is further complicated by the fact that the existing risk-management plans differ greatly from each other, making information transfer across national borders very difficult, especially in emergency cases.

In order to harmonize risk management within the European Union and beyond, and to expand water-related risk management plans to cover whole river basins, in March 1987 the Committee of Ministers of the Council of Europe adopted resolution (87)-2, and established an inter-governmental Open Partial Agreement called EUR-OPA Major Hazards Agreement. Subsequently, the executive secretariat of EUR-OPA in cooperation with the European Space Agency (ESA) organized a number of conferences (e.g. the Strasbourg Forum of November 19-21, 2001, and the Montpellier Forum of December 12-14, 2001), to discuss the issue of risk management, and to develop appropriate strategies for the further development of environmental security in Europe. The background to this process was the framework of the EC Global Monitoring for the Environment and Security (GMES) Action Plan, which came into effect in 2001. Three hydrographical areas were chosen as model regions: the Meuse river basin, the Latin Arc (coastal zone reaching from Portugal to Italy), and the Danube river basin. Of these, the Danube appears to be the most challenging as this region encompasses 13 countries (Figure 1), some of which are EU member States, while others are Pre-Accession or Candidate Countries. Moreover, the economic situation of the various countries is very diverse, as is their recent political history.

Specific measures in the Danube region

In November 2001, the first conference of the European Academy of Sciences and Arts on "Water in Europe" was held in Budapest, Hungary (Wilderer et al., 2002). The aim of the two-day meeting was to acquire a better understanding of the specific inter-dependencies in the Danube basin between river water, ecological and environmental concerns, social issues, economic relationships and culture (Figure 2). This complex matrix was discussed in a holistic way, taking into account not only ecological, social and economic concerns, but also traditions, beliefs, sentiments and aesthetic ideas as well.

Crises can arise as a result of a wide range of events, such as excessive water extraction upstream, pollution from towns or factories, chemical spills, etc.

Efforts are underway to harmonize risk management both within the European Union and neighbouring countries and to expand water-related risk management plans to cover whole river basins

The Danube river basin is perhaps the most challenging region for coordinated risk management as it encompasses 13 countries, some of which are EU member States, while others are Pre-Accession or Candidate Countries

tiful Blue Danube" in terms of water quality and the beauty of the riparian landscape.

- Standards and regulations developed in the EU Member States are to be implemented in the Danube region but need to be adapted to the specific local situations. The 6th EU R&D Framework Programme can help in the development of appropriate actions focused on water-resource management.
- The EU can provide key support the Danube countries in the process of implementing advanced material recycling and re-use strategies. Actions have to be taken to avoid mixing and dilution, and to capture, treat and recycle waste streams of all types.
- Prevention of hazards and increased environmental security is of great importance. In particular, attention has to be paid to the reduction of nutrient emissions from municipalities, industries and agriculture.
- River navigation is an efficient means of bulk transport. From an integrated perspective it needs to be promoted for both, ecological and economic reasons.

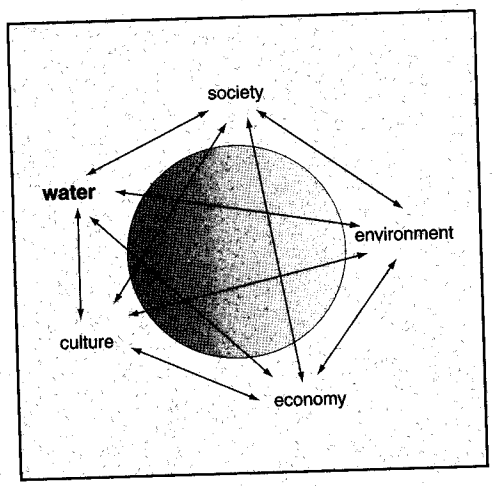
To achieve sustainable development it is commonly assumed that the social structure of human society, the environment and the economy in the region must equally be held in balance. However, sustainable development depends not only on socio-economic and environmental measures but on "aesthetic measures" as well, given the effect they can have on people's sense of wellbeing.

With respect to risk and crisis management in a multi-cultural region like the Danube river basin, aspects relating to the cultural heritage of the region need to be taken into account as well as physical, chemical and biological parameters. Only if they are, can countermeasures against the development of natural or man-made disasters be implemented effectively, as only if the cultural context is taken into account can the need to perform a given action at a given time and in a particular place be communicated effectively across political, economic and philosophical boundaries.

