Perspectives for work and business in the e-economy: the contribution of the European R&D programme IST

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Abstract: This paper aims to provide a concise overview of R&D achievements of Key Action II of the Information Society Technologies (IST) programme under the European Commission’s 5th framework programme for research, development and innovation and how these activities relate to the e-economy. Since the beginning of IST in 1999, some 450 projects have been launched in the area of new methods of work and electronic commerce with a funding budget of half a billion euros. The R&D activities were accompanied by policy initiatives such as eEurope and the European Research Area that were launched at the beginning of the new millennium. The paper shows that technology development efforts underpin the policy initiatives and both together offer a coherent approach towards an online Europe.

Keywords: Information and communication technologies; European R&D programme; technology management; policy making; e-business; socio-economic research.


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This paper was presented in a concise form at the 3rd European e-Business and e-Work Conference, Prague, Czech Republic, 16-18 October 2002. The views expressed in this article are those of the author and do not necessarily reflect the official European Commission’s view on the subject.

1 Introduction

The last few years have been marked by a rapid acceleration in the development and adoption of new business solutions and practices for work and business. Challenges range
from building a global infrastructure that promotes trust and confidence, to the research, development and broad take-up of novel technologies, applications, business processes and organisational practices aimed at empowering individuals - whether as entrepreneurs, workers or consumers - and enterprises, small and large, as participants in a sustainable global economy.

E-economy logic is penetrating traditional sectors. Ultimately, the old economy and the e-economy will become integrated. This is mainly due to two key developments. The first is the exponential growth of the internet. The internet responds to the needs of economic actors in the global economy, further amplifying globalisation of the economy, of people, and of ideas. The second is the power of information; knowledge, ideas and brainpower are becoming the world’s main economic resource. Today, the main added value of a product is in the know-how required to design and market it – and in the services that come along. Also, intangible goods – content, software, knowledge, etc. represent an ever-growing share of the economy.

In the past the economy was somehow static, involving little change. Today, the rapid switchover to the e-economy requires radical changes in attitude and is challenging people’s ways and habits: it opens up an era of intense creative thinking, with ideas competing against ideas. The digital age calls for bold minds, an innovative spirit, open-mindedness, and vision. Entrepreneurship at all levels becomes the backbone of all businesses.

2 Work and business in the e-economy

The e-economy challenges business in many ways. E-technologies and globalisation are leading to a blurring of organisational boundaries. The creation of value becomes more and more dependent on intangibles. Uncertain and fast-changing environments require organisational abilities such as flexibility, speed, and adaptability. The networked economy resembles an ecology of organisms, interlinked and coevolving, constantly in flux, deeply tangled. It will ultimately change the way businesses relate, both to each other, to the individuals who provide their core competencies, and to their environment.

2.1 Value

The emergence of the internet and network technologies has led to a new perception of value for individuals and organisations.[1] Drivers for this are:

- **The network effect**: nodes and connections, the basic ingredients of networks, increase in complexity exponentially with the growing number of nodes. However, adding intelligence to the nodes enables a network to reach levels of unforeseeable ‘smartness’. The number of possible interactions and options grows exponentially. Also, in a network environment, small efforts can lead to large effects. Mathematically, the sum value of a network increases as the square of the number of members, which means that adding a few members can dramatically increase the value of the network for all members, with a self-reinforcing effect.
• The law of abundance: in contrast to traditional thinking, where value is related to ‘scarcity’, value in the network economy is seen as the ‘opportunities of relationships.’ For example, the first fax machine had a significant intrinsic value as a technological device, but its operational value was zero, until the second fax machine was built and installed. The opportunities to communicate via fax messages with an ever-growing user community grew exponentially with the increasing number of fax machines becoming operational. As fax machines became abundant and affordable, their value shifted from technological to operational. Hence, the larger a (user) community becomes, the more value a product acquires as a relationships-enabling means. Also, the more connections there are between members in a net, the more intermediary nodes there can be. Everything in a network is intermediating something else. Since a relationship involves at least two members investing in it, value increases exponentially with each investment.

• Intangible assets: in a digital economy, value is no longer dependent on tangible assets alone. Whereas in the traditional economy value is derived mainly from investment in tangibles such as plant and machinery, in the e-economy ‘smart’ resources such as information, knowledge, brands, relationships, and the capability to innovate become indispensable.

2.2 Trust

A key question of the e-economy is, ‘How can you do business with somebody that you do not see?’ [2]. As e-business relies on technologies and infrastructures that reduce geographical distance, open communication networks and information systems become vulnerable to integrity and security threats that may undermine the very essence of collaboration: trust. In the e-economy trust must be established and maintained by security technologies such as cryptography and authentication (e.g. biometrics, electronic signatures, etc.), and by technologies that enhance privacy and help protect and manage intellectual rights, digital assets and identities.

2.3 Relationships

Business success depends on the ability to innovate. Innovation comes from the clash of ideas. Networks provide a natural environment for this. Connectivity breeds relationships. The internet does not only facilitate hyperlinking of documents; people and organisations become ‘hyperlinked’ as well [3]. The e-economy is about the right set of connections between people and organisations, be they customers (customer relationships management – CRM) or suppliers (supply-chain management – SCM).

When relationships are fostered via networks, roles become blurred: The seller becomes the ‘buyer’ of valuable feedback on his product. Mass customisation enables businesses to see customers, suppliers, regulators, and even competitors as stakeholders who can make meaningful and positive contributions (Figure 1).
2.4 Knowledge

Managing knowledge is another core competence of e-economy businesses. To leverage the power of knowledge, one must know where to find it and once found, know what to do with it. Knowledge can be either explicit or tacit. In the case of the former, knowledge is formal and systematic and thus easy to capture, store and communicate. Tacit knowledge on the other hand is personal, a combination of experience and intuition, and as such heavily dependent on the individual owner’s commitment to the organisation and to its need to generate value from it. In this sense, a great deal of trust and loyalty between the individual and the organisation is necessary to leverage organisational knowledge, including its tacit dimension. This is why the e-economy is not only for the big players. It empowers in particular the individual and the smart SME [4].

2.5 Internetworking

For businesses, large and small, collaborative partnerships have become central to competitive success in fast changing global markets. Since many of the skills and resources essential to an organisation’s competence lie outside its boundaries, and outside management’s direct control, partnerships are not an option any more but a necessity. Organisations today have to be ‘smart’ in their ability to conceive, shape and sustain a wide variety of collaborative partnerships. Hence the challenge: the ‘capacity to collaborate’ becomes a core competence of organisations.

Collaborative partnerships are held together because of the added value they offer. There are a variety of strategic goals that organisations may pursue by entering into cooperation with others, goals such as, resource optimisation (sharing investment with regard to infrastructure, R&D, market knowledge, etc. and the sharing of risks, while maintaining the focus on one’s own core competencies); synergy creation by linking complementary competencies (i.e. to offer customers a solution rather than a mere product or service); achieve critical mass in terms of capital investment, shared markets and customers; achieve increased benefits (i.e. in terms of shorter time-to-market, higher quality, with less investment.)
As the economy is ‘going digital’ businesses are starting to realise what implications this will have on business processes and on the organisation as a whole. The transformation involves much more than setting up a digital infrastructure and requires more than the capability to enter into a virtual collaboration with other partners [4].

Whereas in the past the aim for organisations was to integrate the supply-chain as tightly as possible, the focus is shifting from the vertically integrated towards the internetworked organisation. One of its characteristics is its focus on the core business whilst outsourcing other activities via the internet and e-business exchanges to partners that may have the expertise to perform specific tasks better and more cost-effectively (Figure 2).

**Figure 2** Traditional versus internetworked business

3 Applied research to address the new business and work challenges

Since the beginning of the IST Programme in 1999, some 450 projects have been launched in the area of new methods of work and electronic commerce [5]. They address mainly the areas shown in Figure 3.
3.1 Technologies and infrastructures for trust and security

Trust and security technologies are key for the development of the Information Society. These technologies embrace a wide range of techniques like cryptography, authentication mechanisms and infrastructures (including electronic signatures), privacy enhancing technologies, tamper-proof hardware and components, and support the development of emerging business models. They empower users to manage effectively their personal rights and they help to prevent and fight abuses. The key challenge for such technologies is to make them scalable and interoperable to cope with the growing needs to secure communications and relations on open and public networks.