Approach to a multilateral risk and crisis management

Straightforward water-related risk and crisis management requires the development and implementation of a sequence of actions to be accomplished by (1) scientists, (2) civil society and policy-makers and (3) engineers. Of paramount importance is a fast and smoothly working communication network between these three groups of players. With respect to the case of the Danube, communication must function across the governmental, administrative, educational and language barriers which have existed since 1918. Thus, in the case of the unfolding of a catastrophic event, the officer in charge of the local fire brigade needs to understand the signals raised by a monitoring and evaluation station, even when located far away outside of his own domain, for instance so that sand bags can be put in the right place at the right time to avoid or limit flood damage.

Figure 2. Interaction between water and the socio-economic, environmental and cultural situation in a region



The participants in the first European Academy of Sciences and Arts conference on "Water in Europe", held in 2001, agreed that successful preservation and restoration of the beauty of the river would be a major contribution to the development of the economy and environment of the region

In order to implement adequate risk and crisis management, cultural and linguistic factors need to be taken into account to ensure measures to counter natural or manmade disasters will be effective

image analysis may be especially suited, as may methods which are based on the response of aquatic indicator organisms.

The data collected needs to be continuously evaluated in order to predict short and long term changes in flow and quality conditions downstream, and to predict undesirable developments. The results of this evaluation exercise must be available within the time frame in which decisions are to be made in order to initiate appropriate countermeasures. In the case of accidents the time available may only be a matter of minutes. Therefore, high-speed computers should be brought in service and high-speed mathematical/ numerical evaluation methods developed and implemented.

Most importantly, the results of data evaluation need to be translated into signals informing decision-makers about the current situation and alerting them to any problems as they arise. Obviously, a matrix containing a large amount of analytical data is inappropriate. The data must be condensed into the form of "indicator values". In the simplest case, such an indicator value could be a colour. Green would indicate that everything is fine, yellow would alert decision-makers to potential problems and red would call for immediate action.

When actions are due, decision-makers at the level of the river basin as a whole, the national level and/or the very local level need further advice. To facilitate the decision-making process a set of catastrophe scenarios need to be identified beforehand. Numerical simulation conducted on the basis of the current data could help in the choice of countermeasures, this being the approach which provides the greatest chance of avoiding or limiting damage or loss. But again, the results of computer simulation need to be available almost instantaneously, and the results have to be comprehensible in Germany as well as in Bulgaria or in any other country of the Danube region. The challenge involved in developing such a risk and crisis management system is considerable but the task deserves the effort it requires.

Conclusions

- Risks affecting fresh water are increasing as a result of climate change and economic growth, and these risks affect the Danube region in particular. In order to bolster economic and environmental security in Europe in the context of progress towards European integration, a modern risk and crisis management system needs to be developed and implemented.
- Such a system would not only be applicable to European river basins but also to other hydrographical regions around the world.
- The development of such a system requires the integration of various scientific disciplines and close cooperation with government and business as well as civil society. The creation of a task force covering expertise in relation areas of science and civil society groups is a possible approach to this challenge.

To facilitate the decision-making process a set of catastrophe scenarios need to be identified beforehand. Numerical simulation conducted on the basis of the current data could help in the choice of countermeasures

Scientific Uncertainty and Environment-Related Technologies

Panayotis Christidis and Dolores Ibarreta, *IPTS*

Issue: Our society is becoming increasingly cautious about the impacts of technological development. The media covers science-related news extensively and public opinion is highly responsive to scientific results that identify potential dangers. The on-going debate within the scientific community concerning the outlook of the environment at a global level has entered a new, politically-charged phase.

Relevance: Policy-makers need sound and timely scientific advice in order to take action regarding the environmental issues society is worried about. The underlying economic and political interests can be considerable and are sometimes strong enough to lead to a distortion or misinterpretation of scientific information. Without a reliable framework of analysis of scientific information, application of the precautionary principle is far from trivial.

Introduction

Even though science has made huge leaps in analysing and evaluating environmental risk issues, the debate concerning the actions needed to ensure a sustainable future for the planet has led to diverging opinions that cover the whole spectrum from extreme pessimism to excessive optimism.

The technology-pessimistic view sees the danger of technological progress destroying the environment while, on the other side, the technology-optimists believe that technology is the ultimate solution.

The fact that scientific results are used to support conflicting arguments –and often both sides use the same results– is not a new phenomenon. In today's world however, with the speed and power that modern means of information and communication offer, a possible misjudgement of the risk can influence public opinion and stimulate political action without allowing time for science to thoroughly analyse the situation. Benefiting from the situation, a wide range of pressure groups can often influence political decisions even at national level. There are numerous examples available, such as the questions of global warming and GMO risks, where policy-makers in the EU and the USA support widely differing positions as a result of the different pressures they are subject to.