Because of the mounting discussion on electronic signature policy, all authentication and identification technologies have received a lot of attention. Research at technical level on cryptography is well advanced in Europe. For example, the Belgian algorithm called ‘Rijndael’ won the Advanced Encryption Standard competition organised by NIST in the US. Since 1999, Europe’s top cryptographic players work in NESSIE to address the medium to longer-term improvement of cryptographic primitives, in particular for novel mobile and multimedia applications. NESSIE has launched an enlarged competition on encryption algorithms fulfilling the requirements of new multimedia applications, mobile commerce and smart cards. ASPIS offers an innovative approach to protect the use of DVD ROM executable and data files, including secure internet connections based on access control authentication mechanisms. PKI Challenge aims at creating a fully integrated public key infrastructure to be developed in Europe as a key building block for a world wide integrated system. This will remove a major barrier in the development of e-commerce.

Once building blocks are properly developed, integrating them in robust infrastructures, and testing a smooth operation is a long undertaking. These issues range from the scalability of the solutions, to the legal impact of the implementations. It also requires careful assessment of the interoperability of the security mechanisms, whilst continuing to guarantee a fair and adequate quality of service.
3.2 Secure financing and transactions

In this domain, the projects mainly address the security of financial electronic transactions and hardware securing technology, whilst leaving the business process mainly uncovered. In this area the smart card is also a vehicle of choice for secure financial deployment. Work in this area is also strongly coordinated with the eEurope initiative on smart cards.

3.3 Digital rights management

This area concentrates on electronic transfer and trade of digital content to which rights are associated. This digital content relates to music, films, books, reviews, newspapers and magazines, cultural heritage, software, databases, specialised information (e.g. economic intelligence), educational material, games and entertainment. Attached to these contents are a number of rights, such as the copyrights or author’s rights held by organisations or individuals that imply that the use of the digital content is not free. The use of this content must be authorised and rise to the payment of fees to the rights holder. In the e-economy, content is sold in digital form and the complete sales operation (advertisement, catalogues, negotiation, contracting, payment and delivery) is carried out electronically.

3.4 Smart cards

Research on smart cards goes far beyond the cards themselves: common solutions for reading the cards are just as important. The FINREAD initiative [6] brings together technology companies and payment solution providers to specify a European standard for secure smart card readers. FINREAD is supported through a cluster of related projects. Embedded FINREAD extends the existing PC-based smart card reader to other access channels, such as the mobile phone, TV set-top boxes, web phones, PDAs etc. Formal certification of the security architecture is being taken forward under Trusted FINREAD, whilst the FINREAD showcase will promote and disseminate the FINREAD specification.

3.5 Dependability

The DEPPY initiative promotes dependability enabling technologies by fostering a dependability-aware culture in developing, managing and operating the whole life cycle of technical and business components, systems, networks and infrastructures [7]. Last year DEPPY activities included, thematic workshops and working groups on various themes like interdependencies, early warning systems, etc. as well as joint European/US workshops on attack tolerance and on R&D strategy for a dependable information society, in collaboration with the US Department of State and DARPA.

3.6 Smart organisations

Smart organisations, i.e. knowledge driven, adaptive and learning as well as agile in their ability to create and exploit the opportunities of the internetworked economy are key signposts of the shift from the industrial to the digital era. These organisations are virtual
in concept, highly flexible, dynamic, and capable of leveraging the power of network
technologies to meet customer demands for high added-value products and services in a
global market. R&D projects in this area explore and validate technologies and
architectures to develop platforms for interoperability of organisational applications,
tools to manage knowledge in organisations, mobile applications, innovative models for
process distribution and reengineering models for networked organisations [8]. However,
technology is only an enabler. The challenge is in using technology to its full potential.
Projects selected in 1999 concern the improvement of functional integration within and
between organisations, both in volatile virtual arrangements and in more permanent
supply-chain configurations. Many projects aim at providing early benefits to SMEs, i.e.
a sensible balance between innovation and usability. The R&D focus shifted later to
process distribution and interoperability of heterogeneous enterprise software,
incorporating intelligence into business processes, and developing applications for
wireless and mobile environments.

3.7 E-business

Projects in this area deal with the dynamic creation of highly customised products and
services in response to changing market demands and electronic mediation to identify
and select value constellation partners (e.g. via automated negotiation, auctioning and
agent-based contracting). R&D includes issues such as life cycle management of highly
customised products and services across dynamic value constellations (i.e. from product
conception all the way to product dismantling and resource recovery), extended products
(which combine tangible and intangible elements), customer relationships management
and online solutions for alternative dispute resolution.

3.8 Knowledge management

A number of projects address knowledge technologies in the context of organisational
knowledge management, teamwork and business collaboration, thus aiming to enhance
effectiveness and cooperation within and between organisations. A cluster of projects [9]
in this area has emerged from the first calls for proposals, and has been substantially
reinforced by a large number of projects dealing with ontologies such as
ONTO-LOGGING which aims at developing a set of tools for modelling and managing
distributed knowledge management systems, ONTOWEB which is a thematic network on
ontology-based information exchange for knowledge management and e-commerce, and
COMMA which aims at implementing a corporate memory management framework
based on agent technologies.

3.9 E-work

The move from ‘teleworking’ towards ‘e-working’ represents a new phase for the
European workforce. Better working environment, better working conditions, and a better
reconciliation of work and personal life are the objectives. Research activities within IST
reflect these requirements.
3.10 Mobile and ubiquitous e-business and e-work

Mobile communications are increasingly dominating the new generation of e-commerce and e-work systems. Despite all their technology and market issues, the emerging GPRS and UMTS platforms will be of major importance in the near future. However, research is still required to fine-tune the technology solutions, and to better comprehend the deployment difficulties and opportunities [10].

3.11 Sustainable workplace design

From the 1999 IST work programme, the emphasis on workplace design has evolved to focus more tightly on multidisciplinary R&D for sustainable workplace design, including the architectural and resource-efficiency issues. This work will continue to address multidisciplinary development for workplace and office design and will extend its focus, inter alia, to social inclusion and regional development issues in response to the recent eEurope initiative. The inclusion of all people who might be marginalised by the digital divide is becoming more prominent. In addition, the link with the new ways of working is extremely strong. These activities will enhance sustainability through providing the platforms and tools needed in future dynamic, satisfying, safe, secure, mobile and distributed workplaces. They may also open new paths to improved resource use efficiency in the workplace and built environment, e.g. through replacing physical prototyping by virtual prototyping or establishing highly utilised offices in the vicinity of people’s homes [8].

3.12 Economic, legal and social research

Successful development requires a strong interplay between the technical, economic, social and legal issues. Integrated socio-economic and technological research is therefore necessary to monitor and assess the development and impact of new technologies. One third of the IST Key Action II R&D projects have at least one work-package exclusively dedicated to economic, legal, social or policy related research necessary to guide and optimise the project’s results and impact.

The core of socio-economic research activity however is implemented through 50 projects contracted so far in IST Key Action II [11]. The interdisciplinary character of this field of work is particularly challenging in terms of setting and achieving focused objectives in a fast moving and highly dynamic environment. Projects cluster around three distinct fields, such as measuring the new economy, identifying shaping factors of the emerging new ways of work and business and contributing to supporting EU policies (Figure 4).
To reflect on the increased importance of the e-economy in the world and to assess its likely impact in Europe, a workshop was organised in April 2000, by the Directorate-General Information Society of the European Commission in cooperation with the Directorates-General Economic and Financial Affairs and Employment, focusing on the ‘New Economy of the Global Information Society’ [12].

4 The policy framework

In 2000, the Member States of the European Union adopted in Lisbon a strategy [13] for accelerated development of the e-economy with the objective for Europe “to become the most competitive and dynamic knowledge-based economy in the world, capable of sustained economic growth, with more and better jobs, and greater social cohesion”, by the year 2010. (Figure 5).

This puts the mastery of e-business at the top of Europe’s priorities.
4.1 The eEurope Initiative

At the Lisbon Summit in March 2000, heads of state and government committed themselves to a number of measures, including target dates, to bring eEurope forward [14]. The Göteborg Council adopted in June 2001 the eEurope+ initiative that complements eEurope by extending eEurope activities to enlargement countries [15]. The initiative set out to accelerate progress in the legal framework on telecommunications and e-commerce and to reorient financial instruments. Common legislative and regulatory efforts by the Commission and EU Member States were benchmarked on progress.