The speed and power of modern information and communications technologies mean both the public and policy-makers can have a wide range of information rapidly available on any issue

The views expressed here are the author's and do not necessarily reflect those of the European Commission.

to be made based on more reliable information about the risks and benefits of new environment-related technologies.

Policy-makers need to have access to sound scientific advice that facilitates timely and informed decision-making on environmental issues. In order to do so, they need to draw upon a variety of scientific sources in relevant disciplines, allowing the full diversity of scientific schools of thought and opinion to be taken into account. The analysis should cover the scientific, technological, socio-economic, legal and ethical aspects of the issues examined; past experience shows that conflicts often arise as a result of the differences between these contrasting perspectives. It is also important to exploit the expertise of both the public and the private sector, and to involve all sides in a public debate on the main issues. Bringing all these aspects together while maintaining scientific objectivity is a difficult challenge, and one in which the increasing trend for early involvement of all stakeholders may be useful. Such an involvement allows scientists, who are the ones to carry out the actual assessment, to take different aspects of the issue into consideration during the process. The standard procedures that ensure the quality of scientific information (e.g. peer review) are certainly an important dimension of policy advice, but they require a lot of time, which is not always available.

Applying the precautionary principle

The Precautionary Principle (PP) dictates a priority commitment to caution in the face of uncertainty. This may seem simple *per se* but applying it is not devoid of complexity. The issue of when and how to use the Precautionary Principle is giving rise to much debate and to mixed, sometimes contradictory views. Some critics feel that implementing the Precautionary Principle will result in added costs for society and that it leads to decisions that are not based on "sound science." The main controversy is due in part to the fact that some critics have interpreted "precautionary" decisions as veiled forms of trade protectionism. Its greatest problem, as a policy tool, is its extreme variability in interpretation. The Commission's Communication (COM (2000) 1) tries to provide guidelines for the use of the Precautionary Principle in a politically transparent process, while emphasizing the need for a careful review of scientific data. The Commission wants to define its application so as to reduce controversy and, while doing so, it highlights the role for science in the process.

According to the Commission's Communication, "*Decision-makers need to be aware of the degree of uncertainty attached to the results of the evaluation of the available scientific information. Judging what is an 'acceptable' level of risk for society is an eminently political responsibility. Decision-makers faced with an unacceptable risk, scientific uncertainty and public concerns have a duty to find answers. Therefore, all these factors have to be taken into consideration.*" It is not, however, always possible for policy-makers to evaluate precisely the risks of scientific uncertainty, especially if their access to reliable scientific information is not guaranteed.

A recent report from the European Environment Agency, "Late lessons from early warnings: the precautionary principle 1896-2000" (EEA, 2001), examines how the concept of precaution has been applied – or not – by policy-makers over the past century when addressing a broad range of hazards linked to public health and the environment in Europe and North America. The report's 14 case studies provide many examples where inaction by regulators had costly and unforeseen consequences for human health and the environment or where early warnings, and even "loud and late" warnings, of problems were clearly ignored. Among the report's main "late lessons", three are

Scientific advice often plays a secondary role in the decision-making process, since the information it provides is not always easily understood by policy-makers or the public

The analysis provided to policy-makers should cover the scientific, technological, socio-economic, legal and ethical aspects of the issues examined, as past experience shows that conflicts often arise as a result of the contrasting perspectives of different disciplines

Critics of the precautionary principle point to its potential costs for society and the risk that precaution be used as a veiled form of protectionism

resistant crops to wild or semi-domesticated relatives thus creating "superweeds"; horizontal gene transfer and recombination to create new pathogenic bacteria; vector recombination to generate new virulent strains of virus, especially in transgenic plants engineered with viral genes; insect pests quickly developing resistance to crops with Bt (Bacillus thuringiensis) toxin; massive use of Bt toxin in crops affecting non-target organisms and producing negative effects in the ecosystem equilibrium.

There is indeed a great deal of uncertainty over the potential impact of GMOs on the environment and a shortage of empirical data. At the same time, computer modelling exercises are being run, with a view to evaluating the potential adverse effects on the environment of the release of GMOs. These will be combined with farm-scale trials within the EU in due course. Additionally, Directive 2001/18, a revised version of the previous Directive 90/220/EEC, on the *Deliberate Release into the Environment of Genetically Modified Organisms* defines risk assessments of GMO crops. The revised Directive has now formally introduced the precautionary principle in the description of its objective, providing a more visible recognition of this underlying uncertainty (Part A, Article 1).