Overseeing the eEurope Action Plan, a benchmarking programme, with a total of 23 key indicators, monitors and measures the progress of the Information Society in Europe. The eEurope 2002 Benchmarking Report [16] presented first results and achievements, e.g.,

- a new telecoms package, including a regulation on ‘unbundling the local loop’, aiming to generate improvements for consumers and industry in Europe, were rapidly adopted
- a light, but effective, legal framework on e-commerce was set up
- internet penetration increased from 18% in March 2000 to 38% in December 2001
- nearly 90% of schools are now connected to the internet and over 90% of businesses have internet access; governments are moving online
- Europe now has the fastest research network in the world.
Some elements of the eEurope Action Plan [14] are:

4.1.1 Dependability of information infrastructures

The Information Society is increasingly relying on infrastructures for life-critical and business-critical functions. The wording ‘information infrastructure’ is used to collectively indicate the ensemble of media, network and communication infrastructures up to the application level. New and more sophisticated instances of attacks (e.g. virus, denial of service) are growing. The economical damages caused by disruptions in the functioning of the internet are increasing. In response to this scenario a series of specific targets on secure networks have been set in the eEurope 2002 Action Plan. One of these is to improve cooperation amongst national computer emergency response teams (CERTs).

4.1.2 Secure networks and smart cards

A proposal of eEurope is to improve the security of on-line transactions by supporting the development of certification services and internet security solutions and by encouraging the development of common specifications for smart cards. In January 2002 the European Council adopted a resolution on a common European approach and specific measures for ‘network and information security’ [17], to which the IST programme provides the technological support.

Smart cards are private, personal and secure objects possessed and directly controlled by citizens. Accordingly, they are perceived as trusted tokens holding their specific data. Smart cards operating as ‘trust enabling’ tokens can act as key elements in providing open and friendly access to applications and services of the Information Society.

As part of the overall eEurope initiative a smart card charter [18] and common requirements were devised. Both were endorsed by a large constituency of 450 organisations involving major card issuers, the chip card industry and user communities. They also identified issues that need to be resolved before smart cards can fulfil their potential to fully support the aspirations of citizens with respect to technology.

The smart card charter addresses the needs of citizens and the business community in terms of business cases, multi-functionality and interoperability of systems and infrastructure, and the provision of trust in all aspects of service delivery.

4.1.3 Promoting privacy-enhancing technologies and best practices

Besides the technical solutions offered by projects launched in the area of privacy enhancing technologies, policy activities involve the development and animation of the e-Forum on privacy in information society [19] to become a portal for awareness activities and exchange of experiences and best practices with respect to improving security, ensuring privacy, preventing and protecting from attacks.

4.1.4 Work in a knowledge-based economy

The European strategy for growth and employment, adopted at the Lisbon Summit in March 2000 sets the challenging goal of increasing participation in employment to nearly 70% by 2010 [13]. This requires action to improve the employment prospects of groups with low employment rates, especially women and older workers. Work can be made
more attractive and accessible through flexible work arrangements such as e-work. Particular efforts should be made to attract women to the knowledge economy and IT professions where they are massively underrepresented and where they represent a largely untapped resource in most countries. This must be accompanied by the modernisation of work organisation. Greater flexibility brings benefits of variation in the time and place of work to people in work. Social partners are encouraged to support agreements on flexible working to the benefit of both employers and employees.

4.1.5 GoDigital for SMEs

To accelerate the take up of e-business in Europe, the eEurope Action Plan aims to “encourage SMEs to ‘go digital’ through coordinated networking activities for the exchange of knowledge on best practices, e-commerce readiness, and benchmarking.” GoDigital is an EU initiative to support SMEs doing business online. It is part of the eEurope Action Plan 2002 launched to implement the Lisbon strategy. Specific objectives of this GoDigital initiative [20] are:

- to identify the main obstacles SMEs face as they engage in e-business
- to propose specific actions to help SMEs ‘go digital’, in particular by building on existing policies and initiatives
- to ensure consistency among the various policies and initiatives launched for supporting SMEs going digital at the European, national, regional and local levels
- to learn from practical experience and to benchmark various strategies to help SMEs going digital.

The first SMEs GoDigital conference took place in Brussels on 16 May 2002. Participants welcomed the conference as a timely event to discuss progress of the GoDigital initiative. The conference provided very precise recommendations on issues regarding policy, awareness and skills, entrepreneurship and on securing digital SMEs [21].