As a concrete example of science advice in this area, there is the Austrian case over Bt maize in 1999. Article 16 of Directive 90/220/EC (now Article 23 in the revised Directive), known as the 'safeguard' clause, allows a Member State to provisionally prohibit, within its territory, the use and/or sale of a product that has received consent under this Directive, if it has justifiable reasons to consider that this product constitutes a risk to human health or the environment. This is, in a way, a precautionary principle clause and as such was invoked by Austria when prohibiting the marketing of Monsanto's GM maize –into which the Bt toxin had been genetically engineered– after the publication of a scientific study, which addressed possible adverse effects of pollen from GM Bt-maize on the monarch butterfly. The Scientific Committee on Plants advised the Commission on this issue upon request, concluding that the allegations did not constitute new scientific evidence to change the initial risk assessment that had formed the basis of the marketing approval of the product.

Even though the scientific evidence was deemed insufficient by the scientific committee responsible, the case of Bt GM in Austria shows that risk assessment policies have evolved in response to both science and to public perceptions and the concerns of other stakeholders. The scope of risk assessments of the environmental release of GM crops has widened to include long-term and indirect effects on flora and fauna. Possible adverse effects on insects such as monarch butterflies, the main argument used by Austria, are being given greater consideration. Even organisms further up the food chain are included in the assessment, such as the consequences for predator species ingesting insects that had themselves ingested such GM products. This trend is reflected in the newly introduced monitoring plan of the revised 2001/18 Directive that aims to "trace and identify any direct or indirect, immediate, delayed or unforeseen effects".

Austria's invocation of the 'safeguard' clause in the Directive on the release of GMOs could be considered a concrete example of the precautionary approach being used in practice

How can ERA improve the communication between science and policy?

The European Research Area (ERA) may prove an opportunity for an improvement in the way scientific analysis is used as an input for policy-making. The ERA will use an open coordination approach that combines inputs from the Union's Programme for RTD, national RTD programmes and European research organizations, and will incorporate them into a Union-wide common research policy. The three new instruments inclu-

The European Research Area (ERA) may prove an opportunity for an improvement in the way scientific analysis is used as an input for policy-making

Keywords

uncertainty, precautionary principle, environment, European Research Area

Notes

1. "Paralysis by analysis" refers to a situation in which, intentionally or otherwise, demands for additional information or analysis postpone decision-making.

2. This line of argument draws on preliminary results of an on-going ESTO study on The scientific basis of applying the Precautionary Principle, co-ordinated by Prof. E. Millstone, SPRU (UK).

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ABOUT THE IPTS

The Institute for Prospective Technological Studies (IPTS) is one of the seven institutes making up the Joint Research Centre (JRC) of the European Commission. It was established in Seville, Spain, in September 1994.

The mission of the Institute is to provide techno-economic analysis support to European decision-makers, by monitoring and analysing Science & Technology related developments, their cross-sectoral impact, their inter-relationship in the socio-economic context and future policy implications and to present this information in a timely and integrated way.

The IPTS is a unique public advisory body, independent from special national or commercial interests, closely associated with the EU policy-making process. In fact, most of the work undertaken by the IPTS is in response to direct requests from (or takes the form of long-term policy support on behalf of) the European Commission Directorate Generals, or European Parliament Committees. The IPTS also does work for Member States' governmental, academic or industrial organizations, though this represents a minor share of its total activities.

Although particular emphasis is placed on key Science and Technology fields, especially those that have a driving role and even the potential to reshape our society, important efforts are devoted to improving the understanding of the complex interactions between technology, economy and society. Indeed, the impact of technology on society and, conversely, the way technological development is driven by societal changes, are highly relevant themes within the European decision-making context.

The inter-disciplinary prospective approach adopted by the Institute is intended to provide European decision-makers with a deeper understanding of the emerging S/T issues, and it complements the activities undertaken by other Joint Research Centres institutes.

The IPTS collects information about technological developments and their application in Europe and the world, analyses this information and transmits it in an accessible form to European decision-makers. This is implemented in three sectors of activity:

- Technologies for Sustainable Development
- Life Sciences / Information and Communication Technologies
- Technology, Employment, Competitiveness and Society

In order to implement its mission, the Institute develops appropriate contacts, awareness and skills for anticipating and following the agenda of the policy decision-makers. In addition to its own resources, the IPTS makes use of external Advisory Groups and operates a Network of European Institutes working in similar areas. These networking activities enable the IPTS to draw on a large pool of available expertise, while allowing a continuous process of external peer-review of the in-house activities.