4.2 eEurope 2005

Building on the achievements of the eEurope 2002 discussed above, EU leaders decided at the European Council in Seville in March 2002, to launch eEurope 2005. The objective of the new action plan is to provide a favourable environment for private investment and for the creation of new jobs, to boost productivity, to modernise public services, and to give everyone the opportunity to participate in the global information society. Therefore eEurope 2005 aims to stimulate secure services, applications and content based on a widely available broadband infrastructure. The action plan is based on two groups of actions that reinforce each other. On the one hand, it aims to stimulate services, applications and content, covering both online public services and e-business; on the other hand it addresses the underlying broadband infrastructure and security matters.

The action plan comprises four separate but interlinked tools. Firstly, policy measures to review and adapt legislation at national and European level; to ensure that legislation does not unnecessarily hamper new services; to strengthen competition and interoperability; to improve access to a variety of networks; and, to demonstrate political
leadership. eEurope 2005 [22] identifies those areas where public policy can provide an added value and therefore focuses on a limited set of actions in priority areas. Some key targets are:

- connecting public administrations, schools, health care via broadband
- interactive public services, accessible for all, and offered on multiple platforms
- to provide online health services
- removal of obstacles to the deployment of broadband networks
- creation of a dynamic e-business environment
- creation of a Cyber Security Task Force.

Secondly, eEurope 2005 will facilitate the exchange of experience, of good practices, demonstration projects, and sharing the lessons from failures. Projects will be launched to accelerate the roll out of leading edge applications and infrastructure. Thirdly, policy measures will be monitored and better focused by benchmarking of the progress made in achieving the objectives and of the policies in support of the objectives. Fourthly, an overall coordination of existing policies will bring out synergies between proposed actions. A steering group will provide a better overview of policy developments and ensure a good information exchange between national and European policy makers and the private sector. This steering group would also make the early participation of candidate countries possible.

4.3 Sustainable development

There is a growing public and political awareness that sustainable growth can be realised by using material and natural resources more efficiently. This can be achieved by improving processes, products, product to service conversion, and structural change.

Process reengineering for e-business has been given a major stimulus by the emergence of multimedia information infrastructures. Product improvement has come through use of new materials, and through the increase of information content in products. Many products can be substantially de-materialised. On the one hand, with advanced communications, products become services: a newspaper becomes an on-line news service; an instruction manual becomes an interactive technical advice service. On the other hand, structural changes in the way markets and transport infrastructures are organised and used, and in the way people work and live, promise great benefits.

A set of case studies of how the transition to a knowledge economy can contribute to resource-use efficiency and sustainable development were published in May 2000 [23], together with the proceedings of the conference ‘Towards a Sustainable Information Society’ held in February 2000 [12].

4.4 Towards the European research area

In January 2000 the European Commission decided to create the ‘European Research Area’ [24] to contribute to better framework conditions for research in Europe by combining efforts undertaken on a European level with those in Member States. In the past, the European Union concentrated its work and initiatives on facilitating research
cooperation between partners from different countries through a series of successive framework programmes. These cooperative efforts have led to many scientific and technological successes. However, it was realised that making the most out of the huge research potential in Europe requires more than the provision of funds for the support of cooperative activities.

The 6th framework programme for research [25], which lays out the priorities for research on European level in the years 2002-2006, aims at bundling and focusing these research efforts towards the objectives of the European Research Area. The programme aims to promote world-class research in key priority areas of exceptional interest and added value to Europe through activities such as:

- scientific and technological research, development and demonstration
- cooperation with researchers and research teams from third countries
- dissemination and exploitation
- human resource development, including the promotion of training of researchers
- development of research facilities and infrastructures for research
- promotion of better links between science and society.

The new programme’s envisaged eight research areas and topics are:

- genomics and biotechnology for health
- information society technologies
- nano-technologies, intelligent materials and new production processes
- aeronautics and space
- food safety and health risks
- technologies for sustainable development and transport
- citizens and governance in the knowledge-based society
- issues regarding the new and emerging scientific and technological developments of relevance to Europe.

5 Conclusions

The European R&D programmes, such as IST [26], continue to play a major role in supporting the development of technologies and applications that help bring about and shape the Information Society and the e-economy. Besides notable R&D achievements, important progress has also been made in the area of standardisation and consensus building between the research, business communities and societal groups in Europe. It is recognised that technology alone will not be able to sustain the creative potential of the e-economy. Policies, such as eEurope and the European Research Area, are needed to bundle efforts into a coherent strategy for the benefit of all European citizens.
References

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